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Working Party on the Transport of Dangerous Goods

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## PROPOSALS FOR AMENDMENTS TO ANNEXES A AND B OF ADR

Section 9.2.2.5, 9.7.8 and 8.3.8: Explosion protectionTransmitted by the Government of Germany

## SUMMARY

<b>Executive Summary:</b>	The aim of this document is the adaptation of the ADR regulations concerning explosion protection
<b>Action to be taken:</b>	Amend the text in paragraphs 9.2.2.5, 9.7.8 Add a new paragraph to 8.3.8
<b>Related documents:</b>	ECE/TRANS/WP.15/2006/13

**Introduction**

As explained in a previous INF-paper, Germany sees the need to adapt the ADR regulations concerning explosion protection to recent European developments in this field. Main reasons for this need are:

- From a legal point of view, the explosion protection in the EU is meanwhile regulated by two so called ATEX-Directives (Directive 94/ 9 /EC and 1999/92/EC). These directives concern equipment as well as operational requirements and - through national implementation - have to be observed also when transporting dangerous goods.
- From a technical point of view, the ATEX-Directives reflect the state of the art in the field of explosion protection and so the take-over of ATEX-conform equipment and procedures could be a convenient way to widely accepted and safe technical solutions for the transport of dangerous goods.
- From a practical and economical point of view regarding new equipment (e. g. battery operated electronic devices) and procedures (e. g. vapour recovery), a reassessment of the explosion hazards in connection with the transport of dangerous goods appeared to be necessary.

Especially due to the last aspect, Germany carried out a research project in order to find a sound and ATEX-conform basis for the rating of explosion hazards during transport of dangerous goods (class 2 and class 3). In this project, a potentially explosive atmosphere in vehicles for class 2 and class 3 substances has been investigated experimentally in practice (filling stations) and under controlled test conditions. In addition, the experimental situations were simulated by a Computational Fluid Dynamic programme. Furthermore the effectiveness of non-electrical ignition sources (especially hot surfaces) was assessed in experimental tests. As a result of this project the following main issues for a further development of the ADR regulations can be identified:

### **Hazards during transportation and loading/unloading**

The investigations show that the individual explosion hazards during transportation are by far exceeded by those during loading and unloading. So any safety concept necessarily has to incorporate the loading and unloading activities including the interfaces with local installations. Here it has to be borne in mind that regulations cover only normal operation plus the usual malfunctions and usual operating errors and are not intended to take account of any catastrophic failures (due to external impact).

### **Sub-groups for FL-vehicles**

Vehicles of type FL range from battery vehicles for pressurized gas to un-pressurized tankers for flammable liquids. Regulations for FL vehicles have to cover the worst case with regard to the formation of dangerous areas. The worst case is doubtless – and this has been confirmed in the project - the filling of flammable liquid without vapour recovery through an open dome. On the other hand the results of the project confirm that with regard to the distribution of petrol by tank vehicles equipped with vapour recovery systems no or only very restricted dangerous areas have to be taken into account (Vapour recovery for petrol distribution is mandatory in the EU and these kinds of transports make up the majority of all transports of dangerous goods). So without a greater differentiation of the FL-vehicle group, a majority of transports will continue to be subjected needlessly and uneconomically to a maximum of requirements. An improvement of this situation is possible by a further differentiation in the FL-vehicle group and the research project indicates that the following sub-grouping of FL-vehicles would be reasonable with respect to explosion protection requirements:

- FL-vehicles for class 3 without vapour recovery
- FL-vehicles for class 3 with vapour recovery
- FL-vehicles for class 2

### **Integrated safety of electrical and non-electrical equipment**

An integrated explosion safety concept for electrical and non-electrical equipment is state of the art and should be incorporated into ADR and as a consequence non-electrical equipment with potential ignition sources (pumps, motors, brakes, exhaust lines) has to be taken into account in a similar way as is the case now for electrical equipment. So – if necessary – explosion protected non-electrical equipment has to be installed. The selection of appropriate ATEX-approved equipment which is available on the market could facilitate this task essentially.

