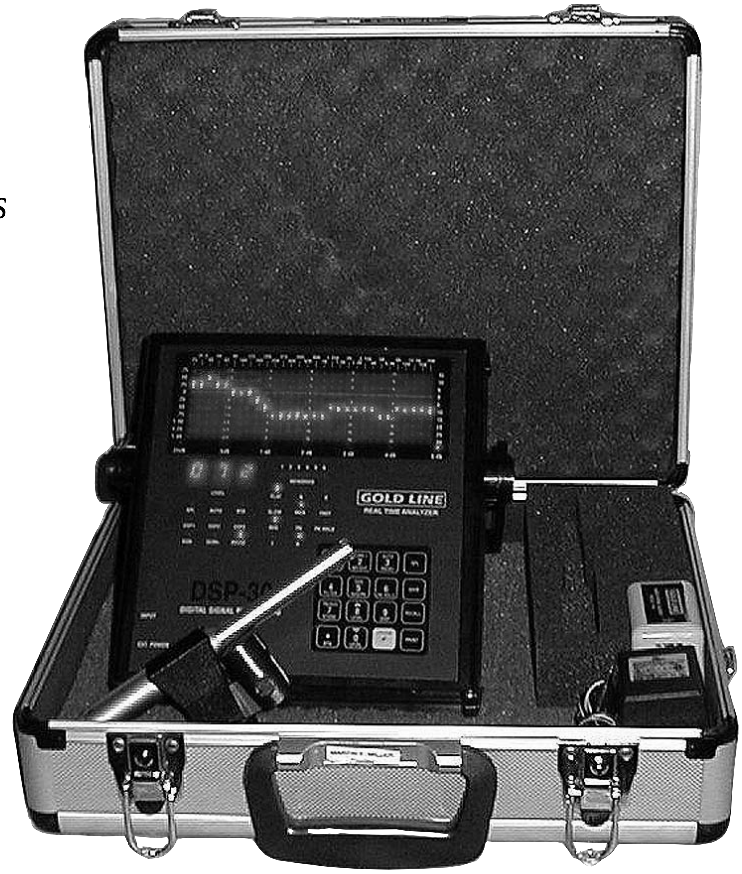
INFORMATION ON NEW SAFETY & SECURITY TEST AND MEASUREMENT SYSTEM

- *Now Intelligibility Can Be Measured*
- *Meets or Exceeds International Standards*
- *Test CD Developed by TNO in Holland, Developer of STI in Europe*
- *Analyzer Developed by Gold Line*
- *Stand Alone Analyzer Measures Sound Level and Speech Intelligibility Index (STI)*
- *Available in the Gold Line Professional Audio ProKit*



SAFETY AND SECURITY ANNOUNCEMENTS MUST BE INTELLIGIBLE[1]

WHAT IS INTELLIGIBILITY?

Speech intelligibility is not a physical quantity like Amperes, Volts, or BTU's. It is the degree to which we understand spoken language. Speech is not necessarily intelligible simply because it is audible. Everyone has experienced speech signals that are loud enough but overly reverberant, suffer from echoes or distortion and therefore are not understandable. Announcements in airports, train stations and places of worship often suffer from this problem.

CAN INTELLIGIBILITY BE MEASURED?

A number of methods for quantifying speech intelligibility have been approved for use by major international standards. Some of these methods are based on the measurement of physical quantities such as speech and background noise levels (quantitative methods), and others are based on subject-based testing (subject based methods) where specially designed word lists are read and subjects who write down what they think they heard.

WHAT ARE THE ACCEPTED METHODS?

Speech Transmission Index (STI): A quantitative method. Its measurement is covered in the International Electrotechnical Commission (IEC) standard 60268-16.

[1]Gold Line is grateful to Bose Corporation for permission to reprint excerpts from a paper presented to the National Fire Protection Association Congress, "Understanding Speech Intelligibility and the Fire Alarm Code", May 2001.

Articulation Index (AI): Covered by ANSI S3.5 (1969) from the American National Standards Institute.

Phonetically Balanced Word Scores: A subject-based method covered by ANSI S3.2 (1989) and the International Organization for Standardization publication ISO/TR4870.

Modified Rhyme Test: A subject-based method covered in ANSI publication S3.2(1989).

WHICH STANDARD IS BEST FOR MY APPLICATION?

