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THE JOINT NORDIC PREDICTION METHOD FOR RAILWAY NOISE.

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INTRODUCTION

This is a simple prediction method for airborne railway noise to be used in Denmark, Finland, Norway and Sweden. The method makes it possible to predict the A-weighted energy equivalent and maximum noise levels, and is intended to be used as a planning- and noise reduction tool. Its use will be closely related to future noise regulation criteria. The conditions and limitations for the use of the prediction method i given in (1), only the main aspects will be covered in this summary.

THE METHOD.

For practical reasons, the method is built up in such a manner that the equivalent noise level is first determined for a train speed of 80 km/h, using fig.1. The value thus obtained is next corrected for train type (ΔL_t), speed (ΔL_f), ground effect (ΔL_m), screening (ΔL_s) and such factors as rail joints, steel bridges and reflections from buildings (ΔL_d). The final value for the equivalent noise level will thus be:-

$$L_{eq} = L + \Delta L_t + \Delta L_f + \Delta L_m + \Delta L_s + \Delta L_d \qquad \text{dBA}$$

A similar procedure is used for finding the (average) max. noise level.

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(1) NOISE FROM RAIL TRAFFIC. KILDE report 67a,1983. Sponsored by The Nordic Council of Ministers noise group, NBG, Stockholm.

FIG.1

THE BASIC DIAGRAM FOR DETERMINING THE 24 HOUR ENERGY EQUIVALENT NOISE LEVEL, L. VALID FOR:- TRAIN SPEED= 80 KM/H, CONT.WELDED RAIL, STRAIGHT AND LEVEL TRACK.

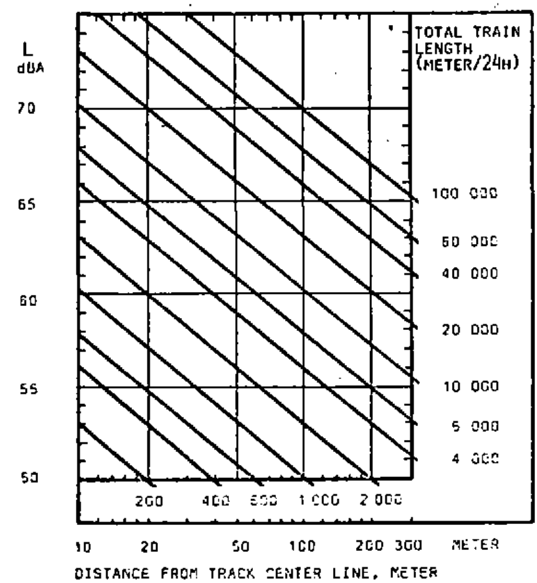


FIG.2

THE CORRECTION TERM FOR TRAIN SPEED, ΔL_F

FOR DIESEL TRAINS THIS CORRECTION TERM IS SET EQUAL TO ZERO ON ACCELERATION STRETCHES.

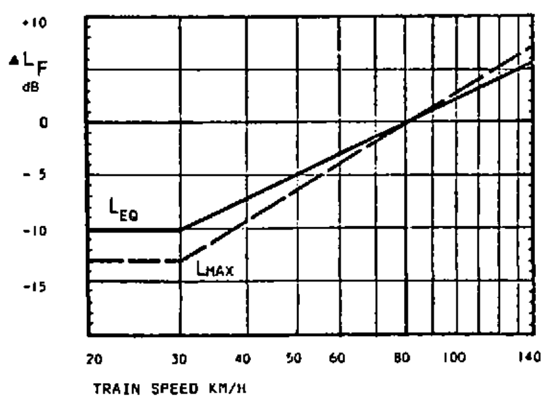
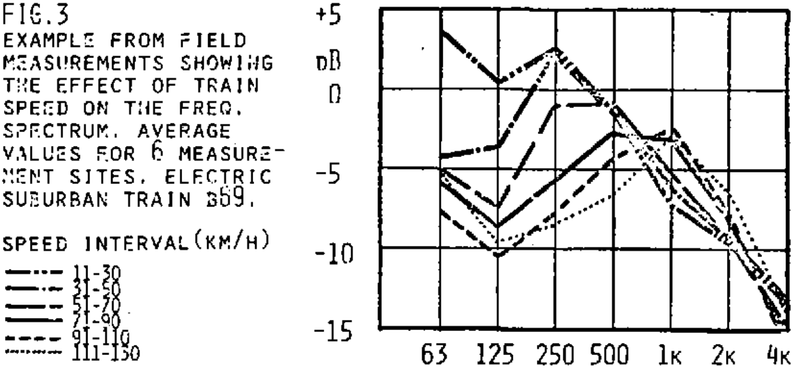


