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**ECONOMIC COMMISSION FOR EUROPE****INLAND TRANSPORT COMMITTEE**

**Working Party on the Transport  
of Dangerous Goods**  
(Seventy-second session,  
Geneva, 13-17 May 2002)

**PROPOSALS OF AMENDMENTS TO ANNEXES A AND B OF ADR****Part 9 of ADR****9.7.6 Rear Protection of the Tank****Submitted by the Government of Germany****SUMMARY**

Executive Summary:	Proposal for improvement of the rear protection of tanks
Action to be taken:	Amendment of section 9.7.6 (ADR)
Related documents:	TRANS/WP.15/1999/15, TRANS/WP.15/1999/48

**Introduction**

In some of the former sessions of the Working Party, amendments to the requirements for the rear protection of tanks have been discussed in order to achieve a better protection of the rear end of the tank. After that, Germany announced a review of the discussed documents.

## **Proposal**

Amend section 9.7.6. to read as follows:

"Rear protection of tanks

The rear side of the tank shall be sufficiently protected against rear impact by a bumper, by other means of protection or by protection provided by the design of the tank.

The protective means shall provide protection over the full width of the tanks and shall be capable of absorbing a collision energy of at least 150 kNm without the tank sustaining any damage which would cause leakage. For the determination of the energy absorption capacity, the impact energy specified above shall be assumed as being equally distributed over the entire surface of the protective means.

Examples for appropriate protection by the design of the tank are

1.) Shell with a minimum thickness according to 6.8.2.1.17 respectively 6.8.2.1.18 (not reduced thickness) multiplied by factor 1.2.

or

2.) A double rear endwall consisting of an inner shell of at least the reduced thickness according to, the table in 6.8.2.1.19 and an outer shell with a thickness of at least 2 mm Steel respectively 3 mm Aluminium alloy. The distance between the two shells of a double wall should be at least 50 mm. [If in the final edition of EN 13094 a measure will be required for the distance between the two shells of a double wall reference should be made to this standard.]”

## **Justification**

In its final summary report the THESEUS research project refers to the extensive analyses performed and indicates that the rear tank ends of semi-trailers are the main impact points in accidents (approx. 30 %). Protection for this tank area was hitherto provided on the basis of the currently valid regulation, which requires an "adequately rigid bumper". Because of the characteristic features of tank ends, this measure does not provide complete protection. Because the bumper does not cover the entire end area, it does not prevent impacting vehicles from coming into direct contact with the rear end of the tank.

In European practice this ADR requirement is interpreted differently. In some cases the rear underdrive protection required in Directive RL 70/221/EEC, which is designed, for example, to prevent passenger cars from underdriving tank vehicles in rear-end accidents, is considered to be a rear-end protection for tank vehicles as required by ADR.

The THESEUS study showed that for rear-end accidents at a speed of 10-30 km/h and a realistic impact mass of 16-22 t the rear-end impact protection cannot always prevent tank failure. For example, in one rear-end collision the shaft of the windscreen wiper of the impacting vehicle penetrated the rear tank end.

The THESEUS summary report includes the results of an extensive analysis of a large number of accidents that have actually taken place. A figure under item 2,8 shows the distribution of impact points on a tank semi-trailer. The side impacting vehicles hit most frequently appears to be the rear tank end.

To underline the significance of this problem concerning the safety of tank transportation, we refer to a tragic accident on a German motorway several years ago. A double-decker coach hit the rear end of a tank semi-trailer loaded with fuel oil. The plate between the lower and the upper deck of the passenger compartment damaged the rear side of the tank. Parts of the tank contents reacted to form an aerosol and were distributed within the coach. The aerosol was ignited and the coach burnt out. Twenty members of a British military orchestra died.

It appears from the analysis results of the eight real vehicle/vehicle collisions involving a rear-end impact which were investigated within the framework of the THESEUS study that the entire rear-end wall is always endangered.

An evaluation of these eight tests was carried out to determine the energy absorption capacity of the tanks only. The respective values are given in table 4.9 of the final summary report. These values varying from 125 kNm to 185 kNm were determined at precise conditions (certain mass of the car, velocity etc.). The average value was approx. 150 kNm.

A special bumper, other means of protection or the design of the rear side of the tank itself should have an energy absorption capacity of 150 kNm to sufficiently protect the tank in a rear-end accident. The examples for appropriate protection by the design of the tank shall be deemed having an energy absorption capacity of at least 150 kNm.

In the case of a single not reduced wall (example 1.)) the factor 1.2 should be seen as an equivalent for the better absorption capacity of the double wall(example 2.)), where the space between the two walls is able to absorb energy and in addition by means of a certain redundancy with the second wall a higher safety can be achieved even if the total thickness of the double wall is the same as the thickness of the single wall .

It cannot be guaranteed, however, that the containment function of tanks capable of withstanding 150 kNm always remains unaffected, but many of the normal rear-end collisions would be covered.

For this reason and particularly with regard to standardization, it is recommended to have alternative means of impact protection for tank ends.

For constructions other than those of examples 1 or 2 efficiency of the rear protection may be proved by calculation or by performing a test.

Forces resulting from a crash onto the rear endwall will be led into the cylindrical part of the shell. This part has proved in several accidents to withstand this stress without failure (it may be deformed).

This proposal cannot be justified with a scientific cost-benefit analysis.

However, Germany would like to point out that during a serious collision on a motorway near Munich in 1985, 25 people were killed and others seriously injured. A coach hit the rear end of a tank semi-trailer, which was driving more slowly. The rear end of the tank failed, the tank contents (kerosene) were spilled into the coach and ignited. This accident could have been avoided with better rear-end protection.

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