Proceedings of The Institute of Acoustics

CONTROL OF NOISE FROM HEAVY GOODS VEHICLES

1.J Anoni,2. M Michael,3. J Roberts,4. M Vuillermoz

South Bank Polytechnic, London SE1 0AA

INTRODUCTION

Within the London area heavy goods vehicles make a considerable contribution to the general noise environment and are especially intrusive at night time when people are attempting to sleep. Indeed road traffic noise is probably today's most widespread source of noise pollution and fortunately much can be done using present technology to reduce the noise levels emitted by existing lorries. In an attempt to reduce noise nuisance the Greater London Council introduced a night-time (2100 hrs to 0700 hrs) and weekend ban on heavy goods vehicles exceeding 16.5 tonnes gross weight on roads in the Greater London Area which came into effect on 31 January 1986. A survey carried out by the GLC showed however that a blanket restriction could harm industry within London, so the GLC considered it necessary to institute a licencing system for certain vehicles. For vehicles which have a maximum permissible weight of between 7.5 and 16.5 tonnes, the GLC is implementing the EEC Council Directives (2) on noise emission limits current at the time of manufacture before issuing special permits which allow access to London during the time periods mentioned above. In addition it set out to find ways in which lorry noise could be reduced to meet the EEC Directive and so gain access but without incurring significant extra cost.

As part of this programme the South Bank Polytechnic was commissioned to carry out drive-by noise tests on a selection of lorry tractor units and to design 'hush-kits' to be fitted to the vehicles to reduce the noise emission. This paper considers the results of some of this work.

MEASUREMENTS

All measurements of the drive-by noise were carried out in accordance with standard practice (2) and (3). This entailed the simultaneous measurement of the linear and dB(A) sound levels, which were recorded on magnetic tape on site. Octave band analysis was performed on the recorded data later under laboratory conditions.

The drive-by noise of each lorry was recorded without any secondary acoustic treatment, and then compared with results obtained with the 'hush kit' fitted.

The lorry was driven steadily at pre-determined engine speed in accordance with the EEC Council Directive, and then accelerated over a 20m distance. The drive-by noise was measured on both sides of the lorry.

CONTROL OF NOISE FROM HEAVY GOODS VEHICLES

'HUSH KIT' PACKAGE

The kits developed consisted basically of side panels which were bolted between the top of the chassis and bottom of the cab on each side of the engine, with acoustic absorbent added to the underside of the cab, all in such a manner as to minimise potential interference with vehicles maintenance.

The actual shape of the side panels depended on the lorry, but were made of 6mm thick 16 swg mild steel plate covered with acoustic absorbent type "Salex Acoustic Barrier Material MS5".

RESULTS

The drive-by noise levels of four different lorry tractor units were measured. A and B were British made, C and D were German. Examples of the results of the octave band analysis on the four lorries before and after acoustic treatment are given in figures 1 to 4.

VEHICLE A (See Fig 1)

The vehicle tested was two years old and met the EEC Directive criteria. The major noise was in the 1kHz octave band and below.

The silencer fitted by the manufacturer was most effective in suppressing the low frequency "throbbing" noise which is common to so many diesel heavy goods vehicles. The underside of the cab adjacent to the engine was lined with "Salex Acoustic Barrier Material MS5" and the side panels were fitted to the top of the chassis on either side of the engine. The reduction in the noise level was between 1dB(A) and 2.5dB(A).

VEHICLE B (See Fig 2)

This vehicle as delivered was brand new and met the specifications contained in the EEC directive for 'vehicles intended for the carriage of goods, having an engine power equal to or exceeding 147Kw and a permissible mass exceeding 12 tonnes". The peak in the spectrum at 125Hz was very noticeable, giving the overall sound a most distinctive low frequency throbbing character and in our opinion determining the noise nuisance of the vehicle. This vehicle was treated acoustically as Vehicle A which reduced the noise level by between 1dB(A) and 2dB(A).

The low frequency exhaust noise was subjectively distinctly noticeable even though it does not contribute significantly to the measured overall dB(A) level.

