# ESTIMATING COMMUNITY NOISE IN A STANDARD WAY: A DISCUSSION ABOUT AND THE STATUS OF ISO 9613-2

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## 1. INTRODUCTION

This summarizes the status of the work of a large working group of Canadians and Iraq occupiers who, on and off, have worked on developing a national, if not North American standard that is comparable to the international standard dealing with prediction of outdoor noise levels.

The ISO 9613-2, and subsequently, we hope, the new Draft ANSI S12.62 deals with the propagation of noise outdoors accounting for various environmental factors: barriers, foliage, berms, ground effects, etc. Essentially the Standard is a collection of algorithms that can be used with hand calculations or in computer programs; they can help estimate the noise from one or more sound sources. The method described in this standard is general in the sense that it may be applied to a wide variety of noise sources, and covers most of the major mechanisms of attenuation.

ISO 9613-2 is a much used standard in most countries in the world and is much maligned, sometimes deservedly so. This paper reviews the existing ISO 9613-2 and indicates issues the ANSI working group has with adopting the standard as written several months ago.

This standard specifies an engineering method for calculating the attenuation of sound produced by one or more sound sources during downwind propagation or, equivalently, for propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night outdoors, in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favorable to propagation from sources of known sound emission (sound power level).

The method also predicts a long-term average A-weighted sound pressure level. The long-term average A-weighted sound pressure level encompasses levels for a wide variety of meteorological conditions, and seasons of the year.

The calculation method consists specifically of octave-band algorithms (with nominal midband frequencies from 63 Hz to 8 kHz) for calculating the attenuation of sound, which originates from a point sound source, or an assembly of point sources. The source (or sources) may be moving or stationary.

This method is applicable in practice to a great variety of noise -fixed base installations, surface transportation sources, industrial noise sources, construction activities, and many other ground-based noise sources. It does not apply to sound from aircraft in flight, or to blast waves from mining, military, or similar operations.

Specific terms are provided in the algorithms for the following physical effects:

- Geometrical divergence,
- Atmospheric absorption,
- Ground effect,
- Reflection from surfaces,
- Screening by obstacles,
- Propagation around one or more buildings (housing),
- Foliage, and
- Industrial sites

The basic equation is

$$L_{fT}(DW) = 10\ \lg \left\{ \frac{\left[ (1/T) \int_0^T p^2{}_f(t)\,dt \right]}{p_0^2} \right\} dB$$

Where

$L_{fT}$(DW) = downwind average octave band level, $f$ is octave band mid frequency, p = sound pressure, $p_0$ = 20 μPa, and T= integrating time

This standard assumes that the wind blows from the source to the receiver. If this standard is used either to predict at multiple receivers or to draw noise contours, then it implicitly assumes that the wind is omni-directional, and simultaneously blows from the source to each receiver.

The equations to be used are for the attenuation of sound from point sources and their image sources from reflecting objects other than the ground. Extended noise sources therefore, such as road and rail traffic or an industrial site (which may include several installations or plants, together with traffic moving on the site) are represented by a set of sections, each having a certain sound power and directivity. Attenuation calculated for sound from a representative point within a section is used to represent the attenuation of sound from the entire section. A line source may be divided into line sections, an area source into area sections, each represented by a point source at its center.

$$L_{fT}(DW) = L_W + D_c - A$$

where

$L_W$ is the octave-band sound power level, in decibels, produced by the point sound source relative to a reference sound power of one picowatt (1 pW):

$D_c$ is the directivity correction, in decibels, that describes the extent by which the equivalent continuous sound pressure level from the point sound source deviates in a specified direction from the level of an omnidirectional point sound source producing sound power level $L_W$. $D_c$ equals the directivity index D1 of the point sound source plus an index $D\Omega$ that accounts for sound propagation into solid angles less than $4\pi$ steradians; for an omnidirectional point sound source radiating into free space, $D_c = 0$ dB;

A is the octave-band attenuation, in decibels, that occurs during propagation from the point sound source to the receiver.

These values of "A" are determined from the algorithms.

## 2. STATUS TO DATE (August 2004)

The working group, composed of perhaps 40 people of which ten or so are active, originally was planning to help produce an ANSI Nationally Adopted International Standard (NAIS) that would essentially adopt all technical requirements of the ISO 9613-2 (which it had to) but also contain editorial changes and an annex that provided notes and commentary to help interpret sections that were a problem. For example, the barrier equation includes a non-zero term for a small path length difference which implies even a roadway curb will give 3-5 dB attenuation as a barrier.

As a result of financial issues, and after all, for developers as apposed to volunteers, standards is a moneymaking proposition, ASA will not develop any more NAIS documents. This gives the working group an opportunity to start fresh and develop a standard set of algorithms, like ISO 9613-2 or not, that are based on agreed upon ways of doing things. It implies that all who use the standard will estimate the same propagation losses.

A big issue is the relationship between the actual propagation and those that estimated with this standard. Many users of software expect the software to predict levels measured. I submit that is hard or impossible to do because:

1- Little is known about micro atmospheric conditions on any day, much less based on some weather prediction

2- Ground impedance is not well characterized and its relationship to propagation losses is not well developed. In any location with hard/soft/ conditions, chances are good that only a few people, if any, have good data at all with which to input to a program.

3- Foliage data are almost none existent and the data available suggest a very large uncertainty.

4- Sound power data of machines are either unknown or with high uncertainty because the data do not reflect actual operating conditions, added appurtenances (like conveyor belts or duct attenuators the field performance of which is unknown), and so on.

5- Sound data are often transient.

6- Configurations of propagation paths are often unknowable or so complex that data to describe them are not feasible to obtain.

With all of this, it remains for the working group to determine how to resolve this. I strongly believe, though, that every algorithm must include an estimate of uncertainty, which I suspect will be high, to indicate to laypersons and to professional that the narrow contours on a piece of paper

## REFERENCES

ISO-9613-2, 1996 "Acoustics — Estimation of outdoor sound propagation by calculation"
Bies, D.A. and Hansen, C.H., Engineering Noise Control. 2nd Ed.