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PROPOSAL FOR DRAFT AMENDMENTS TO REGULATION No. 94
(Frontal collision protection)

Transmitted by the Expert from Switzerland

Note: The text reproduced below was prepared by the expert from Switzerland in order to introduce a sound exposure limit for airbag deployment and in order to allow the measurement of the sound exposure level (SEL).

Note: This document is distributed to the Experts on Passive Safety only.

A. PROPOSAL

Text of the Regulation,

Insert new paragraph 2.12., to read:

"2.12. "Driver airbag" means an airbag assembly intended to protect the driver in his seat in the event of a frontal collision."

Paragraphs 2.12. to 2.14. (former), renumber as paragraphs 2.13. to 2.15.

Insert new paragraph 2.16., to read:

"2.16. "Sound exposure level (SEL)" means the energy-equivalent level (Leq) measured or calculated for one second."

Insert new paragraphs 5.3. to 5.3.3., to read:

"5.3. Sound exposure limit for airbag deployment

5.3.1. The sound exposure level measured at the position of the driver's ears or other occupant's ears shall not exceed a sound exposure level (SEL) of 125 dB(A).

5.3.1.1. The arrangement and installation of dummies for measuring the sound exposure level shall be carried out according to annex 3 paragraph 2.1.1. for front seats, and according to annex 3 paragraph 2.2.1. for rear seats respectively, if one or more than one passenger airbag(s) for rear seats is (are) built in.

5.3.1.2. The measurements shall be taken for the driver airbag and for the passenger airbag(s) at the position of the "inside" ear of each dummy (the ear towards the centre of the vehicle).

5.3.1.3. If there is a driver airbag and one or more than one passenger airbag(s), the measurements shall be taken by deploying at the same time the driver airbag and as many passenger airbag(s) as dummies have been installed according to paragraph 5.3.1.1. above.

5.3.2. The measurements shall be taken using measuring microphones capable of handling at least up to 170 dB Peak level and a precision integrating sound level meter (at least class 1 according to IEC 804 1/).

5.3.3. The windows and the rooftop of the vehicle shall be closed and the ventilation in the middle position."

1/ International Standard No. 804 of the International Electrotechnical Commission, Central office, Rue de Varembé 3, CH-1202 Geneva

B. JUSTIFICATION

Deployment of airbags in passenger cars has been shown to be potentially harmful for hearing and has caused permanent hearing damage in several cases. The impulse noise caused by airbag deployment exceeds current impulse noise exposure limits.

In order to facilitate the application, the sound exposure limit as well as the requirements for the measuring equipment and evaluation should be kept as simple as possible, and well-established standardized parameters should be used.

Effects reported for airbag deployment included permanent ringing (tinnitus) or hearing loss at high frequencies. Both effects are located in the inner ear. Rupture of the ear drum has not been reported, and if it ever happened would be curable.

Therefore it is sufficient to fix an exposure limit for the prevention of permanent damage to the inner ear. As an approximation of the transmission characteristics of the outer and middle ear A-weighting is appropriate.

The sound exposure level (SEL) is the energy-equivalent level (Leq) measured or calculated for one-second. Precisions integrating sound level meters display the SEL directly. Unlike peak levels the SEL is a phase-independent (root mean square; RMS) value and therefore much more stable even in the presence of interfering reflections (from windows etc.).

The proposed sound exposure limit (SEL) of 125 dB(A) is based on the evaluation of 600 cases of permanent hearing damage due to military impulse noise. The limit of 125 dB(A) SEL is identical to an energy-equivalent level (Leq) of 80 dB(A) calculated for 8 hours.

More advanced methods based on mathematical models of the ear may be more precise, especially regarding the protective effect of low frequencies. But the low-frequency content of the airbag noise is very variable as it depends on the interior volume of the car and the state of windows or rooftop (open or closed) during airbag deployment.

Therefore we propose the simple assessment of airbag noise as described above.