CONTROL OF NOISE FROM HEAVY GOODS VEHICLES

VEHICLE C (See Fig 3)

This vehicle as delivered just met the 88dB(A) criterion. A large proportion of the noise existed in the 2kHz octave band and below. The acoustic treatment as in the previous cases reduced the noise level by between 1dB(A) and 2dB(A).

VEHICLE D (See Fig 4)

The analysis of this lorry's drive-by noise without any modifications revealed that most of the noise is centred in the 63 and 125 Hz octave bands with the peak spectrum at 125Hz. This vehicle as delivered was brand new. The treatment improved the noise level by between 1dB(A) and 1.5dB(A).

CONCLUSION

The results show that the addition of side panels to the lorry chassis and the underside of the cab signiticantly reduced the overall noise level. Most of the vehicles met the EEC Directive criteria when delivered and Vehicle A was especially quiet.

Vehicle A carries a silencer which reduced the 125Hz octave band sound pressure level output to less than 70dB, while Vehicle B, C and D produced over 90dB in the same octave band, which indicate that their exhaust systems were far from optimum. This shows the capacity for vehicle manufacturers to meet stringent noise criteria if sufficient attention is paid to noise considerations at the design stage. These newer HGV's make up to 20 per cent of the vehicles between 7.5 and 16.5 tonnes driving in London. But unfortunately some manufacturers are still failing to apply available technologies to reduce noise levels. Vehicles B, C and D are cases in point where the major source of the annoying noise was due to an insufficiently sized exhaust silencer. There is a strong indication that the GLC will at sometime in the future, if not abolished, reduce the 88dB(A) limit to 85dB(A). Our measurements show that only one vehicle with a 'hush kit' added meets this stringent criterion.

It is likely that the 'hush kit' packages will be used in the main for older vehicles. Vehicles up to 4 or 5 years old are found to make up about half the HGV fleets in the GLC area. When new, such vehicles might have met the criteria for the earlier EEC test procedures 77/212 but would probably now require acoustic treatment to meet the current procedure EEC 81/334.

Vehicles up to 10 years old may not have had to meet any noise emission regulations when they were manufactured and would almost certainly require treatment. The limited attenuation provided by the simple packages described above would not be expected to provide sufficient noise reduction in all cases, and fleet operators may need to select vehicles for use during this 'ban' period. It would be economically useful and socially desirable to monitor the progress of the GLC 'ban' to provide information on the value and effectiveness of the measures described here.

CONTROL OF NOISE FROM HEAVY GOODS VEHICLES

The drive-by tests of the noise emission from some heavy goods vehicles (results not included here) showed that the exhaust noise was subjectively important, but with certain vehicles - even new ones - the exhaust noise was so pronounced as to be the major factor determining the level of annoyance. In some cases the noise level from the exhaust gave a pronounced peak in a low octave band at least 12dB greater than any other part of the sound spectrum.

THE 'A' WEIGHTING NETWORK

The use of the 'A', 'B' and 'C' standard weighting networks stems from the research carried out by Robinson and Dadson (4) into the subjective effects of loudness. The 'A' scale is intended for use in measuring sound pressures below 55dB and the filtering approximates to the 40 phone equal loudness contour. This has a flatter response except at the two extremes of the frequency range. The inference to be drawn is that at higher sound levels the use of the 'A' scale is not appropriate and that the 'C' scale should be used instead. Furthermore, because the response of the 'C' weighting network is approximately flat it can be said that at high levels, measurements made using a liner response would be preferable to 'A' weighting.

The unit specified in the EEC Directive is dB(A). Unfortunately the sound levels measured during the tests were in the region of 90dB re 2×10^{-5} Pa where use of the 'C' scale or linear response is more appropriate. Thus vehicles which emitted a distinctly annoying low frequency tonal throb gave dB(A) readings less than those required by the EEC Directive.

One of the conclusions of this paper is that the dB(A) unit may not be the most appropriate for this type of measurement and that further investigation is required.

