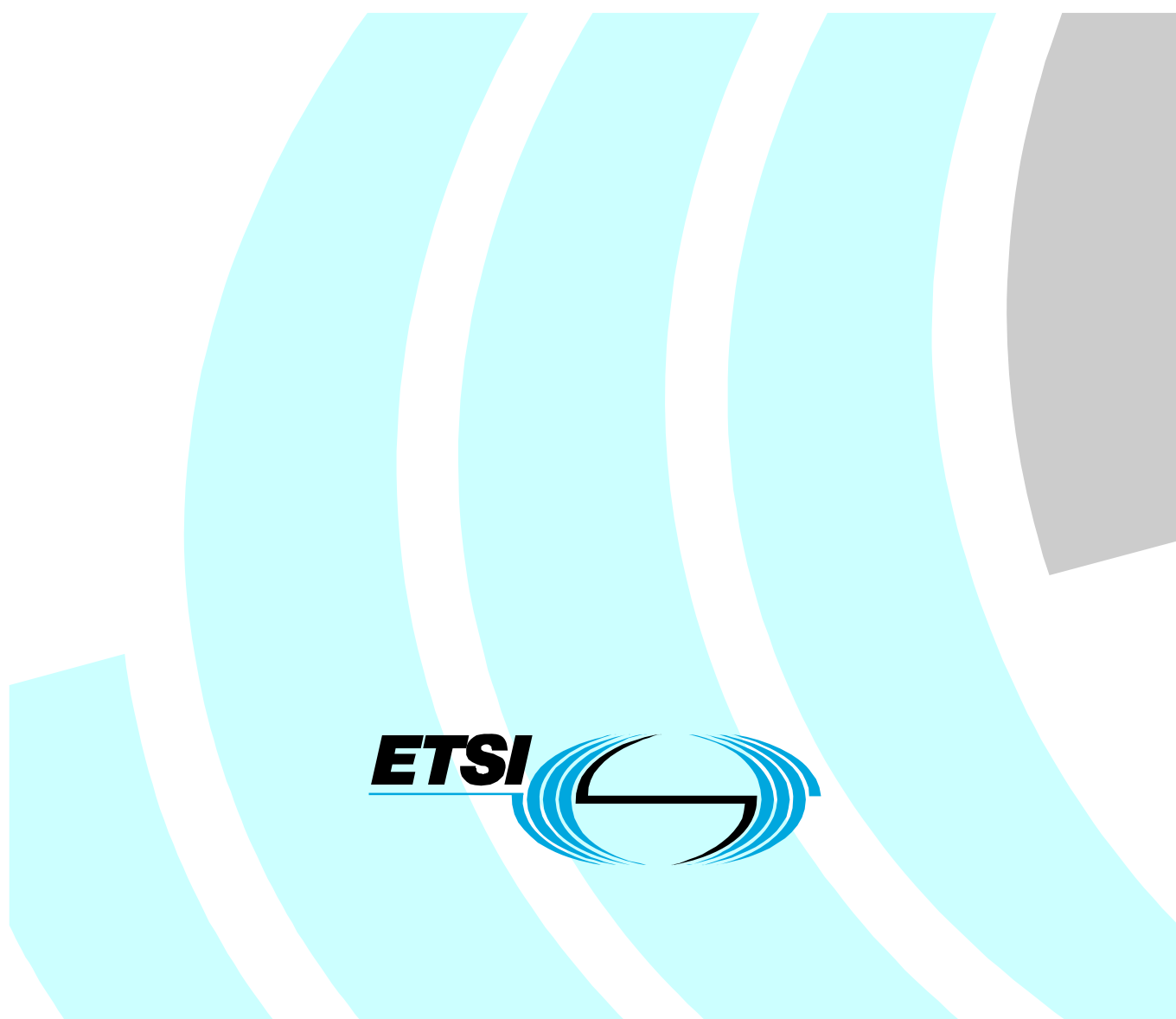


**Speech and multimedia Transmission Quality (STQ);
Requirements and tests methods for terminal
equipment incorporating a handset when connected to the
analogue interface of the PSTN**



Reference

DES/STQ-00129

Keywords

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ), and is now submitted for the ETSI standards Membership Approval Procedure.

The present document has been produced by ETSI in order to update the contents of initial standards for PSTN (e.g. TBR 38 [15]).

In particular, the update aims to take benefits of recent improvements in test methods and test equipments. Even the purpose of the standard is to consider Narrowband speech characteristics and test methods, the new test methods leave the door open for further services (e.g. wideband speech).

In this release 1 of the present document, no new measurement will be added except limitation of acoustic shock which is a requirement for safety. Previous requirements and test methods are kept in an annex in order to be used for terminals designed with LRGP method. Status of this annex is planned to be informative, but only in release 2.

The new measurements needed for handset terminal including speech processing functions will be introduced in a further release taking into account this type of terminal.

Introduction

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

1 Scope

The present document specifies the technical characteristics (electrical and acoustic requirements and measurement methods) to be provided by a single, handset telephony, terminal equipment which is intended for connection by 2 wires to an analogue interface of a PSTN. This interface is characterized 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.

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

The present document only applies to terminal equipment supporting handset telephony.

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

The present document also applies to any type of analogue handset terminal intended to be connected to a gateway.

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

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

The present document gives requirements for new test methods based upon use of HATS and new test signals

In an annex, requirements with test methods corresponding to previous test methods (LRGP) and test signals are given.

The application of the present document is intended also for handset telephony function employing a radio link (e.g. DECT);

The application of the present document is not intended for:

- a handset telephony function with speech transmission performance specially designed for the less able (e.g. with amplification of received speech as an aid for the hard of hearing);
- a handset telephony function with speech transmission performance specifically designed to cater for hostile environments;
- any handsfree or loudspeaking voice telephony function;
- a handset telephony function employing speech processing techniques other than coding.

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

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
 - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
 - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

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

- [1] ITU-T Recommendation G.122 (03/93): "Influence of national systems on stability and talker echo in international connections".
- [2] ITU-T Recommendation P.64 (11/07): "Determination of sensitivity/frequency characteristics of local telephone systems".
- [3] ITU-T Recommendation P.51 (08/96): "Artificial mouth".
- [4] ITU-T Recommendation P.57 (11/05): "Artificial ears".
- [5] IEC 651: "Sound level meters".
- [6] ISO 3 (1973): "Preferred numbers - Series of preferred numbers".
- [7] ITU-T Recommendation P.79 (11/07): "Calculation of loudness ratings for telephone sets".
- [8] ITU-T Recommendation O.41 (10/94): "Psophometer for use on telephone-type circuits".
- [9] ETSI ES 200 677: "Public Switched Telephone Network (PSTN); Requirements for handset telephony".
- [10] ITU-T Recommendation P.50 (09/99): "Artificial voices".
- [11] ITU-T Recommendation P.56 (03/93): "Objective measurement of active speech level".
- [12] ITU-T Recommendation P.58 (08/96): "Head and torso simulator for telephony".
- [13] ITU-T Recommendation P.501(09/01): "Test signals for use in telephonometry".
- [14] ETSI EG 202 518: "Speech Processing, Transmission and Quality Aspects (STQ); Acoustic Output of Terminal Equipment; Maximum Levels and Test Methodology for Various Applications".
- [15] ETSI TBR 38 (05/98): "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".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] ITU-T Recommendation P.360 (07/06): "Efficiency of devices for preventing the occurrence of excessive acoustic pressure by telephone receivers and assessment of daily noise exposure of telephone users".
- [i.2] ITU-T Recommendation P.35 (1988, Blue Book): "Handset telephones".
- [i.3] ITU-T Recommendation P.65 (03/93): "Objective instrumentation for the determination of loudness ratings".

- [i.4] ETSI ES 202 738: "Speech Processing, Transmission and Quality Aspects (STQ); Transmission requirements for narrowband VoIP loudspeaking and handsfree terminals from a QoS perspective as perceived by the user".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

artificial ear: 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

diffuse field equalization: equalization of the HATS sound pick-up, equalization of the difference, in dB, between the spectrum level of the acoustic pressure at the ear Drum Reference Point (DRP) and the spectrum level of the acoustic pressure at the HATS Reference Point (HRP) in a diffuse sound field with the HATS absent (application of reverse nominal curve of table 3 in ITU-T recommendation P.58 [12])

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

handset telephony: 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

NOTE: The term "live speech" is also frequently used to describe "real-time speech". For the purposes of the present document, they should be considered as having the same meaning.

handset: 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

handsfree function: function whereby telephony transmission and reception is facilitated by the use of microphone(s) and loudspeaker(s) placed at a distance from the user

NOTE: No handset is required to be used and normally the handset is not active.

Head And Torso Simulator (HATS) for telephonometry: manikin extending downward from the top of the head to the waist, designed to simulate the sound pick-up characteristics and the acoustic diffraction produced by a median human adult and to reproduce the acoustic field generated by the human mouth

loop state: state in which the TE draws sufficient DC current to activate the exchange

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

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

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

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

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

3.2 Symbols

For the purposes of the present document, the following symbols apply:

Ω	Ohm
dB	decibel

dBPa	sound pressure level with respect to 1 Pa, expressed in dB
dBPa(A)	"A" weighted sound pressure level with respect to 1 Pa, expressed in dB
dBV	voltage level with respect to 1 V, expressed in dB
dBVp	psophometrically weighted voltage level with respect to 1 V, expressed in dB

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

a.c.	alternating current
d.c.	direct current
e.m.f.	electromotive force
ERL	Echo Return Loss
ERP	Ear Reference Point
HATS	Head And Torso Simulator
ITU-T	International Telecommunications Union -Telecommunications sector
LRGP	Loudness Rating Guard-ring Position
MRP	Mouth Reference Point
Pa	Pascal
PSTN	Public Switched Telephone Network
r.m.s.	root mean square
RL	Return Loss
RLR	Receiving Loudness Rating
SLR	Sending Loudness Rating
SPL	Sound Pressure Level
STMR	SideTone Masking Rating
TE	Terminal Equipment
V	Volt

4 Speech transmission aspects

4.1 General

4.1.1 Polarity independence

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

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 clause 4.2.

4.1.2 Feed conditions

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

NOTE: Some requirements are only specified for single or specific values of feed resistance.

Test: Compliance shall be demonstrated by performing the tests of clause 4.2 with the feed resistances specified in this clause.

4.1.3 Power supply

Requirement: Where the terminal handset function is intended to be used with power additional to that derived from the network, the requirements of clause 4.2 shall apply only when such additional power is provided and operating within specification.

Test: Compliance shall be demonstrated by performing the tests of clause 4.2 with the power supply connected and operative.

4.1.4 Volume control

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.

Test: Compliance tests of clause 4.2 shall 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 1 000 Ω , unless otherwise specified in the appropriate requirement.

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

4.1.5 Test setup

Setup for handsets

The handset is placed in the HATS position as described in ITU-T Recommendation P.64 [2]. The artificial mouth shall conform with ITU-T Recommendation P.58 [12]. The artificial ear shall conform with ITU-T Recommendation P.57 [4], type 3.3 or type 3.4 ears shall be used.

Unless stated otherwise if a volume control is provided the setting is chosen such that the nominal RLR is met as close as possible.

Position and calibration of HATS

All the sending and receiving characteristics shall be tested with the HATS, it shall be indicated what type of ear was used at what application force. For handsets if not stated otherwise 8N application force shall be used.

The horizontal positioning of the HATS reference plane shall be guaranteed within $\pm 2^\circ$.

The HATS shall be equipped with a type 3.3 or type 3.4 artificial ear for handsets.

For all measurements except RLR, this signal is diffuse field corrected as described in ITU-T Recommendation P.58 [12] using the reverse nominal curve of Table 3. For RLR measurement, it is corrected by DRP to ERP correction as described in ITU-T Recommendation P.57 [4].

Informative note: For binaural headsets two artificial ears are required. The type 3.3 or type 3.4 artificial ears as specified in Recommendation P.57 [4] shall be used. The artificial ear shall be positioned on HATS according to ITU-T Recommendation P.58 [12].

4.1.6 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).

