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SERIES P: TELEPHONE TRANSMISSION QUALITY, TELEPHONE INSTALLATIONS, LOCAL LINE NETWORKS

Subscribers' lines and sets

Efficiency of devices for preventing the occurrence of excessive acoustic pressure by telephone receivers

ITU-T Recommendation P.360

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION P.360

EFFICIENCY OF DEVICES FOR PREVENTING THE OCCURRENCE OF EXCESSIVE ACOUSTIC PRESSURE BY TELEPHONE RECEIVERS

Summary

It is known that an excessive acoustic pressure level may produce auditory damage to the users. To prevent the occurrence of excessive acoustic pressure generated by the earphones of handset or headset, the telephony terminal equipment needs to implement devices to limit the acoustic pressure level.

This Recommendation proposes limits to the acoustic pressure generated by the handset and headset earphones and some guidance on how to measure it.

It includes also some guidance to avoid speech degradation due to the use of devices implemented in the terminal to prevent the occurrence of excessive acoustic pressure.

Source

ITU-T Recommendation P.360 was revised by ITU-T Study Group 12 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 3rd of December 1998.

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

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NOTE

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Recommendation P.360[1]

EFFICIENCY OF DEVICES FOR PREVENTING THE OCCURRENCE OF EXCESSIVE ACOUSTIC PRESSURE BY TELEPHONE RECEIVERS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988; revised in 1998)

1 Scope

The use of devices for preventing the occurrence of excessive acoustic pressure by telephone receivers is recommended in Recommendation K.7. Methods for checking the efficiency of such devices in response to short duration impulses and for longer duration disturbances, such as tones, are given in this Recommendation. A method is also given for checking that such devices do not have adverse effects on normal speech signals.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] IEC Publication 60318 (All Parts:1998), *Electroacoustics – Simulators of human head and ear.*

[2] IEC Publication 60711:1981, *Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts.*

[3] IEC Publication 60651:1979, *Sound level meters.*

[4] ITU-T Recommendation P.57 (1996), *Artificial ears.*

[5] ITU-T Recommendation P.58 (1996), *Head and torso simulator for telephonometry.*

[6] CCITT Recommendation K.7 (1984), *Protection against acoustic shock.*

[7] IEC Publication 60950:1991, *Safety for information technology equipment.*

[8] CCITT Recommendation O.6 (1988), *1020 Hz reference test frequency.*

3 Definitions and abbreviations

This Recommendation defines the following terms:

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

3.2 Ear Reference Point (ERP): A virtual point for geometric reference located at the entrance to the listener's ear, traditionally used for calculating telephonometric loudness ratings.

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[1] Previously P.36.

3.3 ear-Drum Reference Point (DRP): A point located at the end of the ear canal, corresponding to the ear-drum position.

Relevant abbreviations in Recommendation P.10 apply.

DRP Ear-Drum Reference Point

ERP Ear Reference Point

PCM Pulse Code Modulation

4 Efficiency of protection again excessive acoustic pressure

The testing methods provided in this Recommendation only cover the application of in-band signals, but the same sound pressure limits apply if ringing signals appear with the telephone set in off-hook conditions.

On the basis of the finding of scientific studies, several authors or organizations have proposed ear-damage risk criteria based on variations in acoustic pressure, under impulse conditions for which, parenthetically, there is no single definition. Likewise, ear-damage risk criteria have also been proposed for longer duration acoustic disturbances, such as tones. However, these criteria cannot be directly transposed to the test conditions and measurements described below. Nor could the results be cross-checked without introducing certain hypotheses that are not specified in this Recommendation, the purpose of which is merely to describe a method simple both in its application and in the analysis of the results obtained. The criteria recommended are based on experience gained in several countries about the telephone receiver quality necessary to ensure the safety of users and operators. Administrations may wish to adopt lower limiting levels to reduce user annoyance caused by acoustic disturbances, but the limiting levels should not be so low as to have adverse effects on normal speech levels. In Annex A, some data from IEC Publication 60950 explaining the values determined for the acoustic pressure level limits are given.

Recommendations P.57 and P.58 define several types of artificial ears. The use of the appropriate type of artificial ear is determined by the size or the type of the earpiece of the handset or of the headset. It has been decided that the acoustic level measured by the artificial ear shall never be corrected. It means that for the type 1 artificial ear the acoustic pressure level shall be measured at the Ear Reference Point, and for all the other types of artificial ears the acoustic pressure level shall be measured at the Drum Reference Point. Due to recent contributions, it appears that it is not appropriate to weight the level measured by the type 2 and 3.x artificial ear by a "mean" ERP/DRP correction factor.

