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NOISE AND LOUDNESS EVALUATION

Noise and the Lorry Driver

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1. Introduction

In spite of the fact the data on the incidence of dangerous industrial noise have been collected (rather sporadically) for nearly half a century, one area in which information is distinctly sparse is that of noise exposure in transport. Such little data as is available suggests cab levels in commercial road vehicles in the 80 to 100 dB(A) region, while our own measurements in passenger cars (1) (and trains) have shown a wide incidence of intense infrasound in various forms of travel.

It is well established (2) that exposure to intense noise causes damage to hearing, and there is some evidence that noise can affect task performance (particularly vigilance tasks)(3) in a way which could have an influence on road safety. Work on the effects of infrasound has shown that some individuals may experience balance disturbance, again suggesting an increased risk of accident.(4)

The research to be presented here comprises a small, but in the authors' opinion representative, study of noise levels in a range of lorry cab interiors, since the study aimed to provide as good a picture as possible of the noise hazard; all tests included measurements of not only dB(A) and dB linear levels, but also octave bands from 4 Hz centre frequency upwards.

2. Instrumentation

A low frequency measuring system using a frequency modulator, sound level meter and tape recorder was used for measurements up to 1 kHz, and a direct measurement using only a sound level meter, was used for higher frequencies. The tape was played back in real time, using a demodulator and low frequency analyser. Because of the fluctuations which occurred in the low frequency sound, and the considerable amount of data to be analysed, a B and K level recorder was used to record the output of the system. The level recorder was operated at a slow writing speed to 'average' the fluctuations and the lowest frequency limiting of 2 Hz enabled the octave centre frequency of 4 Hz to be recorded without attenuation.

3. Results

Spectra shown in Figure 1 are typical of those obtained in new and older vehicles. The new vehicles are, in general, quieter than the older vehicles, averaging about 84 dB(A) compared with 88.5 dB(A). The distribution of the spectra shows convergence in the infrasonic

region whilst the 'audible' region shows a much wider spread in the noise levels, suggesting that the low frequency infrasound is less affected by the design difference and condition of the vehicle. The conditions of the road surface is one parameter influencing cab interior noise. Driving a vehicle at 30 mph over a road surface which changes from smooth tarmac to rough cobbles produce a maximum increase in sound pressure level of 13 dB at 63 Hz. Opening the window 1 inch on the driver's side of the cab whilst the vehicle travelled at 50 mph produced considerable increases in the low frequency sound pressure levels. The maximum measured increase being approximately 9 dB at 4 Hz, whilst the overall sound level increased from 112 dB, 85 dB(A) to 118.5 dB, 85.6 dB(A).

Opening the window of older vehicles produces less effect than in the newer vehicles, probably due to disturbance of door seals, grommets and ventilators of older vehicles with usage allowing an air flow into the cabin.

Figure 2 compares the spectra obtained in the driving and coasting condition and suggests that even with the engine switched off the driver is exposed to high levels of infrasound, and noise in excess of 82.5 dB(A). For this test the vehicle, fully ladened, was accelerated in top gear to a speed of 50 mph down a steady incline and the engine was then switched off with the gear in neutral. The heavy load, giving a gross vehicle weight of 32 tons, made it possible to maintain a constant speed of 50 mph for 1¼ minutes.

The general shape of all the spectra obtained are similar, falling from over 100 dB in the octave centred at 2 Hz down to 80 dB in the octave centred at 1 kHz.

4. The Hazard to Hearing

The measurements in heavy goods vehicles operating under normal motorway conditions showed that the cab interior noise could be between 79 dB(A) and 92 dB(A) depending on a number of factors among them being, lorry age, total mileage logged, acoustic treatment and road surface. Under current UK regulations a solo driver may drive continuously for 5½ hours, and with a co-driver he can be travelling in the cab for a period of up to 14 hours. Figure 3 shows that for a continuous exposure of 5½ hours the noise level should not exceed 92 dB (A) and for 14 hours the acceptable level is reduced to 87 dB(A). There is no doubt, therefore, that some drivers are exposed to noise, which, over their normal working day, carries with it a hearing damage risk.

5. The Hazards of Infrasound

The results also indicate that large differences exist between measurements on the 'linear' and 'A' weighted sclaes of a sound level meter. Examination ~~of Figure~~ of Figure 1 shows that the difference between the two scales averages at about 20 dB and suggests, therefore, that there is considerable energy in the low frequency region. This low frequency, defined as infrasound for frequencies below 20 Hz, is the major component of the sound pressure levels in the cabs. Although little is known of the auditory hazards of infrasound, research is being carried out at two main centres in this country and the results of their experiments suggests that the infrasound in motor vehicles, by its effect on balance and concentration, may represent a hazard to road safety.

6. Conclusions

Details of typical results obtained in cabs of heavy goods vehicles have been shown and the work has added to the pool of knowledge available on commercial vehicle noise.

Although older vehicles are, predictably, noisier than those which have been in service for a shorter time, the low frequency sound in the octave bands centred at 4 Hz, 8 Hz and 16 Hz showed similarity in all vehicles. The shape of the spectra follows a general pattern falling from above 100 dB at the lowest frequency of 4 Hz down to 70 dB in the audible range.

