

Tyre-Road Noise of New and Retreaded Truck Tyres

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Abstract

The measurement of tyre noise emissions is part of the Regulation 2001/43/EC and part of the ECE Regulation 117; the latter came into force in the year 2005. For truck tyres (and passenger car tyres as well) the tyre noise test is carried out as a pass by test with a (loaded) truck equipped with 4 equal (test) tyres with a velocity between 60 km/h and 80 km/h. The measured noise values have to be calculated back to a velocity of 70 km/h and this calculated value is reduced by one dB(A) (measuring uncertainties) and must be lower than a limit value which is different for different tyre types.

About half of the trucks in Germany are equipped with retreaded tyres, mainly on the drive and towed axles. Retreaded tyres are not part of the regulations mentioned above. One aim of the investigation was to look if retreaded HGV tyres should be incorporated into the regulation.

In connection with the German retreaders organisation (BRV) two retreading companies provided BAST with HGV tyres:

- Ihle: 24 sets (18 sets hot retreaded and 6 sets cold retreaded) of HGV tyres (IHL)
- Bandag: 10 sets of cold retreaded HGV tyres (BAN)
- Reference: 5 sets of comparable new HGV tyres

The tyres were built on carcasses of different manufacturers with different profiles for the different axle positions (steering-, drive- and towed axles). The test truck was a IVECO Stralis tractor with additional load on the fifth wheel. The test track was the testing ground of BAST in Sperenberg (surface according ISO 10844). The tests were carried out by Müller BBM in order of BAST.

- All tyres fulfilled the requirements of the Regulation 2001/43EC.
- Tyre noise emissions are very different for the different profiles.
- Tyres with the same profile but different carcasses used before retreading had nearly the same tyre noise emissions.
- The differences of tyres for the same purpose (axle position) of different manufacturers with different profile designs vary 2-3 dB(A).
- Retreaded tyres were not louder but sometimes more silent than comparable new tyres.
- The noise emission values of all (retreaded and new) test tyres fell far below the limit values of the Regulation 2001/43EC, e.g. tyres with steering axle profile minus 3 to minus 6 dB(A).
- Compared to 70km/h the tyre road noise is about +2 dB(A) louder at 80 km/h.
- No difference was found between cold and hot retreaded tyres.

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1. Introduction

In Europe about 45% of all goods are transported on roads. In Germany about 360 Bill. tkm cargo is transported by trucks (70%) and the annual increase amounts to about 2,5% per year. About 70% is transported via the federal trunk road network. The share of Heavy Good Vehicles (HGV) > 3,5 t on motorways amounts to 15% in average, but can reach on some motorways up to 25 % [1]. Truck traffic is taking place day and night and is annoying for the population living beside motorways during night (sleeping) time. The noise emission of a truck moving at 80 km/h is about 3 dB(A) louder than a passenger car moving at 120 km/h. Figure 1 shows as example the traffic on one measuring site at the motorway A8 vs. time of day and figure 2 shows the calculated noise emissions from that traffic at a 25 m distance. The noise of trucks is dominant between 2 and 6 o'clock in the night.

