MEASUREMENT OF ROAD TRAFFIC NOISE AND TRAFFIC COUNT

Tasks

- Traffic count
- A weighted sound-pressure level measurement
- Compare the different type of A weighted sound-pressure level techniques, (L'_{Aeq} vs. L'_{Aeqm})

Traffic count

The report should be involving the measurements parameters:

- The exact address of the measurements. Prepare a map about the measurements or take a snapshot from google maps and please indicate the measurements position.
- The time/date/temperature (appr.),
- The meteorological condition by norm:
    - appr./internet wind speed (< 6 m/s)
    - It should be dry weather (the rainy weather could be influenced the measurements)

The table should be involving the number of vehicles passing all specific direction.

For this measurement of traffic noise let choose at least 6 different crossroads with different traffic load.

- 1st could be an almost "abandoned" street (such as *Bertalan Lajos street* next to the department)
- 2nd could be characterized a normal road traffic (such as *Budafoki street*).
- 3rd could be characterized a highly traffic (for example *Irinyi street* go to Pest).
- Other possibilities measurement could be on a bridge, you can go in to Metro, etc...

Place of traffic count: ……………………………………………… Date (duration): ………………………………………………									
Direction	A direction			B direction			C direction		
	A – B	A – C	A – D	B – A	B – C	B – D	C – A	C – B	C – D
Category No.1									
Category No.2									
Category No.3									
Notes:									

1. Table Observation for the vehicles and their velocity depend on the categories

The number of direction is depending on the type of the crossing.
Categories:

1. Car, van, motorcycle (appr. Mass<3500kg)
2. Truck, bus
3. Truck with trailer, double bus (articulated)

Please take a note about the extreme sound pressure sources (motorcycle w/o muffler, horn).

A weighted sound-pressure level measurement

Six different places should be chosen.

- Measurements duration: >5min.
- Sample frequency 5sec

This produces sum 12 x 5 = 60 data.

Place of measurement

The reference point for the measurement place and the middle line of the road (separation) is in at a distance of approximately 7.5m. The position of pressure device should be approximately 1.5m from the ground.

Equations for calculate the noise level (from the norm)

Equivalent noise level ("A" weighted sound-pressure level):

$$L'_{Aeq} = 10 * \lg\left[\frac{1}{\sum t_i} \sum \left(t_i * 10^{0,1*L'_{Aeqi}}\right)\right] + K$$

- In the case of traffic noise K=0
- t_i - duration of measurement
- L_{Aeqi} - A weighted sound-pressure level in i^{th} case [dB]

Equivalent noise level with traffic count

$$L'_{Aeqm} = 10 * \lg \sum_{i=1}^{3} \left(10^{0,1*L'_{Aeqmi}}\right)$$

$$L'_{AeqM1} = 15.0 + 10 \lg Q_{M1} + 16.7 \lg v_{M1}$$

$$L'_{AeqM2} = 17.3 + 10 \lg Q_{M2} + 19.0 \lg v_{M2}$$

$$L'_{AeqM3} = 13.2 + 10 \lg Q_{M3} + 16.7 \lg v_{M3}$$

- Traffic Q_{M1}-Q_{M3} in car/hours (car category No.1 – car category No.3. respectively)
- Average velocity in different car category (v_{M1}-v_{M3})
- L_{AeqMi} - A weighted sound-pressure level in i^{th} case [dB]

Finally results should be evaluated by comparing to the norm value, which is based on human health. Please search publications about norm value in town during the day (6 a.m – 10 p.m.).

