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ECONOMIC COMMISSION FOR EUROPE
INLAND TRANSPORT COMMITTEE
World Forum for Harmonization of Vehicle Regulations (WP.29)
Working Party on Passive Safety (GRSP)

REGULATION NO. 22 INTERPRETATION NEEDED

Transmitted by the Expert from Poland

UN ECE Regulation No. 22, in paragraph 7.4.2.2.9, sets a verification requirement for the testing apparatus that is impossible to meet, just by a virtue of basic laws of physics:

"7.4.2.2.9. With the unloaded carriage and a drop height of up to 450 mm, the velocity of the carriage after 250 mm of travel shall be 4.0 ± 0.1 m/sec..."

Comment:

There must be a mistake in the above sentence. Even in the case of neglecting the friction of the carriage, which implies a free drop in vacuum conditions, no object could possibly reach a velocity of 4.0 m/sec under the earth gravity of 9,81 m/sec^2.

The above can be proved by a simple calculation:

(a) potential vs. kinetic energy balance: $m \times g \times h = \frac{m \times v^2}{2}$

(b) based on the above, the free drop velocity is: $v = \sqrt{2 \times g \times h}$

(c) for the height of 0.25 m (250 mm), the free drop velocity is: $v = \sqrt{2 \times 9.81 \times 0.25}$ = **2.21 m/sec**

The real value of velocity will always be smaller because of friction of the carriage bearings, so the verification requirement for the carriage velocity to reach 4.0 m/sec is impossible to meet.

To reach the required value of 4.0 m/sec,

(d) the drop height, resulting from eq. (a), would have to be at least: $h = \frac{v^2}{2 \times g} = \frac{4^2}{2 \times 9.81}$ = **0,815 m**

We suspect a typing error, but since it is a test apparatus verification requirement, an official explanation, eg. a corrigendum, would be most appreciated, so the test results could be validated in accordance to the requirements of the Regulation No. 22.