

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Sound system equipment –  
Part 16: Objective rating of speech intelligibility by speech transmission index**

**Équipements pour systèmes électroacoustiques –  
Partie 16: Évaluation objective de l'intelligibilité de la parole au moyen  
de l'indice de transmission de la parole**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, 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 either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

#### IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

---

### A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

### A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Recherche de publications IEC -

[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

#### Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [sales@iec.ch](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



---

**Sound system equipment –  
Part 16: Objective rating of speech intelligibility by speech transmission index**

**Équipements pour systèmes électroacoustiques –  
Partie 16: Evaluation objective de l'intelligibilité de la parole au moyen  
de l'indice de transmission de la parole**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 33.160.01

ISBN 978-2-8322-8862-7

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD .....	7
INTRODUCTION .....	9
1 Scope .....	12
2 Normative references .....	12
3 Terms and definitions .....	12
4 Description of the STI model.....	18
4.1 Overview.....	18
4.2 Applicability of the STI model.....	19
4.3 Theoretical details .....	19
4.3.1 Envelope function and envelope spectrum.....	19
4.3.2 Reduction of modulation .....	20
4.3.3 Role of the octave-band noise carriers.....	20
4.3.4 Theoretical overview.....	20
4.4 Measurement of STI.....	22
4.4.1 Direct and indirect methods .....	22
4.4.2 Full STI.....	23
4.4.3 STIPA.....	23
4.4.4 Choice of method .....	23
5 Direct method of measuring STI – User guidance .....	25
5.1 Overview.....	25
5.2 STIPA .....	26
5.3 Application .....	26
5.4 Limitations .....	26
6 Indirect method of measuring STI (impulse response) – User guidance .....	27
6.1 Overview.....	27
6.2 Application .....	27
6.3 Limitations (non-linear distortion).....	28
7 Limitations of the STI model .....	29
7.1 General.....	29
7.2 Frequency shifts .....	30
7.3 Centre clipping.....	30
7.4 Dropouts .....	30
7.5 Jitter .....	30
7.6 Digital voice compression systems.....	30
7.7 Overestimation of STI under low background noise conditions .....	31
7.8 Frequency response .....	31
7.9 Echoes .....	32
7.10 Fast amplitude compression and expansion .....	34
7.11 Non-linear distortion.....	35
7.12 Hearing impaired listeners .....	35
7.13 Impulsive and fluctuating noise .....	35
7.14 Conclusion.....	35
8 Measurement procedures, post-processing of data and applications.....	36
8.1 General.....	36
8.2 Acoustical input .....	36

8.3	Acoustical output .....	38
8.4	Electrical input .....	38
8.5	Electrical output .....	38
8.6	Examples of input/output combinations .....	38
8.6.1	Acoustical input – Acoustical output .....	38
8.6.2	Electrical input – Electrical output (e.g. assessment of wired and wireless) communication systems) .....	38
8.6.3	Acoustical input – Electrical output (e.g. assessment of microphones) .....	38
8.6.4	Electrical input – Acoustical output (e.g. assessment of PA systems) .....	39
8.7	Spatial averaging of STI measurements .....	39
8.8	Post-processing of measured MTF data .....	40
8.9	Issues concerning noise .....	40
8.9.1	General .....	40
8.9.2	Measurement of background noise .....	41
8.9.3	Fluctuating noise .....	41
8.10	Analysis and interpretation of the results .....	41
8.11	Binaural STI measurements .....	42
9	Use of the STI as a design prediction tool .....	42
9.1	Overview .....	42
9.2	Statistical predictions .....	43
9.3	Prediction from simulated impulse response .....	43
Annex A (informative)	The basis of the STI concept .....	44
A.1	Introduction to this annex .....	44
A.1.1	Purpose .....	44
A.1.2	Modulation transfer function (MTF) .....	44
A.1.3	STI model .....	45
A.1.4	STI modulation frequencies .....	46
A.2	Calculation of the STI .....	46
A.2.1	General equation for STI .....	46
A.2.2	Gender-specific octave band weighting and redundancy factors .....	47
A.2.3	Adjustment of the MTF for ambient noise .....	48
A.2.4	Adjustment of the MTF for auditory masking and threshold effects .....	48
A.3	Calculation of the modulation transfer ratio values .....	49
A.3.1	Direct method: Analysis of the STI test signal .....	49
A.3.2	Indirect method: Determination of the modulation transfer function (MTF) .....	50
A.4	Auditory effects on the STI .....	51
A.4.1	Overview .....	51
A.4.2	Level-dependent auditory masking .....	51
A.4.3	Absolute speech reception threshold .....	54
A.5	Generation of the STI test signal (direct method) .....	54
A.5.1	Pink noise source signal .....	54
A.5.2	Generating octave band carrier signals .....	54
A.5.3	Intensity modulation of the carrier signals .....	55
A.5.4	Applying the speech spectrum to the STI test signal .....	55
A.6	Spectrum of STI test signal .....	55
A.6.1	Standardized speech spectrum .....	55
A.6.2	Speech-shaped noise .....	55
Annex B (normative)	STIPA method .....	57