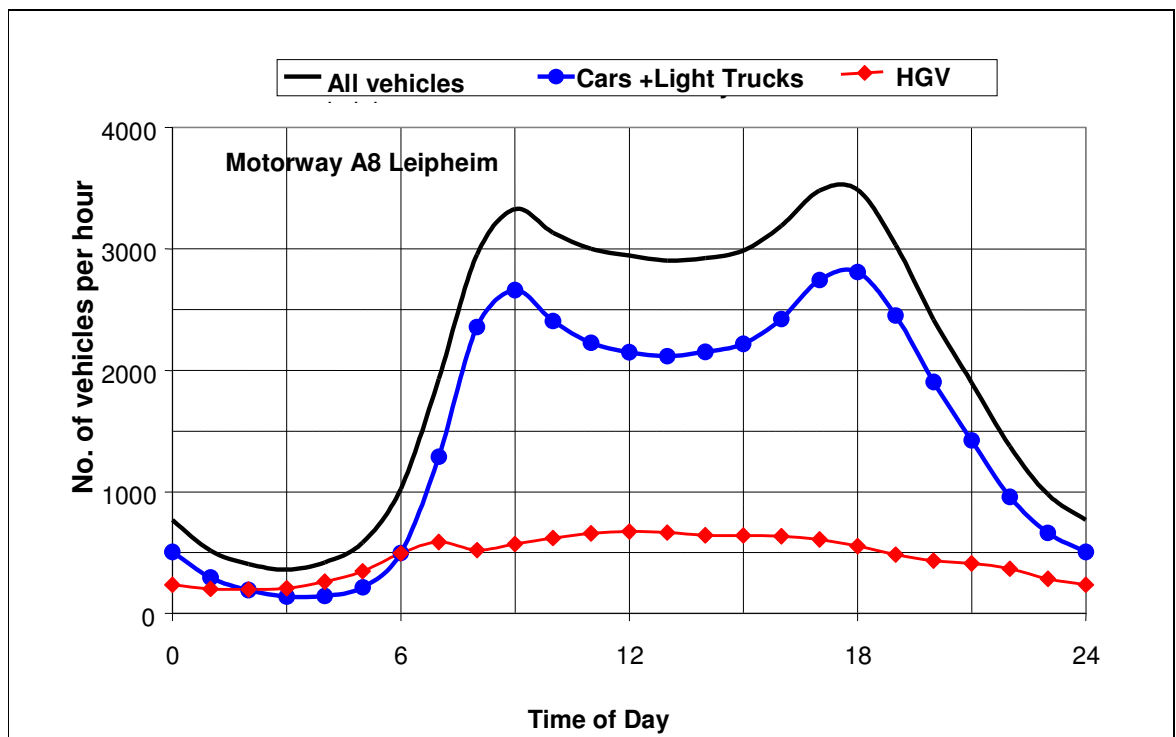


Fig.1: Motorway Traffic vs. Time of Day

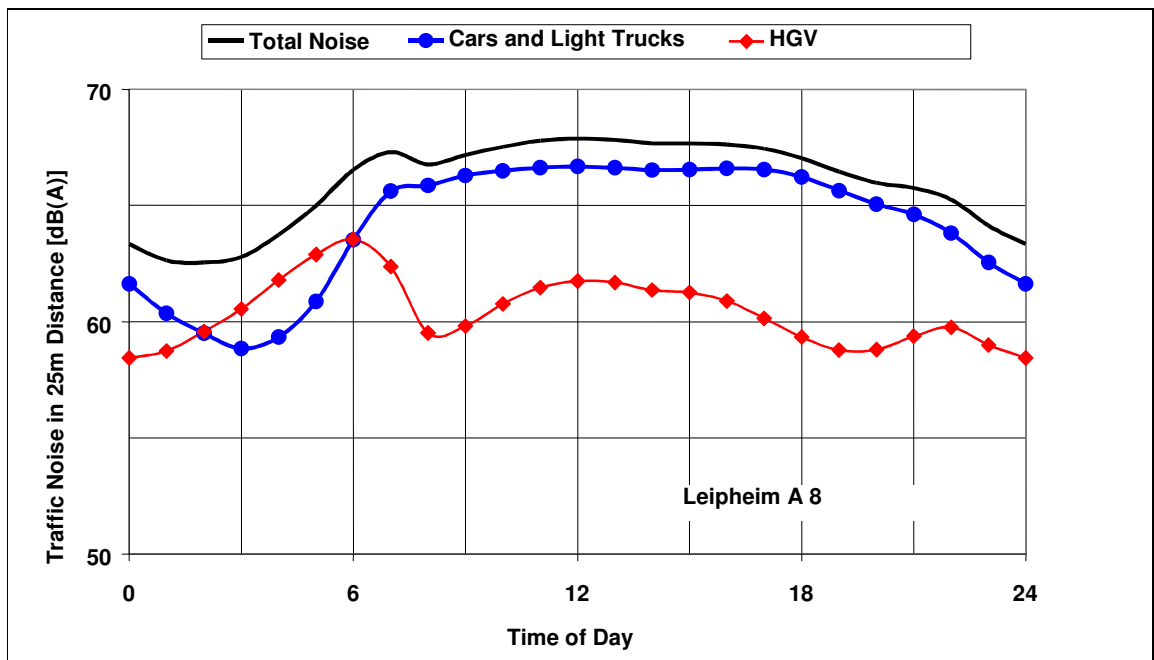


Fig.2: Calculated Traffic Noise in 25 m Distance vs. Time of Day

This was the reason to initiate research work on truck tyre noise emissions. Because half of the trucks in Germany are equipped with retreaded tyres the study includes new and retreaded tyres.

