LISTEN INC

Product Information

NEW!

CLEAR™ Distortion Measurement

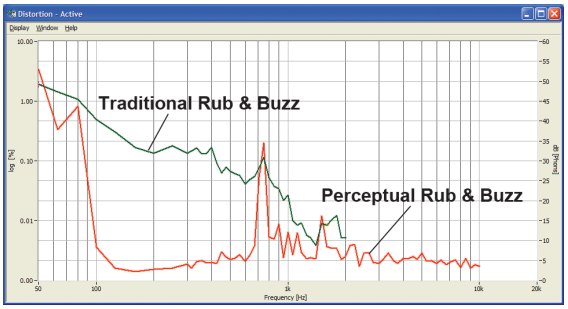
Clearly better... Perceptual Rub & Buzz Testing

Introduction

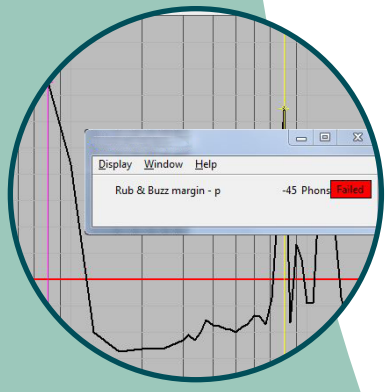
The new CLEAR (Cepstral Loudness Enhanced Algorithm for Rub & Buzz) algorithm from Listen offers true perceptual Rub & Buzz analysis for production line applications. It uses a simplified auditory perceptual model to measure the loudness of Rub & Buzz distortion in phons rather than the more traditional dB SPL and % distortion units. These better identify whether distortion due to manufacturing defects can be heard by the listener than conventional measurements. In addition to a result which corresponds more accurately to the human ear, this new test method also offers two significant advantages for use on the production line. It is less sensitive to transient background noises than traditional methods, therefore is reliable in noisy environments, and it is much simpler to set limits than when using conventional distortion measurements.

Perceptual vs. Conventional Rub & Buzz

Conventional Rub & Buzz detection has been widely used on the production line since Listen introduced it in SoundCheck Version 1 back in 1996. It offers excellent identification of Rub and Buzz defects caused by manufacturing problems, and will continue to do so. In recent years, some manufacturers have moved to a defect detection model where they prefer only speakers with audible faults to fail QC checks. This is because if only speakers with audible faults rather than any faults are rejected then yields are higher. Perceptual Rub & Buzz offers a means of identifying and precisely quantifying this with all the benefits and reliability of an automated test system.



Perceptual Rub & Buzz using the new CLEAR™ algorithm shows audible distortion more clearly. Traditional Rub & Buzz measurements do not take into account the insensitivity of the human ear to low and high frequencies, therefore it is more difficult to identify problem areas and set limits on a production line. This speaker clearly shows audible distortion below resonance (<100 Hz) and at cone breakup (750 Hz). Both curves are shown on a 60 dB scale for easier comparison even though the units are different (Perceptual distortion in Phons and traditional distortion in %).



The CLEAR Rub & Buzz Detection Algorithm

Listen's CLEAR™ Rub & Buzz detection algorithm uses true perceptual analysis to 'hear' any faults in the speaker. It offers many advantages over other 'perceptual' Rub & Buzz analysis systems:

- **Low Cost:** The CLEAR™ algorithm to add-on to SoundCheck costs just $500. Other test equipment manufacturers charge up to $10,000 for their Rub & Buzz software.
- **True Perceptual Rub & Buzz:** The CLEAR™ Algorithm is a true perceptual Rub & Buzz algorithm. Based on well-proven psychoacoustic principles, it accurately replicates the human ear using mathematical models found in MP3 encoders that mimic the way that both the ear and the brain interpret sound. This results in close to 100% correlation to the human ear.
- **Less sensitive to transient background noise:** A significant advantage of our Perceptual Rub & Buzz algorithm is that it is very insensitive to transient background noise – tests show that it offers far more consistent results with high background noise levels than other Rub & Buzz measurement methods. This makes it ideal for noisy factory environments.
- **Flexible:** The CLEAR™ Rub & Buzz detection system is extremely flexible. While it can of course be configured for a simple pass/fail result, it can also offer detailed results including defect analysis and offers a calibrated loudness value rather than simply a comparison to a reference.
- **Better Correlation to Human Ear:** Testing carried out by an independent laboratory shows excellent correlation to the human ear.

