Organisation intergouvernementale pour les transports internationaux ferroviaires
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(English only)

RID: **13th Session of the RID Committee of Experts' standing working group**
(Geneva, 15 – 19 November 2021)

Subject: **Proposal to amend RID 4.3.2.2.4 for tank-container transports on rail**

Information transmitted by CEFIC

SUMMARY

Executive summary: CEFIC intends to propose an amendment to RID 4.3.2.2.4 for tank-containers transported on rail only. This informal document drafts the content of the proposal.

Decision to be taken: None

Related documents: OTIF/RID/CE/GTT/2020/INF.1
OTIF/RID/CE/GTT/2020/INF.2
OTIF/RID/CE/GTT/2020/INF.3
OTIF/RID/CE/GTT/2019/INF.4

Introduction

1. RID 4.3.2.2.4 determines the applicable filling degrees of shells (i.e. tank-containers) transported by rail, stating that shells shall not be filled between 20% and 80% of their capacity. The respective regulation intends to avoid negative repercussions as possible derailments or others from sloshing movements at filling degrees in between those values.

2. Within the scope of a risk assessment in accordance with the CSM regulative, conducted by BASF SE regarding the newly developed extra-large tank-containers, scientific investigations were undertaken to elaborate the effects from sloshing movements for tank-containers, including extra-large tank-containers and conventional ISO tank-containers. Based on the obtained results of simulations, driving trails and impact tests, no negative

states could be detected where occurring forces initiated by sloshing movements would lead to negative repercussions, such as derailments or others.

3. Increasing transport via rail will be a significant contributor supporting the EU Green Deal ambition to reduce transport GHG emissions by 90%. To fully seize the potential of rail transport, the proposed amendment of RID 4.3.2.2.4 enables a more flexible and efficient utilization of existing tank-container fleets. Customer requirements in terms of volumes within the 20% to 80% can be met without special equipment. High density products can be transported in conventionally dimensioned tank-containers, enabling fleet standardization. More product streams can be realized using rail only, strengthening rail transportation. Deliveries do not need to be split into two or more transports. Respective transports are especially an opportunity for site-to-site shipments, or between sites with enclosed intermodal terminals.

Proposal

4. It is proposed to amend the regulation for all tank-container types in accordance with RID chapters 6.7 and 6.8 transported on rail only and to allow filling degrees between 20% and 80% if it can be assured that a partially filled tank-container will not be transported on the road.

5. This proposal does not affect ADR and is solely intended for RID transports, i.e. rail carriage of dangerous goods. Accordingly, filling degree restrictions for road transportation remain.

6. If a rail transport is preceded or followed by a road transport, ADR 4.2.1.9.6 is applicable.

7. Accordingly, it is proposed to amend the text in the right-hand column of RID 4.3.2.2.4 as follows (new text underlined):

"**4.3.2.2.4** Shells intended for the carriage of substances in the liquid state or liquefied gases or refrigerated liquefied gases, which are not divided by partitions or surge plates into sections of not more than 7 500 litres capacity, shall be filled to not less than 80% or not more than 20% of their capacity.

This provision is not applicable to:

– shells carried by rail only;

– liquids with a kinematic viscosity at 20 °C of at least 2 680 mm^2/s;

– molten substances with a kinematic viscosity at the temperature of filling of at least 2 680 mm^2/s;

– UN 1963 HELIUM, REFRIGERATED, LIQUID and UN 1966 HYDROGEN, REFRIGERATED, LIQUID."

Technical justification

8. Within the framework of the conducted risk assessment in accordance with the CSM Directive ((EU) 402/2013) regarding the newly developed extra-large tank-containers, the effects of sloshing movements inside the vessel of different systems have been investigated scientifically. Besides the extra-large tank-containers, conventional ISO tank-containers and tank-wagons have been subject to the investigations as well.

9. Appropriate investigations have been conducted to assess the repercussions of sloshing movements by (1) driving trails with different fillings degrees to determine the driving characteristics of different systems (i.e. extra-large tank-containers and iCTW, ISO tank-containers and tank-wagons), (2) multi-body simulations of different systems with varying filling degrees and densities in defined scenarios as critical track layouts and excessive cornering speeds, and (3) long-term shunting trails with varying filling degrees.

10. To investigate the effects from sloshing movements driving trails have been conducted with different systems (i.e. extra-large tank-containers and conventional transport tanks) and increasing velocities through a double S-curve, whereas they have been pulled and pushed. Furthermore, based on the acquired data the simulation models of (2) are fitted and failure states are determined.

11. The assessment of the sloshing movements by driving trails is based on the lateral water movements, which have a direct impact on the lateral force on the axle box. Accordingly, the quotient of the lateral force and the permissible maximum force (EN 14363) is assessed to examine the running safety. The respective data is gathered using a variety of sensors located at the wagon and axle boxes, including displacement sensors measuring the lateral movements of the primary springs. Accordingly, the lateral force can be calculated based on the gathered data and spring specifications. For each system and test ride the derived results are compared to their respective maximums in accordance with EN 14363. For each systems the lateral force on the axle box is significantly smaller than the allowable maximum. Similar results have been calculated for all scenarios and filling degrees of 0%, 50%, 75% and 100%.