REFERENCES:

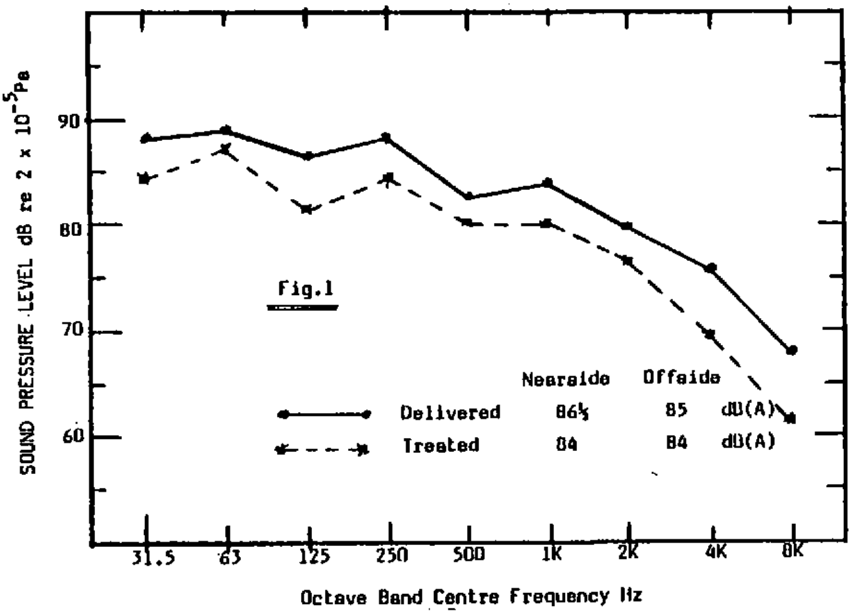
1. Night-time and Weekend Ban, Prog. Ref T22, T40 GLC (1984)

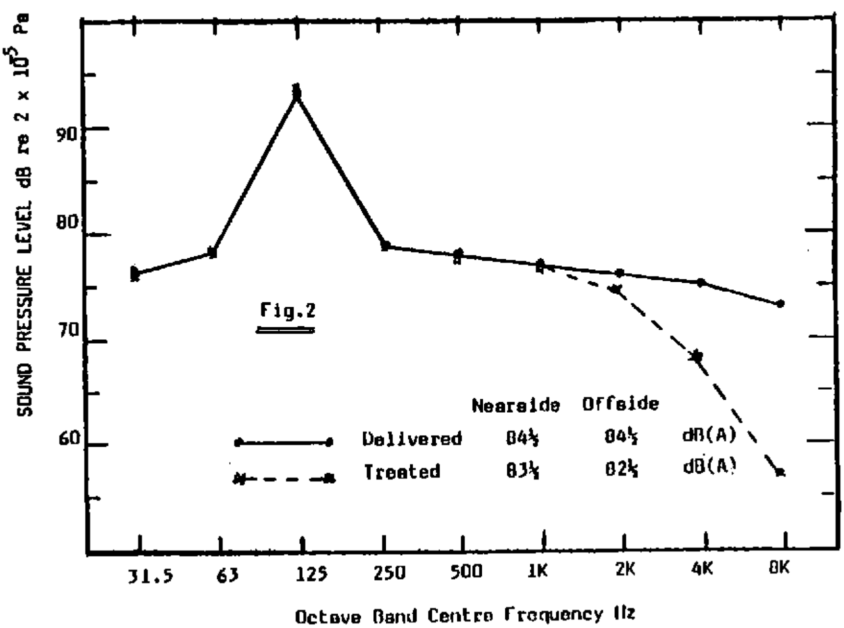
2. EEC Council Directive 81/334

3. ISO R364: 1964

4. D W Robinson & R S Dadson: "A Re-determination of the Equal-Loudness Relations for Pure Tonnes", BJAP, Vol 7, 166-181, (1956)

