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Guidelines for Environmental Noise Measurement and Assessment



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Note: This document is currently under review.

I. INTRODUCTION

It has been recognized and accepted for some time that high noise levels can cause temporary or permanent hearing loss. In addition, noise has other effects which are not as well documented. Noise can cause annoyance, interfere with sleep, impair speech communication and interfere with working efficiency.

Nova Scotia Environment and Labour has developed an environmental guideline which serves to facilitate the evaluation of noise pollution in our environment.

II. EFFECT OF NOISE ON PEOPLE

The effect of noise on people is an extremely complicated field. In fact, there is a separate branch of science which deals with the subject. The science of psychoacoustics studies how the physically-measurable properties of sound relate to human judgements or "noisiness". There are a number of factors which affect the way we perceive a sound and they include the following:

1. loudness
2. frequency
3. impulse tendency
4. variability of the sound level with time
5. the circumstances surrounding the occurrence of the sound (time of day, location, and recipient's attitude to the source of the noise).

III. NOISE MEASUREMENT PARAMETERS

Noise is essentially unwanted sound. Therefore, the terms noise and sound can be used interchangeably.

Sound Pressure Level

Sound is defined as any pressure variation (in air, water or some other medium) that the human ear can detect. The unimpaired human ear can detect sound ranging from 2×10^{-5} newtons per square meter (threshold of hearing) to over 200 newtons per square meter (threshold of pain). This large range, over ten million units, combined with the non-linear manner in which the human ear responds to sound pressure has prompted the use of the decibel scale (dB) as a unit of sound pressure level measurement. The decibel is a dimensionless unit which expresses a logarithmic ratio of the square of the measure sound pressure level to the square of a reference level.

Sound pressure level is not commonly used as an evaluator for ambient or community noise. It does, however, serve as a basis for most units of measure and therefore is an important concept to understand. The result of using the decibel scale is a condensed scale which is much easier to handle. The threshold of hearing becomes the starting point, defined as 0dB. Each time the sound pressure level is multiplied by 10, 20 dB is added to the sound pressure level. Thus 2×10^{-4} newtons per meter becomes 20 dB and 2×10^{-3} newtons per meter becomes 40 dB and so on.

The A Weighted Level

The effect of noise on humans is not a simple relationship to sound pressure level. The frequency content of sound has an important effect on the way a sound is perceived by humans. Loudness depends upon the acoustic energy at each discrete frequency present in the sound. This is because the human ear is discriminatory in the way it responds to sounds at different frequencies. The average human ear can hear over the range of 20 to 16,000 hertz, or cycles per second. Researchers in psychoacoustics have developed a scale which closely approximates the response of the human ear. The scale is called an A weighted scale and is expressed in A weighted decibels, dBA. Most sound level meters available are equipped with an electronic weighting network designed to reproduce the response of the human ear.

Equivalent Sound Level

It is, however, important that the time varying characteristic of noise be considered in any community noise evaluation. The equivalent continuous sound level measurement L_{eq} is formulated such that in a given period of time the stated steady noise level contains the same noise energy as the actual time varying noise.

The equivalent sound level is measured in terms of dBA. The equivalent sound level, then, takes into account the major factors influencing the effect of noise on a person, magnitude, frequency range, and time variation.

The L_{eq} or equivalent sound level measure gives an average sound level over a period of time, but weighs the average toward the peak sound levels. When factors such as time of day, impulse tendencies, and pure tone characteristics of the sound are taken into consideration, equivalent level gives a good correlation with observed community reaction.

IV. THE GUIDELINE

There are a number of characteristics that an effective noise control guideline should have:

1. The measurement should reflect the effect that the noise has on humans.
2. The measure of noise used should be predictable, given a knowledge of the noise source. (This allows for its use as a planning tool)
3. The measurement equipment must be commercially available and must be reasonably priced and workable by semi-skilled technicians.
4. The system of measurement should be comparable to systems used in other jurisdictions.
5. Most important, the level must be set such that the health and welfare of the public is adequately protected while permitting a continuation of normal functions and activities.

Noise legislation should be designed primarily to protect public health and within reasonable economic restraints provide a quiet and restful environment in which to live, work and play.

Nova Scotia Environment and Labour has established the following criteria for this guideline:

$L_{eq} \leq 65$ dBA between 0700 to 1900 hours

$L_{eq} \leq 60$ dBA between 1900 to 2300 hours

$L_{eq} \leq 55$ dBA between 2300 to 0700 hours

In order to be sure that a representative sample is gathered during any one of the periods, a minimum of two continuous representative hours of data in one period is required, unless the sound being generated is reasonably steady and the L_{eq} is not expected to change drastically.

For the purposes of this guideline noise levels will be measured in areas where people normally live, work, or take part in recreation. The guideline does not apply to the work force of a company. The latter situation comes under the jurisdiction of the Occupational Health and Safety Act.

Municipalities will continue to be responsible for the nuisance-type noise sources. This would include disturbing the peace, faulty mufflers, loud speakers, etc. These types of offences can be handled through the existing police force.

Any operation which requires an Environmental Approval from this department will be considered to come under the jurisdiction of this guideline. In most cases, this would not include building construction which is a municipal responsibility.

There are a number of noise sources which by their nature would have to be excluded from the guideline. These include, but may not be limited to:

1. agricultural operations
2. transportation
3. emergency signals and vehicles
4. emergency energy release devices
5. motor vehicle race tracks

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Nova Scotia Department of the Environment