12. Following the experimental investigations, it can be concluded that for no system and filling degree combination a critical state has occurred due to sloshing movements.

13. As in (1) driving trails have been conducted with a maximum velocity of 25 km/h in a predefined scenario, critical driving situations are further simulated with different systems (i.e. extra-large tank-containers and conventional transport tanks) to assess the effects from sloshing movements with higher velocities above speed limits, following the derailment safety criteria given in EN 14363 and EN 15839.

14. Accordingly, the following driving situations are simulated in the multi-body-simulations software SIMPACK: (a) canted curve with high velocities in train formations, (b) s-curve during shunting and (c) buffing impacts during shunting.

15. The assessment regarding the effects from sloshing movements is based on the simulated values for the quotient of the lateral to vertical wheel contact force and the respective limit value given in EN 14363. Furthermore, the wheel lift in accordance with EN 15839 is regarded. Both criteria are elaborated for each wheelset of each wagon over the entire path of a simulated scenario with varying filling degrees of the vessels.

16. To account for longitudinal and lateral sloshing movements occurring through the simulated driving scenarios, respective models have been implemented to investigate the repercussions on the new systems driving safety.

17. The following systems in the different scenarios were simulated: tank-wagon, extra-large tank-container and ISO tank-container. Each system for each scenario was simulated with a density of 0,997 t/m^3 and filling degrees of 0%, 50% and 100%.

18. Additionally, the tank-wagon and the extra-large tank-container were further simulated with a filling degree of 75% and a density of 0,997 t/m^3.

19. Furthermore, the tank-wagon and the extra-large tank-container were simulated with a filling degree of 50% and a density of 1.8 t/m^3.

20. For all simulations, the maximum quotient (Y/Q > 0.8) is only reached at higher velocities as the maxima for each respective scenario, resulting in similar observations for all investigated scenarios, systems, and filling degrees.

21. Generally, the observed Y/Q values are higher for any scenario for empty or fully loaded systems, than for partially loaded systems.

22. Additionally, the loss of cargo by tilting and lifting of the tank-container through sloshing movements was investigated, indicating no critical states as well.

23. Based on the conducted simulations it can be stated, that for the investigated systems no critical states caused by sloshing movements have been detected for both criteria.

24. To further assess the influences from sloshing movements, a partially filled extra-large tank-container was equipped with accelerations sensors and routed over a hump yard more than 200 times. Furthermore, the respective scenario is simulated likewise (2). The gathered acceleration gather data is compared to the total weight specific limit acceleration values derived from EN 14363. For driving trails and simulations, no negative or critical influences and states caused by sloshing movements inside the vessel could be detected.

25. The conducted scientific investigations cover a variety of critical situations where sloshing movements might impact the driving behavior within the railway system. However, it could be elaborated that filling degrees of tank-containers above 20% and less than 80% have no negative repercussion on the safety within the railway system.

26. Accordingly, it is proposed to adjust the respective requirements in RID 4.3.2.2.4.

Suggestions for operational implementation

27. Applicable regulations determine the loading instance as responsible entity for the shipment of dangerous goods. Accordingly, this instance is responsible to ensure that e.g. tank-containers are suitable to the good (i.e. tank code, material compatibility etc.). Also, they must ensure that the loading unit fulfills given gross weight restrictions of the transport units, considering the filling degree and density of the good. Furthermore, the shipper is responsible for the correct marking, the placarding and to observe the segregation rules. The given proposal yields in the obligation to ensure the accurate transport mode (i.e. rail) for partial shipments is chosen.

28. Furthermore, handling entities such as terminals must ensure as well, that when transport units are switched between intermodal units, gross weight restrictions are not exceeded. Critical cases regarding the maximum allowable gross weight are e.g. intermodal tank-containers with exploited gross weights of 39 t, which cannot be transported on roads, or three gross weight exploited 20 ft ISO tank-containers (3 x 36 t) on a 90 t gross weight container carrying wagon. In general, loading and handling entities need to ensure, that transport systems do not exceed weight limits. This is transferable to partially loaded tank-containers.

29. The credible worst-case scenario following the amendment is a partially loaded tank-container transferred from rail to road. Accordingly, suitable requirements should be implemented following an amendment of RID 4.3.2.2.4, to ensure that partially filled (20% < x% < 80%) tank-containers are not transported by road.

30. Thus, tank-containers should be marked if they are partially filled. Tank-containers for the intermodal use are marked with placards on all four sides, whereas tank-wagons are marked on the two longitudinal sides only. Accordingly, partially filled tank-containers, which can be transported via rail only, could be marked on the two longitudinal sides only as well.

31. As partially filled tank-containers regardless of their size, would not be allowed on road, a distinctive marking or label needs to be introduced. Respective markings could be, e.g. a warning triangle with a percentage sign or a crossed-out road (truck).

32. Furthermore, a note stating the derogated filling degree should be added to the shipment documents, stating that such transports can be fulfilled by rail only.