

ENVIRONMENTAL NOISE CALCULATION

CALCULATION AND MODELLING

Environmental Noise Calculation

Noise levels can be calculated instead of being measured. In some cases, calculation is preferable and may be the only practical method, for example, where there are relatively high residual noise levels, where future levels need to be predicted or alternative scenarios need to be compared. Calculation is also useful for large-scale noise mapping and where there is limited access to the measurement position. Calculation is normally performed in accordance with a national, source-specific standard.



Input Data

Calculations are made using a computer model of the environment with defined noise sources, topography and features that affect the propagation of the noise to (receiver) points of interest. Input data for the model can be available from various sources, for example:

- GIS or AutoCAD® files for buildings and topography
- Databases of traffic flow data
- Airborne laser scanners for topographic height information

- Sound level measurements for source levels and levels at receiver points used for calibration

In many cases, input data can be incomplete, out of date, inconsistent, or over-complex. So, in order to optimise calculations, data often needs to be processed prior to calculation. By linking input data to databases, dynamic noise maps can be made that reflect the change in the input data in the noise contours.

Optimising Calculations

Results need to be accurate, even for strategic noise maps, as the consequences can be far-reaching and the actions based on these results expensive. Accuracy is influenced by any simplifications used to speed up the calculation:

- Maximum source-receiver distance (a fetching radius) for calculation (for example, 2 – 3 km). However, result quality needs to be checked as sources might occur in clusters
- For steady results at the edge of any “calculation tile” of a larger area the relevant model area should exceed the result area by the size of this fetching radius. Thus, for a calculation area of 1 km², 25 km² of model area may be required
- Neglect irrelevant emitters. This can be done by defining an acceptable maximal total error margin
- Maximum reflection distance (reflector fetching radius). The major influence of reflectors is close to a source or receiver – thus reflections further away can be omitted. Typically, a 30 m reflector fetching radius produces sufficiently good results with optimal calculation time

Validation Ensures Optimal Accuracy

Like measurements, the calculation should also be calibrated. This usually involves some form of valid measurements at selected positions where the measured long-term levels can be compared to the calculated ones. However, unlike measurements, calibration of a calculation is performed after the first calculation and used to refine results to the optimal accuracy.

Care should be taken that the measurement data is equivalent to that calculated. The calculation normally results in long-term, average L_{Aeq} levels, and using results from a single day's measurement can give systematic errors caused by non-representative wind conditions and

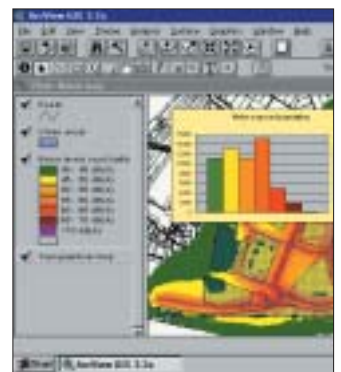
the state of ground cover. This error can be up to 10dB. In addition, measured data is not source-specific and includes contributions from sources other than those under investigation. Longer-term monitoring and post-processing of the results to "remove" unwanted contributions are recommended.

Two approaches can be taken. The first is global correction of noise levels where the map can be adjusted "en-masse" to optimise the difference between calculated and measured values.

Alternatively, local correction of noise levels – by measuring close to the sources under investigation, the source levels can be estimated. A calculation model that describes the whole ambi-

ent condition is defined. Sources with unknown emission are roughly estimated. The calculation software then uses an iterative technique to find emission values which best fit the measured data at the receptor positions while considering effects such as other sources, reflections and diffraction. This method shows acceptable results, and is preferred as good quality calculation results are not adjusted to the worse (as may happen with global correction).

In some cases, for example when investigating possible future scenarios, validation with measurements is not possible. Here, careful analysis of the results, or comparison with similar situations, is required to ensure optimal accuracy.



Product Guide

Brüel & Kjær offers solutions to all the above-mentioned applications.

Please use this table as a guide to relevant products.

Application	Key Features	Products and their Key Features
Modelling outdoor noise	Noise level mapping Environmental impact assessments Scenario comparison Fulfil EU IPPC 1996/61/EEC	7810 Predictor 7812 Lima
Large-scale noise mapping	Fulfil EU END 2002/49/EC (for example, interim methods) Large-scale data handling Interface with external databases and software	7812 Lima
Measuring sound powers of noise sources Validating calculations	1) Sound intensity method 2) Sound pressure method 3) L_{Aeq} 4) L_{DEN} 5) GPS position	2260 Investigator ^{1) 2) 3) 5)} 2260 Observer ^{2) 3) 5)} 2250 Hand-held Analyzer ^{2) 3)} 7816 Acoustic Determinator ^{2) 3)} 3637 Noise Monitoring Terminal ^{3) 5)} 3631 Noise Monitoring Terminal ³⁾ 3597 Noise Monitoring Terminal ^{3) 5)} 7802/40 Noise Monitoring Software ^{3) 4) 5)}
Airport noise maps	Noise level mapping Import of actual flight information	7834 INM Link
Modelling aircraft noise	Noise level mapping Footprints and time histories	7812 Lima

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