B.1	Overview.....	57
B.2	Test signal .....	57
Annex C	(normative) Verification of STI measuring devices .....	59
C.1	Specification of the measuring device .....	59
C.2	Signals for testing STI implementations .....	59
C.3	Testing the dynamic range in the modulation domain .....	59
C.3.1	General .....	59
C.3.2	Modulation depth testing for STIPA direct method .....	59
C.3.3	Modulation depth testing for STI indirect method .....	60
C.4	Testing of cross-talk between octave-band filters .....	61
C.4.1	Flank attenuation slopes .....	61
C.4.2	Octave band filter testing – STIPA direct method .....	61
C.4.3	Performance verification files.....	62
Annex D	(informative) Use of STI measuring devices.....	63
D.1	Overview.....	63
D.2	STIPA characterises only the speech transmission channel .....	63
D.3	Examples of test scenarios for STIPA tests.....	64
D.4	Equipment and resources needed for a STIPA test .....	67
D.4.1	Availability of the test signal .....	67
D.4.2	A source of the STIPA test signal .....	67
D.4.3	A STIPA analyser .....	67
D.5	Steps in the overall procedure .....	67
Annex E	(informative) Qualification of the STI and relationships with other speech intelligibility measures.....	68
E.1	Relationship between the STI and word/sentence scores .....	68
E.2	Relationship between STI and listening difficulty.....	68
Annex F	(informative) Nominal qualification bands for STI .....	70
Annex G	(informative) Examples of STI qualification bands and typical applications .....	71
Annex H	(informative) Non-native listeners .....	72
Annex I	(informative) Effect of age-related hearing loss and hearing impairment on speech intelligibility.....	73
Annex J	(normative) Setting and adjustment of STI test signal level.....	74
J.1	Overview.....	74
J.2	The concept of 'speech level' and the method of measurement .....	74
J.3	Real speech level .....	74
J.4	Corrected speech level derived from real speech level.....	75
J.5	Comparison of dynamic structures of speech and test signals.....	75
Annex K	(informative) Example test report sheet for STI measurements .....	77
Annex L	(normative) Prediction of the STI using statistical methods.....	79
Annex M	(informative) Adjustments to STI data to simulate alternative ambient noise spectra and different speech levels.....	81
Annex N	(informative) Other methods of determining speech intelligibility.....	91
N.1	Overview.....	91
N.2	Word tests .....	91
N.3	Modified rhyme tests.....	91
N.4	Speech intelligibility index (SII) .....	92
N.5	PESQ .....	92
Annex O	(informative) Alternative direct methods for measuring Full STI .....	93

Annex P (normative) Information to be provided by manufacturers.....	94
P.1 Purpose of this annex .....	94
P.2 Form in which the information is to be provided .....	94
P.3 Required information.....	94
P.4 Declaration .....	94
Annex Q (informative) Effect of uncertainties of selected parameters on STI uncertainty.....	95
Q.1 STI calculation framework.....	95
Q.1.1 Overview .....	95
Q.1.2 Statistical MTF.....	95
Q.1.3 Corrections.....	95
Q.1.4 Effective SNR .....	96
Q.1.5 Modulation transfer index (MTI) .....	96
Q.1.6 Speech transmission index (STI) .....	96
Q.2 The effect of RT uncertainty on STI uncertainty .....	97
Q.2.1 General .....	97
Q.2.2 Modulation transfer function.....	97
Q.2.3 Uncertainty in the STI .....	97
Q.2.4 Conclusions:.....	99
Q.3 The effect of S/N uncertainty on STI uncertainty .....	99
Q.3.1 General .....	99
Q.3.2 Ideal transfer function.....	99
Q.3.3 Reverberation.....	100
Q.3.4 Conclusions:.....	101
Q.4 The effect of signal level uncertainty on STI uncertainty.....	101
Q.4.1 Overview .....	101
Q.4.2 Auditory masking.....	101
Q.4.3 Conclusions.....	103
Bibliography.....	104
Figure 1 – Envelope function (panel A) of a 10 s speech signal for the 250 Hz octave band and corresponding envelope spectrum (panel B).....	20
Figure 2 – Modulation transfer function – Input/output comparison.....	21
Figure 3 – Effect of a single delayed arrival on the MTF (idealised conditions).....	33
Figure 4 – Idealised STI (Male speech Spectrum) versus delay and level of secondary arrival .....	34
Figure A.1 – Theoretical expression of the MTF .....	44
Figure A.2 – Measurement system and frequencies for the STI method .....	46
Figure A.3 – Auditory masking of octave band ( $k-1$ ) on octave band ( $k$ ).....	52
Figure A.4 – Relationship between STI and speech level for different reverberation times.....	53
Figure D.1 – Schematic representation of the definition of a speech transmission channel.....	64
Figure E.1 – Relationships between some speech intelligibility measures .....	68
Figure E.2 – Relationship between STI, speech intelligibility scores and listening difficulty ratings [43], [44].....	69
Figure F.1 – STI qualification bands.....	70