Subject-Based Methods

These methods are used mainly in academic research, or in rare cases to resolve a dispute over the performance of an installed audio system. Researchers trying to develop new insight into how a particular variable affects speech intelligibility would likely use one of the subject-based methods. Conducting subject-based tests requires a skill level not often present outside of the sciences. Hundreds, even thousands of words must be used in a single test before a reliable result can be obtained.

Quantitative Methods

Because subject-based tests are so difficult to conduct, and because informal subject-based tests fail in fundamental ways to produce reliable, repeatable and unbiased results, researchers have worked to develop methods of measuring speech intelligibility that are based on the measurement of acoustical quantities, rather than the use of subjects.

SPEECH TRANSMISSION INDEX (STI) METHOD:

In part, as a result of the weaknesses in the Articulation Index method, the military and others began funding the research and development of a quantitative method of measuring speech intelligibility that was more comprehensive - one that could measure a system that had virtually any combination of the factors commonly found to affect speech intelligibility. The work that eventually led to what is now called the Speech Transmission Index method was started in the 1970's at a well-known research laboratory called TNO in the Netherlands, mainly under NATO funding. The method developed proved robust under a wide array of conditions from a talker in a room to a telephone system to an area PA system. The STI method has been implemented in a number of commercially available devices and is today an international standard used extensively throughout the world. The STI method has an advantage in that it correctly accounts for all of the factors in the talker-to-listener transmission path that affect intelligibility. The method is based on replacing speech with a repeatable signal that has the same characteristics as actual speech.

STI Excitation Signal

Speech can be decomposed into two spectra, the audible spectrum and the modulation spectrum, in order to construct a kind of artificial speech signal that has the same properties. The audible spectrum can be represented using a wide bandwidth noise signal comprised of the seven octave bands from 125Hz to 8kHz, each octave having a level that matches that of real speech. The individual octave bands of noise can then be modulated according to the fourteen frequencies in the modulation spectrum. To fully represent real speech, all of the various combinations of octave bands and modulation frequencies are needed: seven octave bands from the audible spectrum times fourteen frequencies from the modulation spectrum for a total of 7 x 14 = 98 different combinations. To test a system, these modulated octave bands can be used as the test signal instead of speech. Intelligibility is estimated by measuring the amount of modulation that is lost between the input and output of the system.

SOME CONCLUSIONS

Sufficient scientific and engineering know-how exists today to accurately and reliably design for and measure speech intelligibility in virtually every environment. Tools exist to aid the engineer to design systems that will pass the minimum intelligibility requirement, and easy-to-use instruments are now available for measuring intelligibility according to international codes and standards. The costs associated with meeting the speech intelligibility requirement are not zero, but they can fairly be described as modest or even negligible when compared to total system cost. The National Fire Protection Association (NFPA) has taken the important step of requiring intelligibility in every voice alarm system. Thus a code-based mechanism now exists ensuring that when a voice alarm system is used, we can be certain that its effectiveness will not be compromised because of poor speech intelligibility.

TOOLS AVAILABLE FROM GOLD LINE TO MEASURE INTELLIGIBILITY

1. THE TEF ANALYZER

A TEF is an affordable digital spectrum analyzer which in addition to making conventional audio or electrical measurements, has special swept filters to implement a noise resistant form of measurement known as Time Delay Spectrometry "TDS".

The TEF analyzer is a single rack space device used with TEF Factory Software to provide for various types of acoustical measurements. Some common applications are room acoustics, polar plots, impedance or distortion measurements and community noise measurements.

Measurements with a TEF

Intelligibility: TEF is one of the few platforms which can conduct the Speech Transmission Index ratings "STI" to define the intelligibility of speech in a real world environment.

Time Domain: Find the arrival time of a signal from microseconds to seconds. TEF can be calibrated to any zero dB reference. Accordingly it can read Sound Pressure Level or an electrical level in dBv, dBu and dBm.

Frequency Domain: Find the frequency of a signal from 6Hz to approximately 24kHz and display that signal as amplitude, frequency and/or phase. The program can also recognize harmonics or harmonic distortion.

Polar Plots: TEF can post process frequency response information into polar plots to show a loudspeaker's directivity at various frequencies.

Polar Energy Time Curve: TEF Can measure the direction of origin for a reflection, allowing the engineer to understand what surfaces are having the greatest effect upon sound quality.

