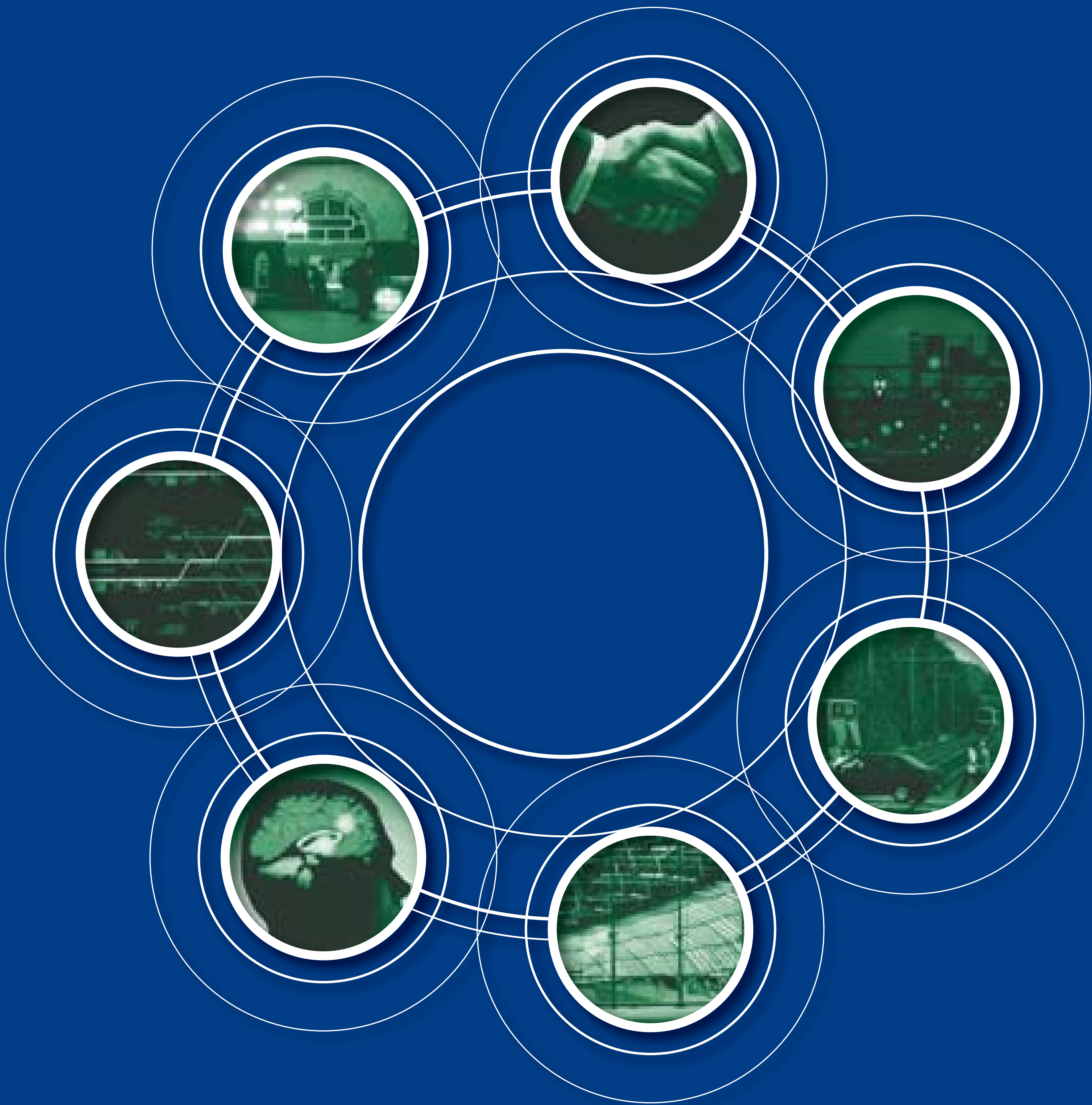
Rail Safety & Standards Board

Research Programme

Operations

T680 Mapping the extent of the train horn noise problem - Horsham



Spectrum
ACOUSTIC CONSULTANTS

T680 – Train Horn
Noise Mapping – Horsham

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SECTION **TITLE** **PAGE**

1. SUMMARY

The Rail Safety and Standards Board (RSSB) has received complaints regarding noise disturbance, from residents living near to whistle boards close to the Allcards rail crossing to the north of Horsham.

