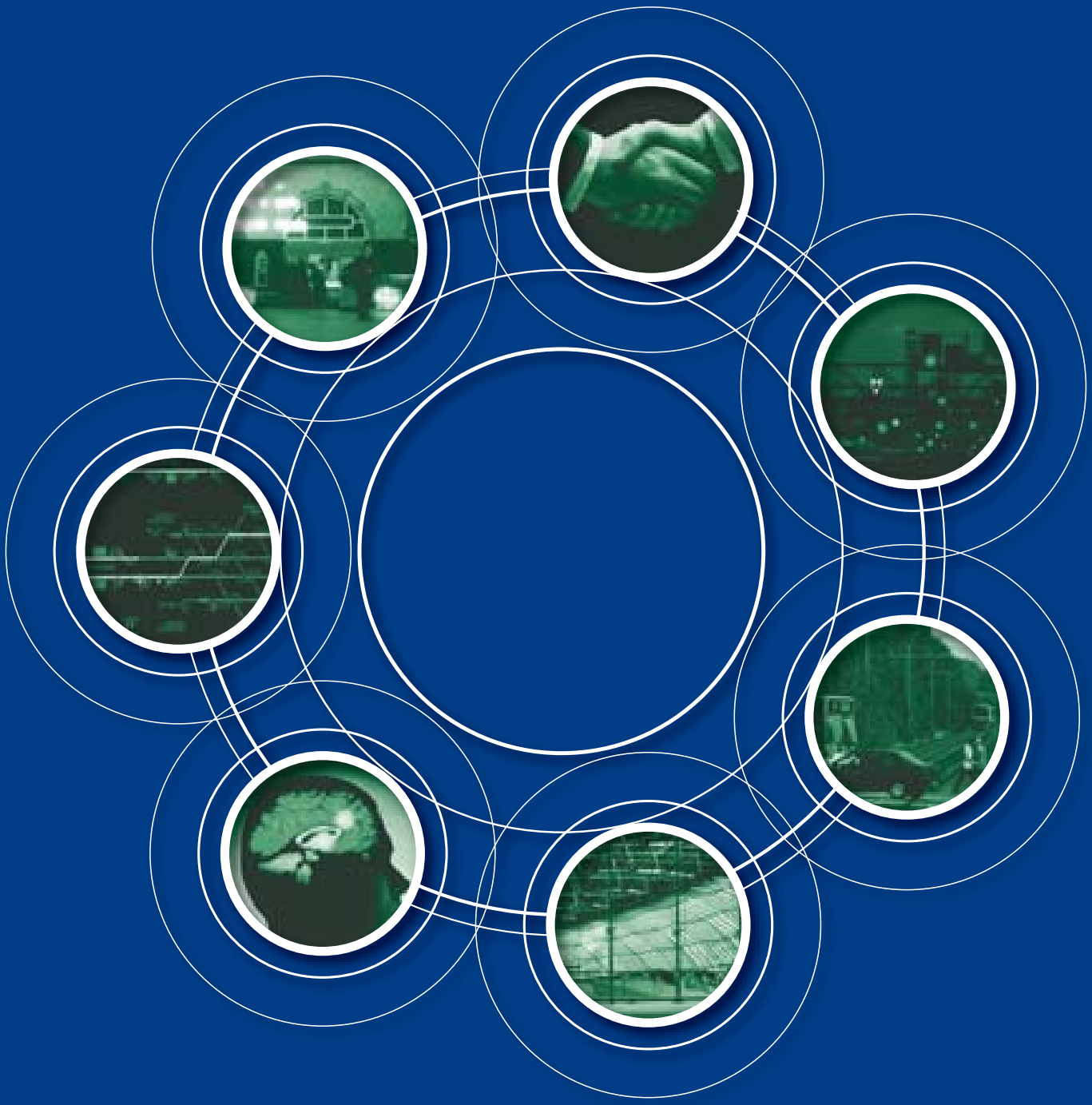
Rail Safety & Standards Board

Research Programme

Operations

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



Spectrum
ACOUSTIC CONSULTANTS

T680 - Train Horn Noise Mapping - Lingfield

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Issued By
N D Treby BEng(Hons) MIOA MAES
Senior Consultant

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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 Lingfield Station.

The RSSB has instructed Spectrum Acoustic Consultants Ltd to develop an acoustic model showing noise propagating from each of five 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 site in Lingfield. Following a survey to establish the typical noise level of the train horns, these 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

Lingfield is in Sussex, and the whistle boards are all near to Lingfield Station, approximately 10km east of Gatwick airport. An Ordnance Survey map of the area is given in Appendix A. Crossing locations are marked on the map given in Appendix B.

There are three rail crossings, each with whistle boards. The crossing and board locations as advised by the RSSB are as follows:

- Rushfords – to the north of the station, with no whistle board on the “up line” (towards London), but one whistle board on the “down line” (from London), 420m north of the crossing. Grid reference TQ392445.
- Park Farm – to the north of the station, with one whistle board on the up line 265m south of the crossing (at the northern end of the Station platform) and one whistle board on the down line. 265m north of the crossing. Grid reference TQ393441. However, in reality, the Park Farm Down Whistle Board is approximately 40m south of the Rushfords Crossing. Therefore the actual board position has been used in the acoustic modelling.
- Racecourse – to the immediate south of the station, with one whistle board on the up line 261m south of the crossing and one whistle board on the down line. 281m north of the crossing. Grid reference TQ394437. (In addition horn soundings occur at the southern end of Lingfield station platform – this is discussed in section 5 below.)