Noise Level Analysis: TEF can log SPL over seconds or hours, to show a plot of levels over time. This program provides measurements such as Leq, Ldn, Min and Max SPL and the ability to log levels over times up to 24 hours.

Real Time Analysis: TEF can do conventional real time analysis to display frequency vs. magnitude based on all energy over a period of time. Resolutions are from 1/12th octave to 1 octave.

TEF is a precision measurement system that requires training. A 3 day course of instruction is offered with the purchase of a TEF.

2. MODEL DSP30 WITH THE STI-CIS™ INTELLIGIBILITY OPTION

The DSP30 is a DSP-based 1/3 octave audio spectrum analyzer and sound pressure level meter. The analyzer is handheld, can be battery operated and is extremely easy to use. In addition, the DSP30 can be enhanced with a series of software/hardware options.

OPT STI-CIS™ to Measure Intelligibility

This option includes the STI-PA signal developed by TNO Laboratories in the Netherlands where the STI method was researched and developed. The STI-PA signal, contained on an audio CD, is input to the system under test.

STI measurements can be made by most without significant training. Once the STI-PA signal has been input to the system under test, a single button push on the DSP30 will produce the STI, converted to the Common Intelligibility Scale as specified in IEC standard 60849, in about 15 seconds. The STI-PA signal can be left continuously playing, making it possible to simply move the DSP30 to a new position and a new measurement initiated.

OPT 112 – 1/12th Octave Resolution

Used with: DSP30, DSP30RM and DSPCIW analyzers. The 1/12th octave option allows the user to shift the DSP analyzer to a higher frequency resolution. Higher resolution is used to set crossovers or analyze frequency or standing waves. The higher resolution also provides the information necessary to use parametric equalizers and other types of notch filters.

Frequency ranges: DSP 1/3rd Octave Standard - 20Hz to 20kHz
1/12th Octave Low - 27Hz to 141Hz
1/12th Octave High - 150Hz to 794Hz

OPT DAS – Distortion Analysis

Used with: DSP30, DSP30RM, DSPCIW analyzers. The Distortion Analysis Option provides software required for the DSP analyzer to measure total harmonic distortion (THD) from 0.02% to 9.99%. An external signal generator such as Gold Line's Model TS1 or TS2 is required to input a test tone to the system under test. The analyzer will show the primary test frequency and resulting harmonics with the total harmonic distortion shown as a numeric value. No computer is needed with this option.

OPT DOSE – Dosimeter Measurements for OSHA Compliance

Used with: DSP30, DSP30RM, DSPCIW analyzers. The Dosimeter software option allows the DSP analyzer to analyze an environment, view results and print reports showing Max Peak SPL, Average SPL, Accumulated Dose and Octave analysis. This is the information necessary when comparing sound levels to OSHA regulation 1910.95. for noise exposure limits.

OPT NC – Noise Criteria Measurements

Used with: DSP30, DSP30RM, DSPCIW analyzers. The Noise Criteria option software allows the DSP analyzers to analyze room environments and to compare the sound spectrum to official Noise Criteria Standards. Results in the NC range of 63Hz to 8kHz are compared to the standard NC curves. This comparison is displayed along with the octave frequency information. NOISE CRITERIA FREQUENCIES: 63, 125, 250, 500, 1000, 2000, 4000 & 8000Hz

OPT RT60 – RT60 Analysis

Used with: DSP30, DSP30RM, DSPCIW analyzers. The RT60 Option measures the reverberation time of a room. The reverberation time is how long it takes for a sound to decay by 60dB in a room. Measurements taken can be stored and printed. No computer is needed with this option.
MEASUREMENT FREQUENCIES: 125, 250, 500, 1000, 2000 & 4000Hz.
MEASUREMENT RANGE: 0.1 to 10s in 0.01s (1/100ths) increments.
OPTION KIT CONTAINS: An upgraded EPROM device, a jumper cable to internally connect the circuit board to the front panel and a jumper cable to connect the DSP to an external gate source such as a Gold Line PN3B Pink Noise/Tone Generator.

OPT STA – Speaker Timing Analysis

Used with: DSP30, DSP30RM, DSPCIW analyzers. The Speaker Timing Analysis option provides software required to set the electrical delay for timing loudspeaker systems. The software allows the DSP analyzer to measure the time for a signal to travel from it's source to a given position (Propagation time). No computer is needed with this option.

MEASUREMENT RANGE: 1ms to 999ms; 0.01s to 10s.

GOLDLINE
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