A number of operating parameters influence the noise levels, among them being; the effect of opening the window, road surface, road speed and engine running condition. This paper does not attempt to identify the various sources of vehicle noise but shows that under normal operating conditions drivers are exposed to noise levels, subaudible and audible, which, is sustained for long periods, may endanger hearing and reduce road safety.

7. References.

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2) W Burns and D W Robinson, "Hearing and Noise in Industry" H M S O (1970)

3) D H Holding, Editor. "Experimental Psychology in Industry" Penguin Books (1969)

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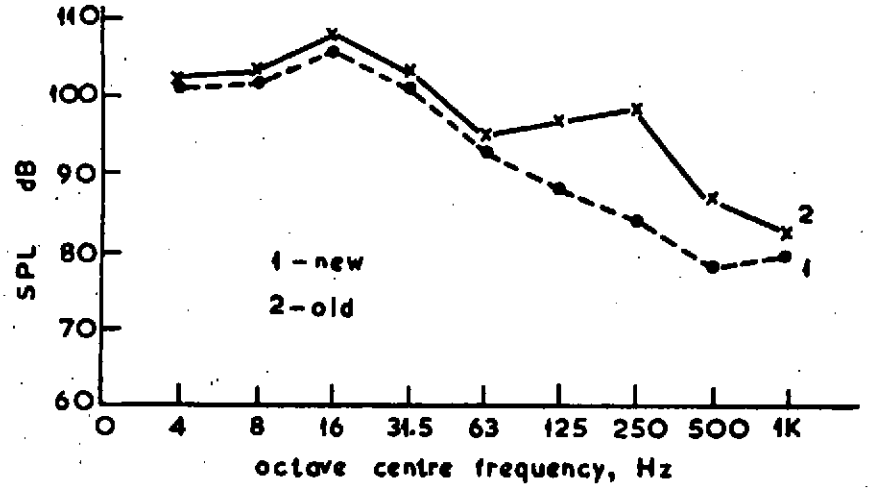

Fig. 1 Comparison of spectra obtained in new and old vehicles

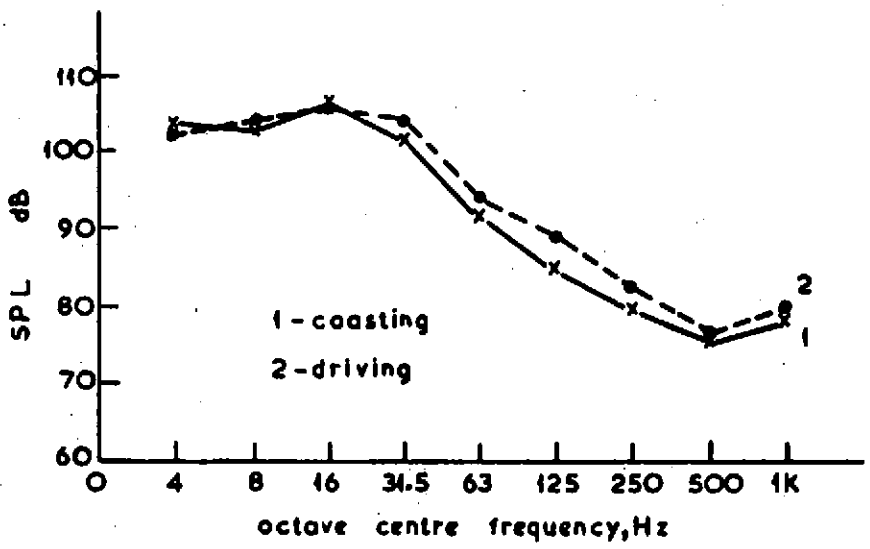

Fig. 2 Coasting and driving noise in cabs. Vehicle speed 50 m p h

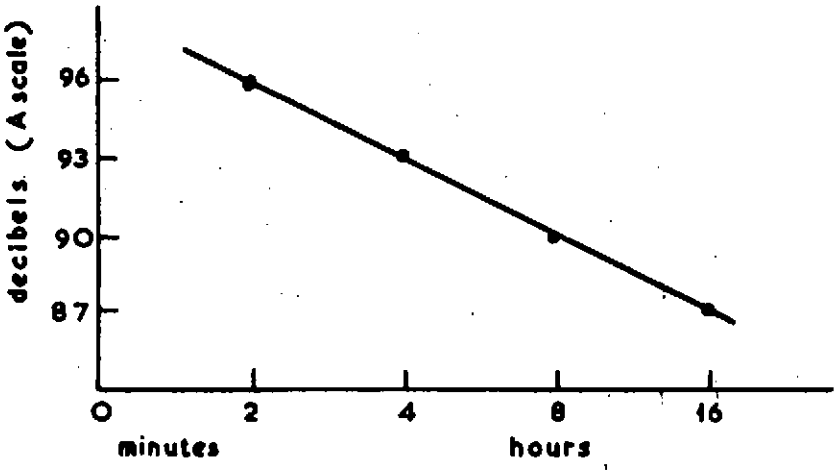

Fig. 3 Maximum permitted daily exposure.