## **De-energizing of equipment during specified operations**

The ADR incorporates the concept of differentiation between permanently energized equipment and equipment which can be switched-off or de-energized. The results of the research project strongly support a further upgrading of this intelligent and flexible concept. On the one hand non-electrical equipment should be incorporated (switch-off, de-energize, control of surface temperature) as far as necessary. On the other hand, the type of operation during which de-energizing is required shall be identified and given in the regulations. Example: *During loading of class 3 liquid through the open dome hole, all equipment of the vehicle which is not suited at least for Zone 2, shall be switched-off, de-energized or cooled down to surface temperatures below 350 °C.*

## **Specification of requirements for explosion protection equipment**

Whereas electrical equipment can be specified according to the IEC standards, for non-electrical equipment such basic requirements (Directive 91/9/EC) and performance standards (EN 13463-x) are available only on a European level. In this situation requirements should at least be referenced in ADR or some basic statements should be incorporated explicitly: Example: *Non-electrical equipment is suited for use in Zone 1 if the equipment shows no effective ignition sources during normal operation and in case of faults which normally have to be taken into account.* The situation is similar with respect to flame arresters and equipment which is resistant to explosion pressure. For flame arresters an international standard is in preparation (ISO DIS 16852).

## **Proposal**

Amend the text in paragraph 9.2.2.5 and 9.7.8 to read follows:

### 9.2.2.5 Permanently energized circuits

9.2.2.5.1 *(delete old text and replace it by the following)*: Permanently energized electrical equipment (including the leads) which is not subject to 9.2.2.3 and 9.2.2.4 and which is not situated in a zone as defined in 9.7.8.2 shall be suitable for use in Zone 2. This requirement is met if the equipment satisfies the general requirements of IEC 60079 parts 0 and 14 and the additional requirements applicable from IEC 60079 part 15. It shall be suitable for the explosion group and the temperature class of the dangerous substances intended for transport. The spatial area at the vehicle to which the above requirement applies can be essentially restricted if the vehicle is intended for the carriage of substances of class 2 or class 3 with a vapour recovery system for loading and unloading. For the limits see 9.7.8.3.

9.2.2.5.2 *(keep old text of the ADR)*

9.7.8 *(replace whole section)* Explosion protection requirements (FL vehicles)

9.7.8.1 Electrical and non-electrical equipment shall be suitable for the zone where it is to be used. The specific requirements for the explosion group and the temperature class according to the substances to be carried shall be met.

9.7.8.1.1 Electrical equipment is suited for Zone 0 or Zone 1 if it meets the requirements of IEC parts 0 and 14 as well as the additional requirements of one of the standards IEC 60079 parts 1, 2, 5, 6, 7, 11 or 18. Electrical equipment is suited for Zone 2 if it meets the requirements of IEC 60079 parts 0 and 14 and the additional requirements of IEC 60079 part 15.

9.7.8.1.2 Non-electrical equipment is suitable for use in zones if it meets the following requirements with regard to the avoidance of effective sources of ignition:

Zone 0: no source of ignition under normal operation, in the case of expected malfunctions and the case of rare malfunctions.

Zone 1: no source of ignition under normal operation and the case of expected malfunctions.

Zone 2: no source of ignition under normal operation.

The relevant qualification shall be proven by the manufacturer of the equipment by means of an assessment of the hazard of ignition and the result shall be indicated in the operating instructions.

9.7.8.1.3 The proof of suitability for electrical as well as non-electrical equipment is deemed to be furnished for example by a declaration of conformity in accordance with Directive 94/9/EC.

9.7.8.1.4. Non-electrical equipment comprising a potential ignition source is deemed as suitable for Zone 2 and for substances of temperature class T1 to T4 as well as of the explosion groups IIA and IIB for the purpose of this regulation if it does not generate sparks and does not have surface temperatures of more than 350°C during normal operation.

9.7.8.2 The following zone attribution shall apply at FL vehicles

- Zone 0:  
Inside tank compartments, fittings for filling and discharge and vapour recovery lines
- Zone 1:  
Inside cabinets for equipment and hoses used for filling and discharge .  
Area within a radius of **0.5** m around connections at vapour recovery systems which are not permanently technically tight.  
  
Area within a radius of **1.5** m around  
- automatic pressure relief safety valves (class 2) and/or  
- venting devices (class 3)

Area up to a distance of **0.2** m around the cabinet if the venting device is in the cabinet (class 3).

9.7.8.3 Equipment (electrical and non-electrical)

- which cannot be put out of operation or which cannot be de-energized and
  - which is not subject to the provisions in accordance with 9.2.2.3 or 9.2.2.4 and
  - which is situated outside the zones mentioned in 9.7.8.2
- shall be suitable for use in Zone 2 if it is situated in the following areas which have to be temporarily protected:
- Class 2: radius of 1.5 m around the outlet opening of manually activated purging or pressure relief devices.
  - Class 3 without vapour recovery system: The entire vehicle
  - Class 3 with vapour recovery system: A radius of 3 m around outlet openings of manually activated pressure relief devices.

