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REQUIREMENTS FOR AN EXTERNAL NOISE MEASURING PROCEDURE FOR COMMERCIAL VEHICLES WITH GREATER ENVIRONMENTAL EFFECTIVENESS

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INTRODUCTION

Recent studies show that the noise emission in day-to-day road traffic has decreased only slightly in the past 15-20 years. This is rather disappointing from both the environment's and the development engineer's point of view if one considers the fact that the latter had to implement noise reduction measures of up to 14 dB(A) on individual vehicles in series production in the same period of time.
The objective of the following report is both to analyse what causes can be attributed to this discrepancy and to highlight ways and requirements designed to enhance the effectiveness of noise-reducing measures on trucks in future.

A LOOK BACK ON 25 YEARS OF ANTI-NOISE LEGISLATION

Changes in the Noise-Limit Values for Trucks in the EC

As can be seen in the diagram in Fig. 1, the past 25 years haveseen numerous reductions in permissible noise values, measuring conditions having been adapted to the state of the art at the respective point in time. The most serious modification was made in 1985: Since then it has not been the 3rd gear but the loudest gear that is measured in accelerated drive-by. This resulted in an indirect increase in the main noise values of 3-5 dB(A), by which vehicles at that time had to be acoustically improved to comply with the limit value which had not been changed.
As a result, in the period of time under review the permissible drive-by levels were lowered by 15 dB(A) for trucks below 150 kW engine output and by 14 dB(A) for trucks from 150 kW engine output onwards.

Changes in the Noise Situation in real Traffic

The tremendous reduction in noise in individual vehicles under type-testing conditions raises the question as to what degree these are actually

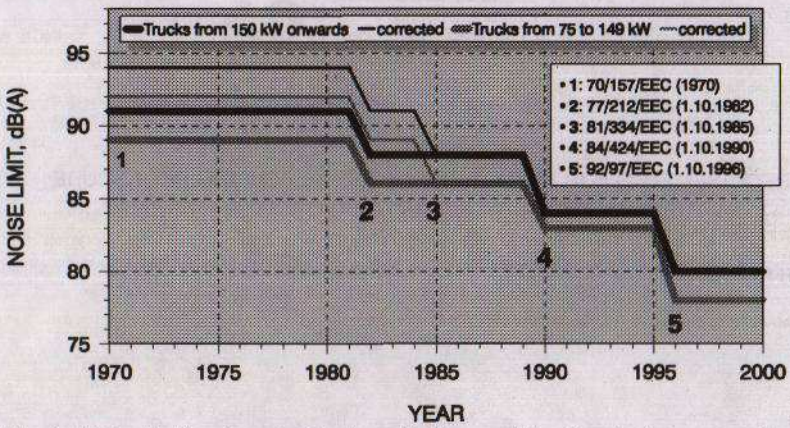

Fig. 1: Noise limit values for trucks with the modification in the measuring method taken into consideration (1985)

reflected in real traffic situations. The corresponding analyses and measurements conducted by renowned institutes on a large number of individual vehicles with differing operating conditions and at noumerous measuring places furnish disappointing results[1] and [2].
Even if one takes into consideration the fact that the latest results are from 1992, the expectations are far from being met:
In the lower output range virtually no average noise reduction was measured in the period from 1978 to 1992 - in any of the traffic situations under consideration. As regards the maximum values, only slight improvements were noticeable.
Only in trucks over 150 kW were marked noise improvements of 3-4 dB(A) recorded, particularly in constant conditions in urban areas.
A similar picture is achieved in the time-related change of the offensiveness of truck noise as subjectively viewed by the population and expressed in opinion polls: the percentage of persons annoyed by this noise dropped only slightly in the period of time under review. The increase in traffic appears to have been just about cancelled out by the noise-improvement measures implemented on vehicles [2].

REASONS FOR THE MINOR IMPROVEMENTS IN THE NOISE SITUATION IN REAL TRAFFIC

The following summary of aspects shows why the truck-related noise reductions designed to comply with noise limit values do not sufficiently translate into a marked improvement in the noise situation in real traffic:

- The operating conditions in type testing and in real traffic are incomparable in respect of engine speed, vehicle speed and vehicle acceleration, which is why different noise-generating sources predominate

in each case. In type testing these sources are particularly the load-dependent tyre/road noises in conjunction with a high degree of slip between tyre and road.

- The further development of measurement regulations has not kept pace with the development in truck technology. Consequently, today high torques are available already at low engine speeds, so that low consumption and even low noises can be achieved at low engine speeds.