Truck-trailer combinations and tractor–semitrailer combinations as well have different tyre sizes and profiles for the different axles. The tyres can be distinguished in tyres for steering axles, tyres for drive axles and tyres for towed axles. Steering axle and the wider towed axle tyres have in most cases a longitudinal profile; drive axle tyres have rib profiles for traction purposes. Drive axle tyres are in general 3-5 dB(A) louder than the other tyres. This can be heard if a truck passes by. Figure 3 shows as example a coast-by test with a truck at 80 km/h and a standard microphone position of 7,5 m from the centreline of the truck. The first peak shows the noise of the steering axle tyres passing the microphone, the second peak after 0,16 sec is the drive axle tyre noise (same tyre type used in the test).

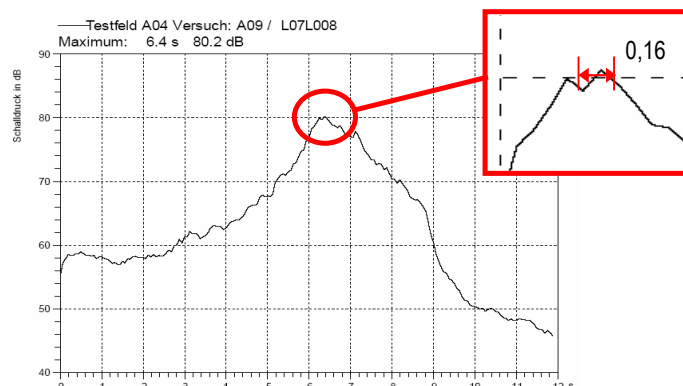


Fig. 3: Coast-By Noise Measurement of a Truck at 80 km/h

2. Measuring Program

In connection with the German retreaders organisation two retreading companies provided BAST with HGV tyres:

- 24 sets (18 sets hot retreaded and 6 sets cold retreaded¹) of HGV tyres (Ihle)
- 10 sets of cold retreaded HGV tyres (Bandag)
- 5 sets of comparable new HGV tyres as reference

The tyres were built on carcasses of different manufacturers with the different profiles for the different axle positions (steering-, drive- and towed axles). The test truck was a IVECO Stralis tractor with an additional load on the fifth wheel to ensure the required axle load distribution of 14% for the steering axle and 86% for the drive axle, see Fig 4. The axle distance was 3,6m (required: <5m). The test track was an ISO surface (according ISO 10844) laid at the testing ground of BAST in Sperenberg. The tests were carried out according regulation 2001/43EC by Müller BBM in order of BAST.



Fig 4: Test Vehicle, Iveco Stralis with Additional Load on the 5th Wheel

The test velocity was 60-80 km/h and the measuring values were recalculated to 70 km/h. According to the regulation the measuring values (L_{Amax}) were rounded down to the next integer value and 1 dB(A) must be subtracted for measuring uncertainties. This value (type approval value: L_R) has to be lower than the limit value specified for each tyre type.

3. Measuring Results

The legal limit value for steering axle tyres amounts to 76 dB(A). After the reducing procedure described above the new tyre has a noise emission value (L_R in Fig. 5,6,7) of 71 dB(A), which is 5 dB(A) below the limit value. The hot retreaded (Ihle) tyres - which were build on carcasses of different manufacturers – vary between 71 and 72 dB(A), which is also far below the limit value, see figure 5.

¹ „Hot retreaded“ means that the profile is pressed into the hot rubber material in the vulcanisation process.
„Cold retreaded“ means the vulcanisation of a prefabricated profiled rubber band on the carcass.

