IEC 60268-16

Edition 5.0 2020-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

IEC 60268-16:2020-09(en-fr)

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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.
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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