FIG.3

EXAMPLE FROM FIELD MEASUREMENTS SHOWING THE EFFECT OF TRAIN SPEED ON THE FREQ. SPECTRUM. AVERAGE VALUES FOR 6 MEASUREMENT SITES. ELECTRIC SUBURBAN TRAIN B69.

SPEED INTERVAL (KM/H)



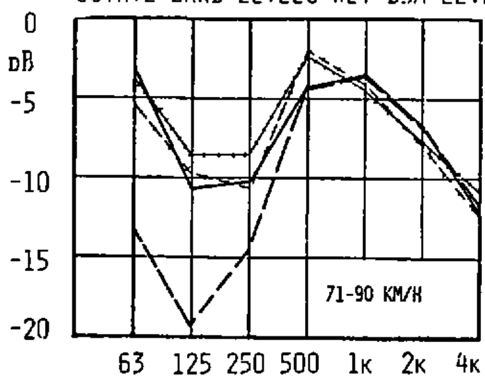
OCTAVE BAND LEVELS RE. DBA LEVEL

FIG.4

EXAMPLE FROM FIELD MEASUREMENTS SHOWING THE EFFECT OF RAIL CONDITION ON THE FREQUENCY SPECTRUM FOR GOODS TRAINS

PASSENGER TRAINS

BEFORE / AFTER RAIL GRINDING. ELECTRIC LOCOMOTIVE.



MEASUREMENT POSITION 7.5M FROM TRACK CENTER LINE 2M ABOVE RAIL LEVEL. ENERGY EQUIVALENT LEVELS CORRECTED TO A TRAIN LENGTH OF 100M (SEE REF.3).

(4) J.Kragh et al. Environmental Noise from Industrial Plants. General Prediction method. Lydteknisk Lab., Lyngby report 32, 1982.

(5) H.E.A.Brackenhoff et al. Interdepartementale Commissie Geluidhinder, Report HR-IL-13-01, Delft, April 1981. (In Dutch).

Only the speed correction term for L_{eq} and L_{max} is given here (fig.2).
The prediction method is based on the available railway noise litterature and on results from fairly comprehensive measurements carried out in Denmark and Norway (2,3).
The sound propagation model used is a simplified version of ref.4 (see page 4), which in turn is based on (5).
Typical noise emission spectra are given for various train types and train speeds, mainly as a starting point for calculating indoor noise levels, since the spectral changes do not significantly affect the outdoor A-weighted levels.

FURTHER DEVELOPMENTS.

The simple prediction method is being systematically tested against field mesurements by VTT, The Technical Research Center of Finland. Over the next 4-5 years it is likely that the method with be superseded by a more detailed version. In the meantime, a number of interesting aspects relating to railway noise generation and propagation are being studied in a project sponsored by the Norwegian Pollution Control Agency, SFT. For instance, when measuring the noise emission from electric trains it is quite clear that

- the spectral distribution of the emitted noise is dependent on train speed and train type (fig.3) and that these effects are more important on electric trains than on diesel trains,
- the A-weighted noise levels do not increase in a regular manner with speed.

The spectral distribution is also more dependent on measurement site geometry and rail conditions than one might expect; and the dependence of "average source height" on train type, site and speed pose problems in the development of a more detailed prediction method (fig.4). Finally remains the question of whether the sound propagation model of (4) and (5) is completely suitable or not, for the use in a more detailed (and accurate) prediction method of the future.

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(2) J.Kragh, O.Carlsen. Støj fra accelererende tog, Lydteknisk Lab., Lyngby,Report LL1260/82. Dec.1982.
(3) M.Ringheim. Støymåling på skinnegåande trafikk, KILDE rapport 43,1981, and KILDE report on results from 1982 measurements on electric trains (not yet published).