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### Inland Transport Committee

#### Working Party on the Transport of Dangerous Goods

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

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Item 2 of the provisional agenda

Tanks

#### Clarification of the definition of “maximum working pressure” for tanks

Transmitted by the Government of Switzerland<sup>1, 2</sup>

#### Introduction

1. In informal document INF.22 submitted to the September 2015 session of the RID/ADR/ADN Joint Meeting, the representative of Switzerland highlighted the differences in interpretation of the current wording of the definition of “maximum working pressure” (MWP) for tanks. These differences have recently proved problematic, particularly within the various working groups dealing with tanks for the carriage of dangerous goods (notably those of CEN/TC296). The differences of opinion, which are sometimes fundamental, are preventing work from progressing as it should.

2. Several experts welcomed the proposal to take the reference point for MWP in the ullage space at the top of the shell. However, the new wording of the definition of MWP proposed in the informal document was not adopted. The working group on tanks thought that care should be taken to avoid any unintended consequences related to other aspects, such as the design pressure of the tank. In particular, the case of gravity discharge tanks, which are designed for a calculation pressure of twice the static pressure of the substance to be carried, should be considered.

3. Switzerland hereby submits a revised proposal that takes account of the contributions from the United Kingdom and Germany. It is intended to clarify the definition of MWP to make it unequivocal and thus avoid any possible misinterpretation.

<sup>1</sup> In accordance with the draft programme of work of the Inland Transport Committee for 2016-2017, (ECE/TRANS/WP.15/2015/19 (9.2)).

<sup>2</sup> Circulated by the Intergovernmental Organisation for International Carriage by Rail (OTIF) under the symbol OTIF/RID/RC/2016/17.



## Explanation

4. The current wording of the definition of MWP is the result of a number of successive amendments made to RID and ADR. However, it does not provide clear answers to the following questions:

- I. Where and in which position of the tank should MWP to be determined?**
- II. Does the static pressure relating to the substance to be transported need to be taken into account?**
- III. How is MWP determined for tanks fitted with breather devices?**

5. **With regard to question I:** first of all, it must be pointed out that the definition of MWP specifies a gauge pressure, i.e. the result of pressure in excess of atmospheric pressure (as mentioned in 1.2.2.3 of RID/ADR in respect of receptacles).

We are of the opinion that MWP is the effective pressure likely to be achieved **at the top of the tank in its operating position.**

The text of the 1974 definition of MWP referred to the value of the pressure at the top of the shell. Furthermore, a similar reference is given in the definition of “Maximum allowable working pressure (MAWP)” for portable tanks in 6.7.2.1 of RID/ADR: “a pressure (...) measured at the top of the shell while in operating position (...”).

It is important to mention that exceptional and accidental cases, such as when a tank overturns, must be disregarded, as they imply other pressure conditions that do not correspond to the **maximum working pressure**.

6. **With regard to question II:** it is important to establish a general distinction between two types of tank:

- Pressure tanks designed according to standard EN 14025; and
- Gravity discharge tanks (without the use of pressure above the liquid or solid) intended for the carriage of substances that have a vapour pressure of not more than 110 kPa (1.1 bar) (absolute pressure) at 50 °C that are designed for a calculation pressure of twice the static pressure of the substance to be carried but not less than twice the static pressure of water, according to standard EN 13094.

7. The main function of MWP is to provide operators with information on the correct use of their tanks. It is important to point out that the conditions in which the tanks are used, including the static pressure (product height) and dynamic forces in normal conditions of carriage, such as pitch, should be disregarded in the calculation of MWP.

They are already taken into account in the dimensioning calculations of the tank (cf. 6.5.1 of standard EN 13094 and 5.1 of standard EN 14025).

8. The pressure tanks and vacuum-operated tanks covered by standard EN 14025 have a maximum allowable working pressure much higher than 0.5 bar. The static head of the liquid in this type of tank is minimal or even negligible in respect of the minimum calculation pressure or the opening pressure of the safety valves with which they are fitted.

9. For gravity discharge tanks, there would be an effect from inclusion of the static head of the liquid in the calculation of MWP. It could have consequences on the dimensioning of the tank and determination of the tank test pressure.

10. The instructions for markings under 6.8.2.5.1 specify that the maximum allowable working pressure must be inscribed on pressure-filled or pressure-discharge

tanks. Such marking is not required on gravity discharge tanks (indicated by a “G” in their tank code). This distinction is thus a very clear indication that MWP does not prevail for this type of tank.

11. The link to conditions and inspection of the tanks should also be observed. Standard EN 12972:2007 is sufficiently clear on the matter, as it distinguishes between tanks with a working pressure (mainly pressure tanks covered by standard EN 14025) and those without (gravity discharge tanks covered by standard EN 13094). The procedures prescribed by the standard were approved by the Joint Meeting and have been applied by all stakeholders since its entry into force in 2003.

12. Returning to the subject of question II, by taking the top of the tank as the reference point, it is definitely the pressure generated by the vapour pressure and gas contained in the tank’s ullage space that has to be taken into account. Furthermore, there is no mention of static pressure in the current definition of MWP in RID and ADR.

Therefore, when paragraph (c) of the definition states “to which the tank is subjected by its contents”, it is definitely referring to the pressure generated by the vapour pressure of the product being transported and gas contained **in the ullage space of the tank**. On that basis, **the product’s static pressure must be disregarded**.

13. To provide greater clarity, the penultimate paragraph of the definition of MWP should be merged with the text in paragraph (c), to which it is relevant.

