Informal Document No... 16
(50th GRRF, 10-13 September 2001)
Agenda Item: .4

Original: RUSSIAN / ENGLISH

Proposals

Of the Russian Federation in regards to the ECE Regulations No. 111 Concerning the Approval of Tank Vehicles of Categories N and O with Regard to Rollover Stability

Transmitted by the Russian Federation

The proposals are referred to the last version of the Draft Regulations (document TRANS/WP.29/705). -

1. The first proposal concerns Annex 3, p. 5 - vehicle loading

The test procedure is as follows. It is suggested to load the tank by water. If the normal fluid for carriage is petrol (or other fluid lighter than water), the tank is loaded partly (in case of petrol -75% of the volume). When tilting the platform, the fluid center-of-gravity deviates to the direction of tilting. If the vehicle rolls over at the platform inclination angle P<23°, (3 shall be corrected because deviation of the fluid center-of-gravity deteriorates this criterion.

In accordance with the p. 5, the manufacturer shall submit calculation of the correction coefficient.

The calculation of the correction coefficient is more complicated than calculation described in the Annex 5 of the Regulations, which, in accordance with the p. 5.1.2 of the Regulations, in case of doubts (perhaps, when (3 is close to 23°), should be checked by the test on a tilting platform. Thus test results are verified by the similar tests, which is not acceptable.,

The proposal is as follows:

The tank vehicle should be loaded fully by water. Overloading by 30% should not cause vehicle malfunctioning or touching the jounce limiters by the suspension springs. In this case the fluid center of gravity will not deviate from the vehicle centerline and the correction formula for a tank vehicle of any shape can be written as follows:

$$tg\beta_g = tg\beta_w \frac{M_g}{M_w} \cdot \frac{H_w}{H_g} + \frac{T}{2H_g}\left(1 - \frac{M_g}{M_w}\right)$$

Where:

β_g and β_w - platform tilting angles in case of normal fluid (i.e. petrol) and water, respectively;

Mg and Mw - vehicle sprung mass in case of normal fluid (i.e. petrol) and water, respectively;

H_g and H_w - height of the vehicle center-of-gravity in case of loading by normal fluid (i.e. petrol) and water, respectively;.

T - theoretical wheel track at the vehicle cross section at the center-of-gravity point.

All the parameters mentioned in the formula can be found in the design documentation.

The justification of the formula is presented in the Annex.

The correction according to the mentioned formula shall be performed only in case when ($\beta < 23°$ (limit), as loading a tank by water instead of lighter fluid increases the value of β.

2. The second proposal

On the 49th GRRF meeting the Russian delegation in the Informal Document No. 16 suggested to consider expedience of inclusion of determination of a vehicle roll angle into the static stability test procedure. That was motivated by the statement that the value of roll angle allows showing a vehicle dynamic trend to roll over, whilst adoption of the Regulations concerning dynamic stability is currently postponed. We hope that all participants have considered our proposals and may now provide their comments.

The Russian Federation in the past period has considered additional data on 40 tests of the tank vehicles with the purpose of evaluation of relation between vehicle roll angle when tilting on a platform and vehicle limiting speed at the “lane change” test maneuver. The certain correlation between those two parameters has been indicated. If at the present meeting the decision on measurement a vehicle roll angle when tilting on a platform had been made, the Russian Federation will prepare the related additions to the Regulation No. 111.

3. The third proposal

The stability calculation procedure (Annex 4) includes calculation of lateral acceleration in case of roll over of a single vehicle and a tractor in tractor-semi trailer combination. The influence of a semi trailer on the tractor roll over is described through the force acting in the coupling device. The semi trailer in the calculations is presented by the suspension cornering stiffness, which average statistical value is calculated by the empirical formula.

Thus calculation method does not consider capability of rolling over the semi trailer firstly and does not include calculations of the particular tractor-semi trailer combination with semi trailer design parameters provided.

We think that calculation method presented in the Annex 5 shall be extended to the particular tractor-semi trailer combination with semi trailer design parameters provided, because those particular parameters may be the first cause of roll over of the entire combination.

The Russian Federation may prepare the additions to the Regulation No. 111 in this respect by the next GRRF meeting.

Annex

Formula justification.

