SIGNIFICANT DIFFERENCES BETWEEN IEC-179 AND IEC-651, TYPE I
FOR MEASURING IMPULSIVE NOISE SIGNALS.

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Despite the availability of sound level meters with impulse and/or Leq characteristics, the vast majority of sound level meters in use today are equipped with "Fast" and "Slow" response only.

Even if an SLM is equipped with Imp. or Leq, many users hesitate to use these facilities, sometimes for lack of understanding, but more often because certain rules or recommendations require that he uses "Fast" or "Slow".

For many types of noise containing a certain amount of impulses, such as noise from modern office equipment, exhaust noise, machinery noise, etc., this poses a problem of inaccuracy. If all SLMs responded equally well (or badly) to impulses of various kind in their "Fast" response, this inaccuracy might be corrected for in a relatively simple way. However, new technology and the introduction of IEC-651, type 1, instead of IEC-179 has increased the difference between SLMs with respect to accuracy in the "Fast" response mode.

The total accuracy of an SLM depends on 1) the proper placement in the sound field, 2) the acoustical performance of the instrument, 3) the electrical performance of the instrument and 4) proper calibration. While 1), 2), and 4) have remained unchanged, 3) the electrical performance has undergone some changes due to the introduction of new technology.

The electrical performance of an SLM contains several aspects: 1) the frequency weighting, 2) the amplitude linearity and 3) the detector/indicator performance.

The last part, detector/indicator performance, is where the major changes have occurred, somewhat unnoticed.
With the introduction of the digital displays, it was necessary to change the requirements to read-outs.

The requirement of a resolution of 0.1 dB for digital read-outs makes it impossible for the human eye to follow changes of the last digit on the display, if the noise signal varies even slightly. It is thus necessary to decide upon a certain time period after which the signal must be read out.

Having determined a time period it was also necessary to decide which value, i.e., max, average or other, of the signal should be displayed. IEC-651 decided to display the maximum RMS value which had occurred during the previous time period.

While on an analog meter the user had been used to apply what is generally known as "eye-ball-averaging", he is now reading max. values off a digital display.

Inasmuch as the analog meters were assumed to present a certain amount of overshoot (0.1 to 1.1 dB according to IEC-179, and max. 1.1 dB according to IEC-651) the user would tend to apply an "average" reading of a fluctuating signal which would eliminate the top 1-2 dB of the signal.

The fact that the electrical circuit now makes the decision and displays the max. RMS reading will make future measurements more uniform, but also higher in value. This is illustrated in fig. 1.
The reason for requiring an overshoot when using analog meters was probably the complexity of the time constants involved in a detector/meter circuit configuration.

The detector time constant is determined by the R-C loading of the detector itself, and is thus a rather simple and calculable figure. In series with a meter circuit containing also inductance and added resistance, it became a more difficult quantity to determine, and thus the 1 dB overshoot was allowed.

In later technology the indicating unit is not a retroactive circuit, and thus the time response is determined by the R-C constant of the detector circuit alone. This gives possibilities not only for a more well-defined response, but also for a faster response, better dynamic range and better handling of signals with high crest factor.

IEC-651, type 0 sets requirements to the accuracy and time weighting characteristics of the detector circuit. These requirements are based upon the typical response of an R-C network, and can (and probably will) be fulfilled by most type 1 instruments applying a digital read-out.

Fig. 2 "Fast" response of different Sound Level Meters to a 2 kHz tone-burst. Reference is a continuous 2 kHz tone with the same amplitude as for the tone-burst. Reference level is 4 dB below FSD.
In figure 2 is shown the ideal rise time function in "Fast" response required for type 0 instruments and also four typical response curves from four precision type sound level meters of three different makes, all being in accordance with IEC-179 and IEC-651, type 1 requirements. It is easy to see that differences of up to 4 dB can occur due to the difference in detector/indicator time response.

If such difference is now added to the difference in reading described in the first half of this paper, a difference of the order of 3-6 dB can easily be obtained between analog meter readings and readings from a digital display, although both instruments are fulfilling the required standard.

This of course occurs only when the sound signal is question has some content of impulsive noise or is fluctuating to some degree. However, in many instances this can be the case without even being noticed, as for instance in measuring noise from modern office equipment, or in measuring exhaust noise, both types of noise are generally judged to be fairly constant (apart from typewriter noise).

While the IEC-651 has indeed improved on uniformity in reading, it would also be desirable to recommend a tighter conformance to the desired time weighting response in order to eliminate differences from instrument to instrument.

In the present situation where technology permits the use of proper measurement techniques, the real question may be whether standard requirements should reflect the technological development and call for proper Leq measurements to replace both "Fast" and "Slow"-based estimates of Leq. In addition we only need "Peak" measurements to indicate the likelihood of impulse content and to give an estimate of the maximum crest factor of the noise signal.