



# STI-PA Fact Sheet

## Why speech intelligibility measurements?

In case of emergency, public address systems in buildings like airports, railway stations, shopping centers or concert halls have legal requirements to (clearly) inform persons in danger about escape information and directions. However if such announcements are misunderstood due to poor system quality, tragic consequences may result. Therefore, it is essential to design, install and verify sound reinforcement systems properly for intelligibility. In addition, a variety of other applications such as legal and medical applications may require intelligibility verification.

The IEC 60849 and other national standards shown in the table below require electro acoustic sound systems for emergency purposes to be verified under realistic circumstances, in order to ascertain a minimum level of speech intelligibility in case of an actual emergency.

Thereby, speech intelligibility from a regulatory view is not a subjective measurement, but can be verified with several, more or less complex methods that have been standardized in IEC 60268-16.

Other national or local regulatory bodies implement recommendations or requirements to conduct these measurements for maintaining minimum speech intelligibility.

Various local to national jurisdictions also then define whether or not it is mandatory to conduct the intelligibility

measurements. These by-laws may vary depending on the type of business or venue, and the national or regional regulations, although the trend is certainly in the direction to require this testing.

## How does STI-PA compare to STI and RASTI

STI measured in public address systems has been very time consuming, as the complete set of 98 measurements of modulation transfer functions (MTF) have to be obtained and summed. Due to the complex nature and the time required almost no really useful STI measurement systems were available for years.

With the appearance of MLS based systems, STI was more often obtained, as it can be calculated out of the transfer function, as long as the entire system is strictly linear and synchronous. But this means there must be no non-linear processing or conditions, including compressors or limiters, which is a rather rare situation. So STI-PA has been developed specifically to cope with the heavily non-linear processing environment common to advanced sound systems, and to reduce the measurement time required to a practical level.



STI-PA Measurements with the NTI Acoustilyzer AL1

| National Standards |  |
|--------------------|--|
| IEC 60849          | Sound systems for emergency purposes   |
| NFPA 72            | National Fire Alarm Code 2002 (2002 edition, section 7.4.1.4)  |
| BS 5839-8          | Fire detection and alarm systems for buildings. Code of practice for the design, Installation and servicing of voice alarm systems |



## RASTI - Room Acoustics Speech Transmission Index

In order to cope with the long times required full STI measurement, a faster intelligibility method called RASTI was developed. RASTI acquires only few points of a complete MTF set. But this in turn weakens its ability to comprehensively test, and heavily compromises its resistance against outside interference. This also leads to poor correlation between subjectively evaluated STI and RASTI. However, RASTI was previously the only method to measure speech intelligibility with a portable instrument.

## Now STI-PA

A rising awareness for security issues, new technology, and the shortcomings of RASTI together triggered the speaker manufacturer Bose and the research institute TNO to develop a new method for speech intelligibility measurements of PA installations. The result of these efforts is STI-PA, which supports fast and accurate tests with portable instruments. STI-PA stands for Speech Transmission Index for Public



Acoustilyzer AL1  
STI-PA test results of the modulation indices

Address systems. Portable STI-PA analyzers, e.g. NTI's Acoustilyzer, are able to evaluate speech intelligibility within 15 seconds per position and are thus well suited for wide-area measurements and high productivity.

## Calculation of % Alcons based on STI-PA Measurement

$$\text{Alcons (\%)} = 10 \text{ Exp } ((1-\text{STI}(\text{CIS}))/0.45))$$

The calculation of STI-PA based on Alcon measurements is not applicable based on the difference in the measurement technology.

## Who can and should conduct STI-PA measurements?

Even though the mathematical background and the implementation is rather complex, the operation of STI-PA using the AL1 Acoustilyzer is very simple. Even unskilled operators can easily conduct these measurements. The instrument's internal storage functionality also simplifies the measurements in larger buildings, where many measurements must be taken. The access to the detailed measured MTF (Modulation Transfer Function) matrix enables experts to post-process all measurement data.