4.1 Efficiency of protection against short duration impulses

In order to check whether a telephone set affords satisfactory protection against the risk of acoustic shocks due to short duration impulses, it is recommended that its characteristics be examined as follows:

a) the entire telephone set, including the protective device, is placed in normal operating conditions as regards current supply and its position for the exchange of a call (e.g. with the handset in vertical position);

b) the earpiece of the handset or headset earphone is applied in the normal way to an artificial ear conforming to Recommendation P.57;

c) the artificial ear is electrically connected to a precision sound level meter conforming to IEC Publication 60651, correctly calibrated and having the necessary circuits for measuring peak acoustic pressure levels. This equipment should at least be of type 2 for prototype testing, and may be of type 3 for checking mass-produced sets;

d) electrical impulses are applied to the telephone set by a suitable assembly. For analogue two-wire terminals, the impulses are superimposed on the d.c. supply without the latter short-circuiting them. As an example, these impulses may be produced by a generator whose components are those described for symmetric-pair repeater tests (R_3 = 25 ohms, C_2 = 0.2 μF). The test voltage is between 0 and 1.5 kV. For analogue four-wire systems, the impulses are applied across the terminals of the receive circuit. For digital four-wire systems, transverse impulses are applied between the send and receive pairs;

e) the telephone set is also checked for self-generated acoustic impulses such as those produced by operation of the hook switch or by pulse dialling;

f) for both cases d) and e) above, the peak acoustic pressure level observed (maximum instantaneous value) should be below +46 dBPa for the handset and +39 dBPa for the headset. In the long term, Administrations are recommended to limit this value to +41 dBPa for handsets in common use.

NOTE 1 – It could be useful to repeat some tests more than one time, to ensure that the protection system is not damaged.

NOTE 2 – According to the data presented in Annex A, it seems appropriate to use different limits for specific cases, for instance, for the headsets used by operators.

4.2 Efficiency of protection against longer duration disturbances

In order to check whether a telephone set affords satisfactory protection against the risk of acoustic hazards due to longer duration disturbances, such as tones, it is recommended that its characteristics be examined as follows:

a) the entire telephone set, including the protective device, is placed in normal operating conditions as regards current supply and its position for the exchange of a call (e.g. with the handset in vertical position);

b) the earpiece of the handset or headset earphone is applied in the normal way to an artificial ear conforming to Recommendation P.57;

c) the artificial ear is electrically connected to a precision sound level meter conforming to IEC Publication 60651, correctly calibrated to measure A-weighted sound pressure levels. This equipment must be of type 2 for prototype testing, and may be of type 3 for checking mass-produced sets;

d) a 1000 ± 20 Hz[2] sine wave signal is applied to the telephone set. For analogue terminals, its amplitude is increased until it reaches 10 V_{rms} across the set's terminals or until the steady-state acoustic output from the telephone receiver reaches its limiting value, whichever occurs first. For digital terminals a digitally encoded signal representing the maximum energy deliverable by the network transmission system and/or by the coding system is used (e.g. +3.14 dBm0 for G.711 coding);

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[2] The ISO list of preferred frequencies includes 1000 Hz. It is a commonly used reference frequency in acoustic testing. Recommendation O.6 suggests 1020 Hz be used when testing PCM systems to avoid being at a submultiple of the 8000 Hz sampling rate. Recommendation O.6 may need to be considered when testing digital telephones.

e) the telephone set is also checked for self-generated acoustic disturbances, such as tone dialling signals fed back to the receiver;

f) for both cases d) and e) above, the steady-state A-weighted sound pressure level should be below +31 dBPa(A) for the handset and +24 dBPa(A) for the headset ("slow" response).

NOTE 1 – Tones or other disturbances which are inherently limited to less than 0.5s duration should be evaluated as short duration impulses under 4.1. Repetitive disturbances, such as those which might be produced during automatic tone-type dialling, should be evaluated under 4.2 using the sound level meter set for "slow" response averaging.

NOTE 2 – According to the data presented in Annex A, it seems appropriate to use different levels for specific cases, for instance, for the headsets used by operators.

