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INLAND TRANSPORT COMMITTEE

Working Party on the Transport of Dangerous Goods

Joint Meeting of the RID Safety Committee and the
Working Party on the Transport of Dangerous Goods

# REPORT OF THE SESSION */

held in Bern from 20 to 23 March 2006

## Annex 1 : Report of the Working Group on Tanks

## Addendum

The secretariat has received from the Central Office for International Carriage by Rail (OCTI) the English translation of the report of the working group on tanks, prepared in German and partially in English by the representative of Germany in the course of the session (informal document INF.38).

1. The working group on tanks met from 20 to 21 March 2006, concurrently with the RID/ADR/ADN Joint Meeting which had entrusted it with a relevant mandate.

2. The working group considered the following official and unofficial documents:

TRANS/WP.15/AC.1/2006/4 (Switzerland), TRANS/WP.15/AC.1/2006/9 (Portugal), TRANS/WP.15/AC.1/2006/6 (France), TRANS/WP.15/AC.1/2006/10 (Portugal), TRANS/WP.15/AC.1/2006/8 (Netherlands), INF.3 (Netherlands), INF.21 (Belgium), INF.9 (UIP), INF.26 (AEGPL), INF.14 (Germany) (OCTI/RID/GT-III/.... (TRANS/WP.15/AC.1/....)

3. The working group was made up of 23 experts from 11 countries and 3 non-governmental organizations.

4. Documents **ECE/TRANS/WP.15/AC.1/2006/8, INF.3 and INF.26** had already been dealt with in plenary (see ECE/TRANS/WP.15/AC.1/102, para. 5-12). There was a lengthy discussion on the need to take into account the effects of accidents and in connection with this, the requisite and necessary level of safety for tanks in general and the risks and effects of a BLEVE.

5. In the end, the working group on tanks was mandated to examine the effectiveness of protective measures in this respect, taking Chapter 6.7 into account. This Chapter, which concerns portable tanks, contains some requirements with regard to engulfment in fire and the fitting of safety devices.

6. The working group was also requested by the working group on standards to resolve a problem in determining the wall thickness of tanks using the equivalence formula for calculating the wall thickness.

7. The order of discussion of the documents was determined by the requirements and the presence of the experts.

**Item 1. Document TRANS/WP.15/AC.1/2006/4 (Switzerland – 6.10.3.7 (a))**

8. In this document, Switzerland requested a discussion on the alternative design of the suction boom for vacuum-operated waste tanks and hence the possibility of fitting a rotating crown wheel between the shell and the (external) stop-valve.

9. This type of construction already existed before the restructuring of ADR, but was not taken into account when the new Chapter 6.10 was introduced. In order to continue to allow the construction of this alternative, multilateral special agreement M 134 was proposed and signed by several countries.

10. The group discussed the proposal, taking into account the existing text and multilateral special agreement M 134. The problem is compliance with 6.10.3.7 (a) for suction booms with a rotating crown wheel, where a shut-off device cannot be fitted between the inside of the tank and the suction boom.

11. However, notwithstanding the provisions for the construction and equipment of tanks in accordance with Chapter 6.8, there are provisions for vacuum-operated tanks that exist because

of the special devices with which these tanks are fitted. In particular, these are so-called protected zones, in which the items of equipment are deemed, by definition, to be protected. Some members of the group already saw problems with the existing rules, according to which the items of equipment in the protected areas are also deemed to be protected even without additional protection.

12. After a discussion on the actual construction, the group agreed to the proposal, with the amendment of "stresses" to read "loads" in the last sentence.

**6.10.3.7** (a) Amend to read as follows:

"(a) the boom is fitted with an internal or external stop-valve fixed directly to the shell, or directly to a bend that is welded to the shell; a rotation crown wheel can be fitted between the shell or the bend and the external stop valve, if this rotation crown wheel is located in the protected area and the stop-valve control device is protected with a housing/cover against the danger of being wrenched off by external loads;".