Sound level meter: Roline RO-1350 Sound level meter

- **Measurement standard: IEC-651 Type 2**
- Display: 3 1/2 digit LC display
- Display range: 1999
- Frequency range: 31.5 Hz…8 kHz
- Frequency validation: A and C
- **Measuring range: A or C (LO) 35 dB…100 dB**
- **Measuring range: A or C (HI) 75 dB…130 dB**
- **Resolution: 0.1 dB**
- Output DC: 10mV/dB
- Output AC: 0.55V rms for each measuring range step
- Maximum Frequency: 12kHz
- Maximum Operating Temperature: +50°C
- Maximum Sound Level: 135dB
- Minimum Frequency: 30 Hz
- Minimum Operating Temperature: 0°C
- Minimum Sound Level: 35dB
- Analog output signal
- Power supply: AM-6 (9V battery)
- Dimensions: 240 x 68 x 25mm
- Weight: 215g

Sound pressure is not equally sensed by human ear at different frequencies - compensated with dB(A), dB(B) or dB(C) filters

http://www.engineeringtoolbox.com/decibel-d_59.html

The human ear is more sensitive to sound in the frequency range 1 kHz to 4 kHz than to sound at very low or high frequencies. Higher sound pressures are therefore acceptable at lower and higher frequencies than in the mid range.

The knowledge about human ear is important in acoustic design and sound measurement. To compensate, sound meters are normally fitted with filters adapting the measured sound response to the human sense of sound. Common filters are