When tilting the platform during static stability testing (please refer to the figure),

$$tg\beta_w = \left(T/2 - X_w\right)/H_w;\ \text{so}\ X_w = -tg\beta_w \cdot H_w + T/2$$

$$tg\beta_g = \left(T/2 - X_g\right)/H_g$$

Where X w and X g - lateral deviations of centers of sprung masses due to tank rolling incase of loading by water and normal fluid (i.e. petrol), respectively;

All other parameters are described in the Proposals.

$$X_w = M_w \cdot g \cdot T/2 \cdot \cos\beta_w / C_{DRES}$$

$$X_g = M_g \cdot g \cdot T/2 \cdot \cos\beta_g / C_{DRES}$$

Where CDRES - summary cornering stiffness of suspension and tires referred to the level of the ground surface (please refer to the Annex No. 4 to the Regulations No. 111). Since $\beta = 20 - 25°$ assume that:

$$g \cdot T/2 \cdot \cos\beta_w / C_{DRES} \approx g \cdot T/2 \cdot \cos\beta_g / C_{DRES} = \mu$$

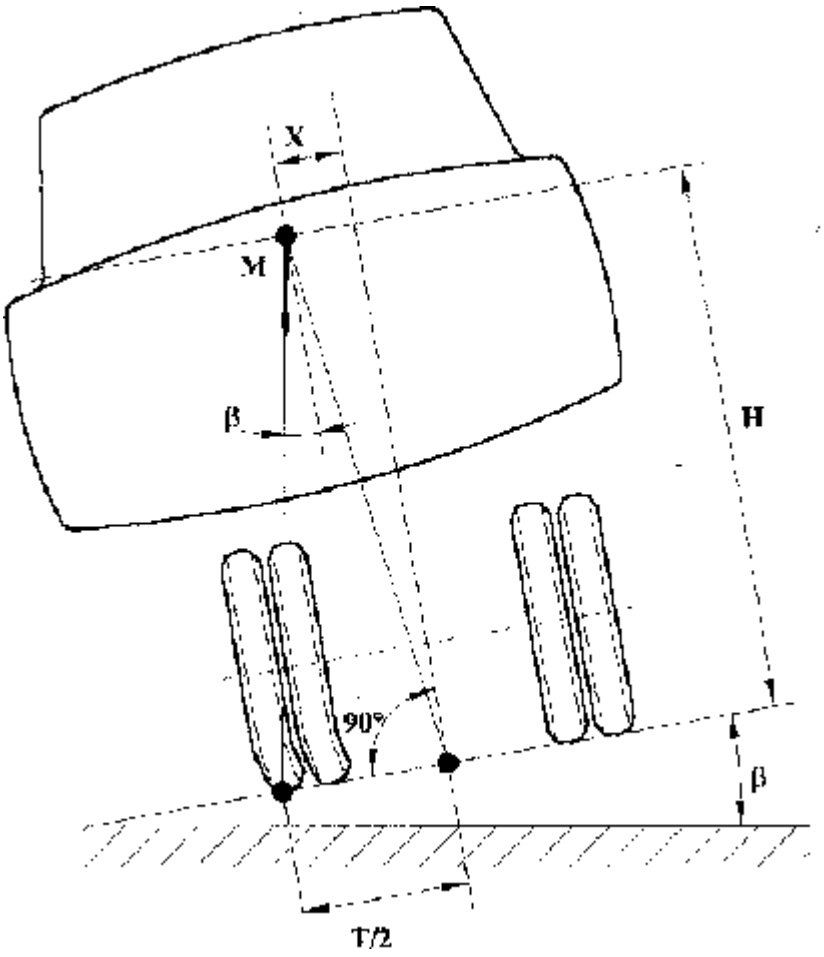
Therefore:

$$X_w = \mu \cdot M_w;\quad \mu = \frac{X_w}{M_w}$$

$$X_g = \mu \cdot M_g;\ X_g = \frac{X_w}{M_w} \cdot M_g;$$

When putting into the formula *(2)* the value of *Xg* calculated by using formulas (1) and (3), the result is:

$$tg\beta_g = tg\beta_w \cdot \frac{H_w}{H_g} \cdot \frac{M_g}{M_w} + \frac{T}{2H_g}\left(1 - \frac{M_g}{M_w}\right)$$



The scheme of “Tilt test”