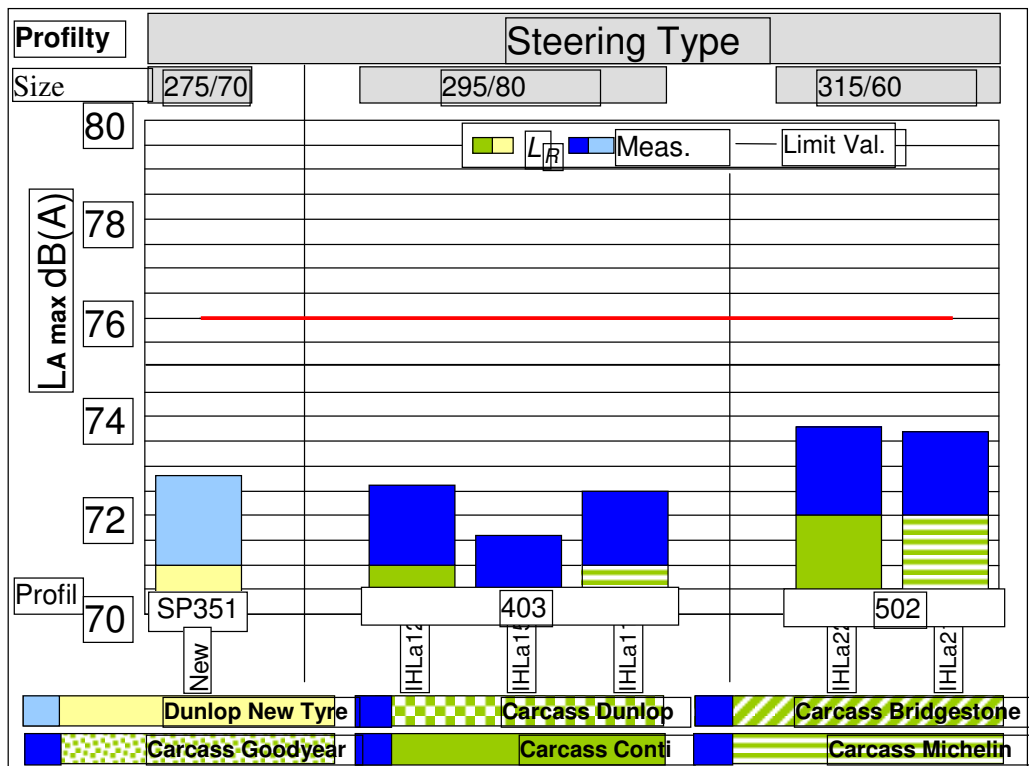


Fig. 5: Tyre Noise, Steering Axle Tyres on Different Carcasses, Hot Retreaded (new left)

The drive axle tyre noise results of the hot retreaded tyres are shown in Figure 6. There are also only small differences if the same profiles are realised on the tyres with different carcasses. The type approval values are 0-3 dB(A) below the limit values and retreaded tyres have noise emission values which were lower or as high as new tyres.