**Item 2. (a) Document ECE/TRANS/WP.15/AC.1/2006/6 (France – Inspections and tests in accordance with 6.8.2.4)**

**(b) INF.14 (Germany – 6.8.3.4.6: Inspections and tests on tanks for refrigerated liquefied gases)**

**(c) INF.21 (Belgium – Comments on document 2006/6 and informal document INF.14)**

13. France's proposal ECE/TRANS/WP.15/AC.1/2006/6 was based on a discussion at the working group's last meeting and its aim was to clarify the application of the provisions of 6.8.2.4.2 and 6.8.2.4.3 concerning the periodic tests and inspections.

14. Belgium agreed with the proposal in principle, but in informal document INF. 21, tried to achieve further clarification to avoid misinterpretation.

15. Informal document INF. 14 dealt with the question of the periods between periodic tests and inspections on tanks for refrigerated liquefied gases, and its purpose was also clarification.

16. The group decided to conduct the discussion of these documents on the basis of informal document INF. 21, and agreed to the text it contained, with the following amendments:

(a) Amend 6.8.2.4.2 and 6.8.2.4.3 to read as follows:

"6.8.2.4.2 Shells and their equipment shall undergo periodic inspections at least every

eight years /six years. | five years.

These periodic inspections shall include:

- an external and internal examination;

- leakproofness test in accordance with 6.8.2.4.3 of the shell with its equipment and check of the satisfactory operation of all the equipment;

- as a general rule, a hydraulic pressure test 9 (for the test pressure for the shells and compartments if applicable, see 6.8.2.4.1).

Sheathing for thermal or other insulation shall be removed only to the extent required for reliable appraisal of the characteristics of the shell.

In the case of tanks intended for the carriage of powdery or granular substances, and with the agreement of the expert approved by the competent authority, the periodic hydraulic pressure test may be omitted and replaced by leakproofness tests in accordance with 6.8.2.4.3, at an effective internal pressure at least equal to the maximum working pressure.

**6.8.2.4.3** Shells and their equipment shall undergo intermediate inspections at least every four years / three years | two and a half years after each inspection (initial, intermediate or periodic inspection).

These intermediate inspections shall include a leakproofness test of the shell with its equipment and check of the satisfactory operation of all the equipment. For this purpose the tank shall be subjected to an effective internal pressure at least equal to the maximum working pressure. For tanks intended for the carriage of liquids or solids in the granular or powdery state, when a gas is used for the leakproofness test it shall be carried out at a pressure at least equal to 25% of the maximum working pressure. In all cases, it shall not be less than 20 kPa (0.2 bar) (gauge pressure).

For tanks equipped with venting systems and a safety device to prevent the contents spilling out if the tank overturns, the pressure test shall be equal to the static pressure of the filling substance.

The leakproofness test shall be carried out separately on each compartment of compartmented shells."

(b) Amend 6.8.3.4.6 to read as follows:

"6.8.3.4.6 By derogation from the requirements of 6.8.2.4, the periodic inspections according to 6.8.2.4.2, shall take place:

(a) at least every three years | at least every two and a half years in the case of tanks intended for the carriage of UN No.1008 boron trifluoride, UN No. 1017 chlorine, UN No. 1048 hydrogen bromide,

anhydrous, UN No. 1050 hydrogen chloride, anhydrous, UN No. 1053 hydrogen sulphide, UN No. 1067 dinitrogen tetroxide (nitrogen dioxide), UN No. 1076 phosgene or UN No. 1079 sulphur dioxide;

(b) at least after six years | at least after 8 years
of service and thereafter at least every 12 years in the case of tanks intended for the carriage of refrigerated liquefied gases.

| | |
|---|---|
| The intermediate inspections according to 6.8.2.4.3 shall be carried out at least six years after each periodic inspection. | A leakproofness test or an intermediate inspection according to 6.8.2.4.3 may be performed, at the request of the competent authority, between any two successive periodic inspections. |

When the shell, its fittings, piping and items of equipment have been tested separately, the tank shall be subjected to a leakproofness test after assembly."

(c) Another consequential amendment must be made to the version of 6.8.2.5.1 adopted for the 2007 edition:

As the term "intermediate leakproofness test" has been amended to read "intermediate test", the Note is no longer necessary and should be deleted.

