MEASURING WITH SOUND LEVEL METERS: THE REAL DIFFERENCE BETWEEN TYPE 1 AND TYPE 2

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1. INTRODUCTION

I will briefly discuss the differences between Type 1 and Type 2 meters, based on ANSI ands IEC standards. However, knowing the differences in instrumentation tolerances, we really do not know how they translate into differences in acquired data. I will discuss the differences in results for two meters, exactly the same except for Type designation.

There are differences between the parameters that instruments: essentially they lie in the differences in instrumentation tolerances between Type 1 and Type 2. The output depends on the spectrum and frequency response of meter. This paper reports the result of a "theoretical study," based on numbers alone, and of a simple measurement test.

So some issues include: What does "frequency range" mean and what is the effect of the frequency range on sound level meter accuracy and it's ramifications for measurement? And what does the "Type" of sound level meter have to do with accuracy of measurements?

2. FREQUENCY RESPONSE OF SOME METERS

To give some idea as to the frequency response reported in the literature of some manufacturers, Table 1 shows data gleaned from product data sheets:

Meter	Type	Range (Hz)
CESVA SC-160	2	31-16k (OB)
RION NA-26	2	20-8k
RION NL-22	2	20-8k
RION NL-32	1	20-20k
Norsonic N-118	1	6.3-20k
Norsonic N-121	1	0.1-20k
LD 812, 820	1	?
LD-824	1	2.5-20k (1/3rd OB)

Table 1 Claimed frequency ranges of some meters

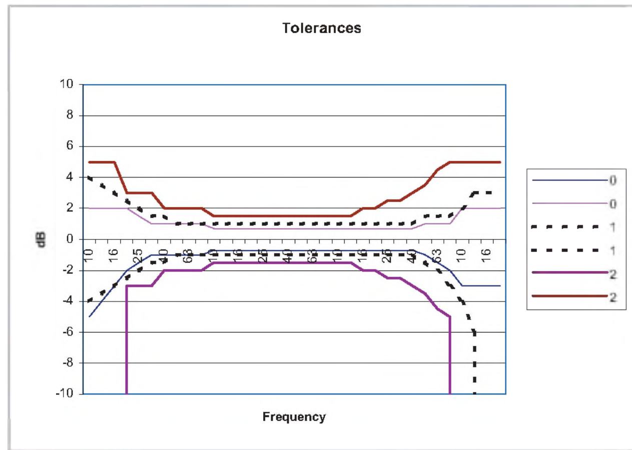

Figure 1 Tolerances on meters per ANSI

When discussing tolerances, the meter and the microphone together must meet specs. And the most inaccurate component is probably the microphone because it is electromechanical

The A-weighting filter has tolerances associated with it. The frequency response is

10 - 20k Hz in S1.4-1983
10 - 100k Hz in S1.4A-1985

The sum of all energy in the band, and weighted per the curve, is the range for which the "dBA" is meant. Any other range (like 50 to 800 Hz) is not the same. It is a partial weighting. That is for a sound measurement any differences between the A-weighted levels measured with two meters depends on the spectrum and the meter response. A-weighted value is the energy modified by the A-weighted curve. This brings up a really basic, if exaggerated, question: What does it mean to measure a smaller frequency range? Suppose you measure only between1000 Hz and 1250 Hz 1/3rd OB data. Is that somehow an A-weighted number?

3. COMPARISON OF METERS

I did a theoretical modeling of noise and a field test with three different meters to evaluate differences.

2.1 Modeling Procedure

I put random noise into meter simulated by random numbers into a mathematical model of an A-weighting filter of different bandwidths. The energy sum, Correct for A-wtd. Was calculated and I computed the difference between highest and lowest values of A-wtd data for a given (random) spectrum. This was done 30 times. Figure 2 shows the results of a series of broad band spectra for different meter types. Figure 3 shows, for 30 measurements, the means, standard deviations, as well as a maximum range for the results.

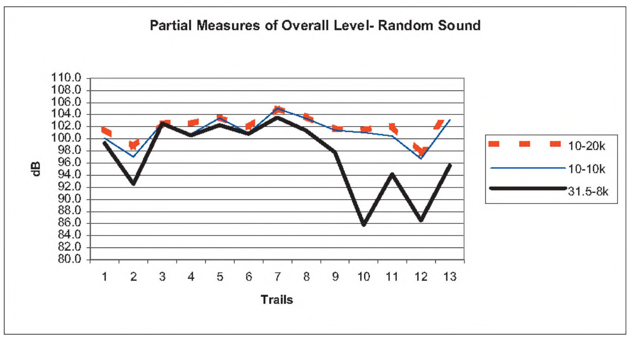

Figure 2 Partial measures of Overall level

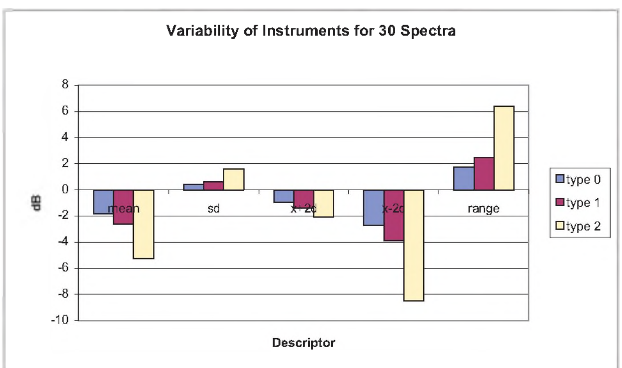

Figure 3 Difference between Types for 30 measurements

2.2. Field test:

I used three integrating-averaging sound level meters of identical sizes, identical preamps, presumed almost identical electronics, different microphone, A-weighted and measured 10 Min Leq with Autostore. The meters were: RION NL-21, Type 2, RION NL-22, Type 2, and the RION NL-32, Type 1. Placed about 12 cm apart and 1-m from ground, I measured traffic noise about 15 m from the right-of-way. Table 2 shows the results of six, 10-min samples.

	NL-21	NL-22	NL-32
1	66.3	66.5	66.4
2	66.6	66.7	66.6
3	67.3	67.5	67.3
4	65.8	66.0	66.0
5	67.2	67.4	67.3
6	68.0	68.2	68.1
Hourly Average	66.9	67.1	67.0

Table 2 ten-minute Average sound level for three meters.

4. DISCUSSION AND CONCLUSIONS

4.1 Discussion

The oral presentation contains more details on both modeling and field tests. The field tests included attempting to determine the effects of microphone windscreens. There is a lot of uncertainty present, some we know, from the results of a traceable calibration and some we don't because we have no apriori and quantitative information about the sound and environment.

4.2 Conclusions

The errors in sound level meters are based on more that we normally think: The tolerance by the manufacturer, the bandwidth of the signal (which may be different for the same type of instrument, the actual signal in the sound, and the orientation of the microphone compared to the sound wave, if indeed we even know where the sound is coming from (discussed a paper long ago.) Also,

Type 2 is the just about the same as a Type 1
- –For this level of uncertainty
- –For this type of noise
- –For this type of sound level meter
- –For the usefulness of the results

Type 2 is better than type 1
- –Less costly
- –Less expensive to break
- –Calibrator less expensive
- –Microphone is less expensive

Type 1 is better than type 2
- –For low noise environments (<20 dB v. < 30 dB or more)
- –For accurate measurements of low frequency or high frequency noise (where tolerances can give differences of + 4)
- –A Type 1 meter is a Type 2 meter