4.1.7 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 4.1: Accuracy of measurements

Item	Accuracy
Electrical signal level	$\pm 0,2$ dB for levels ≥ -50 dBV $\pm 0,4$ dB for levels < -50 dBV
Sound pressure	$\pm 0,7$ dB
Frequency	$\pm 0,2$ %
Application force	± 2 Newton

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

Table 4.2: 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	$\pm 0,4$ 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.

4.1.8 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 highest feed resistance, then at lower values of resistance, decreasing sequentially to the minimum, in order to avoid a heating effect in the test arrangement.

4.1.9 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).

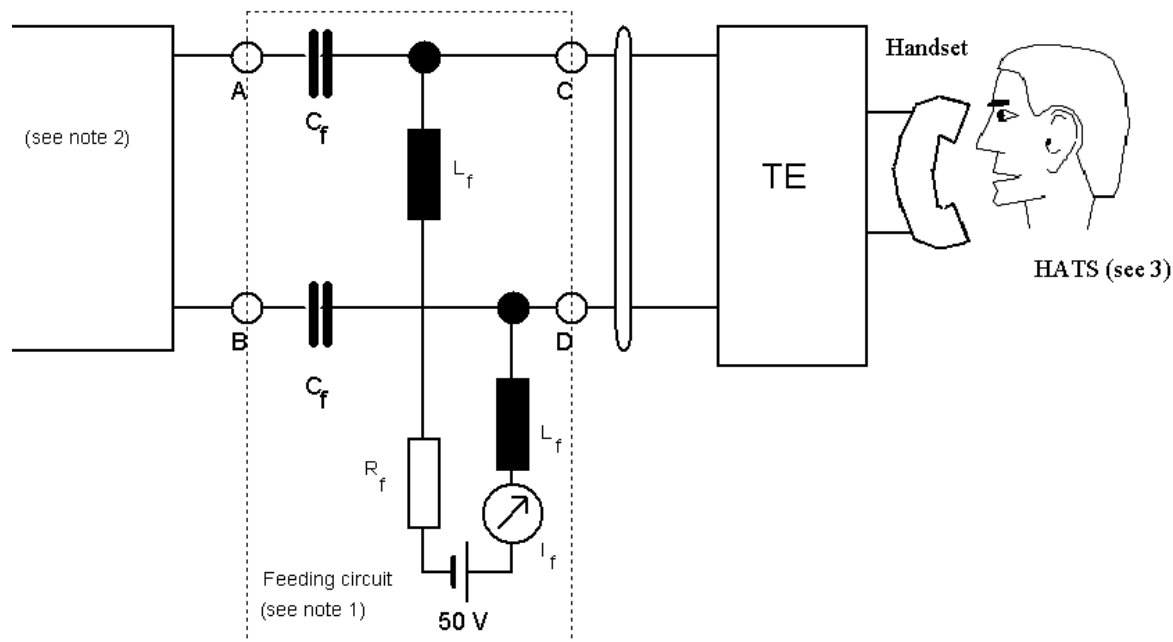
4.1.10 Alternative test methods

The requirements of this test specification were written on the basis of the standard test methods described in the present document . 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 the present document .

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.

4.1.11 Testing arrangements

All tests for transmission performance shall be carried out with the TE connected to the test arrangement shown in figure 4.1. 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 4.3 and 4.5.

NOTE 2: The equipment used for testing is connected between A and B and consists of the following as appropriate: a signal generator with an impedance of $600\ \Omega$, a measuring set, the network either of figures B.6, B.7, or B.8, or a $600\ \Omega$ resistor.

NOTE 3: The handset is placed in the HATS position as described in ITU-T Recommendation P.64 [2]. The artificial mouth shall conform with ITU-T Recommendation P.58 [12]. The artificial ear shall conform with ITU-T Recommendation P.57 [4], type 3.3 or type 3.4 ears shall be used.

Figure 4.1: Circuit for measurement of transmission characteristics

For sending measurements, signal is measured between A and B shown on figure 4.1.

For receiving measurements, signal is measured at the output of HATS's ear with corrections as given in clause 4.1.5.

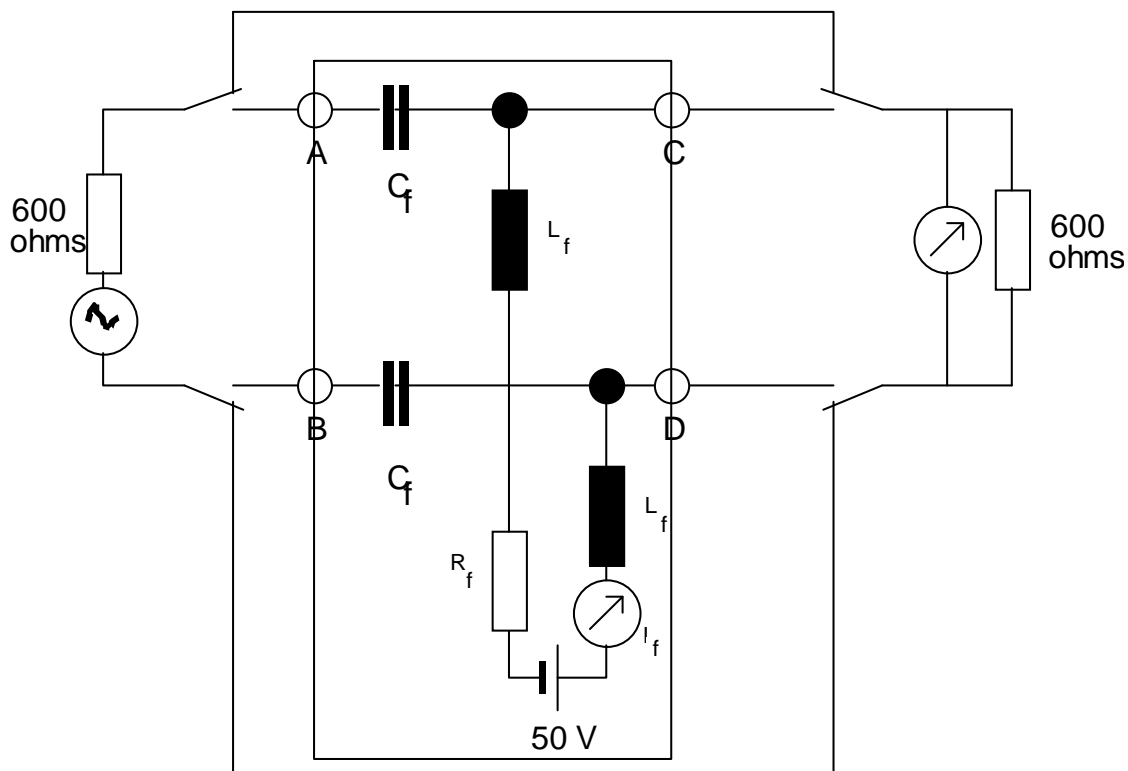


Figure 4.2: Insertion loss test arrangement for the d.c. feeding circuit

When measured with the circuit shown in figure 4.2, the insertion loss of the d.c. feeding circuit shown in figure 4.1 shall have a value less than that given in figure 4.3 for all resistances and frequencies at which it is used.

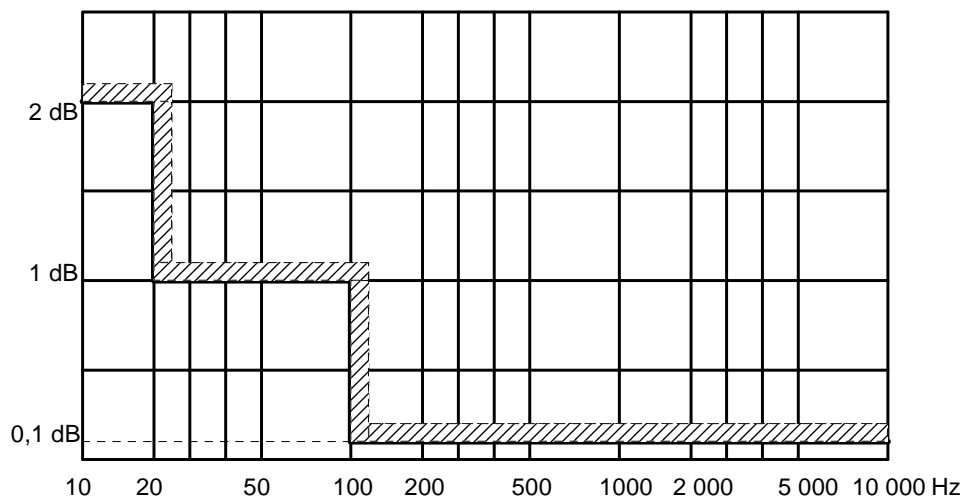
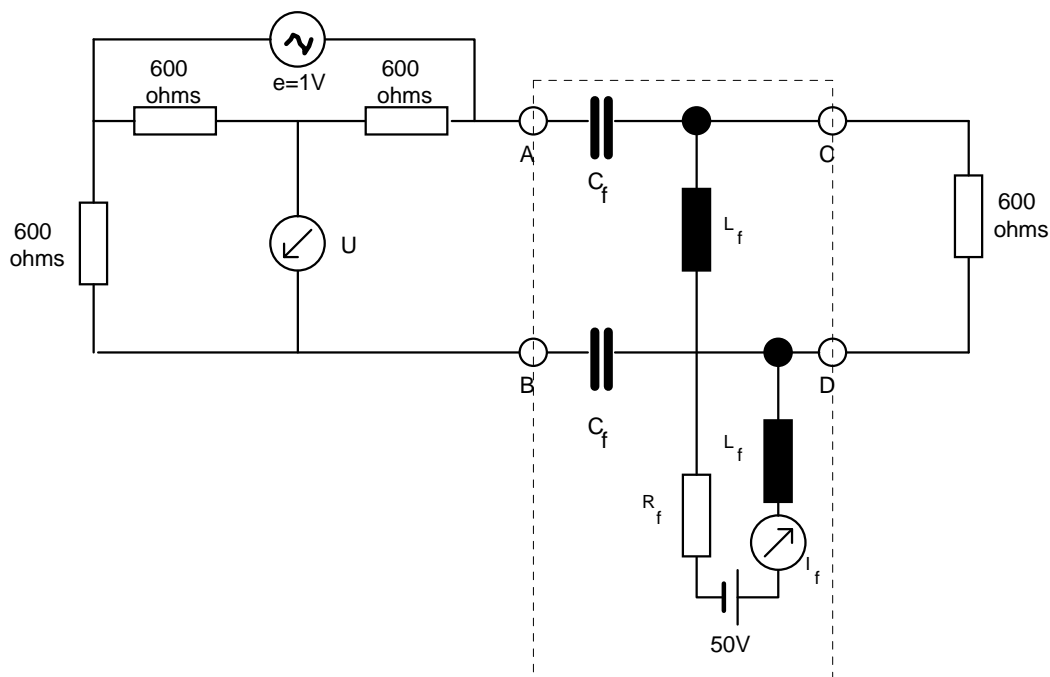


Figure 4.3: Maximum limit for insertion loss



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

Figure 4.4: Return loss test arrangement for the d.c. feeding circuit

When measured with the circuit shown in figure 4.4, the return loss of the d.c. feeding circuit shown in figure 4.1 shall have a value greater than that given in figure 4.5 for all values of R_f and at all frequencies at which it is used.