**Item 3. Document TRANS/WP.15/AC.1/2006/9 (Portugal – Transport of methane refrigerated liquid or natural gas refrigerated liquid (UN 1972) in tanks)**

After the representative of Portugal had introduced the document, the working group again discussed the pros and cons of an opening in tanks for refrigerated liquefied gases in order to inspect the internal condition irrespective of the type of insulation. In this connection, particular attention had been given to the problem of corrosion. The influence the type of insulation (solid or vacuum insulation) has in the carriage of refrigerated methane or natural gas (LNG) cannot be discerned. The occurrence of corrosion at low temperatures and in tanks made of austenitic materials is unlikely, but cannot be ruled out in the event of any impurities or if the optimum material has not been used or the tank has not been treated as well as possible. Inspection openings in these tanks also have disadvantages. For example, the leakproofness of such inspection openings is problematic owing to the low temperatures and fluctuations in temperature.

For these reasons, it was not possible to support this proposal. The representative of Portugal was asked to provide the group with additional information on this matter once investigations had been completed and to redraft the proposal on this basis if need be.

**Item 4. Document 2006/8 (Netherlands), INF.3 (Netherlands) and INF.26 (AEGPL) - Reduction of the risk of a BLEVE (Boiling Liquid Expanding Vapour Explosion)**

Following a presentation of informal document INF. 3, which referred to relevant investigations in the Netherlands, the group discussed the problem in the context of the mandate the group had received from the plenary session. In other words, the group did not again discuss the pros and cons of including demands in the event of accidents in RID/ADR and the aspect of whether dangerous goods tanks were commonly exposed to fire.

Instead therefore, in accordance with the mandate it had received, the group tried to deal with

- evaluating the protective measures set out in INF.3,
- evaluating whether the requirements on this subject contained in Chapter 6.7 could be transferred to Chapter 6.8,
- examining the approach described in INF. 3 to check that it was sufficient.

The existing provisions in Chapter 6.7 of the UN Recommendations concerning fire were considered and compared with the procedure in informal document INF. 3.

The group also examined whether and how the requirements in Chapter 6.7 can be transferred into Chapter 6.8. Some participants pointed out in this respect that the requirement for safety devices that must be designed to withstand fire conditions would mainly apply to carriage by sea. Other participants denied this and referred to the requirements some countries (USA, Canada, United Kingdom) also have for land transport.

According to Chapter 6.7, and in contrast to Chapter 6.8, all tanks have to be fitted with safety devices. The requirement for sufficient relief capacity for gas tanks in the event of fire is set out in 6.7.3.8.1.1; requirements concerning insulation are in 6.7.3.8.1.2. The 30 minute period given in 6.7.2 for the ability of a tank for liquids to withstand fire engulfment was originally laid down for storage tanks, but according to informal document INF. 3, it is considered too short a period for transport tanks in land transport. However, the requirement for sufficient relief capacity of the safety devices in the event of fire is identical in Chapters 6.7 and 6.8, as Chapter 6.8 cross-refers to the formula in 6.7.3. However, this only applies when the tanks are in fact fitted with safety valves.

At length, it was established that it would not be possible for the working group to find in its discussions a fundamental general solution to the BLEVE problem. An (inductive) approach was therefore chosen which, through the collection of possible measures to avoid or reduce the effects of a BLEVE, should result in a list of their advantages and disadvantages.

For the sake of completeness, the chairman of the working group proposed to proceed systematically and to take into account AEGPL's informal document INF. 26.

This approach produced the following list:

| **Hot BLEVE Measure** | | **Cold BLEVE Measure** | |
|---|---|---|---|
| **Pressure relief valve** | | **Additional inspection** | |
| Advantages | Disadvantages | Advantages | Disadvantages |
| – Limitation of the pressure at tank rupture<br>– 30 min protection expected<br>– prevention of overfilling | – in case of overturning limited cooling of the wall in the vapour space<br>– wrenching off in case of accidents?<br>– reliability?<br>– leakproofness? | | |
| **Sun shield** | | **Heat treatment after welding** | |
| Advantages | Disadvantages | Advantages | Disadvantages |
| | Problems when cooling down | | |
| **Complete thermal insulation** | | **Protection against overfilling** | |
| Advantages | Disadvantages | Advantages | Disadvantages |
| – sufficient protection for at least 100 minutes expected<br>– smaller size of safety valves needed | – reduced effect if damaged<br>– Reduced possibility of external visual inspection<br>– water cooling hindered | | |
| **On-board fire equipment** | | **Additional mechanical tank protection** | |
| Advantages | Disadvantages | Advantages | Disadvantages |
| **Reduction of sources of fire** | | **Operational requirements** | |
| Advantages | Disadvantages | Advantages | Disadvantages |
| **Avoiding sources of heat and ignition** | | **Additional technical provisions** | |
| Advantages | Disadvantages | Advantages | Disadvantages |
| **Protection of fuel tank** | | | |
| Advantages | Disadvantages | | |
| **Additional mechanical tank protection** | | | |
| Advantages | Disadvantages | | |
| **Operational requirements** | | | |
| Advantages | Disadvantages | | |
| **Additional technical provisions** | | | |
| Advantages | Disadvantages | | |

This list constitutes little more than a first attempt at a proposed solution in terms of the working group's mandate. The group had to recognise that it could not develop complete

possible solutions in the context of its activities during the Joint Meeting. It established as follows:

– The Dutch approach to preventing a hot BLEVE forms a good basis for continuing the work, taking into account AEGPL's considerations. However, this approach would have to be rounded off, for example with measures to prevent the bottom firing of a tank and to reduce or rule out sources of ignition. So it should not be limited to measures to avoid or reduce the effects of a BLEVE.

– In addition, a corresponding approach to prevent a cold BLEVE would have to be decided or developed.

– For the sake of the completeness of possible measures, it would also have to be investigated whether, in addition to the technical aspects, issues arising from the other risk areas of organisation and people should be considered.

The group therefore recommended that a separate, permanent working group be set up. Its working method remains to be decided and it should work on the basis of the documents referred to, the working group's deliberations and the results of other work that TNO and AEGPL have announced.

**Item 5. Document TRANS/WP.15/AC.1/2006/10 (Portugal – Construction of tanks – inspection of welds)**

As already mentioned in the report of the working group's last meeting (document OCTI/RID/GT-III/2005-B, paragraph 23), the scope of the weld seam inspections set out in 6.8.2.1.23 is not clear with regard to the connections. Standard EN 12972 defines "special consideration of the connections" better than RID/ADR. The document was therefore discussed in connection with the existing standards, which cover the same issues and which will be mandatory by 2009 at the latest. The group finally decided to adopt the proposal with a minor editorial amendment:

6.8.2.1.23 Amend the text for "$\lambda = 0.8$" to read as follows:

"$\lambda = 0.8$: the weld beads shall so far as possible be inspected visually on both faces and shall be subjected to a non-destructive spot check. All weld "Tee" junctions with the total length of weld examined to be not less than 10% of the sum of the length of all longitudinal, circumferential and radial (in the tank ends) welds shall be tested."

**Item 6. INF.9 (UIP – Amendment of special provision TE 3 in 6.8.4)**

The representative of UIP again introduced the problem of a device to check the maximum permissible level of phosphorus, which had already been discussed at the last meeting. According to some members of the group, the pipe inside the tank acts as a sensor and therefore meets the requirements of TE 3 with regard to checking the level of the phosphorus. It was therefore considered that it is not necessary to amend the special provision.

**Item 7. Working group on standards (using material characteristics in the equivalence formula for calculating the wall thickness)**

This problem concerns the use of material characteristics at low temperatures for calculating the minimum wall thicknesses of tanks in accordance with the equivalence formula in 6.8.2.1.18.

The majority of the members of the group were of the view that in this case, only the material characteristics at ambient temperature could be used. However, the relevant paragraphs of RID/ADR were not clearly worded in this respect, as there was previously no need for this. Nevertheless, 6.8.2.1.16 lays down that the stress permitted in the pressure test may not exceed certain material characteristics, which are to be determined at ambient temperature.

Thus until the matter is finally clarified, the elevated material characteristics at low temperatures should not be applied.

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