INSPECTION OF TANK-WAGONS FOR TRANSPORT OF DANGEROUS GOODS IN USING - PROCEDURE AND EXAMPLES FROM PRACTICE

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Abstract: *Transport of dangerous goods in tank-wagons carries the risk of leakage or spillage, which can endanger the lives and health of people, material goods and lead to environmental contamination. The strict application of international regulations and norms that precisely define the mode of transport as well as the requirements for railworthiness and periodical inspection of tank-wagons for transport of dangerous goods, enables the minimization of such risk. This paper provides an overview of the activities carried out during the periodical inspection of tank-wagons for the transport of dangerous goods in accordance with the Regulations concerning the International Carriage of Dangerous goods by Rail (RID) and the current version of EN 12972 (Tanks for transport of dangerous goods - testing, inspection and marking of metallic tanks). Required competencies and knowledge that the expert performing inspection needs to possess are also defined in the paper. Also, examples from years of experience in inspection of these tanks, as well as the basic irregularities and shortcomings observed on individual tank-wagon for transport of dangerous goods are presented. They can be a consequence of both normal wear during long-term exploitation, as well as of improper exploitation, maintenance and even fault in manufacturing process.*
Key words: *inspection, RID, dangerous goods, tank-wagon, expert*

INTRODUCTION

Transport of dangerous goods in tank-wagons, due to potential danger to the environment in case of leakage or spillage of the substance, implies the faultless technical safety of the tank itself and its service equipment. Characteristics of the substance that is transported in the tank determine the material, geometric characteristics, production process, tank equipment, as well as special requirements related to the protection and insulation of the interior or exterior of the tank or the heating of the substance during transport.

The owner or the user of the tank-wagon is obliged to ensure that usage and maintenance of tank-wagons and their equipment are carried out in accordance with the requirements of the Regulations concerning the International Carriage of Dangerous goods by Rail (RID) /1/. Proper usage of the tank (compliance with the prescribed procedure regarding the method of filling and discharging, transport of goods for which the tank is intended and regular maintenance according to the prescribed technology) enables the safe transport of dangerous goods, and design life.

PERIODIC INSPECTION OF TANKS

Tank-wagons are used for the transport of liquid, gaseous, powdery or granular substances and their structure consists of one or more tanks and their equipment and a framework equipped with its own equipment (running gear, suspension, wheelset, buffing and draw gear and brake equipment).

The difference in terms of the purpose and conception of tank-wagons arises from the need for the transport of substances with various physical and chemical properties. In order to facilitate the using of tank-wagons, UIC (*Union internationale des chemins de fer - International Union of Railways*) leaflet 573 (Technical conditions for the construction of tank-wagons) /2/, prescribes unified technical characteristics. RID specifies the requirements for the construction of tank-wagons for the transport of dangerous goods and the obligation to regularly inspect them.

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Tanks for transport of dangerous goods and their equipment shall be subjected to initial inspection before using them (with inspection for type approval or independently for the previously approved tank type), as well as regular (periodic and intermediate inspection) and exceptional checks (if necessary) in exploitation.

The norm applicable to inspection of a tank-wagons for transport of dangerous goods in accordance with RID is EN 12972 /2/. This norm defines types and procedures for inspection (for type approval, initial, periodic, intermediate, and exceptional checks) and tests within these inspections, while periods of regular inspection (maximum 8 years for periodic inspection - intermediate inspection at half of this period) are defined in RID.

Periodic inspection is carried out to determine the current state of the tank and compliance with the requirements of the mentioned regulations. During the periodic inspection of the tank, the knowledge of the initial condition determined at the initial inspection, as well as the knowledge of the data on the exploitation conditions, is of great importance for the evaluation of the condition of tank. When expert performs the inspection, he must have all the relevant technical documents of the tank, including all the tests and maintenance reports up to this point.

Periodic inspection includes examination of documents (a previous inspection report and, if applicable, a tank record), the inspection of the interior and the exterior of the tank, hydraulic pressure test, leakproofness test, as well as the inspection of the service equipment.

The essence of inspection is to determine:

- whether the integrity of the body of the tank has been violated (cracks, deformation, reduced wall thickness, damage of the protective lining or coating);
- the functionality of its service equipment, and whether it is in accordance with the approved type, or requirements of the applicable regulations;
- Is the necessary leakproofness of the closures, covers and other elements of the equipment provided.