The return loss (in dB) is calculated from the formula:

$$RL = 20 \log_{10} \left[\frac{e}{2U} \right]$$

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

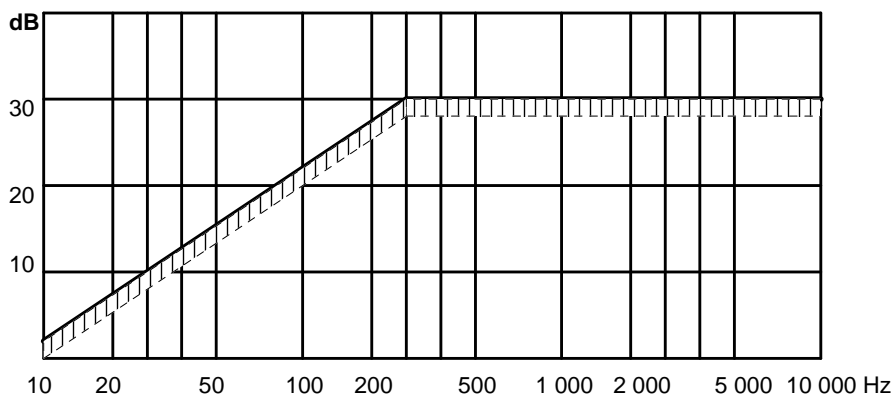


Figure 4.5: Minimum limit for return loss

4.2 Speech performance characteristics

4.2.1 Sensitivity/frequency response

4.2.1.1 Sending Sensitivity

Requirement:

The sending sensitivity when measured according to ITU-T Recommendation P.64 [2] with a load of 600 Ω , as a function of frequency, shall be not greater than the upper limit and not less than the lower limit given in table 4.1 and shown in figure 4.6.

In case of handset connected to gateways intended to be used on very long analogue lines, preemphasis may be accepted and the lower limit of the sending sensitivity response can be extended according to table 4.1

Table 4.3: Co-ordinates of sending sensitivity limit curves

Frequency	Upper Limit	Lower Limit	Extended lower limit
100 Hz	-5 dB		
300 Hz	5 dB	-7 dB	-11 dB
1 000 Hz	5 dB	-5 dB	-5 dB
3 400 Hz	5 dB	-5 dB	-5 dB
4 000 Hz	5 dB		

NOTE: The limits for intermediate frequencies lie on a straight line drawn between the given values on a linear (dB) - logarithmic (Hz) scale.

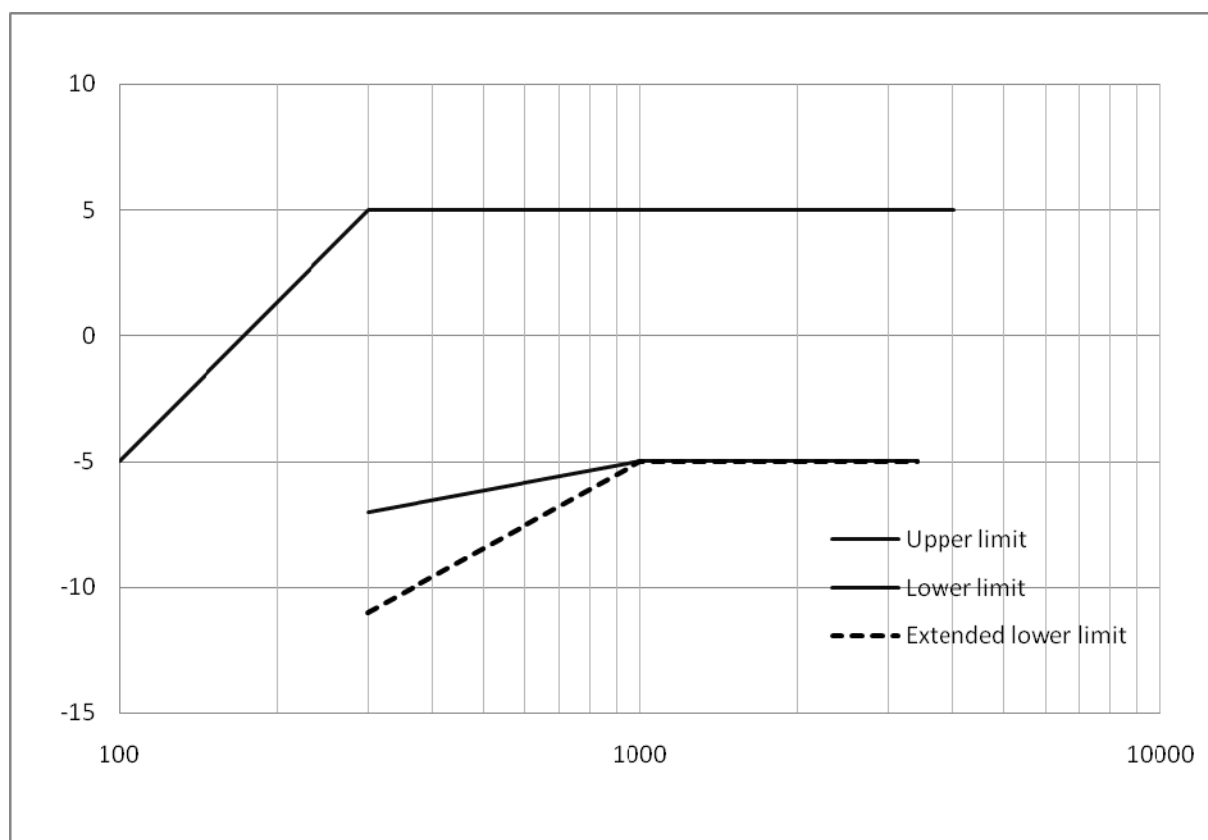


Figure 4.6: Sending sensitivity/frequency limits

Measurement method:

Compliance shall be checked by the test described below when measured with the feed resistance R_f set to 1 000 Ω .

The test signal to be used for the measurements shall be the artificial voice according to ITU-T Recommendation P.50 [10]. If the signal to noise ratio in the high frequency domain is not sufficient Composite Source Signal (CSS) as defined in ITU-T Recommendation P.501 [13] shall be used. The spectrum of acoustic signal produced by the HATS is calibrated under free field conditions at the MRP. The test signal level shall be -4,7 dBPa, duration 20 s (10 s female, 10 s male voice), measured at the MRP. The test signal level is averaged over the complete test signal sequence.

The handset terminal is setup as described in clause 4.1.10. The handset is mounted according ITU-T Recommendation P.64 [2]. The application force used to apply the handset against the artificial ear is 8N (with tolerance given in table 1.

Measurements shall be made at one twelfth-octave intervals as given by the R.40 series of preferred numbers in ISO 3 [6] for frequencies from 100 Hz to 8 kHz inclusive. For the calculation the averaged measured level at the electrical reference point for each frequency band is referred to the averaged test signal level measured in each frequency band at the MRP.

The sensitivity is expressed in terms of dBV/Pa.

4.2.1.2 Receiving Sensitivity**Requirement:**

The receiving sensitivity when measured according to ITU-T Recommendation P.64 [2], 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 of the present document.

Table 4.4: Co-ordinates of receiving sensitivity limit curves

Frequency	Upper Limit	Lower Limit
100 Hz	6 dB	
300 Hz	6 dB	-8 dB
1 000 Hz	6 dB	-6 dB
3 400 Hz	6 dB	-6 dB
4 000 Hz	6 dB	
NOTE 1: The limit curves shall be determined by straight lines joining successive co-ordinates given in the table, where frequency response is plotted on a linear dB scale against frequency on a logarithmic scale. Is a floating or "best fit" mask.		
NOTE 2: The basis for the target frequency responses in sending and receiving is the orthotelephonic reference response which is measured between 2 subjects in 1 m distance under free field conditions and is assuming an ideal receive characteristic. Under these conditions the overall frequency response shows a rising slope. In opposite to other standards the present document no longer uses the ERP as the reference point for receiving but the diffuse-field. With the concept of diffuse-field based receive measurements a rising slope for the overall frequency response is achieved by a flat target frequency response in sending and a diffuse field based receiving frequency response.		

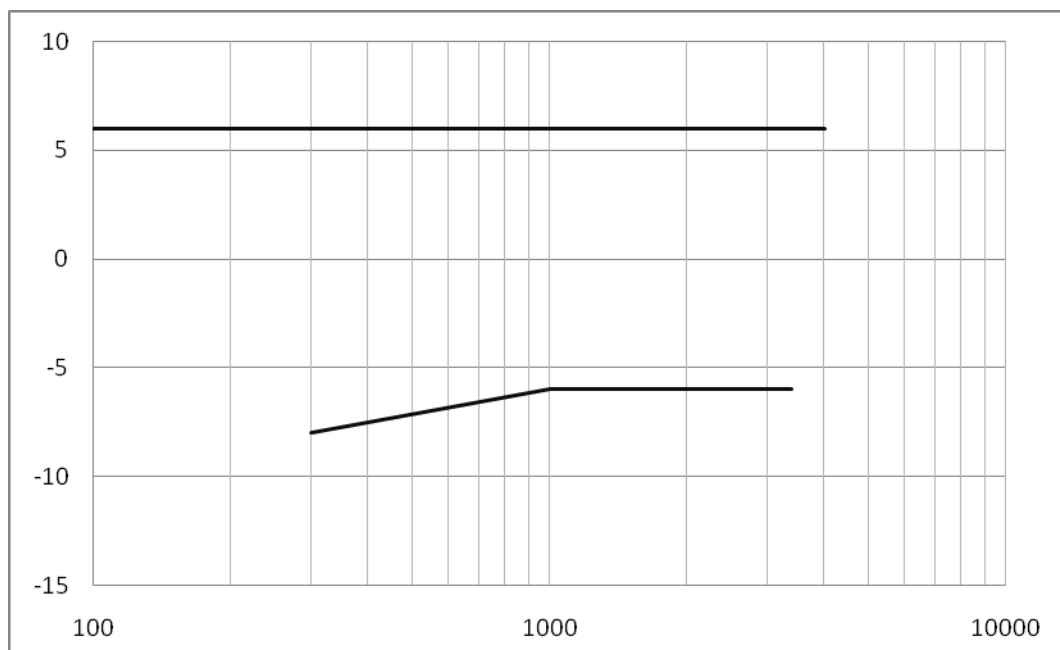


Figure 4.7: Receiving sensitivity/frequency limits for 8 Newtons

Measurement method:

Compliance shall be checked by the test described below when measured with the feed resistance R_f set to 1 000 Ω .

Receive frequency response is the ratio of the measured sound pressure and the input level.
(dB relative Pa/V)

$$S_{\text{Jeff}} = 20 \log (p_{e_{\text{ff}}} / v_{\text{RCV}}) \text{ dB rel 1 Pa / V}$$

S_{Jeff} Receive Sensitivity; Junction to HATS Ear with diffuse field correction.

$p_{e_{\text{ff}}}$ DRP Sound pressure measured by ear simulator Measurement data are converted from the Drum Reference Point to free field.

v_{RCV} Equivalent RMS input voltage.

The test signal to be used for the measurements shall be the artificial voice according to ITU-T Recommendation P.50 [10], duration 20 s (10 s female, 10 s male voice). If the signal to noise ratio in the high frequency domain is not sufficient CSS as defined in ITU-T Recommendation P.501 [13] shall be used. The test signal level shall be -16 dBm0, measured according to ITU-T Recommendation P.56 [11] at the digital reference point or the equivalent analogue point.

The handset terminal terminal is setup as described in clause 4.1.10. The handset is mounted in the HATS position (see ITU-T Recommendation P.64 [2]). The application forces used to apply the handset against the artificial ear is 8N (with tolerance given in table 1).

The HATS is diffuse field equalized as described in ITU-T Recommendation P.58 [12]. The equalized output signal is power-averaged on the total time of analysis. The 1/12 octave band data are considered as the input signal to be used for calculations or measurements.

Measurements shall be made at one twelfth-octave intervals as given by the R.40 series of preferred numbers in ISO 3 [6] for frequencies from 100 Hz to 8 kHz inclusive. For the calculation the averaged measured level at each frequency band is referred to the averaged test signal level measured in each frequency band.

4.2.2 Sending and Receiving Loudness Ratings (SLR and RLR)

4.2.2.1 Sending Loudness Rating (SLR)

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 $2\,800 \, \Omega$, $1\,000 \, \Omega$ and $500 \, \Omega$.

For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the requirement to measure with R_f set to $2\,800 \, \Omega$ shall be replaced by a requirement to measure with R_f set to $2\,300 \, \Omega$.

NOTE: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Measurement method:

The test signal to be used for the measurements shall be the artificial voice according to ITU-T Recommendation P.50 [10], duration 20 s (10 s female, 10 s male voice). If the signal to noise ratio in the high frequency domain is not sufficient CSS as defined in ITU-T Recommendation P.501 [13] shall be used. The spectrum of acoustic signal produced by the artificial mouth is calibrated under free field conditions at the MRP. The test signal level shall be $-4,7 \text{ dBPa}$, measured at the MRP. The test signal level is averaged over the complete test signal sequence.