Figure Q.1 – Uncertainty in absolute value of STI vs reverberation time RT with various degrees of uncertainty in RT .....	99
Figure Q.2 – Uncertainty in absolute value of STI vs reverberation time RT with 1 dB uncertainty in SNR at various SNRs .....	101
Figure Q.3 – Uncertainty in absolute value of STI versus reverberation time RT with various degrees of masking. ....	103
Table 1 – How to use this document .....	10
Table 2 – Comparison of direct and indirect methods .....	22
Table 3 – Suitability of STI test methods for different types of distortion .....	24
Table 4 – Test-method suitability .....	24
Table 5 – Measurement applications .....	25
Table A.1 – MTI octave band weighting factors .....	48
Table A.2 – Auditory masking as a function of the octave band level.....	53
Table A.3 – Absolute speech reception threshold level in octave bands .....	54
Table A.4 – Octave band levels (dB) relative to the A-weighted speech level .....	55
Table A.5 – Filter parameters and s-plane polynomials that produce speech-shaped pink noise. ....	56
Table B.1 – Modulation frequencies for the STIPA method.....	57
Table C.1 – Specification of an STI measuring device.....	59
Table D.1 – Scenario 1, PA with "live" announcer .....	65
Table D.2 – Scenario 2, PA with pre-recorded announcements .....	65
Table D.3 – Scenario 3, "live" meetings and conversations .....	66
Table D.4 – Scenario 4, lecture.....	66
Table E.1 – Categories for listening difficulty .....	69
Table G.1 – Examples between STI qualification bands and typical applications .....	71
Table H.1 – Adjusted intelligibility qualification tables for non-native listeners.....	72
Table I.1 – Adjusted intelligibility qualification tables for normal listeners and people over 60 years old with hearing loss .....	73
Table J.1 – Typical speech and test signal dynamics .....	75
Table J.2 – Comparison of speech and the test signal .....	76
Table K.1 – Example test report sheet .....	77
Table K.2 – Measurement data record sheet.....	78
Table M.1 – Flow chart of post-processing adjustment steps.....	82
Table M.2 – Example calculation.....	87

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SOUND SYSTEM EQUIPMENT –****Part 16: Objective rating of speech intelligibility  
by speech transmission index**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60268-16 has been prepared by IEC technical committee 100: Audio, video and multimedia equipment and systems.

This fifth edition cancels and replaces the fourth edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the spectrum of the male speech test signal has been changed, with significant reductions in the 125 Hz and 250 Hz bands being implemented;
- b) some corrections to formulae have been made;
- c) additional information has been included on prediction and measurement procedures;
- d) spectrum and weighting factors for female speech have been removed;
- e) verification information for STI measurement devices added;
- f) the relationships between STI and number of other speech intelligibility measures have been updated in Annex E;

- g) greater information is given in Annex M about adjustments to the measured STI results to simulate effects of alternative ambient noise and speech levels.

NOTE See Introduction for a historical summary listing the various changes from the first to the fifth edition (current edition).

The text of this International Standard is based on the following documents:

CDV	Report on voting
100/3202/CDV	100/3422/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60268 series, published under the general title *Sound system equipment*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

Speech is considered to be the major method of communication between humans. In many situations, the speech signal is degraded by the signal path or the transmission channel between talker and listener, resulting in a reduction of the intelligibility of the speech at the listener's location.

To quantify the deterioration of the speech intelligibility induced by the transmission channel, a fast and objective measuring method was developed; the Speech Transmission Index (STI).

The STI method applies a specific test signal to the transmission channel and by analysing the received test signal; the speech transmission quality of the channel is derived and expressed in a value between 0 and 1, as the Speech Transmission Index (STI). Using the obtained STI-value, the potential speech intelligibility can be determined.

Although there are limitations to the STI method, the use of STI has proved useful in many situations and has gained international acceptance.

The STI method has been the subject of ongoing development and refinement since its introduction in the 1970s. Major improvements of the STI have been consolidated by incorporating them in successive revisions of IEC 60268-16.

To avoid misinterpretation of STI results, it is important that all users of the STI understand the basic principles behind the operation of the STI, the application domain and the limitations. This document provides substantial information to assist users.