The main built up area of Lingfield is to the west of the railway line, with generally open fields to the east.

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 any 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 acoustic model is an "open site" model. Therefore, screening and reflection effects from buildings, barriers etc have been disregarded;
- Neutral meteorological conditions have been assumed (eg no wind, no temperature inversions etc), 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;
- 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 11th July 2006:

- Position 1: On the west side of the railway, 13m from the down line whistle board for the Racecourse crossing (Grid ref TQ393439).
- Position 2: On the west side of the railway, at the junction of Church Road, The Star Inn public house and the footpath (Grid ref TQ389437).

In addition, measurements were made on a subsequent visit to site on the east side of the railway on 28th July 2006:

- Position 3: On the east side of the railway, where Park Lane crosses the river (Grid ref TQ395441).

These measurement positions are marked on the map shown in Appendix B.

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 railway) train horn noise was clearly audible from soundings at the nearest whistle boards (the whistle board on the up line for the Park Farm Crossing, and on the down line for the Racecourse Crossing). In particular, the Racecourse down board, being so close to the measurement position gave a very clear noise level. However, during the survey there was only one sounding at this board, as trains stop in the station before passing the crossing. Soundings normally only occur at this board for through trains, not stopping at Lingfield Station, and are only a few such trains, which all occur in the morning and evening rush. In any event, the noise levels measured from the single sounding have been used as the source noise levels in the acoustic model, as it was a full sounding. Soundings at the other whistle boards were not clearly audible or measurable above existing background noise levels at this position.

As well as soundings at the indicated whistle boards, trains that were on the down line, stopping at Lingfield Station additionally sounded their horn before departing from Lingfield Station, and heading over the Racecourse crossing. There is no whistle board at this position, but soundings regularly occurred nonetheless.

At measurement position 2, (beside the Star Inn) train horn noise was not clearly audible. During the survey, though soundings were faintly noticeable, higher levels of background noise (from the roads, as well as some localised construction work) masked train horn soundings such that clear measurements could not be recorded.

Therefore, additional noise measurements were recorded on the east side of the railway at position 3. At this position, train horn soundings from the whistle boards were clearly audible, particularly from the closer whistle boards – Park Farm Up and Racecourse Down.

The proximity of Gatwick airport meant that regularly, during both surveys aircraft were passing low overhead. Such events happened approximately every two minutes, with aircraft heading towards the airport as part of the normal flight path. Planes therefore passed directly overhead, at relatively low altitude, giving high maximum noise levels. These occurred approximately every two minutes, much more frequently than trains – 4 events per hour (two trains on the up line, and two trains on the down line). Subjectively, noise levels in this area were more characterised by aircraft noise, than by the railway. All trains observed on this line were Class 377.

Key noise measurements are set out below:

- Train horn noise levels correspond to a maximum A-weighted sound power level (L_{WA})= 130dB. (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 108 dB at 5m.)
- For the purposes of verifying the model, train horn soundings at the nearest whistle boards to position 3, when measured at position 3 were of the following magnitude:

Whistle Board	L_{AFmax} dB measured at position 3 from horn sounding
Rushfords down	Not clearly audible
Park Farm up	62
Park Farm down	54
Racecourse up	56
Racecourse down	53

Table 1: Noise levels measured at position 3

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 on the sites, and the calculation of the train horn sound power is based only on a few events. 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, D, E, F G and H. Source positions have been grouped together following discussions with the RSSB.

Noise from the Rushfords Down whistle board has been modelled individually. Appendix C shows the noise impact of a horn sounding at this board on the whole area, and Appendix D is focussed on showing more detail on a smaller scale (1.5 km by 1.5 km).

The Rushfords Down board is away from built up areas, and the ground on all sides is soft ground, with no height variation. Therefore, the models show train horn noise evenly propagating in all directions.

Noise from the Racecourse Up whistle board has also been modelled individually. These models are shown in Appendix E and F.

Noise from the Park Farm and Racecourse Down whistle boards (three boards in all) have been modelled together, along with the additional sounding at the station on the down line. These models are included as Appendix G and H.

The propagation models for these boards are more complex. 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).

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.

As discussed in Section 4, the acoustic 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 3 (L_{AFmax}, dB)	Model predicted noise level at Position 3 (L_{AFmax}, dB)
Rushfords down	Not clearly audible	-
Park Farm up	62	63 (63)
Park Farm down	54	58 (58)
Racecourse up	56	57 (57)
Racecourse down	53	65 (51)

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

Generally, the model shows a good correlation with the measured level.

The Ordnance Survey map shows the Racecourse down board to be located in a cutting and so will be screened from the receiver position. As the cutting is not deep enough to register OS contour heights, this cutting is not modelled. Nonetheless, running the model with an estimate of the cutting performance shows the model be 2 dB away from the measured level.

7. CONCLUSIONS

Open site acoustic models have been produced, showing the extent of noise propagation from train horn soundings at whistle boards around Lingfield Station. The models are based on train horn noise levels measured during a survey in Lingfield, 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.

Rail Safety and Standards Board Evergreen House 160 Euston Road London NW1 2DX
Reception Telephone +44 (0)20 7904 7777 Facsimile +44 (0)20 7904 7791
www.rssb.co.uk