The handset terminal is setup as described in clause 4.1.5. The handset is mounted in the HATS position (see ITU-T Recommendation P.64 [2]). The application force used to apply the handset against the artificial ear is noted in the test report.

The sending sensitivity shall be calculated from each band of the 14 frequencies given in table 1 of ITU-T Recommendation P.79 [7], bands 4 to 17. For the calculation the averaged measured level at the electrical reference point for each frequency band is referred to the averaged test signal level measured in each frequency band at the MRP.

The sensitivity is expressed in terms of dBV/Pa and the SLR shall be calculated according to ITU-T Recommendation P.79 [7], table 1.

4.2.2.2 Receiving Loudness Rating (RLR)

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 $2\,800 \, \Omega$, $1\,000 \, \Omega$ and $500 \, \Omega$.

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the requirement to measure with R_f set to $2\,800 \, \Omega$ should be replaced by a requirement to measure with R_f set to $2\,300 \, \Omega$.

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Measurement method:

The test signal to be used for the measurements shall be the artificial voice according to ITU-T Recommendation P.50 [10], duration 20 s (10 s female, 10 s male voice). The test signal level shall be -16 dBm0 , measured at the digital reference point or the equivalent analogue point. The test signal level is averaged over the complete test signal sequence.

The handset terminal is setup as described in clause 4.1.5. The handset is mounted in the HATS position (see ITU-T Recommendation P.64 [2]). The application force used to apply the handset against the artificial ear is noted in the test report. The HATS is *NOT* diffuse-field equalized as described in ITU-T Recommendation P.58 [12]. The DRP-ERP correction as defined in ITU-T Recommendation P.57 [4] is applied.

The application force used to apply the handset against the artificial ear is noted in the test report. By default, 8N will be used.

The receiving sensitivity shall be calculated from each band of the 14 frequencies given in table 1 of ITU-T Recommendation P.79 [7], bands 4 to 17. For the calculation the averaged measured level at each frequency band is referred to the averaged test signal level measured in each frequency band.

The sensitivity is expressed in terms of dBPa/V and the RLR shall be calculated according to ITU-T Recommendation P.79 [7], formula 5-1, over bands 4 to 17, using $m = 0,175$ and the receiving weighting factors from table 1 of ITU-T Recommendation P.79 [7]. No leakage correction shall be applied for the measurement.

4.2.3 Sidetone

Requirement:

When measured by the test described in this clause, the SideTone Masking Rating (STMR) shall be not less than the value shown in table 4.3 for each termination specified in that table.

Table 4.5: Sidetone rating

Value of SideTone Masking Rating (dB)		
Termination of figure 4.8	Termination of figure 4.9	Termination of figure 4.10
STMR	STMR	STMR
$\geq +10$	$\geq +10$	$\geq +10$

Measurement Method:

For the first test, the terminating impedance shown in figure 4.10 shall be connected to terminals A and B shown in figure 4.1 and the feeding resistance R_f shall be set to 2 800 Ω (or 2 300 Ω as appropriate).

For the second test, the terminating impedance shown in figure 4.9 shall be connected to terminals A and B shown in figure 4.1 and the feeding resistance R_f shall be set to 1 000 Ω .

For the third test, the terminating impedance shown in figure 4.8 shall be connected to terminals A and B shown in figure 4.1 and the feeding resistance R_f shall be set to 500 Ω .

- a) the impedance shown in figure 4.8 is intended to represent a short line terminated with 600 Ω ;

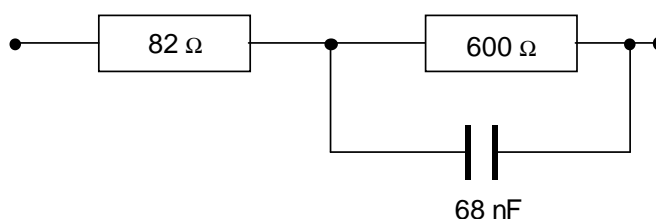


Figure 4.8: Terminating impedance - impedance "a"

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

- b) the impedance shown in figure 4.9 is the harmonized European impedance;

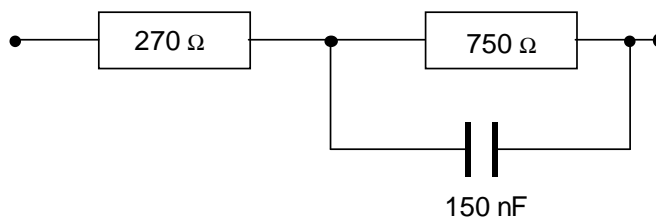


Figure 4.9: Terminating impedance - impedance "b"

For impedance "b", the measurement shall be made with the feeding resistance R_f set to 1 000 Ω .

- c) the impedance shown in figure 4.10 is intended to represent a very long line.

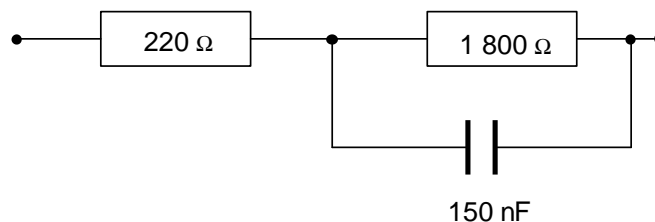


Figure 4.10: Terminating impedance - impedance "c"

For impedance "c", the measurement shall be made with the feeding resistance R_f set to 2 800 Ω (or 2 300 Ω as appropriate).

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

The test signal to be used for the measurements shall be the artificial voice according to ITU-T Recommendation P.50 [10]. The spectrum of the acoustic signal produced by the HATS is calibrated under free field conditions at the MRP. The test signal level shall be -4,7 dBPa, measured at the MRP. The test signal level is averaged over the complete test signal sequence.

The handset terminal is setup as described in clause 4.1.5. The handset is mounted in the HATS position (see ITU-T Recommendation P.64 [2]) and the application force shall be 13N on the artificial ear type 3.3 or type 3.4.

Where a user operated volume control is provided, the measurements shall be carried out at the nominal setting of the volume control. In addition the measurement is repeated at the maximum volume control setting.

Measurements shall be made at one twelfth-octave intervals as given by the R.40 series of preferred numbers in ISO 3 [6] for frequencies from 100 Hz to 8 kHz inclusive. For the calculation the averaged measured level at each frequency band (ITU-T Recommendation P.79 [7], table 3, bands 1 to 20) is referred to the averaged test signal level measured in each frequency band.

The Sidetone path loss (L_{meST}), as expressed in dB, and the SideTone Masking Rate (STMR) (in dB) shall be calculated from the formula 5-1 of ITU-T Recommendation P.79 [7], using $m = 0,225$ and the weighting factors of in table 3 of ITU-T Recommendation P.79 [7].

4.2.4 Distortion

4.2.4.1 Sending distortion

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 5 % with an input of -4,7 dBPa when measured with a load of 600 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 %.

Measurement method:

Compliance shall be checked by the test described below with the feed resistance R_f set to 2 800 Ω and 500 Ω .

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

A 600 Ω resistor shall be connected between A and B shown in figure 4.1.

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 4.1.

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 percentage 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 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 (or 2 300 Ω as appropriate) and 500 Ω .

4.2.4.2 Receiving distortion

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 5 %, when measured with an input e.m.f. of -12 dBV.

With an input e.m.f. 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 %.

Measurement execution:

Compliance shall be checked by the test described below with the feed resistance R_f set to 2 800 Ω and 500 Ω .

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

A signal generator shall be connected between A and B shown in figure 4.1.

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.

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

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

The percentage 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 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 (or 2 300 Ω as appropriate) and 500 Ω .

4.2.5 Linearity (variation of gain with input level)

4.2.5.1 Sending linearity

Requirement: The sensitivity determined with an input sound pressure level of -4,7 dBPa shall not differ by more than ± 2 dB from the sensitivity determined with an input sound pressure level of -19,7 dBPa when measured with a load of 600 Ω .

Measurement method:

A measuring set calibrated in dBV, with an impedance of 600 Ω shall be connected between terminals A and B shown in figure 4.1.

Measurements shall be made with R_f set to 1 000 Ω .

The sending sensitivity at a frequency of 1 000 Hz shall be determined as described in ITU-T Recommendation P.64 [2], clause 8 with the input sound pressure level set to -4,7 dBPa and by using the procedure described in clause 11 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 sound pressure level set to -19,7 dBPa.

4.2.5.2 Receiving linearity

Requirement:

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.

Measurement method:

A signal generator shall be connected between A and B shown in figure 4.1.

Measurements shall be made with R_f set to 1 000 Ω .

The receiving sensitivity at a frequency of 1 000 Hz shall be determined as described in ITU-T Recommendation P.64 [2], clause 9 with the input e.m.f. set to -12 dBV and by using the procedure described in clause 11 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.

4.2.6 Noise

4.2.6.1 Sending noise

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 500 Ω , -64 dBVp when the feed resistance R_f is set to 1 000 Ω , and -60 dBVp when the feed resistance R_f is set to 2 800 Ω .

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the requirement to measure with R_f set to 2 800 Ω should be replaced by a requirement to measure with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Measurement method:

The handset will be positioned as described in clause 4.1.5.

For a correct activation of the system, an artificial voice according to ITU-Recommendation P.50 [10] or a speech like test signal as described in ITU-T Recommendation P.501 [13] shall be used for activation. Level of this activation signal will be -4,7 dBPa at the MRP.

The level at the output of the test setup is measured in dBmp using psophometric weighting according to table 1 of ITU-T Recommendation O.41[8].

4.2.6.2 Receiving noise

Requirement:

The A-weighted noise produced by the apparatus in the receiving direction shall be not greater than -49 dBPa(A).

Measurement method:

Compliance shall be checked by the test described below with the feed resistance R_f set to 2 800 Ω and 500 Ω .

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω . The handset will be positioned as described in clause 4.1.10.

A signal is applied to input of test system in order to ensure correct activation of receiving state. An artificial voice according to ITU-Recommendation P.50 [10] or a speech like test signal as described in ITU-T Recommendation P.501 [13] can be used for activation. Level of this activation signal will be -16 dBm0.

The noise shall be measured just after interrupting the activation signal.

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

4.2.7 Acoustic shock

4.2.7.1 Continuous signal

Requirement:

With a digitally encoded signal representing the maximum possible signal level at the digital interface, the sound pressure level at the ERP shall not exceed +24 dBPa (rms unweighted).

Measurement Method:

Handset is positioned on HATS. Signal used and method of measurement are given in EG 202 518 [14].

4.2.7.2 Peak signal

Requirement:

The receiving equipment shall limit the peak sound pressure at the ERP to less than +36 dBPa under any continuous or transient condition.

Measurement Method:

Handset is positioned on HATS. Signal used and method of measurement are given in EG 202 518 [14].

4.2.8 Instability

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 below.

Measurement method:

Measurements shall be made under the following conditions:

- with R_f set to 2 800 Ω (or 2 300 Ω as appropriate), with the impedance shown in figure 4.10 connected between terminals A and B shown in figure 4.1;
- with R_f set to 500 Ω , with a resistance of 600 Ω connected between terminals A and B shown in figure 4.1.

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.