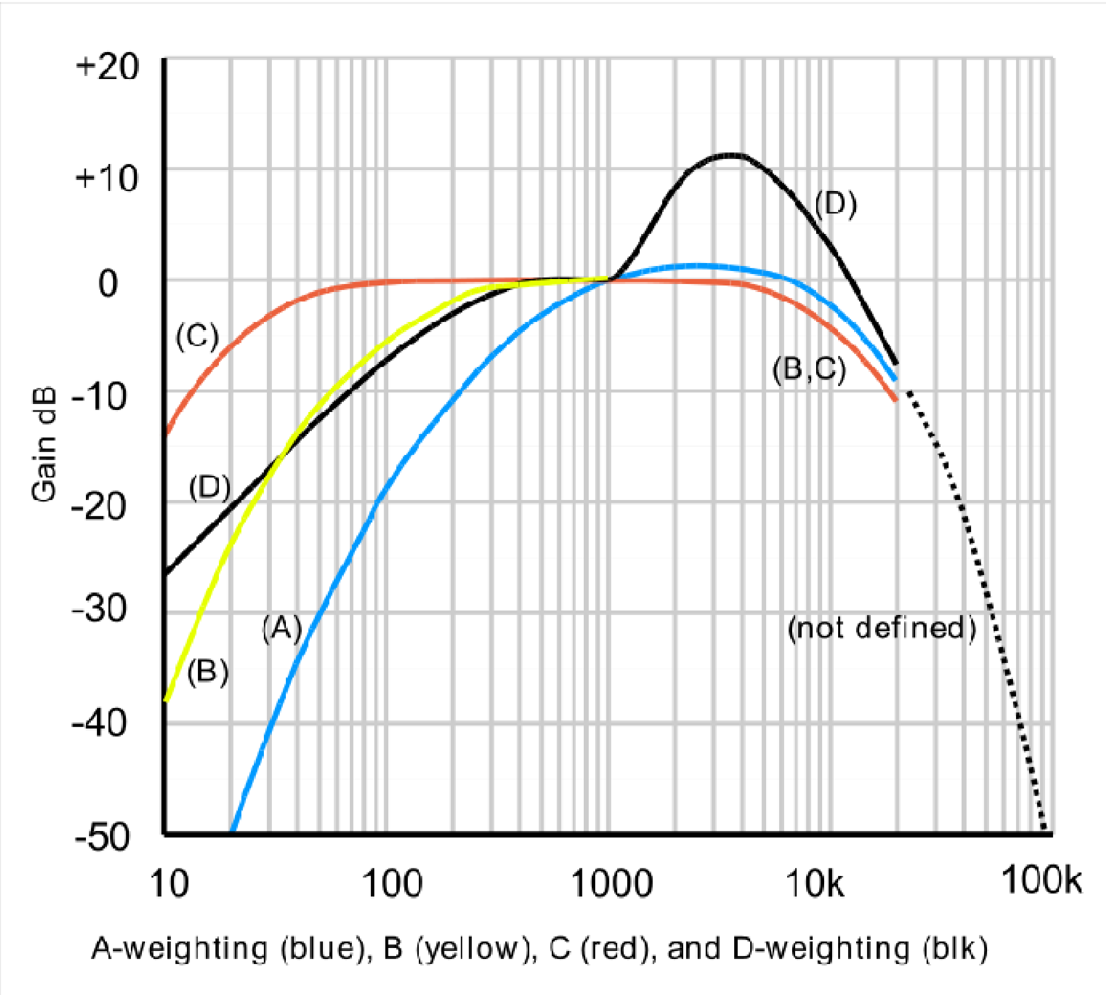
- *dB(A)*
- *dB(B)*
- *dB(C)*

A-weighting

http://en.wikipedia.org/wiki/A-weighting

A-weighting is the most commonly used of a family of curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound pressure level. A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies. It is employed by arithmetically adding a table of values, listed by octave or third-octave bands, to the measured sound pressure levels in dB. The resulting octave band measurements are usually added (logarithmic method) to provide a single A-weighted value describing the sound; the units are written as dB(A). Other weighting sets of values - B, C, D and now Z - are discussed below.

The curves were originally defined for use at different average sound levels, but A-weighting, though originally intended only for the measurement of low-level sounds (around 40 phon), is now commonly used for the measurement of environmental noise and industrial noise, as well as when assessing potential hearing damage and other noise health effects at all sound levels; indeed, the use of A-frequency-weighting is now mandated for all these measurements, although it is badly suited for these purposes, being only applicable to low levels so that it tends to devalue the effects of low frequency noise in particular.[1] It is also used when measuring low-level noise in audio equipment, especially in the U.S.A.[citation needed] In Britain, Europe and many other parts of the world, broadcasters and audio engineers[who?] more often use the ITU-R 468 noise weighting, which was developed in the 1960s based on research by the BBC and other organizations. This research showed that our ears respond differently to random noise, and the equal-loudness curves on which the A, B and C weightings were based are really only valid for pure single tones.



1. Graph: A graph of the A-, B-, C- and D-weightings across the frequency range 10 Hz – 20 kHz

History of A-weighting

A-weighting began with work by Fletcher and Munson which resulted in their publication, in 1933, of a set of equal-loudness contours. Three years later these curves were used in the first American standard for sound level meters.[1] This ANSI standard, later revised as ANSI S1.4-1981, incorporated B-weighting as well as the A-weighting curve, recognising the unsuitability of the latter for anything other than low-level measurements. But B-weighting has since fallen into disuse. Later work, first by Zwicker and then by Schomer, attempted to overcome the difficulty posed by different levels, and work by the BBC resulted in the CCIR-468 weighting, currently maintained as ITU-R 468 noise weighting, which gives more representative readings on noise as opposed to pure tones.[citation needed]

Deficiencies of A-weighting

A-weighting is only really valid for relatively quiet sounds and for pure tones as it is based on the 40-phon Fletcher–Munson curves which represented an early determination of the equal-loudness contour for human hearing.

Because of perceived discrepancies between early and more recent determinations, the International Organization for Standardization (ISO) recently revised its standard curves as defined in ISO 226, in response to the recommendations of a study coordinated by the Research Institute of Electrical Communication, Tohoku University, Japan. The study produced new curves by combining the results of several studies, by researchers in Japan, Germany, Denmark, UK, and USA. (Japan was the greatest contributor with about 40% of the data.) This has resulted in the recent acceptance of a new set of curves standardized as ISO 226:2003. The report comments on the surprisingly large differences, and the fact that the original Fletcher–Munson contours are in better agreement with recent results than the Robinson-Dadson, which appear to differ by as much as 10–15 dB especially in the low-frequency region, for reasons that are not explained. Fortuitously, the 40-phon Fletcher–Munson curve is particularly close to the modern ISO 226:2003 standard.