Intermediate inspection performed at half-time between two periodic inspection involves activities defined for periodic inspection, except hydraulic pressure testing. An exceptional check is carried out as necessary after possible repairs or damage that can diminish the safety of the body of the tank, repair or replacement of the service equipment, repair or replacement of the protective lining or coating, etc.

After the inspection has been carried out, an expert prints the stamp of the designated inspection body on the identification plate of the tank (if the inspection results are in accordance with the requirements of the regulations) and a report on the conducted inspection is issued.

The mentioned inspection of the tank for the transport of dangerous goods in the Republic Serbia is carried out by experts within the approved inspection bodies. Having in mind the requirements of RID, it is necessary for experts to have the appropriate qualifications necessary for successful implementation of all inspection activities, as well as practical experience in this area (expert knowledge in the field of safety of tank-wagons, sufficient knowledge of the technology for the construction of the tank to be inspected, knowledge to use the tank equipment, as well the knowledge on possible failures, etc.). These inspections and assessments must be carried out by a qualified person with the highest degree of professional reliability and technical competence. It is also necessary for expert and the approved body to be independent of the stakeholders and to possess the necessary devices and equipment for inspection.

EXAMPLES

During many years of experience in tank-wagons inspections, various irregularities and shortcomings were detected, which required necessary repairs in order to make the tank appropriate for further usage. These irregularities and shortcomings are results of normal wear during long-term using, as well of improper usage, maintenance and even faults in manufacturing process. In this paper, some examples of such practices are mentioned.

EXAMPLE 1

A tank-wagon for the transport of phosphoric acid is, having in mind the incompatibility of the tank material (P265GH-SRPS EN 10027-1) /3/ and the transported fluid, has the inside, as well as the part of the outside around the tank dome and other connections, coated with rubber-based protection. During the periodic inspection of this tank, a significant damage and poor repair of the previously damaged rubber coating from the inside was noticed. Also, there was leakage of the test medium (water) on the circular angular welded joint of the flange of internal stop-valve and the body of the tank (when tested with hydraulic pressure). At the damaged places, there was contact with phosphoric acid and the basic material of the tank and a corrosive effect, which led to a progressive reduction in wall thickness of the tank body at a value of as much as 0.5 - 1.5 mm (picture 1). The repair of the tank body was carried ou by replacing complete segments around the dome (picture 2) and internal stop-valve, as well as re-rubberizing all damaged surfaces by an adequate procedure.

Picture 1. – Some of the wall thickness measurement points

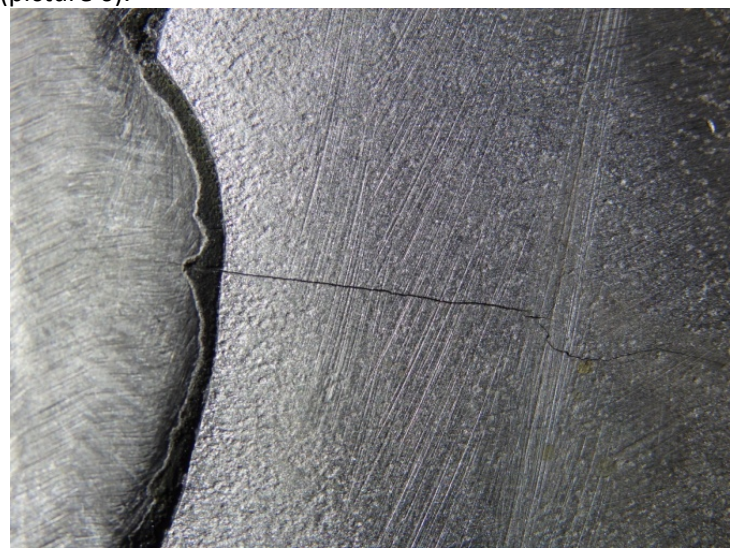
Picture 2. – Replaced segment around the dome

EXAMPLE 2

During internal inspection of several tank-wagons for the transport of acetic acid made of stainless steel (1.4307 /4/), the cracks on the end and the shell were noticed near the welded joint shell-end, as well as the previously repaired cracks in the same zone (picture 3). By removing the thermal insulation from the outside of the tank, it was noticed that the cracks are in the end-effect zone of the longitudinal reinforcement. The repair was done according to the manufacturer's instructions (the cracks were repaired, then the patch was welded from the inside, with the task of preventing the re-occurrence of the crack) (picture 4). From the outer side, the existing reinforcement is extended to the center of the end in accordance with construction of newer tanks.