5 Effect on normal speech signals

It is recommended to check whether the strong-signal attenuation obtained by protective devices does not cause deterioration of the normal signals, e.g. by non-linear distortion. This may be done by conducting a series of measurements using steady-state sine wave signals at a frequency of 1000 ± 20 Hz and relating to the following magnitudes:

N is an electric voltage level at the terminals of the set. *N* is determined by the relation:

$$N = 20\log_{10}\frac{V_{rms}}{0.775}\ \text{(dB)}$$

where V_{rms} represents the r.m.s. value of the voltage across the terminals. The value of V_{rms} = 0.775 volts (–2.2 dBV) gives $N = 0$ and corresponds to a power level of 0 dBm into 600 ohms.

P(*N*) is an acoustic pressure produced by the telephone receiver under given conditions, (this may be the pressure measured on an artificial ear in accordance with Recommendation P.57), corresponding to the application of voltage level *N* across the terminals of the set.

A(*N*) is an attenuation of the electroacoustic efficiency with respect to its reference value *N* = –20 dB. *A*(*N*) is determined by the relation:

$$A(N) = 20\log_{10}\frac{P(-20)}{P(N)} + N + 20\ \ \text{(dB)}$$

[*A(N)* = 0 when *N* = –20 dB].

The values obtained for *A*(*N*) must match those in Table 1 which have been obtained from measurements carried out on several types of set fitted with various protective devices.

Table 1/P.360

N **(dB)**	***A(N)*** **(dB)**
–20	0
–10	< 0.5
0	≤ 2

NOTE 1 – It may be useful to make a few additional measurements to ensure that, at frequencies between 200 Hz and 4000 Hz, the values observed for *A(N)* are of the same order.

NOTE 2 – Some sets of recent design have special features, such as electroacoustic sensitivity which depends on the conditions of d.c. current supply or on the level of the speech signals received, quite apart from the effect of the protective devices. In that case, Administrations intending to use such sets may have to adapt the above conditions, in compliance with their principles.

ANNEX A

Basis for the determination of the limits for the acoustic pressure

A.1 Acoustic limits

A.1.1 Longer duration disturbances

The limit is set to +31 dBPa(A) for handsets and +24 dBPa(A) for headsets.

A.1.2 Short duration impulses

The limit is set to +46 dBPa for handsets and +39 dBPa for headsets.

A.2 Time duration discrimination

The time duration discrimination limit between "long duration disturbances" and "short duration impulses" is defined as 0.08 seconds.

A.3 Calculation of the limits

The basis for the calculation is a generally acceptable noise level of –9 dBPa(A) for 8 hours of exposure in a work place (as an example, see European Council Directive 86/188/EEC). The time dependence is based on equal energy of the acoustic pressure, which allows a 3 dB/octave acoustic increase [–6 dBPa(A) for 4 hours of exposure, ...].

Four factors [called "damage risk" (–10 dB), "exposure time" (+7 dB), "frequency spectrum" (–4 dB) and "sound field" (+5 dB] shall be considered as additional to the base level.

"Damage risk" (Dr): "the acceptable noise level in the work place" is not applicable to non-occupational exposure, for which there should be no damage. So the limit for damage shall be reduced by 10 dB.

"Exposure time" (Et) (+7 dB) is applied to handset application, because it is assumed that the exposure is not permanent. This value is not taken into account for headsets, considering that operators use the headsets continuously.

"Frequency spectrum" (Fs) (–4 dB): for telephony the signal is a narrow-band noise, while at the work place the noise is broadband.

"Sound field" (Sf) (+5 dB) is due to the fact that the test is referred to the ERP of the artificial ear, and that the basis for calculation [–9 dBPa(A)] comes from tests performed in the free field.

So, for **handsets**, for the exposure duration is 2 seconds for long duration disturbances the basis for calculation is chosen as L_{2s} = +33 dBPa(A), and the limit level is calculated as L_{2s} + Dr + Et + Fs + Sf **= +31 dBPa(A**), and for short duration impulses that the basis for calculation is chosen as $L_{0.08s}$ = +48 dBPa(A), and the limit is calculated as $L_{0.08s}$ + Dr + Et + Fs + Sf = **+46 dBPa**, because the frequency weighting is not appropriate for impulsive noise.

For **headsets**, the "Exposure time" (Et) is equal to 0 and the limits become **+24 dBPa(A)** for long duration disturbances and **+39 dBPa** for short duration impulses.

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