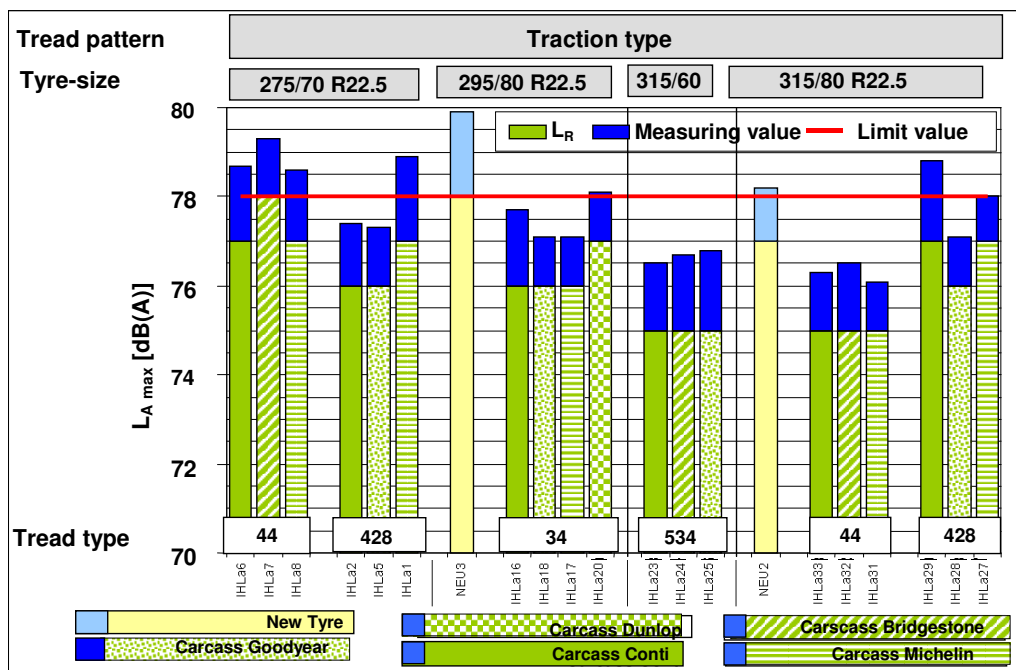


Fig. 6: Tyre Noise, Drive Axle Tyres on Different Carcasses, Hot Retreaded

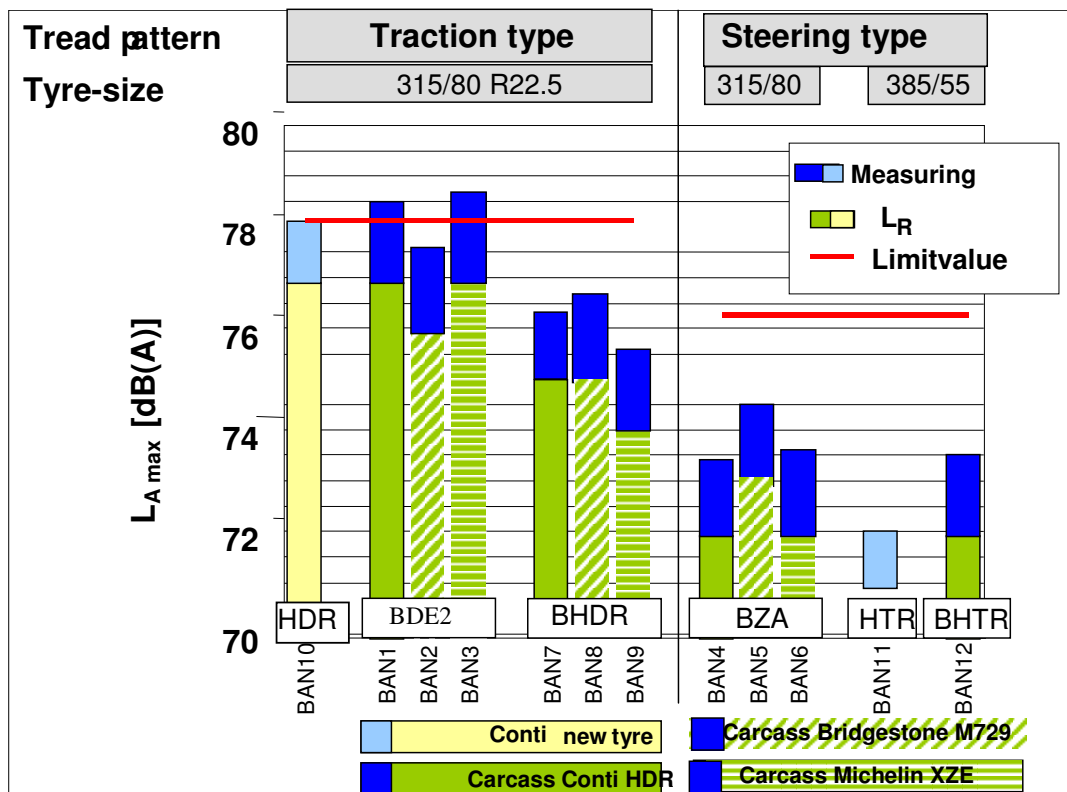


Fig.7: Tyre Noise, Cold Retreaded Tyres: Steering, Drive (315) and Towed Axle Profile (385)

The same statements made for hot retreaded tyres are valid for the cold retreaded tyres, see figure 7. The increase of tyre noise for truck tyres amounts to about 2 dB(A) per 10 km/h, see figure 8. So a truck which was measured in 7,5 m distance at 70 km/h with 74 dB(A) has a noise emission of 76 dB(A) when driving its usual speed of 80 km/h, see figure 8.