EXAMPLE 3

On a tank-wagon for the transportation of oil derivatives, an internal inspection revealed a fault that occurred during the construction of the tank. Namely, at the welded joint of two segments of an end, a crack was spotted. After surface treatment (removing the surface layer of corrosion), it was determined that this is not a crack, but rather a part of the incomplete weld. It has much larger length (about 700 mm) and about 5 mm deep (picture 5). Repair of this welded joint was performed in accordance with the prescribed technology (picture 6).



Picture 3. – Spotted cracks

Picture 4. – The patch in the place of the crack

EXAMPLE 4

Another example of an fault in a construction is noticed on tank-wagon for the transport of oil derivatives with reinforcement in the form of a circular ring ("U" profile welded on the circumference of the tank) with circular openings of sufficient diameter at the side and at the bottom to release the possibly collected condensate, i.e. water. In some cases, this opening is not present at the bottom of the ring or it is of an insufficient diameter, resulting in its closure with impurities. Consequently, it can lead to retention of collected water and the appearance of ice in the space between the ring and the body. This causes deformation of the tank body in that zone and the appearance of the crack. On one such tank, during the internal inspection, welding repairs were detected in the mentioned zone, and during the hydraulic pressure test the test medium leaked. In order to determine the exact location of the cracks, the pressure was exerted on the outside with water in the reinforcement itself, which enabled the cracks to be seen from the inside (picture 7). In addition, penetrant test from the inside was performed, and the patches were set in that zone.

Picture 5. – Part of the incomplete weld

Picture 6. – The repair of welded joint

Picture 7. – The cracks spotted from the inside

EXAMPLE 5

An example that shows that it is not always possible to spot a crack on the tank body during visual inspection, is a tank-wagon with a structural reinforcement in the form of an additional plates from the inside and the outside in tank support zone, where the cracks are located. After the detection of the leakage point from the outside (picture 8) and the inside (picture 9), welding was done in these zones on the inner and outer reinforcement of the tank.

EXAMPLE 6

A tank-wagon for the transport of concentrated sulfuric acid is an example of the influence of its possible mixing with water. Namely, during the internal inspection of this tank made of steel, narrow zones at the bottom were detected with a significantly reduced thickness compared to the designed thickness of body, the cause of which is probably the mixing of acid residues on the bottom with water from the atmosphere or some other source. This diluted sulfuric acid, unlike concentrated, very aggressively affects the material of the tank. The repair was done by welding the additional sheet metal in the mentioned zone (picture 10).

Picture 8. – The leakage point of the test fluid from the outside

EXAMPLE 7

A tank-wagons for the transport of LPG are an example of reduction in thickness of the tank body walls during long-term usage, which requires the measurement of wall thickness during periodic inspection in the case of a noticeable increase in corrosion. A calculation of the shell thickness is drawn up to determine the suitability for further use of the tank for the stated purpose. During inspection of these tank-wagons, a certain number is limited to their use on the reduced number of mixtures compared to the original, because of the reduction in the thickness of the walls of tank body.

Picture 9. – The leakage point of the test fluid from the inside

CONCLUSION

Considering the characteristics of dangerous goods carried in tank-wagons and environmental hazards in the event of leakage or spillage in case of tank or equipment failure, as well as the need for the tank to function properly in its design life, it is necessary to strictly observe the prescribed usage procedure, provide adequate maintenance of the tank and its equipment, as well as periodic inspections prescribed by RID, which must be carried out in accordance with the applicable norm (EN 12972). In this way, in addition to reducing the immobilization (which lead to a greater utilization of the tank in its design life), the safety of the transport of dangerous goods in tank-wagons is significantly increased.

Picture 10. – Additional sheet metal repair zone

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REFERENCES

/1/ The Regulations concerning the International Carriage of Dangerous goods by Rail (RID)
/2/ UIC leaflet 573 - Technical conditions for the construction of tank-wagons
/3/ EN 12972 - Tanks for transport of dangerous goods - Testing, inspection and marking of metallic tanks
/4/ SRPS EN 10027-1 - Designation systems for steels - Part 1: Steel names
/5/ SRPS EN 10027-2 - Designation systems for steels - Part 2: Numerical system