Nevertheless, it will be noted that A-weighting would be a better match to the loudness curve if it fell much more steeply above 10 kHz, and it is likely that this compromise came about because steep filters were difficult to construct in the early days of electronics. Nowadays, no such limitation need exist, as demonstrated by the ITU-R 468 curve. If A-weighting is used without further band-limiting it is possible to obtain different readings on different instruments when ultrasonic, or near ultrasonic noise is present. Accurate measurements therefore require a 20 kHz low-pass filter to be combined with the A-weighting curve in modern instruments. This is defined in IEC 61012 as AU weighting and while very desirable, is rarely fitted to commercial sound level meters.

B-, C-, D- and Z-weightings

A-frequency-weighting is mandated by the international standard IEC 61672 to be fitted to all sound level meters. The old B- and D-frequency-weightings have fallen into disuse, but many sound level meters provide for **C frequency-weighting and its fitting is mandated — at least for testing purposes — to precision (Class one) sound level meters**. D-frequency-weighting was specifically designed for use when measuring high level aircraft noise in accordance with the IEC 537 measurement standard. The large peak in the D-weighting curve is not a feature of the equal-loudness contours, but reflects the fact that humans hear random noise differently from pure tones, an effect that is particularly pronounced around 6 kHz. This is because individual neurons from different regions of the cochlea in the inner ear respond to narrow bands of frequencies, but the higher frequency neurons integrate a wider band and hence signal a louder sound when presented with noise containing many frequencies than for a single pure tone of the same pressure level. Following changes to the ISO standard, D-frequency-weighting should now only be used for non-bypass engines and as these are not fitted to commercial aircraft — but only to military ones — A-frequency-weighting is now mandated for all civilian aircraft measurements.

Z- or ZERO frequency-weighting was introduced in the International Standard IEC 61672 in 2003 and was intended to replace the "Flat" or "Linear" frequency weighting often fitted by manufacturers. This change was needed as each sound level meter manufacturer could choose their own low and high frequency cut-offs (–3 dB) points, resulting in different readings, especially when peak sound level was being measured. As well, the C-frequency-weighting, with –3 dB points at 31.5 Hz and 8 kHz did not have a sufficient bandpass to allow the sensibly correct measurement of true peak noise (Lpk)

B- and D-frequency-weightings are no longer described in the body of the standard IEC 61672 : 2003, but their frequency responses can be found in the older IEC 60651, although that has been formally withdrawn by the International Electro-technical Commission in favour of IEC 61672 : 2003. The frequency weighting tolerances in IEC 61672 have been tightened over those in the earlier standards IEC 179 and IEC 60651 and thus instruments complying with the earlier specifications should no longer be used for legally required measurements.

Environmental and other noise measurements

Label related to a portable air compressor

A-weighted decibels are abbreviated **dB(A)** or **dBA.** When acoustic (calibrated microphone) measurements are being referred to, then the units used will be dB SPL referenced to 20 micropascals = 0 dB SPL. **dBrn adjusted** is a synonym for dBA.

The A-weighting curve has been widely adopted for environmental noise measurement, and is standard in many sound level meters. The A-weighting system is used in any measurement of environmental noise (examples of which include roadway noise, rail noise, aircraft noise). A-weighting is also in common use for assessing potential hearing damage caused by loud noise.

A-weighted SPL measurements of noise level are increasingly found on sales literature for domestic appliances such as refrigerators, freezers and computer fans. In Europe, the A-weighted noise level is used for instance for normalizing the noise of tires on cars.

The A-weighting is also used for noise dose measurements at work. A noise level of more than 85 dB(A) each day increases the risk factor for hearing damage.

Noise exposure for visitors of venues with loud music is usually also expressed in dB(A), although the presence of high levels of low frequency noise does not justify this.

Contacts

Technical Acoustics and Noise Control BMEGEÁTAG15.
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