However, other factors, too, are important for the discrepancies found:

- In real traffic different/louder tyres (including retreaded tyres) on more axles (trailers, semitrailers) are used, which offset the improvements to the driveline. Furthermore, the trucks are mostly laden or partially laden.
- In real traffic vehicles run on road surfaces which are frequently louder (concrete, cobblestone). This too offsets the improvements to the driveline.
- Owing to the age structure of the vehicles on the road, noise reduction measures become effective only much later when truck fleets have been replaced to a large degree. The average fleet age of trucks below 75 kW output, for example, is 8 years (these vehicles are mainly used in city traffic); however, of trucks above 225 kW it is only 3.6 years (typical motorisation for long-haul transport).
- Regulations and guidelines helpful to improving the other noise sources, namely tyres and road quality, are still lacking.

NECESSARY CHANGES FOR THE FUTURE

These reasons also furnish the operating conditions for a modified measuring method. The objective is to show not the **„worst case"** as has been done so far but the **„worst case in real operation"**, particularly in city traffic. This will ensure that a large number of persons will be affected by noise-reducing measures as a result of the limitation to operating modes in city traffic. These aspects alone are expected to lead to considerably enhanced effectiveness.

First Test Results in real Driving Conditions

In a first series of tests with 10 trucks with different engine outputs the first step in an attempt to comply with the operating conditions in real traffic was made by varying the gear only.

Fifty per cent of nominal engine speed was selected as initial eng.speed.

Apart from the initial and final conditions, that operating condition was also selected as an assessment criterion at which the highest drive-by level occurred. The results are summarised in the Fig. 2:

The evaluation shows that even with unladen or partially laden vehicles the operating conditions required in respect of the road speed and engine speed ranges and the vehicle acceleration of 1 m/s^2 can be achieved. Other variational possibilities consist in selecting different initial conditions for the engine speed and/or the road speed.

As a result, even a moderate modification to the existing regulations can achieve the objective of reproducing the „worst case in real operation".

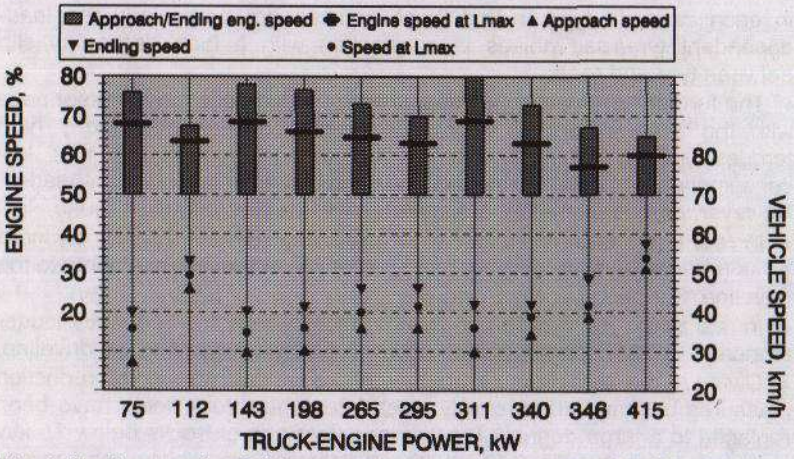

Fig. 2: Engine- and vehicle speed ranges at a method with reduced acceleration (1m/s²)

SUMMARY AND CONCLUSIONS

The reasons for the poor effectiveness in real traffic of the noise reducing measures carried out on trucks in the past 25 years are manifold. As regards the vehicles proper, the most important point is the major difference in the operating conditions if type testing (= worst case) is compared with real traffic situations. As a result, different noise sources become effective, and improvements necessary for type testing have no effect in real traffic situations. Consequently, a future method must be fixed to the real operating conditions (= worst case in real traffic situations). This must cover the operating conditions most frequently occurring in city traffic and, in addition, will be of consequence to a large number of people affected by noise. To prevent the measures implemented on the vehicle from being offset and, consequently, become ineffective by other influences, regulations must be introduced as quickly as possible for the minimisation of tyre/road noises, ie for the approval of tyres and for the construction of new and the repair of existing roads. These regulations too ought to be orientated towards real conditions, so that the highest degree of effectiveness for the minimisation of noise in city traffic can be achieved.

References

[1] Steven, H.: Ermittlung der Geräuschemissionen von Kraftfahrzeugen im Straßenverkehr, Project No. 105 05 140, commissioned by the German Federal Environmental Agency, March 1995

[2] Sandberg, U.: Noise Emissions of Road Vehicles - Effect of Regulations. I-INCE Publication 95-1 in Noise/News International, June 1995