The idea of vapour pressure, which is referred to in paragraph (c), does not apply to the filling or discharge operations defined in paragraphs (a) and (b). It concerns the partial pressure of air or other gases in the ullage space which is likely to be achieved at the tank’s maximum operating temperature as a result of a rise in the temperature of its contents.

14. **With regard to question III:** with the successive revisions of the definition of MWP, and notably when a reference to the prescribed opening pressure of the safety valves was introduced, no reference to **breather devices** was included.

Hence the current wording gives the impression that it covers only pressure tanks and not gravity discharge tanks. We consider that gravity discharge tanks fitted with vents or breather devices should also be covered in the definition of MWP.

15. On the basis of the information provided under question II, it would seem that gravity discharge tanks (indicated by a “G” in the tank code) should be treated differently from pressure tanks.

16. Under 6.8.2.2.6, tanks intended for the carriage of liquids that have a vapour pressure of not more than 110 kPa (1.1 bar) (absolute) at 50 °C shall have a breather device and a safety device to prevent the contents from spilling out if the tank overturns; otherwise they shall conform to 6.8.2.2.7 or 6.8.2.2.8.

17. According to standard EN 13094:2015, tanks must be equipped with a breather device fitted with a safety device to prevent the contents spilling out if the tank overturns, in accordance with standard EN 14595.

18. Under standard EN 14595:2014:

- Pressure breather devices shall have a relieving pressure of not more than 12 kPa (0.12 bar) in their normally installed attitude; and
- The relieving pressure of vacuum breather devices shall be between 0.4 kPa and 2.5 kPa below atmospheric pressure.

19. Gravity discharge tanks can be filled by top loading and/or bottom loading.

- In the case of top loading, the tank is open. It is thus at atmospheric pressure.
  - In the case of bottom loading, the tank is connected to the loading facility for vapour recovery. Since the vapours are returned through the breather vents, slight overpressure is caused by bottlenecks in the cross sectional flow of the vents. Manufacturers' experiences indicate that the overpressure in the tank is around 0.1 bar and remains lower than the set pressure of the vents (otherwise they open), which is very low, and much lower than the tank design pressure.
20. Furthermore, it must not be forgotten that some tanks containing substances that require a LGBV or LGAV tank code, with special provision TE6 taken into account, may be equipped with a device of a design that precludes its obstruction by the substance carried and prevents leakage and the build-up of excess overpressure or underpressure inside the shell. Such tanks are considered to be connected to the outside atmosphere and so do not have a maximum working pressure.
21. The above arguments lead to the conclusion that gravity discharge tanks (without the use of pressure above the liquid or solid) intended for the carriage of substances that have a vapour pressure of not more than 110 kPa (1.1 bar) (absolute pressure) at 50 °C that are designed for a calculation pressure of twice the static pressure of the substance to be carried but not less than twice the static pressure of water and fitted with a breather device have a maximum pressure of 0.12 bar in the ullage space.
- As this figure is relatively low, it may be considered that gravity discharge tanks **have no maximum working pressure**.
22. This approach remains to be validated by the TC 296 WG2 working group. The necessary adaptions to standard EN 13094 are unlikely to be very substantial. Initially, the text of standard EN 13094 could easily be amended as follows:
- Delete the definition of MWP in 3.1.4; and
  - In 6.5.1 (c), replace “1.3 times the maximum working pressure” by “1.3 times the maximum opening pressure of the breather vent”.
- Particular attention should also be paid to the standards concerning the service equipment for these tanks, particularly EN 13081: Vapour collection adaptor and coupler, EN 13314 and EN 13317: Fill hole cover, EN 14596: Emergency pressure relief valve and EN 16249: Cap for the adaptor for bottom loading and unloading, in which reference is made to the maximum working pressure of the tank.
23. Lastly, it is proposed that the wording for compressed or liquefied gases or dissolved gases of Class 2 in the French version should be brought into line with the wording with the English and German versions.
24. On that basis, we propose amending the definition of MWP as follows.

## Proposal

25. The wording of the definition in 1.2.1 of RID and ADR should be amended as follows:
- “*Maximum working pressure (gauge pressure)*” means the highest of the following three pressures **that may be attained at the top of the shell in the operating position**:
- (a) The highest effective pressure allowed in the tank during filling (maximum filling pressure allowed);
  - (b) The highest effective pressure allowed in the tank during discharge (maximum discharge pressure allowed); and

(c) The effective gauge pressure to which the tank is subjected by its contents (including such extraneous gases as it may contain) at the maximum working temperature.

Unless the special requirements prescribed in Chapter 4.3 provide otherwise, the numerical value of this ~~working~~ pressure (~~gauge pressure~~) shall not be lower than the vapour pressure (absolute pressure) of the filling substance at 50 °C.

For tanks equipped with safety valves (with or without bursting disc) other than tanks for the carriage of compressed or liquefied gases or dissolved gases of Class 2, the maximum working pressure (gauge pressure) shall, however, be equal to the prescribed opening pressure of such safety valves.

Gravity discharge tanks (without the use of pressure above the liquid or solid) intended for the carriage of substances that have a vapour pressure of not more than 110 kPa (1.1 bar) (absolute pressure) at 50 °C that are designed for a calculation pressure of twice the static pressure of the substance to be carried and equipped with a breather device have no maximum working pressure.

(The two notes remain unaltered).

## Justification

26. The new wording of the definition of MWP will prevent any divergent interpretations and avoid discussion of the subject.