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

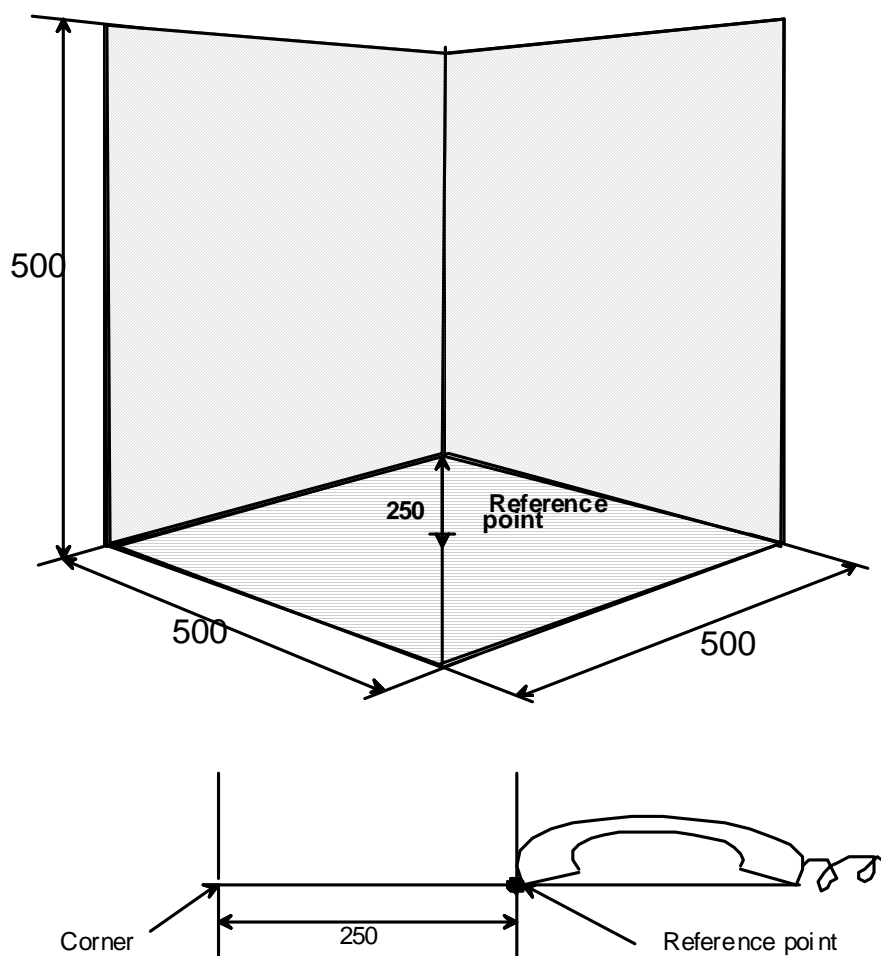
NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

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 4.11.

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 4.11.

Checks shall be made to establish that the signal level resulting from any sustained audio frequency oscillation (up to 10 kHz) measured between A and B shown in figure 4.1 is less than -40 dBV.



All dimensions are in millimeters

Figure 4.11: Handset position for instability test

4.2.9 Echo Return Loss (ERL)

Requirement:

The Echo Return Loss (ERL) shall be not less than 14 dB with respect to the impedance shown in figure 4.12.

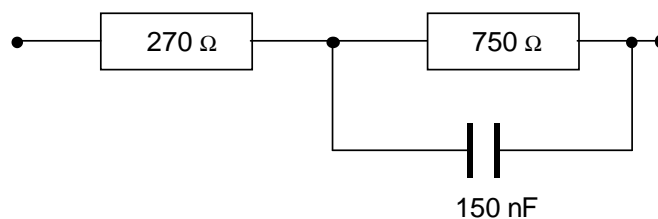


Figure 4.12: Terminating impedance

Measurement method:

Compliance shall be checked by determination of the echo loss as described below with the feed resistance R_f set to 2 800 Ω and 500 Ω .

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

A suitable measuring set for measuring impedance shall be connected between A and B shown in figure 4.1.

The earcap shall be applied to the artificial ear.

Measurements shall be made with R_f set to 2 800 Ω (or 2 300 Ω as appropriate) and 500 Ω .

The test level across A and B shown in figure 4.1 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: 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:

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

where:

Z_t is the apparatus impedance, measured;

Z_b is the reference impedance shown in figure 4.9.

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 [1], using the formula:

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

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.

Annex A (normative): Requirements for LRGP measured terminals

Those requirements are for terminals being designed for measurement with tests methods of Annex B i.e. not using a test set up as described in 4.1.5 (with HATS measurement system).

This annex will become informative in a further release of this document as new terminals will be more and more designed by using HATS measurement methods.

A.1 Speech transmission aspects

A.1.1 General

A.1.1.1 Polarity independence

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

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 B

A.1.1.2 Feed conditions

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

NOTE: Some requirements are only specified for single or specific values of feed resistance.

Test: Compliance shall be demonstrated by performing the tests of annex B with the feed resistances specified in clause A.2.

A.1.1.3 Power supply

Requirement: Where the terminal handset function is intended to be used with power additional to that derived from the network, the requirements of clause A.2 shall apply only when such additional power is provided and operating within specification.

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

A.1.1.4 Volume control

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.

Test: Compliance tests of annex B shall 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 1 000 Ω , unless otherwise specified in the appropriate requirement.

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

A.2 Speech performance characteristics

A.2.1 Sensitivity/frequency response

A.2.1.1 Sending Sensitivity

Requirement: The sending sensitivity when measured according to ITU-T Recommendation P.64 [2] with a load of 600 Ω , as a function of frequency, shall be not greater than the upper limit and not less than the lower limit given in table A.1 and shown in figure A.1.

Test: Compliance shall be checked by the test described in clause B.2.1.1 when measured with the feed resistance R_f set to 1 000 Ω .

Table A.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	-13
Lower limit	300	-14
	2 000	-6
	3 400	-11

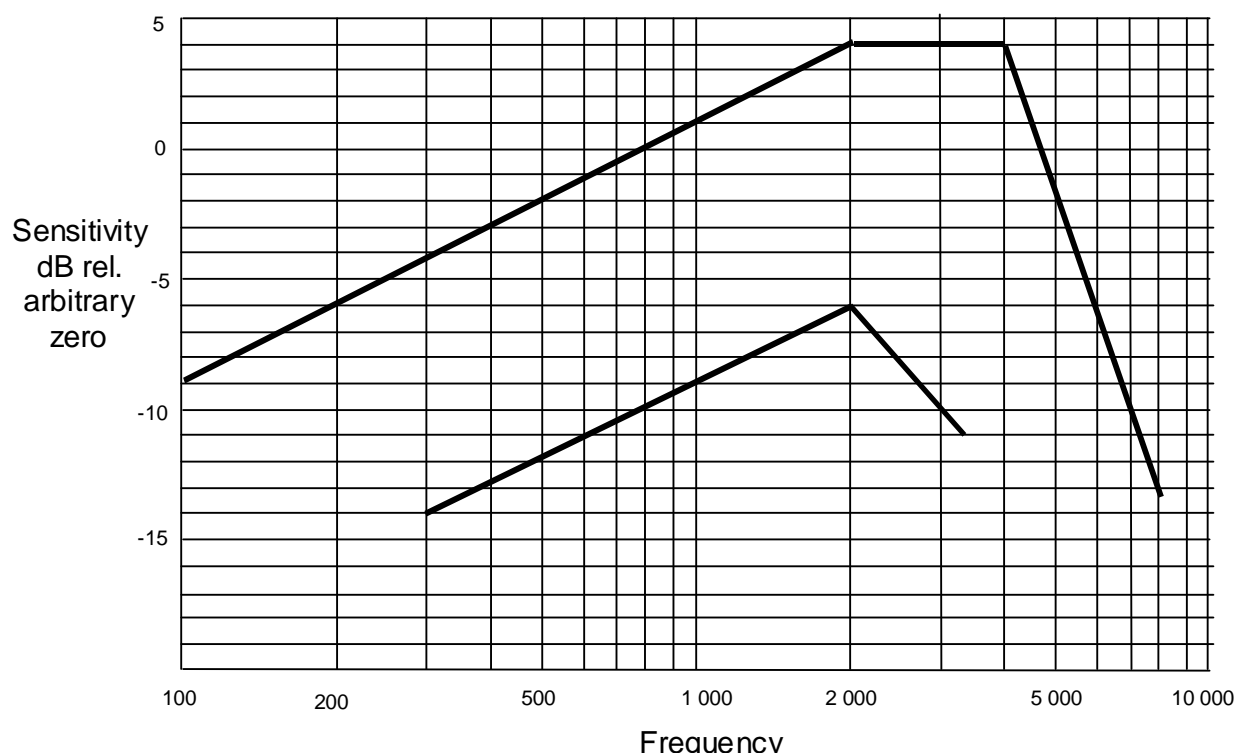


Figure A.1: Sending sensitivity/frequency limits

A.2.1.2 Receiving Sensitivity

Requirement: The receiving sensitivity when measured according to ITU-T Recommendation P.64 [2], as a function of frequency, shall be not greater than the upper limit and not less than the lower limit given in table A.2 and shown in figure A.2.

Additionally, the sensitivity at 8 kHz shall be at least 20 dB below the sensitivity at 1 kHz.

Test: Compliance shall be checked by the test described in clause B.2.1.2 when measured with the feed resistance R_f set to 1 000 Ω .

Table A.2: Co-ordinates of receiving sensitivity limit curves

	Frequency (Hz)	dB relative to arbitrary level
Upper limit	100	-10
	200	+2
	4 000	+2
	8 000	-15
Lower limit	300	-9
	1 000	-7
	3 400	-12

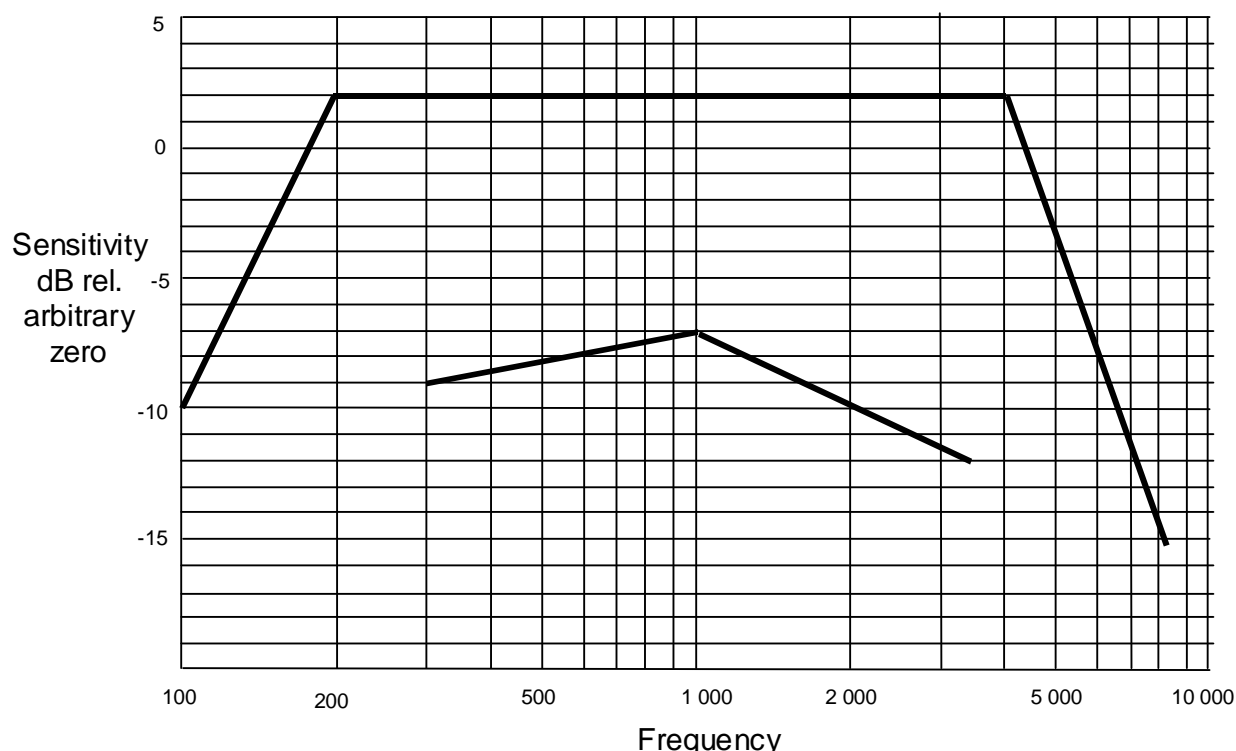


Figure A.2: Receiving sensitivity/frequency limits

A.2.2 Sending and Receiving Loudness Ratings (SLR and RLR)

A.2.2.1 Sending Loudness Rating (SLR)

Requirement: The Sending Loudness Rating (SLR) shall be +3 dB \pm 4 dB when measured with the feed resistance R_f set to 2 800 Ω and 1 000 Ω and +3 dB + 7/- 4 dB when measured with the feed resistance R_f set to 500 Ω .