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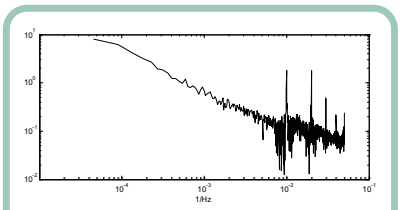
Listen's CLEAR™ Algorithm For Perceptual Rub & Buzz Analysis

Stimulus applied to transducer

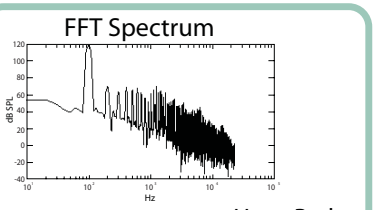
The algorithm uses a sine wave stimulus because this is widely accepted as the standard test signal for production line testing in the loudspeaker industry.

Response Spectrum



The harmonic structure of the response is quantified using the power cepstrum (a cepstrum is a spectrum of a log spectrum). A strong and extended harmonic structure is a signature of Rub & Buzz.

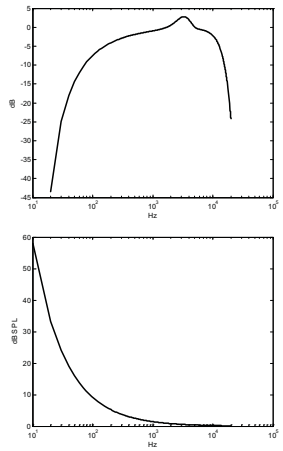
Auditory Filter Bands



Auditory filter bands are applied to the response signal to convert the FFT spectrum (constant bandwidth) to a Bark scale (auditory filter bands). This replicates the way the ear filters sound.

Harmonic Structure

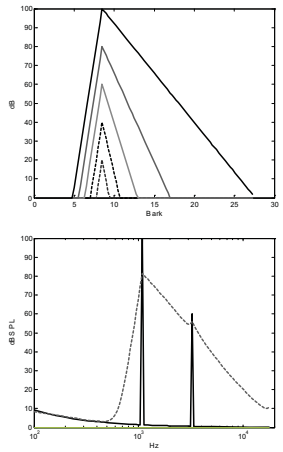
Ear Weighting



An ear weighting filter compensates for the transfer function of the outer to inner ear, and the internal noise of the ear (noise floor due to blood flow) is added. Together these model the frequency response of the ear.

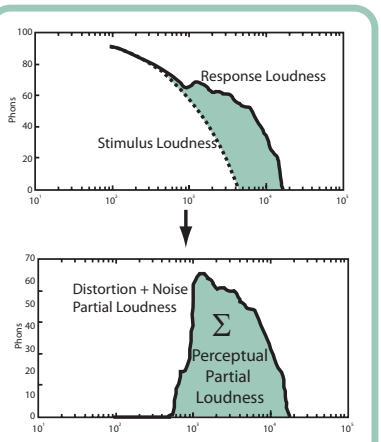
Internal Noise

Frequency Spreading



A frequency spreading function is applied. This is a simple mathematical representation of auditory masking curves and this is how the algorithm mimics the psychoacoustic filters of the ear in in hearing Rub & Buzz defects. These complex curves change with frequency and level.

Partial Loudness Calculation



The fundamental and its masking effects are subtracted out from the result for the response signal to give the distortion of the speaker plus noise. This is summed over the frequency range to give the perceptual partial loudness (in phons) for a single tone of the input signal.

PARTIAL LOUDNESS combined with HARMONIC STRUCTURE

The result of the harmonic analysis (a percentage measurement) is combined with the perceptual distortion for each frequency. This accentuates the rub & buzz, making it easier to identify and set limits.

PERCEPTUAL RUB & BUZZ