CONTROL OF NOISE FROM HEAVY GOODS VEHICLES





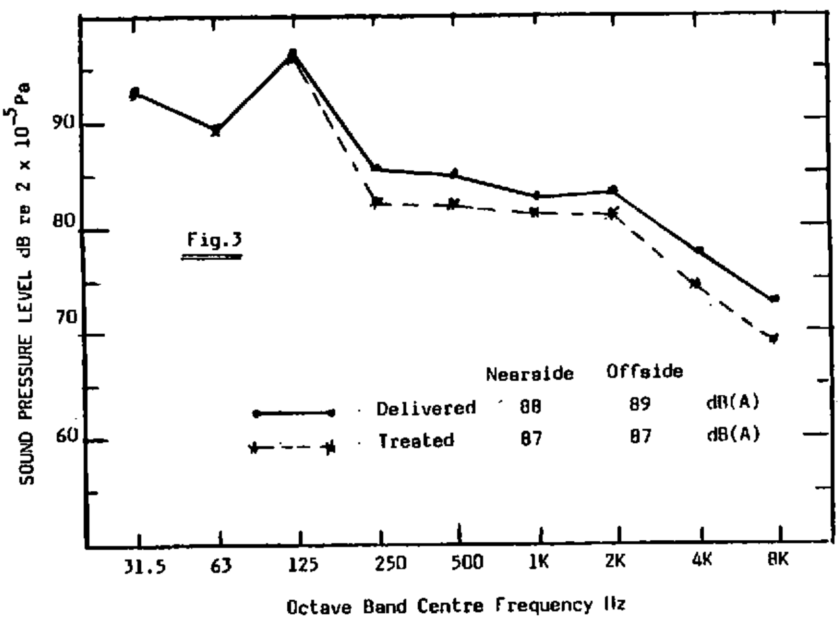


Fig.3
SOUND PRESSURE LEVEL dB re 2 x 10^{-5} Pa
90
80
70
60
Nearside
Offside
Delivered
88
89
dB(A)
Treated
87
87
dB(A)
31.5
63
125
250
500
1K
2K
4K
8K
Octave Band Centre Frequency Hz

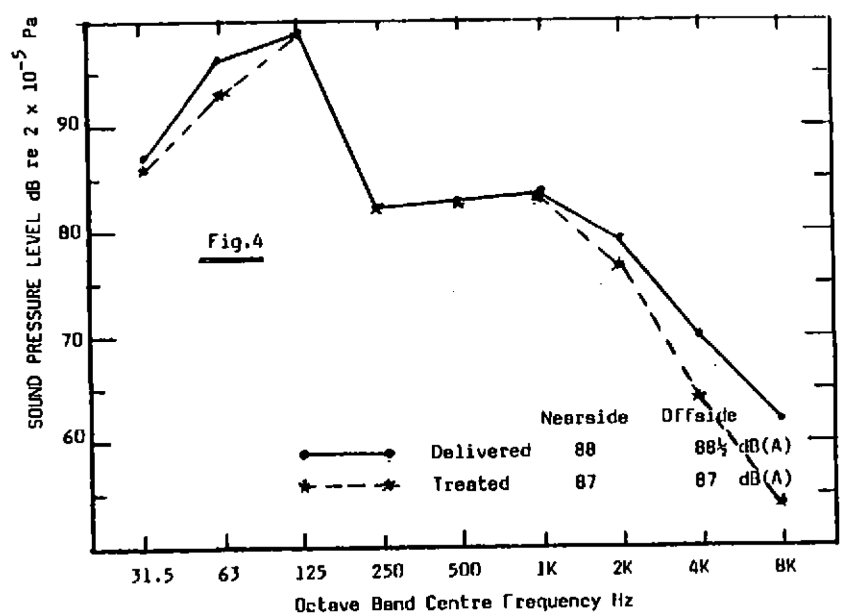


Fig.4
SOUND PRESSURE LEVEL dB re 2 x 10^{-5} Pa
90
80
70
60
Nearside
Offside
Delivered
88
88½ dB(A)
Treated
87
87 dB(A)
31.5
63
125
250
500
1K
2K
4K
8K
Octave Band Centre Frequency Hz