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the requirement to measure with R_f set to 2 800 Ω should be replaced by a requirement to measure with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Test: Compliance shall be checked by the test described in clause B.2.2.1.

A.2.2.2 Receiving Loudness Rating (RLR)

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 $2\,800 \text{ }\Omega$ and $1\,000 \text{ }\Omega$ and $-8 \text{ dB} + 7/-4 \text{ dB}$ when measured with the feed resistance R_f set to $500 \text{ }\Omega$.

For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the requirement to measure with R_f set to $2\,800 \text{ }\Omega$ shall be replaced by a requirement to measure with R_f set to $2\,300 \text{ }\Omega$.

NOTE: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Test: Compliance shall be checked by the test described in clause B.2.2.2.

A.2.3 Sidetone

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

Table A.3: Sidetone rating

Value of SideTone Masking Rating (dB)		
Termination of figure B.6	Termination of figure B.7	Termination of figure B.8
STMR	STMR	STMR
$\geq +5$	$\geq +10$	$\geq +7$

Test: Compliance shall be checked by the test described in clause B.2.3.

A.2.4 Distortion

A.2.4.1 Sending distortion

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 $-4,7 \text{ dBPa}$ when measured with a load of $600 \text{ }\Omega$.

With a sinusoidal input signal of $+5 \text{ dBPa}$ at a frequency of 1 000 Hz, the "total" harmonic distortion (summed up to the 5th harmonic) shall be not greater than 10 %.

Test: Compliance shall be checked by the test described in clause B.2.4.1 with the feed resistance R_f set to $2\,800 \text{ }\Omega$ and $500 \text{ }\Omega$.

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to $2\,800 \text{ }\Omega$ should be replaced by a test with R_f set to $2\,300 \text{ }\Omega$.

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

A.2.4.2 Receiving distortion

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 .

With an input e.m.f. 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 %.

Test: Compliance shall be checked by the test described in clause B.2.4.2 with the feed resistance R_f set to $2\,800 \text{ }\Omega$ and $500 \text{ }\Omega$.

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

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

A.2.5.1 Sending linearity

Requirement: The sensitivity determined with an input sound pressure level of -4,7 dBPa shall not differ by more than ± 2 dB from the sensitivity determined with an input sound pressure level of -19,7 dBPa when measured with a load of 600 Ω .

Test: Compliance shall be checked by the test described in clause B.2.5.1 with the feed resistance R_f set to 1 000 Ω .

A.2.5.2 Receiving linearity

Requirement: 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.

Test: Compliance shall be checked by the test described in clause B.2.5.2 with the feed resistance R_f set to 1 000 Ω .

A.2.6 Noise

A.2.6.1 Sending noise

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 500 Ω , -64 dBVp when the feed resistance R_f is set to 1 000 Ω , and -60 dBVp when the feed resistance R_f is set to 2 800 Ω .

For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the requirement to measure with R_f set to 2 800 Ω shall be replaced by a requirement to measure with R_f set to 2 300 Ω .

NOTE: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Test: Compliance shall be checked by the test described in clause B.2.6.1.

A.2.6.2 Receiving noise

Requirement: The A-weighted noise produced by the apparatus in the receiving direction shall be not greater than -49 dBPa (A).

Test: Compliance shall be checked by the test described in clause B.2.6.2 with the feed resistance R_f set to 2 800 Ω and 500 Ω .

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

A.2.7 Instability

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 clause B.2.7.

Test: Compliance shall be checked by the test described in clause B.2.7.

A.2.8 Echo Return Loss (ERL)

Requirement: The Echo Return Loss (ERL) shall be not less than 14 dB with respect to the impedance shown in figure A.3.

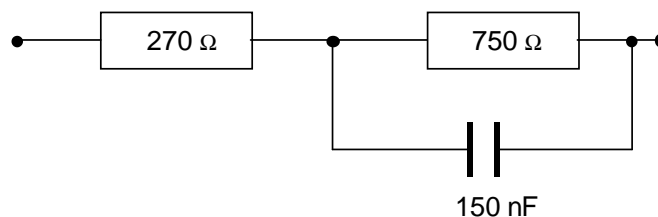


Figure A.3: Terminating impedance

Test: Compliance shall be checked by determination of the echo loss as described in clause B.2.8 with the feed resistance R_f set to 2 800 Ω and 500 Ω.

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω.

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Annex B (normative): Speech transmission compliance tests for LRGP measured terminals

Those tests methods are for terminals being designed for measurement not using a test set up as described in 4.1.5 (with HATS measurement system).

This annex will become informative in a further release of the present document as new terminals will be more and more designed by using HATS measurement methods.

B.1 General conditions for testing

B.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).

B.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 B.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 B.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.

B.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 highest feed resistance, then at lower values of resistance, decreasing sequentially to the minimum, in order to avoid a heating effect in the test arrangement.

B.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).

B.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 ITU-T Recommendation P.64 [2], annex C.

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.

B.1.6 Test levels

B.1.6.1 Sending

Unless otherwise stated in the present document, 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 [2].

B.1.6.2 Receiving

Unless otherwise stated in the present document, 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.

B.1.6.3 Sidetone

Unless otherwise stated in the present document, 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 [2].

B.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.

If no setting of the volume control is specified, compliance tests shall be carried out at the nominal setting of the volume control defined in clause 4.1.4.

B.1.8 Test equipment requirements

Artificial mouth: the artificial mouth shall conform to ITU-T Recommendation P.51 [3].

Artificial ear: the ITU-T Recommendation P.57 [4] 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 Ear Reference Point (ERP) by the correction characteristics specified in ITU-T Recommendation P.57 [4];
- 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 [5], Type 1.

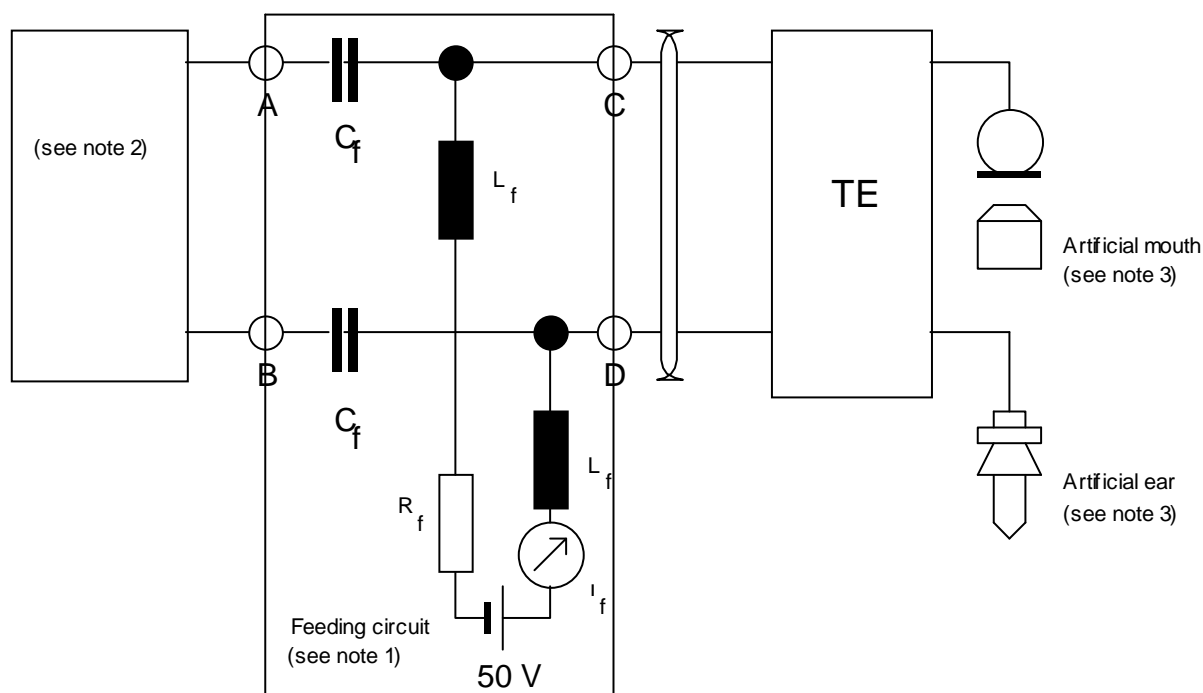
B.1.9 Alternative test methods

The requirements of this test specification were written on the basis of the standard test methods described in the present document . 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 the present document .

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.

B.1.10 Testing arrangements

All tests for transmission performance shall be carried out with the TE connected to the test arrangement shown in figure B.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 B.3 and B.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 with an impedance of $600\ \Omega$, a measuring set, the network either of figures B.6, B.7, or B.8, or a $600\ \Omega$ resistor.

NOTE 3: The artificial mouth and ear are described in ITU-T Recommendations P.51 [3] and P.57 [4] respectively. The TE handset is mounted in the LRGP and the earcap is applied to the artificial ear.