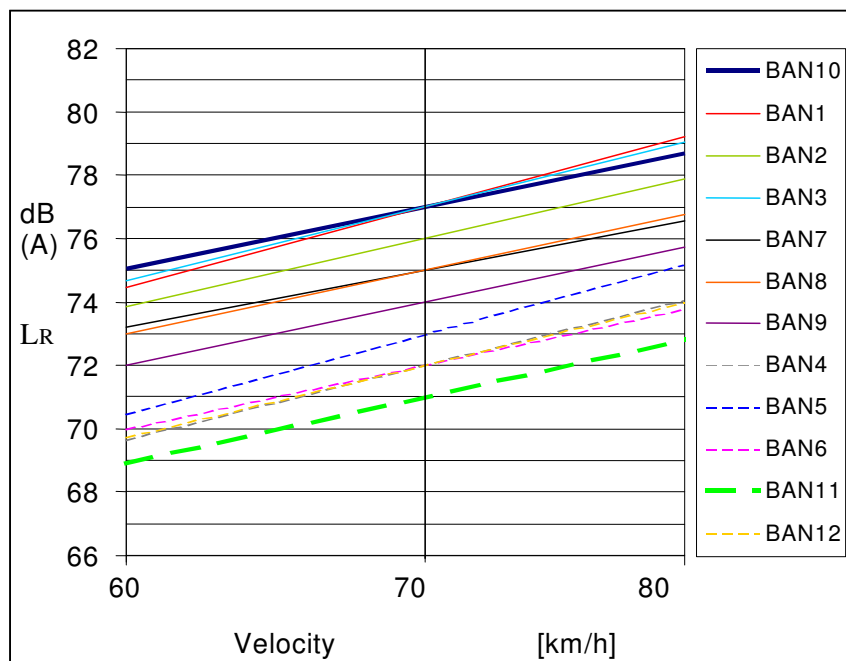


Fig. 8: Tyre Noise vs. Velocity, Cold Retreaded Tyres (Regression from 8 single tests)

4. Other Noise Emission Tests

In 2004 M+P in order of DWW (NL) measured several new truck tyres also according to the above mentioned regulation 2001/43 EC at the test site of BAST in Sperenberg on the same standardised road surface (ISO 10844) where the retreaded tyres were tested [4]. The noise measuring results of the different (new and worn) tyres for the different axle positions are shown in figure 9. In this investigation the steering axle tyres are also far below the legal limit values (minus 5-6 dB(A)) and they are nearly as silent as a non profiled tyre.

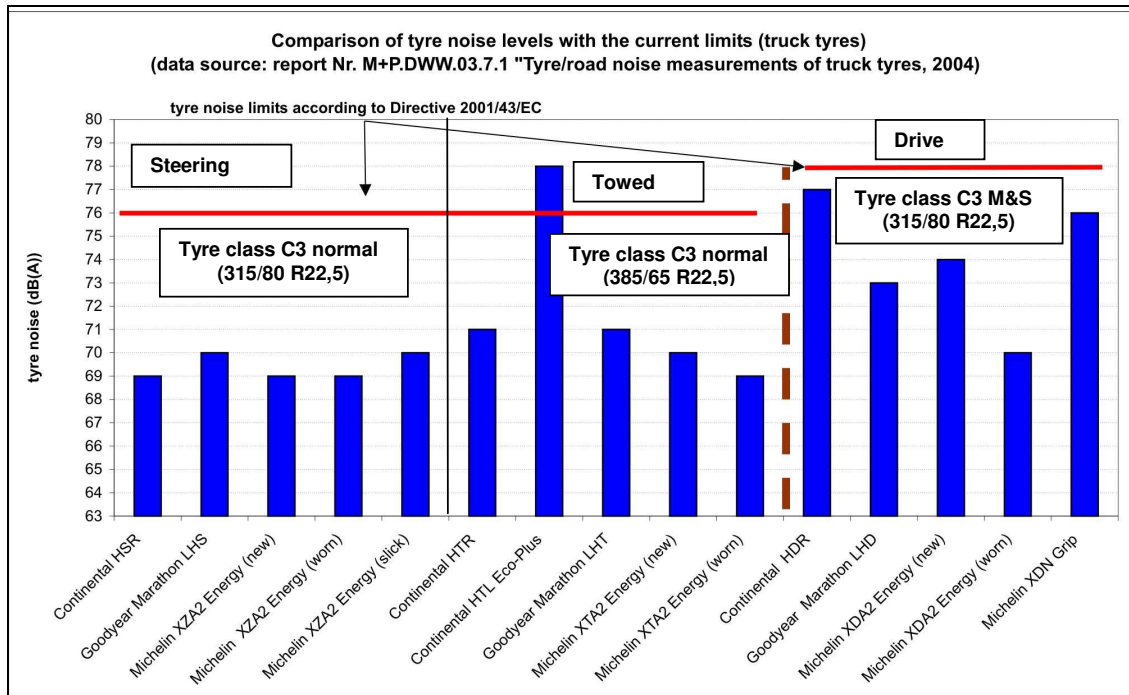


Fig.9: Truck Tyre Noise Measurement Results [4]

With one exception the wider tyres for towed axles are also far below the limit values. The tyre which is louder than the limit value has a lot of holes in one side of the tread pattern, which produces the typical sound of this tyre, see figure 10. The tyre is still on the market. Transitory arrangements in the regulation allow this.