### **Potential applications of the STI**

The STI can be used to measure the potential intelligibility of a wide range of electronic systems and acoustic environments. Typical applications include:

- measurement of public address and sound reinforcement systems;
- measurement and certification of emergency sound and communication systems;
- measurement of communication channels and systems such as intercoms and wireless communication;
- measurement of potential speech intelligibility and communication in rooms and auditoria;
- evaluation of direct speech communication (situations without electronic amplification) in rooms or acoustic spaces, including vehicles;
- evaluation of the potential intelligibility of assistive hearing systems.

**NOTE** The STI method was not designed for the measurement and evaluation of speech privacy or speech masking systems and, therefore, has not been validated for these situations. It is not recommended to use the STI below 0,3, but if this is to be undertaken, specialist expertise and techniques beyond the scope of this standard are required.

### **Potential users of STI**

The range of users of STI measurements is diverse. Among the users who might apply this method are:

- certifiers of voice alarm and other types of emergency systems;
- certifiers of sound reinforcement and audio systems;
- audio and telecommunication equipment manufacturers;
- audio and communication engineers;
- acoustic and electroacoustic consultants;
- sound system installers;
- researchers into STI methods and developers of instruments to measure the STI.

Table 1 summarises which sections of the document may apply to different users and applications.

**Table 1 – How to use this document**

Purpose	Topic	Clauses
All users	Introduction to the STI method	
Routine check of voice-alarm or sound system with STIPA	Direct method of measuring STI	4
In-depth check of or to certify sound system with STIPA and/or impulse response methods	Description of the STI method	5
	Direct method of measuring STI	4 and 5
	Indirect method of measuring STI using the impulse response	4 and 6
	Measurement procedures, and applications	8
	Post-processing of measured MTF data	8.8
	Limitations of the measurement methods	5.4, 6.3
	Optional: Theory and equations governing STI methods	Annex A and Annex B
	Optional: Relationship between subjective and objective measures of intelligibility	Annex F
	Optional: Measurement uncertainties	Annex Q
Measure telecommunication equipment	Direct method only	8.6.2
Manufacturer of STIPA device	Theory and equations governing STI methods	Annex A and Annex B
	Verification of STI measurement device performance	Annex C
	Information to be provided	Annex D
Manufacturer of acoustical analyser and simulation software	Theory and equations governing STI methods	Annex A
	Calibration of STI instruments	Annex C
	Information to be provided	Annex P
Research into intelligibility	Theory and equations governing STI methods	Annex A and Annex B
Using simulation software	Prediction methods	Annex M
Post processing of STI and STIPA measurement	Post processing measurement results	Annex M
	Optional – As per in-depth measurements of STI listed above	
	Optional -Worked calculation example	Annex M
Evaluation of the potential intelligibility of Assistive Listening Systems	As per in-depth measurements of STI listed above	
	Special process for Assistive Listening Systems	8.6.3

### Revision history

The history of revisions is as follows:

- Revision 1: 1988. In the first version of the STI standard, a gender-independent test signal spectrum was used.
- Revision 2: 1998. Gender-specific test signals were introduced, for male and female talkers, each gender relating to a specific set of weighting factors. In addition, weightings were introduced for redundancy factors. The term  $STI_r$  was introduced to signify the use of these redundancy factors.

- Revision 3: 2003. Important differences between Revision 2 and Revision 3 are the introduction of:
  - level dependent masking functions;
  - the STI derivative STIPA;
  - STIPA was specially developed as a fast measurement method that could deal with electro-acoustic and acoustic effects while determining the speech transmission quality of PA systems.
- Revision 4: 2011.
  - The terms  $STI_r$  and Room Acoustic Speech Transmission Index (RASTI) were discontinued.
  - A new function for the prediction of auditory masking effects was introduced.
  - STI corrections for non-native language listeners and some forms of hearing loss were introduced.

## **SOUND SYSTEM EQUIPMENT –**

### **Part 16: Objective rating of speech intelligibility by speech transmission index**

#### **1 Scope**

This part of IEC 60268 defines the STI model, test signals, measurement and prediction methods.

The objective of this document is to provide a comprehensive manual for all types of users of the STI model in the fields of audio, communications and acoustics.

This document does not provide STI criteria for certification of transmission channels (e.g. criteria for a voice-alarm system), but some typical application values are provided in Annex G.

Every measurement method has limitations, and the reader is referred to clauses relating to limitations such as speech privacy, echo and systems using digital voice compression (vocoders).

This document does not cover the case of fluctuating noise on the STI, although some general comments on dealing with this complex issue are provided in 7.13 and 8.9.3.

#### **2 Normative references**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

#### **3 Terms and definitions**

For the purposes of this document, the following terms and definitions apply. ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

##### **3.1**

##### **speech intelligibility**

rating of the proportion of speech that is understood

##### **3.2**

##### **speech quality**

rating of sound quality of a speech signal