



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

P.76

TELEPHONE TRANSMISSION QUALITY

MEASUREMENTS RELATED TO SPEECH LOUDNESS

DETERMINATION OF LOUDNESS RATINGS; FUNDAMENTAL PRINCIPLES

ITU-T Recommendation P.76

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation P.76 was published in Volume V of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

© ITU 1988, 1993

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the ITU.



Documents

Document Sharing Hub

Recommendation P.76

DETERMINATION OF LOUDNESS RATINGS; FUNDAMENTAL PRINCIPLES

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

Preface

This Recommendation is one of a set of closely related Recommendations concerned with determination of loudness ratings. The present one deals with the fundamental principles and the others, as follows, deal with certain additional matters¹⁾.

Recommendation P.48	Specification for an intermediate reference system
Recommendation P.78	Subjective testing method for determination of loudness ratings in accordance with Recommendation P.76
Recommendation P.64	Determination of sensitivity/frequency characteristics of local telephone systems to permit calculation of their loudness ratings
Recommendation P.79	Calculation of loudness ratings
Recommendation P.65	Objective instrumentation for the determination of loudness ratings

1 Introduction

A speech path is, broadly, a transmission path that exists between a talker's mouth and the ear of a listener or, in the case of sidetone, between the mouth and ear of a talker. In typical face-to-face conversation, the speech is transmitted by means of the air path connecting the mouth and ear. Depending on environmental conditions, transmission may be:

- more or less direct, as in the case of two persons conversing in an open, unobstructed location, such as a golf course;
- largely indirect, as in the case of two persons conversing in a small, hard surfaced room where a large proportion of the energy reaching the ear may be due to reflections from the walls, ceilings and floor; or
- something between the two extremes of *a)* and *b)*.

In the case of telephony, the air path is replaced by a system comprising:

- an air path from the mouth to the telephone microphone;
- an air path between the telephone earphone and the ear; and
- a telephone connection consisting of the microphone, earphone and interconnecting circuitry together with a similar system for the reverse direction of transmission. The two situations - face-to-face and using the telephone - differ appreciably in detail but, for speech transmission purposes, they are alike insofar as their function is to provide a means of both-way speech communication.

Telephone engineering is concerned with providing telephone connections which, while not identical to the face-to-face situation, are comparable in effectiveness for providing a means of exchanging information by speech; such telephone connections should also optimize customer satisfaction within technical and economic constraints.

Various tools are used by transmission engineers in planning, design and assessment of the performance of telephone networks. Reference equivalent, based on the criterion of loudness of speech emitted by the talker and perceived by the listener, has been one of the most important of these tools; it provides a measure of the transmission loss, from mouth to ear, of a speech path.

¹⁾ The present Recommendation together with Recommendations P.48, P.78 and P.79 provide complete definitions of overall, sending, receiving and junction loudness ratings, and Administrations are invited to use them to further their studies of Question 19/XII [1].

The *reference equivalent method* is defined in Recommendations P.42 and P.72 *Red Book* and its fundamental principles are briefly explained in [2]. The method for determining *loudness ratings* of local telephone circuits is based upon rather similar fundamental principles but comprises modifications which render it much more flexible and should greatly simplify transmission planning.

A desire to depart from use of reference equivalents as defined by Recommendation P.72 *Red Book* arises from the following reasons:

- 1) reference equivalents cannot be added algebraically; discrepancies of at least ± 3 dB are found;
- 2) replication accuracy of reference equivalents is not good; changes in crew can cause changes of as much as 5 dB;
- 3) increments of real (distortionless) transmission loss are not reflected by equal increments of reference equivalent; 10 dB increase in loss results in an increase in reference equivalent of only about 8 dB.

Use of loudness ratings defined in accordance with the principles given below should largely obviate these difficulties.

In addition to these advantages, the same values of loudness ratings should be obtained whether the determination is by subjective tests, by calculation based on sensitivity/frequency characteristics or by objective instrumentation. The fundamental principles of the method are described below and these differ from those applicable to reference equivalents by the least possible extent to achieve the desirable flexibility.

The loudness rating (which has the dimensions and sign of “loss”) is, in principle, like the reference equivalent, defined by the amount of loss inserted in a reference system to secure equality of perceived loudness to that obtained over the speech path being measured. Practical telephone connections are composed of several parts connected together. To enable the transmission engineer to deal with these parts in different combinations, loudness ratings must be defined in a suitable manner so that “overall”, “sending”, “receiving” and “junction” ratings can be used.

“Sidetone” loudness ratings can also be determined in an analogous manner. Sidetone reference equivalent is defined in Recommendation P.73 *Red Book* and sidetone loudness ratings are defined in § 3 below.

2 Definitions of loudness ratings for principal speech paths

2.1 General

§ 2 deals with principal speech paths, namely from a talker at one end of a connection to a listener at the other. Sidetone paths are treated in § 3 below.

In general, loudness ratings are not expressed directly in terms of actual perceived loudness but are expressed in terms of the amounts of transmission loss, independent of frequency, that must be introduced into an *intermediate* reference speech path and the *unknown* speech path to secure the same loudness of received speech as that defined by a fixed setting of NOSFER. This implies that some interface exists or could, by some arrangement, be found in the unknown speech path into which the transmission loss can be introduced. In practice the unknown speech path is composed of a sending local telephone circuit coupled to a receiving local telephone circuit through a chain of circuits interconnecting the two local systems²⁾. Figure 1/P.76 shows this subdivision of one principal speech path of a telephone connection. The interfaces JS and JR separate the three parts of the connection to which loudness ratings are assigned, namely: *sending loudness rating*, from the mouth reference point to JS; *receiving loudness rating* from JR to the ear reference point; and *junction loudness rating* from JS to JR. The *overall loudness rating* is assigned to the whole speech path from mouth reference point to ear reference point.

²⁾ See Annex B for explanation of certain terms.