Fig.10: Continental HTL Eco-plus

5. Conflict between Tyre Noise, Wet Grip and Rolling Resistance

Another question is the possible conflict between tyre noise, wet grip (safety) or rolling resistance (fuel consumption and air pollution) assuming that the most interesting feature for a truck operator is the mileage of a tyre (but this is based on personnel experience).

This possible impact was examined some years ago by the Federal Environmental Agency in Germany [3]. From this study one can see that no conflict between the above mentioned tyre features exists, see figure 11 and figure 12. A good tyre is good in many features - but maybe not in price.

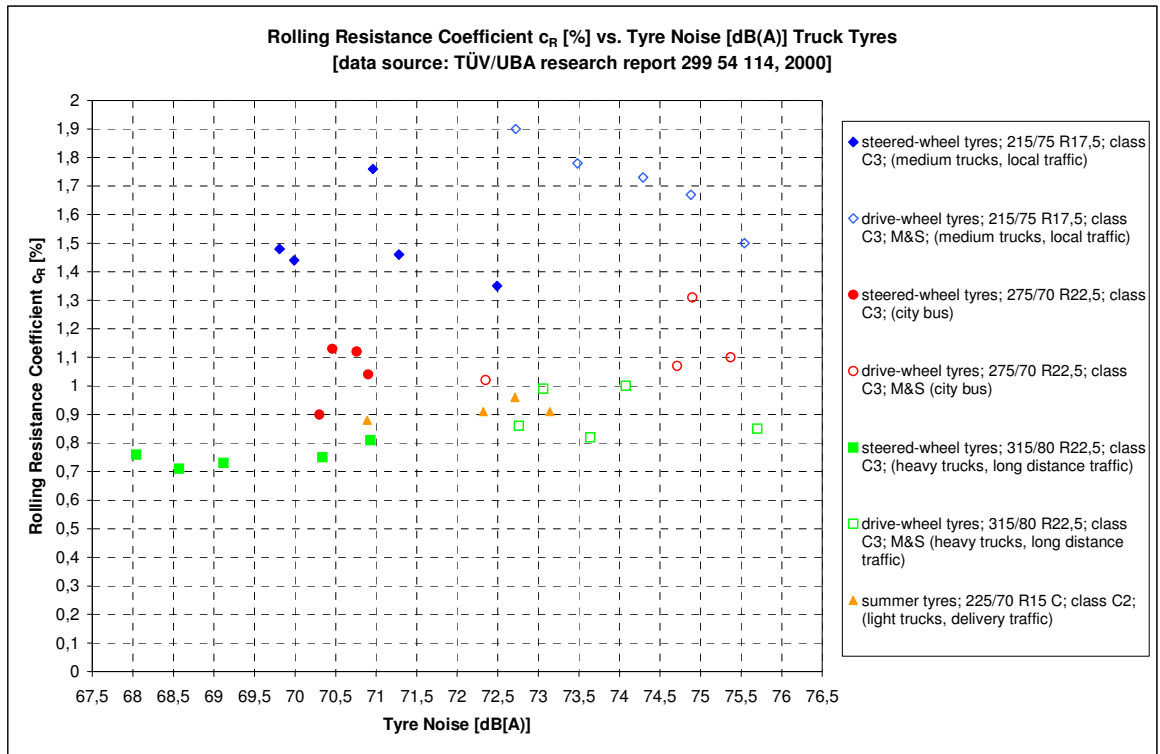


Fig.11: Rolling Resistance and Tyre Noise for Different Truck Tyres

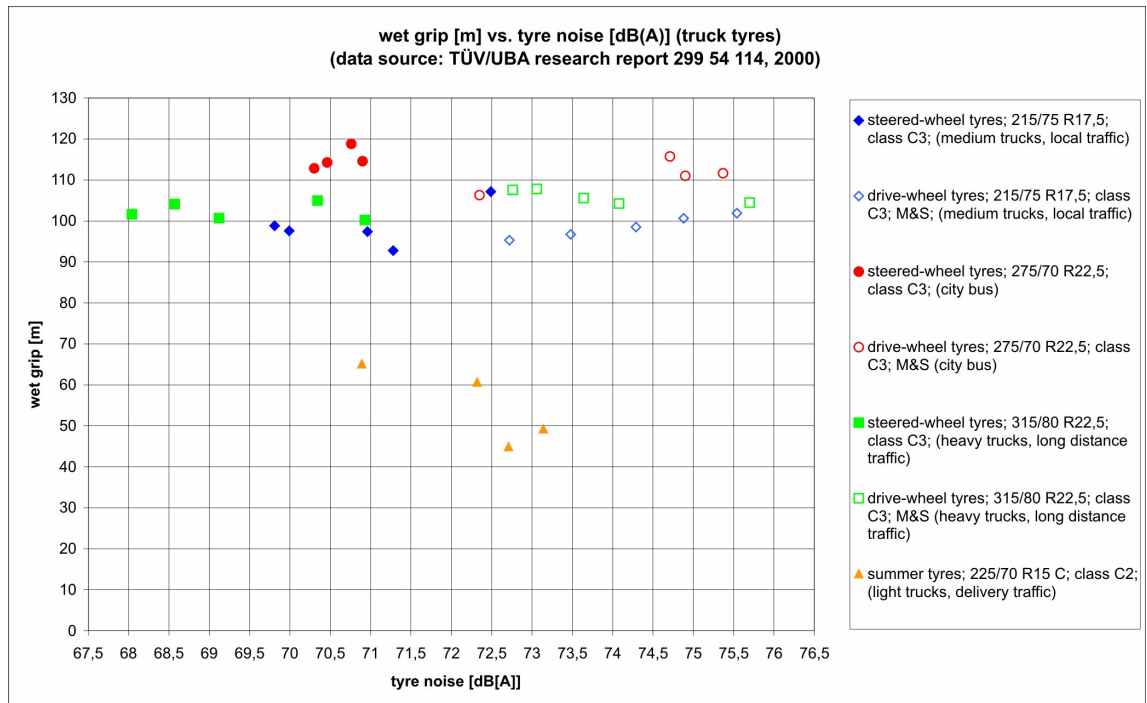


Fig.12: Wet Grip (Stopping Distance on Wet Road Surface) vs. Tyre Noise (225/70R15 tyres: ABS breaking of a light truck from 90 km/h to 10 km/h, all other tyres: trailer measurement)

5. Conclusions

- Truck tyre noise is annoying, especially at nighttime near highways.
- Drive axle tyres are much louder than steering axle or towed axle tyres.
- New, cold and hot retreaded truck tyres were tested in coast-by tests acc. Reg. 2001/43EC.
