TRUE NORTH: A COMPARISON OF MEASURED VS MODELLED NOISE LEVELS WITH INOISE

Henk de Haan *[1] and Virgini Senden †[1]
[1]dBA Noise Consultants Ltd, Okotoks, Alberta, Canada

1 Introduction

Standard ISO 9613-2 [1] is a widely used standard in noise predictions for industrial noise. Various jurisdictions in Canada recommend or require the use of ISO 9613-2. The standard has been implemented in several commercially available software suites that are in use in Canada today, e.g. CadnaA, Predictor and Soundplan. It has been noted that the translation of ISO 9613-2 in software algorithms can be open to interpretation [3], [4]. As a consequence, different software suites may produce different results for the same modelled situation. To help remedy this unwanted situation, Standard ISO/TR 17534-3 [2] was introduced in 2015. Recently, a new software suite has been introduced to the Canadian market, iNoise. iNoise looks and feels very similar to Predictor and is being marketed as a suite that strictly confirms to ISO 9613-2 in combination with ISO/TR 17534-3. Time for a reality check: how do noise levels that were predicted using iNoise compare to measured noise levels?

2 ISO 9613-2

2.1 General

ISO 9613-2 specifies an engineering method for calculating the noise propagation outdoors from a variety of sources with a known noise emission to receptors at a distance under meteorological conditions that are favorable for noise propagation (downwind from source to receptor, wind speed between 1-5 m/s, or a well-developed moderate ground-based temperature inversion). The estimated accuracy of ISO 9613-2 for broadband noise is ± 3 dB for distances up to 1 km and a mean height of source and receiver of less than 30 m, not taking effects from screening or reflections into account. The stated accuracy only applies to the propagation and not to the source description.

2.2 Ambiguities and clarifications in ISO/TR 17534

ISO 9613-2 is not completely unambiguous and some clauses are open to different interpretations. An example of ambiguous text in ISO 9613-2 (page 9, chapter 7.4 Screening) is *"Assume that only one significant sound-propagation path exist from the sound source to the receiver. If this assumption is not valid, separate calculations are required for other propagation paths"*. There is no further definition given for 'significant' and no unambiguous guidance on the number and construction of other propagation paths.

3 Proofing the Pudding

3.1 Predicted vs. Measured Results

It can be useful to compare predicted results with measured results to verify the accuracy of noise models. Several conditions apply:

- The measurements used for calibration should be conducted such that the results apply only to the measured noise sources and are only marginally influenced by e.g. ambient noise levels;
- In order to compare apples to apples, measurements should be conducted under conditions (both operational and meteorological) that resemble modelled conditions (e.g. downwind) or vice versa.

3.2 Test Case

A newly constructed natural gas plant is located in northern British Columbia in a mostly undisturbed (by other noise sources) environment. The regulatory approval for the facility included a condition that mandated a post-construction noise survey. dBA Noise Consultants was retained for the post construction survey.

The facility includes equipment typically found in natural gas plants such as large combustion engines, compressors, electric motors, air coolers and condensors, generators, heaters, vessels and pressure valves. Part of the equipment is housed in industrial buildings with several openings (both silenced and unsilenced louvres, forced ventilation, combustion air intakes, open roof ridges). Some significant noise sources are located outdoors (e.g. coolers and condensors). The buildings are situated in several parallel rows – noise levels at receptors located at the fenceline could be screened by multiple buildings. The ground was sandy and unpaved, but not compacted throughout. It was therefore considered to have a low porosity. ISO 9613-2 recommends a ground factor of 0 (hard) for such a surface.

3.3 Near-field Measurements

During the summer of 2017, we conducted near-field measurements around individual pieces of equipment and in openings to assess sound power levels in accordance with e.g. ISO 3744 [5] If possible, noise sources were

* henk@dbanoise.com
† virgini@ dbanoise.com

approached as point sources, but for most surface-enveloping measurements were used. We also recorded location, height, dimensions, specific operating conditions such as rpm etc. For buildings, we recorded location, height, location, size and number of openings.

3.4 Fenceline Measurements

We also conducted a total of 11 fenceline measurements on several different days at a receptor height of approximately 3.5 m, and at a distance of approximately 140 – 250 m from the nearest dominant noise sources. The locations were at the north, east and south side of the plant. Measurements were conducted under mild downwind (± 45°) conditions, with some cloud cover (up to 7/8). These meteorological conditions were considered to be in accordance with ISO conditions. Other noise sources than the plant were not audible during the measurements. Measurement duration was sufficiently long for the Leq to settle well before the conclusion of each individual measurement. Thus, the measurements were considered to be suitable for a comparison to modelled results. The measured noise levels varied from 61 dBA to 65 dBA.

3.5 Modelling

We modelled the plant in iNoise and compared the calculated noise levels at the fenceline receptors to the measured results. Model settings of note were a ground factor of 0.2 respectively and 0.0 (hard ground). This comparison stems from our preferred general settings using the Predictor software suite (a ground factor of 0 only for surfaces like water or paved, open surfaces, 0.8 for soft ground and 0.2 for hard ground).

3.6 Comparison Measured vs Calculated

The average, highest and lowest differences are included in Table 1. A detailed comparison for the differences between measured and calculated noise levels is included in Figure 1.

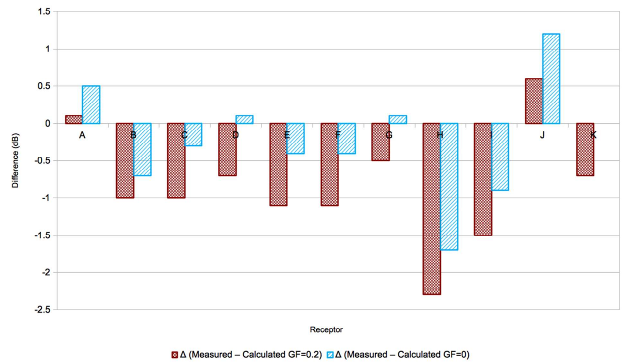
4 Discussion

Results for both comparisons are well within the margin of ± 3 dB that is included in ISO 9613. Average results are slightly below the measured results. A modelled ground factor of 0 for ground surfaces resembles measured noise levels more closely than a ground factor of 0.2. Using a ground factor of 0 follows ISO 9613-2 more closely. iNoise therefore seems capable of accurately predicting noise levels within the accuracy of ISO 9613-2. It is recommended to strictly follow ISO 9613-2 when modelling. Future comparisons could involve measured noise levels over soft (absorbing) ground near the receptor.

Table 1: Comparison Difference Measured vs Calculated Noise Levels (dB).

Description	Ground Factor 0.2	Ground Factor 0.0
Average 11 receptors	-0.8	-0.2
Highest Difference	0.6	1.2
Lowest Difference	-2.3	-1.7

Figure 1: Comparison Measured vs Calculated Noise Levels (dB).



References

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