The RSSB has instructed Spectrum Acoustic Consultants Ltd to develop an acoustic model showing noise propagating from each of two whistle board locations.

Noise levels of train horns have been measured, and open site noise maps produced in accordance with the following standards:

- ISO 9613-1:1993 Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of the absorption of sound by the atmosphere

- ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

The purpose of the acoustic modelling exercise is to map the extent of noise propagation from the train horns, rather than to attempt to predict precise noise levels at specific locations.

2. INTRODUCTION

The Rail Safety and Standards Board (RSSB) is investigating the extent of propagation of noise from train horns, sounded at whistle boards near rail crossings.

Spectrum has been appointed by the RSSB to produce acoustic maps for the Allcards crossing to the north of Horsham. Following a survey to establish the typical noise level of the train horns, noise maps have been produced.

The purpose of the acoustic modelling exercise is to map the extent of noise propagation from the train horns, rather than to attempt to predict precise noise levels at specific locations. Acoustic modelling is always subject to limitations, and these are discussed elsewhere in this report.

3. SITE DESCRIPTION

Horsham is in West Sussex, Sussex, and the whistle boards are both to the south of Littlehaven station. The Allcards crossing is a footpath at grid reference TQ182321.

There are two whistle boards; one on the “down line” (from London), 232m north of the crossing and one on the up line (towards London) 285m south of the crossing.

This is a predominantly built up area, with housing on both sides of both whistle boards. As a result, the precise whistle board locations are inaccessible without gaining access to the railway itself.

The site location plan is shown in Appendix A.

4. ACOUSTIC MODEL PRINCIPLES

The acoustic model follows the procedures set out in ISO 9613 to determine noise levels around the local area. The procedure for generating the model is as follows:

Source noise levels (the noise level of a train horn) were measured at position 1, and the noise level measured assumed to be representative of a sounding at either of the whistle board positions. The model then positions a noise source at each whistle board, and noise levels in the surrounding area are calculated at regular intervals on a grid covering the extent shown. The model takes account of the following features:

- Distance from noise source (due to geometric divergence)
- Atmospheric absorption
- Ground effects (which includes the height of ground relative to the noise source)

Noise contours are then computed showing zones corresponding to the predicted noise levels from the train horn.

As an acoustic model, there are limitations as to the degree of precision of such an assessment. In particular, the following assumptions are made during the modelling process:

- The noise source (the train horn) is assumed to be omnidirectional – that is, it radiates noise equally in all directions. There are anecdotal comments that this may not be the case, but in the absence of precise directivity patterns for the horn, omnidirectional propagation has been assumed;

- The source height is assumed to be 0.5 m above the ground – correlating approximately with the height of the underside of the train, where the horn is fitted;
- The noise level of the train horn is assumed to be consistent. Train Horn noise levels are in reality variable – depending on how the driver operates the horn. The loudest measured case has been used as the source model, though noise levels may occasionally be higher, or lower;
- The noise model is an "open site" model. Therefore, screening and reflection effects from buildings, barriers etc have been disregarded. This is particularly of significance here, as the extent of housing around the whistle board sites will create both screening (reducing noise levels where the whistle boards cannot be seen) and reflected sound (increasing noise levels where sound is reflected off buildings);
- Neutral meteorological conditions (eg no wind, no temperature inversions) have been assumed, and so no meteorological corrections have been made to the model;
- The noise contours produced by the model are generated at a height of 1.5m above the ground level;
- The noise contours are calculated every 50m for the full size model, and every 10m for the larger scale (central zone) model;
- In addition, ISO9613 suggests that for distances up to 1km, the accuracy of any model will be ± 3dB. The standard does not give accuracy estimates for greater distances.

5. MEASUREMENTS

5.1 MEASUREMENT PROCEDURE

Noise levels were measured in two locations on 1 August 2006:

- Position 1: Grid ref TQ181317 – At the Parsonage Road Level Crossing to the south of the Allcards Crossing. The up whistle board was approximately 35m north of the measurement position.
- Position 2: Grid ref TQ183322 – On the east side of the railway, as the footpath turns east towards Treadcroft Drive.

The monitoring was undertaken over a 3 hour period during the day. Measurements were undertaken under neutral weather conditions. Measurements were focussed on the maximum noise levels that occurred (corresponding to train horn soundings) and measurements were made in one-third octave bands. All data has been stored and is available to the RSSB on request – this report details the necessary measurement data used to produce the models.