Figure B.1: Circuit for measurement of transmission characteristics

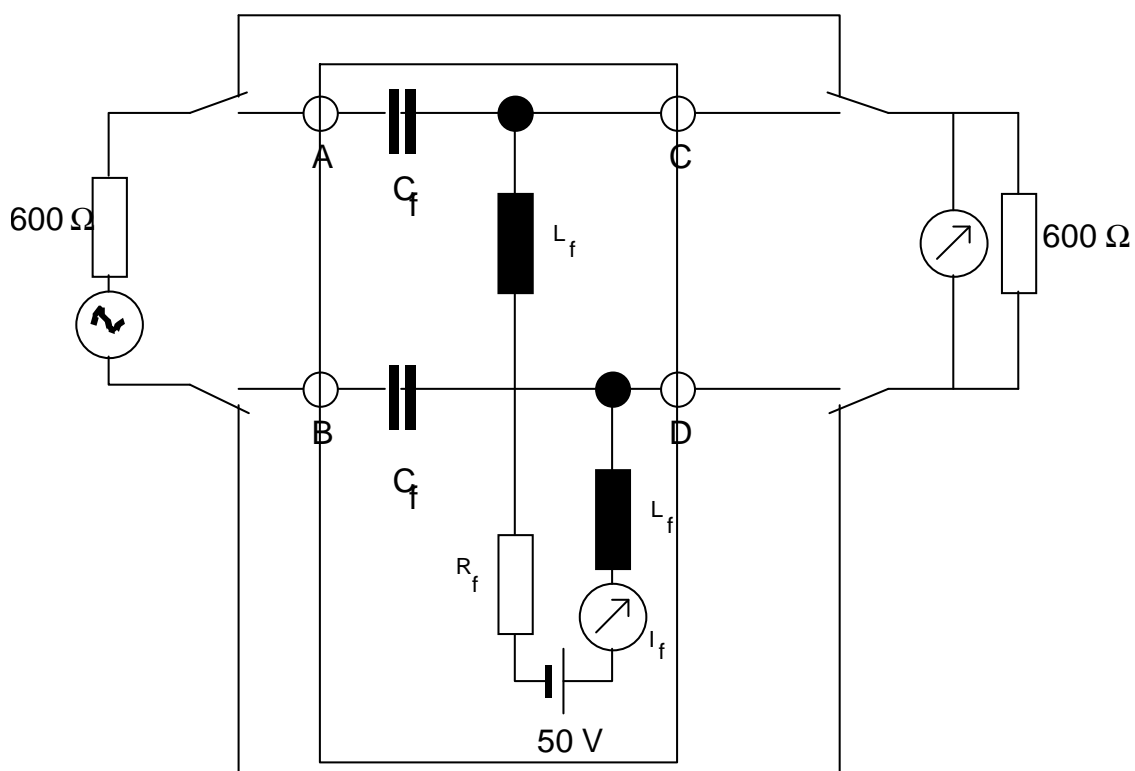


Figure B.2: Insertion loss test arrangement for the d.c. feeding circuit

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

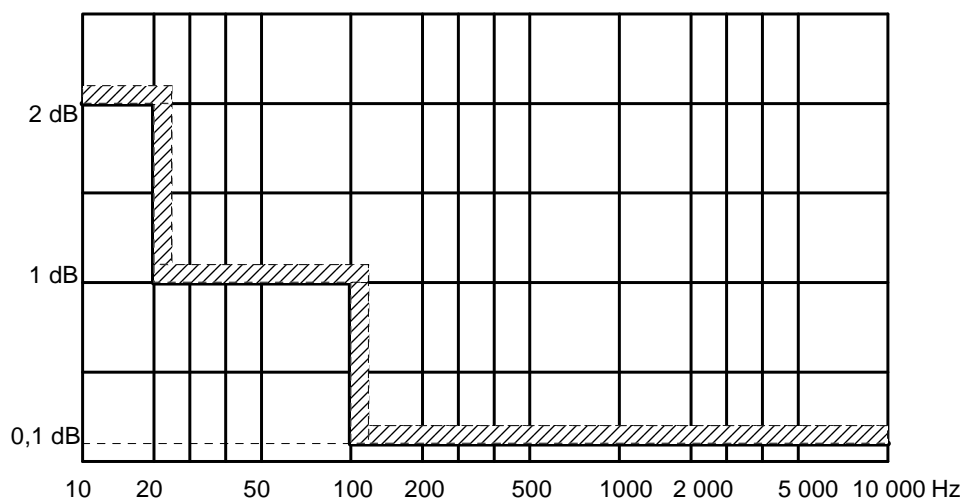
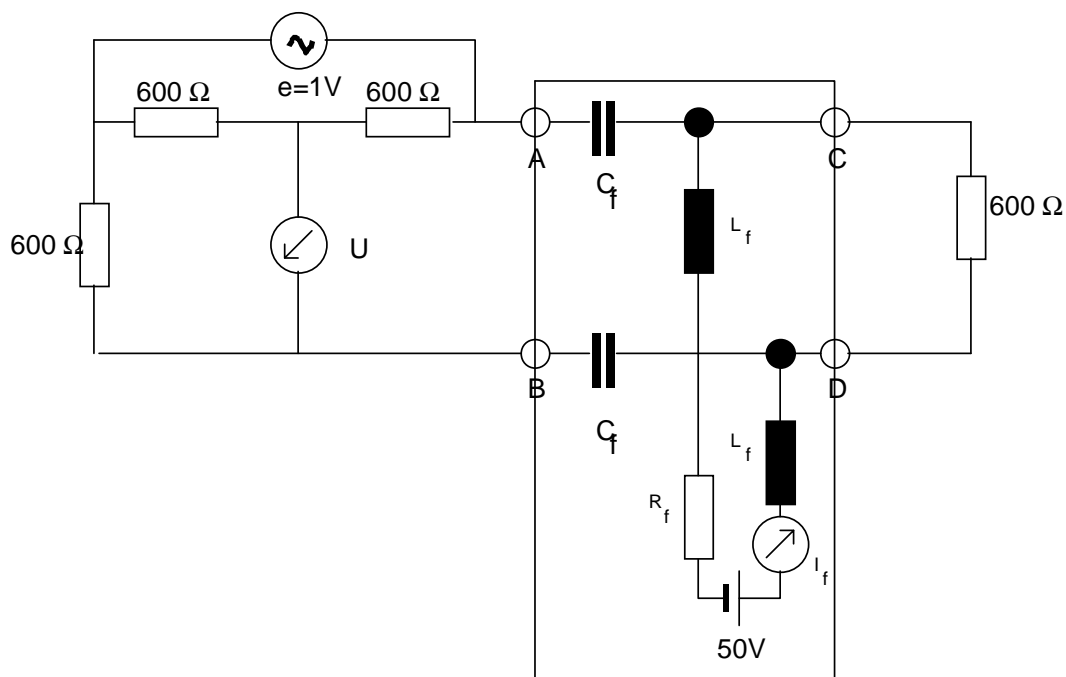


Figure B.3: Maximum limit for insertion loss



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

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

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

The return loss (in dB) is calculated from the formula:

$$RL = 20 \log_{10} \left[\frac{e}{2U} \right]$$

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

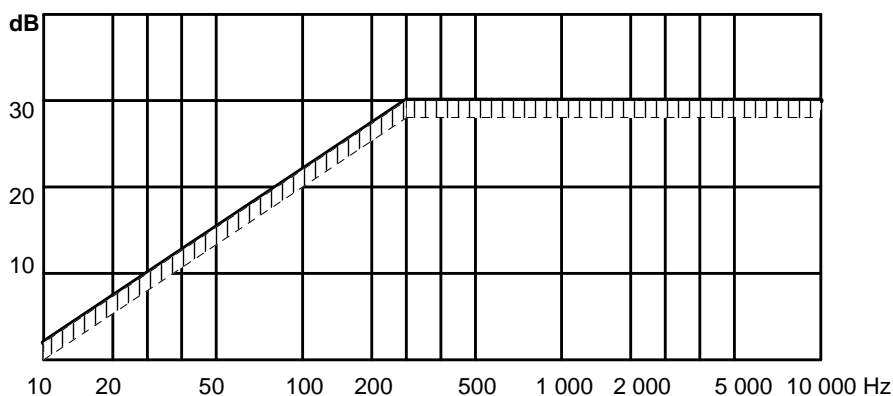


Figure B.5: Minimum limit for return loss

B.2 Speech transmission performance tests for LRGP measured terminals

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

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

B.2.1 Sensitivity/frequency response

B.2.1.1 Sending sensitivity

Purpose:

To demonstrate compliance with the requirements of clause A.2.1.1.

Test configuration:

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

Measurement execution:

The sending sensitivity/frequency response shall be determined as described in ITU-T Recommendation P.64 [2] clause 8 and by using the procedure described in clause 11 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 $1\,000 \Omega$, at 1/12 octave intervals at the preferred frequencies given by the R40 series of preferred numbers in ISO 3 [6] for frequencies from 100 Hz to 8 kHz.

B.2.1.2 Receiving sensitivity

Purpose:

To demonstrate compliance with the requirements of clause A.2.1.2.

Test configuration:

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

Measurement execution:

The receiving sensitivity/frequency response shall be determined as described in ITU-T Recommendation P.64 [2] clause 9 and by using the procedure described in clause 11 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 1 000 Ω , at 1/12 octave intervals at the preferred frequencies given by the R40 series of preferred numbers in ISO 3 [6] for frequencies from 100 Hz to 8 kHz.

B.2.2 Loudness ratings

B.2.2.1 Sending loudness rating

Purpose:

To demonstrate compliance with the requirements of clause A.2.2.1.

Test configuration:

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

Measurement execution:

Measurements shall be performed at each of the 14 frequencies given in table 1 of ITU-T Recommendation P.79 [7], bands 4 to 17, to yield values of the sending sensitivity, expressed in dBV/Pa.

Measurements shall be made with R_f set to 2 800 Ω (or 2 300 Ω as appropriate), 1 000 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 [7], over bands 4 to 17, using $m = 0,175$ and the sending weighting factors from table 1 of ITU-T Recommendation P.79 [7].

NOTE: ITU-T Recommendation P.65 [i.5] 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.

B.2.2.2 Receiving loudness rating

Purpose:

To demonstrate compliance with the requirements of clause A.2.2.2.

Test configuration:

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

Measurement execution:

Measurements shall be performed at each of the 14 frequencies given in table 1 of ITU-T Recommendation P.79 [7], 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 (or 2 300 Ω as appropriate), 1 000 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 [7], over bands 4 to 17, using $m = 0,175$ and the receiving weighting factors from table 1 of ITU-T Recommendation P.79 [7].

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 [7].

NOTE 1: The values of real ear correction of table 2 of ITU-T Recommendation P.79 [7] were derived for one type of handset conforming to the shape defined in ITU-T Recommendation P.35 [i.2].

NOTE 2: ITU-T Recommendation P.65 [i.6] 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.

B.2.3 Sidetone

Purpose:

To demonstrate compliance with the requirements of clause A.2.3.

Test configuration:

For the first test, the terminating impedance shown in figure B.8 shall be connected to terminals A and B shown in figure B.1 and the feeding resistance R_f shall be set to 2 800 Ω (or 2 300 Ω as appropriate).

For the second test, the terminating impedance shown in figure B.7 shall be connected to terminals A and B shown in figure B.1 and the feeding resistance R_f shall be set to 1 000 Ω .

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

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

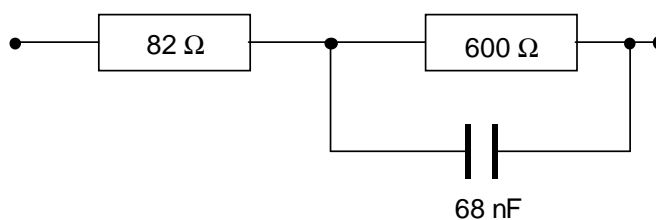


Figure B.6: Terminating impedance - impedance "a"

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

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

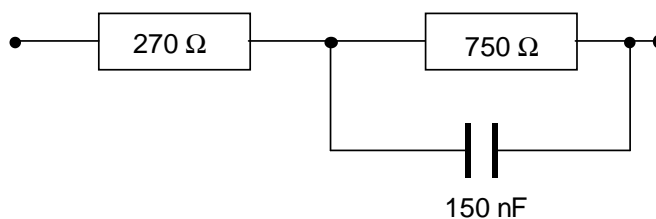


Figure B.7: Terminating impedance - impedance "b"

For impedance "b", the measurement shall be made with the feeding resistance R_f set to 1 000 Ω .

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

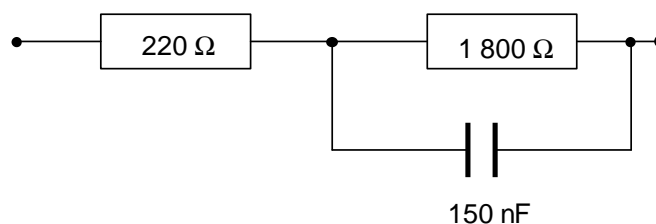


Figure B.8: Terminating impedance - impedance "c"

For impedance "c", the measurement shall be made with the feeding resistance R_f set to 2 800 Ω (or 2 300 Ω as appropriate).

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

Measurement execution:

The sidetone sensitivity/frequency response shall be determined at each of the frequency bands 1-20 in table 1 of ITU-T Recommendation P.79 [7] by the procedure described in clauses 8 and 11 of ITU-T Recommendation P.64 [2]. 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 [7], 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 [7] irrespective of which artificial ear is used.

NOTE: ITU-T Recommendation P.65 [i.7] 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.

B.2.4 Distortion

B.2.4.1 Sending distortion

Purpose:

To demonstrate compliance with the requirements of clause A.2.4.1.

Test configuration:

A 600 Ω resistor shall be connected between terminals A and B shown in figure B.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 A and B shown in figure B.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 percentage 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 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 (or 2 300 Ω as appropriate) and 500 Ω .

B.2.4.2 Receiving distortion

Purpose:

To demonstrate compliance with the requirements of clause A.2.4.2.

Test configuration:

A signal generator shall be connected between A and B shown in figure B.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 e.m.f. of -12 dBV the generator is operated at frequencies of 315 Hz, 500 Hz and 1 000 Hz.

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

The percentage 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 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 (or 2 300 Ω as appropriate) and 500 Ω .

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

B.2.5.1 Sending linearity

Purpose:

To demonstrate compliance with the requirements of clause A.2.5.1.

Test configuration:

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

Measurement execution:

Measurements shall be made with R_f set to 1 000 Ω .

The sending sensitivity at a frequency of 1 000 Hz shall be determined as described in ITU-T Recommendation P.64 [2], clause 8 with the input sound pressure level set to -4,7 dBPa and by using the procedure described in clause 11 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 sound pressure level set to -19,7 dBPa.

B.2.5.2 Receiving linearity

Purpose:

To demonstrate compliance with the requirements of clause A.2.5.2.

Test configuration:

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

Measurement execution:

Measurements shall be made with R_f set to 1 000 Ω .