## Is this a research product or widely used?

STI-PA is the standardized result of extensive scientific

research. But unlike RASTI, within two years as many as four international test instrument manufacturers have implemented the STI-PA approach and offer varying solutions. It is therefore perfectly valid to say that STI-PA is the widely accepted standard for speech intelligibility measurements, combining the accuracy and advantages of full STI measurements with the benefit of extremely short measurement time of only 15 seconds.

## Compatibility?

Thanks to TNO, acting as a certification body, it is guaranteed that instruments from all certified T&M vendors will provide compatible measurement results. Three vendors are currently certified by TNO. Studies and comparisons conducted by Peter Mapp Associates, Colchester, Essex UK, confirmed that all certified vendors provide stable and comparable measurement results. Details of the comparison may be found in the AES publication titled "Is STI-PA a robust measure of speech intelligibility performance?"

## Who is TNO?

TNO is a research and certification institute in the Netherlands, Europe. They are focusing on research around defense, security and safety and they have originally developed the STI as well as the STI-PA technology. Their knowledge is freely useable and not patent protected.

## Patent protected?

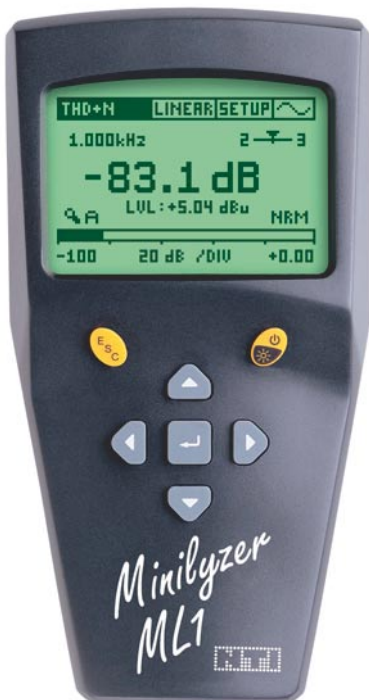
Even though the research part of STI and STI-PA is not patent



protected, BOSE of America has been recently been granted the US-Patent 6,792,404B2 for the idea to implement STI or STI-PA onto a hand held analyzer. NTI maintains a license agreement with BOSE for this patent and is therefore able to market the STI-PA implementation available for the Acoustilyzer.

### Can I buy STI-PA for my AL1?

Yes, STI-PA is an optional function for the Acoustilyzer AL1. Any AL1 user may obtain a STI-PA license. With the key of the license he may request the activation key for his Acoustilyzer AL1 and full functionality is then activated.



*Minitlyzer ML1, can be upgraded to STI-PA functionality*

### I have an ML1. Can I run STI-PA as well?

NTI offers a cross grade package that converts the functionality of the Minitlyzer into an AL1 Acoustilyzer with 100% compatibility in functionality and specification. This functional extension, including the STI-PA option, is then available as with any other regular Acoustilyzer AL1.

### What is a TalkBox, and do I need a TalkBox for STI-PA measurements?

The TalkBox is NTI's calibrated acoustical sound source with built in digital solid state signal generator.

No you don't necessarily need a TalkBox if you are testing only the portion of the system beyond the microphone.

But the use of a Talk as a speaker simulation is advisable if:

- Regulations require a complete end-to-end system check including the microphone. This is the most realistic system check in any event.
- No electrical input is available to induct the electrical test signal.
- The level of the test signal is not clearly defined
- The characteristics of the speakers acoustical environment are not negligible and flat.



*NTI TalkBox*

- The characteristics, sensitivity and frequency response of the speaker's microphone is not known but needs to be considered.
- As above, if for any other reason it is desirable to test the entire signal chain under real conditions.

The TalkBox is also capable of delivering white and pink noise and other special signals, and so is a very useful overall tool for system tuning and testing.

For further information please visit: [www.nti-instruments.com](http://www.nti-instruments.com)