The following equipment was used during the survey:

- Bruel & Kjaer Type 2260 Sound Level Meter serial number 1772229
- Bruel & Kjaer Type 4189 Microphone serial number 2199530
- Bruel & Kjaer Type 4231 Acoustic Calibrator serial number 2229957
- Bruel & Kjaer Type 2260 Sound Level Meter serial number 2311704
- Bruel & Kjaer Type 4189 Microphone serial number 2523534
- Bruel & Kjaer Type 4231 Acoustic Calibrator serial number 2389076

The noise measurement system instrumentation is calibrated biannually using equipment referenced to the British Calibration Service, and the National Physical Laboratory. It was also field checked before and after the survey and sensitivity drift was negligible.

5.2 RESULTS AND OBSERVATIONS

At measurement position 1, (beside the level crossing) queuing traffic at the level crossing gave rise to increased background noise levels. Trains on the up line sounded their horn having already passed the measurement position and so the train masked its own horn noise. Subjectively, soundings of the horn at the up whistle board were short, not allowing the full two-tone sound to be heard. (Short soundings only have sufficient time to generate a single tone.) Also, soundings frequently occurred beyond the whistle board position.

The down whistle board is a considerable distance away, and so no soundings from either board gave generally clearly distinguishable results above background noise. There was one clear measurement of a train horn sounding at the precise up board position however, and this has been used to determine the source sound power level.

At measurement position 2, (beside the footpath) background noise levels were significantly lower, which gave clearly audible train horn soundings from both whistle boards. This position has therefore been used for model verification.

There were 4 train events per hour (two trains on the up line, and two trains on the down line). All trains observed on this line were Class 377.

Key noise measurements are set out below:

- Train horn noise levels correspond to a maximum sound power level of L_{WA} = 126dB. (Sound power level is a measure of how loud the horn is, independent of where the noise level was measured. It can be used to calculate the sound pressure level at a specific distance. In this case, this corresponds to an A weighted sound pressure level of approximately 104 dB at 5m.)
- For the purposes of verifying the model, noise levels measured at position 2 were as follows:

Whistle Board	L_{AFmax} dB measured from horn sounding
Allcards up	65-73dB
Allcards down	58-72dB

Table 1: Noise levels measured at position 2

These noise levels (given in Table 1) can be used to verify the acoustic model – they should correspond reasonably with the noise levels predicted by the acoustic model. It is significant though that there is a large range of levels measured. This corresponds to the variation in operation of the horn, as discussed above. Therefore, there may be a high degree of variability between predicted and measured levels as well as between the model and noise levels regularly experienced by residents.

6. ACOUSTIC MODEL RESULTS

Acoustic models are attached in Appendices C and D. The whistle board positions are indicated with a red asterisk.

The acoustic models are a propagation model of the maximum noise level from any whistle board. As horn soundings will not occur at each board simultaneously, the model shows the highest noise level that could occur at any time a horn is sounded.

The propagation models for these boards is relatively complex. Near to the whistle boards, noise levels propagate evenly, reducing with distance. Further away, ground effects become more significant, particularly as the land slopes up towards then east, and down towards the west. This is as a result of the varying ground conditions (soft ground to the east of the railway line, with hard ground in the built up areas on the west).

As discussed in Section 4, the noise model is inevitably limited in its precision. However, to attempt to verify the model and get an indication of the precision of the model, noise levels measured at position 3 can be compared to the model's predicted levels at this location:

Whistle board	Measured noise level at Position 2 (L_{AFmax}, dB)	Model predicted noise level at Position 2 (L_{AFmax}, dB)
Allcards up	65-73	63
Allcards down	58-72	76

Table 2: Verification of measured levels with model predicted levels (bracketed figures are including cutting – see below)

7. CONCLUSIONS

Open site acoustic models have been produced, showing the extent of noise propagation from train horn soundings at whistle boards around the Allcards Crossing, in Horsham. The models are based on train horn noise levels measured during a survey in Horsham, and are based on a series of assumptions as set out in the report. Any acoustic model is always subject to limitations, and these limitations are also discussed elsewhere in this report.

In particular, a more precise method of characterising the train horn noise level and directivity pattern could be completed by measuring levels in a controlled setting. Such soundings could then be used in determining the noise models to ensure that such models are a clear worst case.

However, taking account of the assumptions and limitations discussed, these noise model maps represent the extent of noise propagation from horn soundings at the whistle boards and other locations detailed.

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