The receiving sensitivity at a frequency of 1 000 Hz shall be determined as described in ITU-T Recommendation P.64 [2], clause 9 with the input e.m.f. set to -12 dBV and by using the procedure described in clause 11 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.

B.2.6 Noise

B.2.6.1 Sending noise

Purpose:

To demonstrate compliance with the requirements of clause A.2.6.1.

Test configuration:

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

A measuring set of high impedance, calibrated in dBV and using psophometric weighting according to table 1 of ITU-T Recommendation O.41 [8], shall be connected between terminals A and B shown in figure B.1.

Measurement execution:

Measurements shall be made with R_f set to 2 800 Ω (or 2 300 Ω as appropriate) 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.

B.2.6.2 Receiving noise

Purpose:

To demonstrate compliance with the requirements of clause A.2.6.2.

Test configuration:

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

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

Measurement execution:

Measurements shall be made with R_f set to 2 800 Ω (or 2 300 Ω as appropriate) 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.

B.2.7 Instability

Purpose:

To demonstrate compliance with the requirements of clause A.2.7.

Test configuration:

Measurements shall be made under the following conditions:

- with R_f set to 2 800 Ω (or 2 300 Ω as appropriate), with the impedance shown in figure B.8 connected between terminals A and B shown in figure B.1;
- with R_f set to 500 Ω , with a resistance of 600 Ω connected between terminals A and B shown in figure B.1.

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.

NOTE 1: For terminal equipment supporting handsfree or loudspeaking functions which is not powered from a separate power supply, the test with R_f set to 2 800 Ω should be replaced by a test with R_f set to 2 300 Ω .

NOTE 2: In some countries, lines are in use which provide less current than that provided by this test. When connected to such lines, TEs with handsfree or loudspeaking functions may not operate correctly.

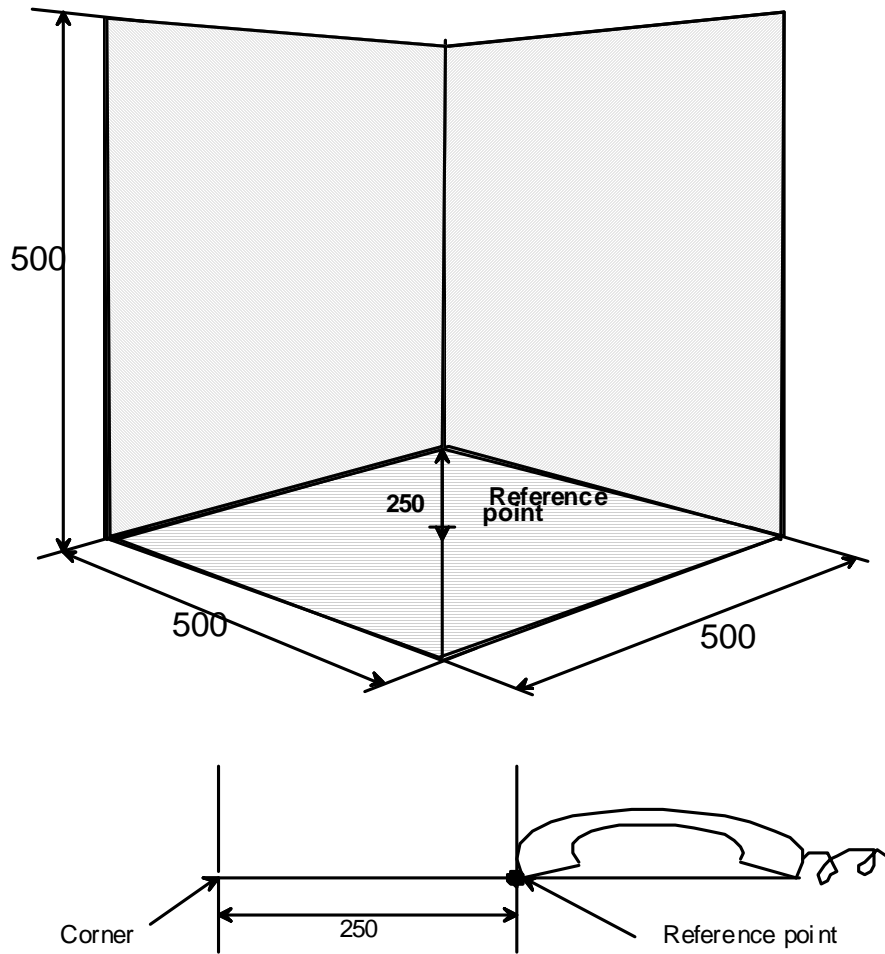
The handset shall be positioned on one inside surface that is of three perpendicular plane, smooth, hard surfaces forming a corner. Each surface shall extend 0,5 m from the apex of the corner. One surface shall be marked with a diagonal line extending from the corner formed by the three surfaces, as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

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 B.1 is less than -40 dBV.



All dimensions are in millimeters

Figure B.9: Handset position for instability test

B.2.8 Echo Return Loss (ERL)

Purpose:

To demonstrate compliance with the requirements of clause B.2.8.

Test configuration:

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

The earcap shall be applied to the artificial ear.

Measurement execution:

Measurements shall be made with R_f set to 2 800 Ω (or 2 300 Ω as appropriate) and 500 Ω .

The test level across A and B shown in figure B.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: 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:

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

where:

Z_t is the apparatus impedance, measured;

Z_b is the reference impedance shown in figure B.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 [1], using the formula:

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

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.

Annex C (informative): Table of changes relative to TBR 38

The table C.1 indicates when requirements and tests methods given in TBR 38 [15] (and transferred in Annexes A and B of the present document) have been modified and the reason of changes.

Table C.1

TBR 038 [15] (and Annexes A and B of ES 202 738 [i.4]) clause		ES 203 038 Clause		Requirement changed	
Number	Title	Number	Title	Y = Yes N = No	Why
	Foreword		Foreword	Y	Presentation of ES and its purposes.
	Introduction		Introduction	Y	
1	Scope	1	Scope	Y	Added: compatibility with radio linked handset.
2	Normative references	2	Normative references	Y	New references added.
3	Definitions, symbols and abbreviations	3	Definitions, symbols and abbreviations	Y	
3.1	Definitions	3.1	Definitions	Y	New definitions added.
3.2	Symbols	3.2	Symbols	Y	New symbols added.
3.3	Abbreviations	3.3	Abbreviations	Y	New abbreviations added.
4	Speech transmission aspects	4		N	
4.1	General	4.1	General	Y	Test setup for handset have been changed (HATS instead of TRGP).
4.1.1	Polarity independence	4.1.1	Polarity independence	N	
4.1.2	Feed conditions	4.1.2	Feed conditions	N	
4.1.3	Power supply	4.1.3	Power supply	N	
4.1.4	Volume control	4.1.4	Volume control	N	
		4.1.5	Test setup	Y	Introduction of HATS.
		4.1.6	Environment for tests	N	A.1.1 of TBR 38 [15] without change.
		4.1.7	Accuracy of measurements and test equipment setting	Y	A.1.2 of TBR 38 [15] with added tolerances for application pressure.
		4.1.8	Order of tests	N	A.1.3 of TBR 38 [15] without change.
		4.1.9	Acoustic environment	N	A.1.4 of TBR 38 [15] without change
		4.1.10	Alternative test methods	N	A.1.9 of TBR 38 [15] without change.
		4.1.11	Testing arrangements	Y	A.1.10 of TBR 38 [15] with replacement of LRGP by HATS.
4.2	Speech performance characteristics	4.2	Speech performance characteristics	Y	New requirements and insertion of test methods (in TBR 38 [15] test methods were given in Annex A).
4.2.1	Sensitivity/frequency response	4.2.1	Sensitivity/frequency response	Y	New limits corresponding to use of HATS. Furthermore it is considered that average lengths of line have decreased, consequently preemphasis is decreased (4 dB in total with a repartition between sending and receiving).

TBR 038 [15] (and Annexes A and B of ES 202 738 [i.4]) clause		ES 203 038 Clause		Requirement changed	
Number	Title	Number	Title	Y = Yes N = No	Why
4.2.1.1	Sending Sensitivity	4.2.1.1	Sending Sensitivity	Y	New limits corresponding to a flat curve with a preemphasis of 2 dB between 300 Hz and 1 kHz. Test uses HATS instead of artificial mouth.
4.2.1.2	Receiving Sensitivity	4.2.1.2	Receiving Sensitivity	Y	New limits corresponding to a flat curve with a preemphasis of 2 dB between 300 Hz and 1 kHz. Test uses HATS and diffuse field correction instead of LRGP.
4.2.2	Sending and Receiving Loudness Ratings (SLR and RLR)	4.2.2	Sending and Receiving Loudness Ratings (SLR and RLR)	Y	Terminals have no more gain regulation with line current. It is no more necessary to increase Loudness Ratings tolerances with Rf = 500 ohms.
4.2.2.1	Sending Loudness Rating (SLR)	4.2.2.1	Sending Loudness Rating (SLR)	Y	Same tolerances for all line resistor values. Test uses HATS instead of LRGP.
4.2.2.2	Receiving Loudness Rating (RLR)	4.2.2.2	Receiving Loudness Rating (RLR)	Y	Same tolerances for all line resistor values. Test uses HATS instead of LRGP.
4.2.3	Sidetone	4.2.3	Sidetone	Y	Terminals and lines have evolved. Same value (10 dB) for all conditions.
4.2.4	Distortion	4.2.4	Distortion	Y	Terminals have evolved.
4.2.4.1	Sending distortion	4.2.4.1	Sending distortion	Y	Decrease of limit for normal level. Test uses HATS instead of LRGP.
4.2.4.2	Receiving distortion	4.2.4.2	Receiving distortion	Y	Decrease of limit for normal level. Test uses HATS instead of LRGP.
4.2.5	Linearity (variation of gain with input level)	4.2.5	Linearity (variation of gain with input level)	Y	
4.2.5.1	Sending linearity	4.2.5.1	Sending linearity	Y	Test uses HATS instead of LRGP;
4.2.5.2	Receiving linearity	4.2.5.2	Receiving linearity	Y	Test uses HATS instead of LRGP;
4.2.6	Noise	4.2.6	Noise	Y	
4.2.6.1	Sending noise	4.2.6.1	Sending noise	Y	Change in test method.
4.2.6.2	Receiving noise	4.2.6.2	Receiving noise	Y	Change in test method.
		4.27	Acoustic shock	Y	Added in ES 202 738 [i.4].
		4.27.1	Continuous signal	Y	
		4.27.2	Peak signal	Y	
4.2.7	Instability	4.2.8	Instability	N	
4.2.8	Echo Return Loss (ERL)	4.2.8	Echo Return Loss (ERL)	N	
		Annex A (normative):	Requirements for LRGP measured terminals	N	Those requirements are requirements of TBR 38 [15].
Annex A (normative):	Speech transmission compliance tests	Annex B (normative)	Speech transmission compliance tests for LRGP measured terminals	N	Those test methods are tests methods of TBR 38 [15].
Annex B (normative):	TBR Requirements Table (TBR-RT)	suppressed			Not applicable for an ES.

TBR 038 [15] (and Annexes A and B of ES 202 738 [i.4]) clause		ES 203 038 Clause		Requirement changed	
Number	Title	Number	Title	Y = Yes N = No	Why
Annex C (informative):	Information for test purposes	suppressed			Not applicable for an ES.
		Annex C	Table of changes relative to TBR 38 [15]		
Annex D (informative):	Bibliography	Annex D (informative):	Bibliography	N	

Annex D (informative): Bibliography

For the purposes of the present document , the following references have been provided within the text for information:

- Council Directive 91/263/EEC on the approximation of the laws of the Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity.
- Council Directive 98/13/EC relating to telecommunications terminal equipment and satellite earth station equipment, including the mutual recognition of their conformity.
- ETSI I-ETS 300 677: "Public Switched Telephone Network (PSTN); Requirements for handset telephony".
- ETSI I-ETS 300 480 (V1.2.1): "Public Switched Telephone Network (PSTN); Testing specification for analogue handset telephony".

History

Document history		
V1.1.1	January 2009	Membership Approval Procedure MV 20090327: 2009-01-27 to 2009-03-27