Note: For currently customary tank vehicles for UN 1203 which meet the requirements of the VOC directive there are no areas which have to be temporarily protected in accordance with 9.7.8.3.

Add a new paragraph to 8.3.8

8.3.8 Electrical and non-electrical equipment which is situated in areas which have to be temporarily protected in accordance with 9.7.8.3 and which is not suitable for use in Zone 2 shall, during the following operational phases, be de-energized (battery master switch), put out of operation or cooled down so far that it cannot become a source of ignition:

- Class 2: During a manually activated purging/pressure relief of filling and discharge equipment.
- Class 3 without vapour recovery system: During a manually activated pressure relief and during filling.
- Class 3 with vapour recovery system: During a manually activated pressure relief.

**Example for consequences: Road tanker for class 3 with vapour recovery**

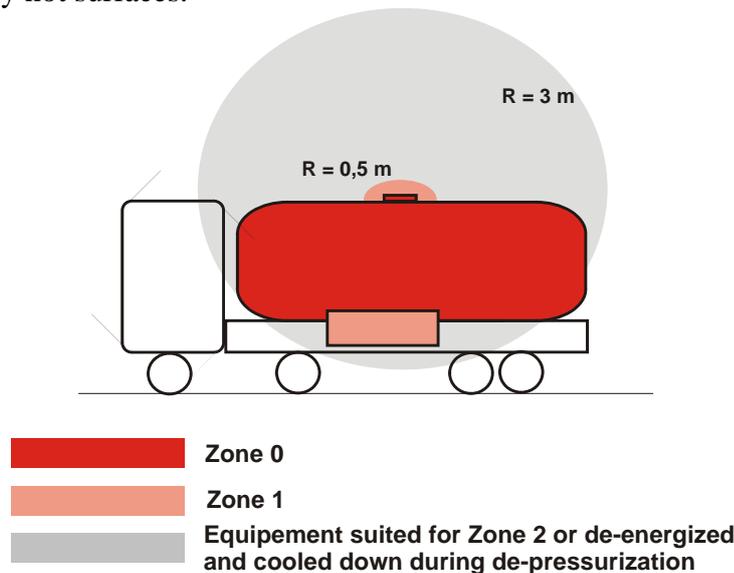
It is supposed that no automatically acting venting device is provided. De-pressurization of the tank is carried out by opening the dome hole cover – this has to be done before filling in order to introduce the loading arm with integrated vapour recovery line. The vapour recovery is performed by fitting the arm gas tight to the dome hole. This type of vehicle is typically used for chemicals in Germany. The following figure indicates the attributed zones respective areas where operational requirements shall be imposed according to the results of the research project:

Zone 0: Inside tank compartments, fittings for filling and discharge and vapour recovery lines (same as ADR).

Zone 1: Inside cabinets for equipment used for filling and discharge and within 0,5 m from the dome hole cover.

In a sphere with radius of 3 m around the dome hole electrical as well as non-electrical equipment which is not in a Zone

- shall comply with the requirements for use in Zone 2 or
- shall during de-pressurization of the tank be de-energized or switched-off or cooled down to avoid ignition by hot surfaces.



Comparison to the present ADR requirements:

No difference to the Zone 0 specification.

Zone 1 shall additionally be attributed to those junctions and fittings of the vapour space and vapour recovery line which are not permanently gas tight in a technical sense. According to the findings in the project this applies to dome holes which are operationally closed and opened and which are likely to show slight leak rates. As a consequence a small (radius 0,5 m) Zone 1 should be attributed.

A remaining controlled area covering permanently energized equipment is cut down from the whole tank vehicle as required by the present ADR to a sphere with radius 3 m around the source. Furthermore, the requirement for permanently energized equipment is reduced from “suitable for Zone 1” to “suitable for Zone 2”. Alternatively in this controlled area de-energizing or cooling down of hot surfaces is acceptable. The latter requirement will rarely be onerous because in the project it is found that temperatures below about 300 °C are sufficient to avoid ignition.

### **Justification**

Adaptation of the ADR regulations concerning the current explosion protection in conformity with the so called ATEX directives of the EC.

### **Safety implications**

Explosion protection is specified more precisely and brought in line with IEC standards and European requirements (ATEX) for both

- equipment (electrical and non electrical) and
- operation (handling).

Credits may be given to vehicles which are in conformity with directive 94/63/EC voc

### **Feasibility**

The proposed equipment is available on the market. With regard to the implementation of operational requirements like the use of the battery master switch (which in some countries are already standard) no problems are expected.

### **Enforceability**

No problems foreseen.

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