- All tyres fulfilled the requirements of the Regulation 2001/43EC (one not in a Dutch study).
- Tyre noise emissions are very different for the different profile types.
- Tyres with the same profile but different carcasses used before retreading had nearly the same tyre road noise emissions.
- The differences of tyres for the same purpose (axle position) of different manufacturers with different profile designs vary 2-3 dB(A).
- Retreaded tyres were not louder but sometimes more silent than the comparable new tyres.
- The noise emission values of all (retreaded and new) test tyres fell below the limit values of the Regulation 2001/43EC, e.g. tyres with steering axle profile minus 3-6dB(A).
- Compared to 70 km/h the tyre road noise is +2 dB(A) louder at 80 km/h, the usual truck driving speed.
- No difference was found between cold and hot retreaded tyres.
- If retreaded tyres should be incorporated into the regulation, families of tyres have to be defined.

6. Literature

- [1] BMVBW Hrsg.: Straßenbaubericht 2004, Bonn 2004
- [2] Glaeser, K.-P.; Beckenbauer, T.: Geräuschemissionen runderneuerter LKW Reifen, BASt Report, 2004
- [3] TÜV/UBA, Report 29954114, München 2000
- [4] M+P: Tyre/road noise measurements of truck tyres, DWW 03.7.1, Delft 2004