



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** March 12, 2001

**In reply refer to:** R-01-01 and -02

Mr. S. Mark Lindsey  
Acting Deputy Administrator  
Federal Railroad Administration  
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About 12:05 a.m. on February 18, 1999, railroad tank car UTLX 643593, which was on the west unloading rack at the Essroc Cement Corporation cement plant near Clymers, Indiana, sustained a sudden and catastrophic rupture that propelled the tank car's tank about 750 feet and over multistory storage tanks.<sup>1</sup> There were no injuries or fatalities. Total damages, including property damage and costs from lost production, were estimated at nearly \$8.2 million. The National Transportation Safety Board determined that the probable cause of the accident was the failure of Essroc Cement Corporation and CP Recycling of Indiana management to develop and implement safe procedures for offloading toluene diisocyanate (TDI) matter wastes, resulting in the overpressurization of the tank car from chemical self-reaction and expansion of the TDI matter wastes. Among other issues raised by the accident were the adequacy of inspection and testing requirements for pressure relief devices on railroad tank cars and the adequacy of provisions addressing changes in product service for railroad tank cars.

After the Clymers accident, the Federal Railroad Administration (FRA) mandated that the pressure relief valves from 4 of 24 tank cars containing TDI matter wastes in storage near Clymers be pressure-tested in accordance with the U.S. Department of Transportation (DOT) *Hazardous Materials Regulations* before any of the tank cars could be transported for unloading. When these tests were performed in March 1999, three of the four valves were not due for retesting until 2003. Each valve had 4 years remaining of its 10-year test cycle. The fourth valve, also on a 10-year test cycle, was due for a retest in 1999. The pressure relief valve from UTLX 643593 was on a 10-year test cycle and not due for a retest until 2003. This valve was also examined and tested in May 1999. All five pressure relief valves failed to meet the tolerances for the start-to-discharge pressure and vapor-tight pressure as required under the regulations.

The teardown and inspection of the pressure relief valves from these five tank cars (the four cars that the FRA required to be tested and UTLX 643593) demonstrated that the valves were in a deteriorated condition. The ethylene propylene rubber O-rings showed evidence of swelling,

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<sup>1</sup> For more information, see forthcoming Hazardous Materials Accident Report NTSB/HZM-01/01: *Catastrophic Rupture of a Railroad Tank Car Containing Hazardous Waste Near Clymers, Indiana, February 18, 1999* (Washington, DC: National Transportation Safety Board, 2001).

hardness, and brittleness, and the metallic components exhibited varying degrees of rust, scale, pitting, and grit. Replacement of the deteriorated O-rings in the pressure relief valve from UTLX 643593 with new O-rings did not, by itself, bring about proper operation of the valve. Even with the new O-rings, the pressure relief valve from UTLX 643953 was within the tolerances for the start-to-discharge and vapor-tight pressures only after all dirt, grit, and other debris had been removed from the sealing surfaces of the valve. Consequently, it appears that the accumulation of rust, scale, and dirt caused the five pressure relief valves to fail to meet the required start-to-discharge and vapor-pressure standards. Therefore, the Safety Board concluded that, based on the deteriorated condition of the pressure relief valves examined in this investigation and the failure of these valves to activate as required, the pressure relief valves on tank cars that transport hazardous materials may require more frequent and rigorous testing to ensure that they remain functional.

The testing interval for a tank car and its components under the DOT *Hazardous Materials Regulations* depends in part upon the types of products that are transported in the tank car. Tank cars that transport corrosive materials must be inspected and retested every 5 to 10 years, whereas tank cars that transport noncorrosive materials must be inspected and retested every 10 years. The regulations also require testing and inspection if there is evidence of damage, corrosion, cracks, dents, or deformation or if the tank car is involved in an accident and is repaired. However, the deterioration of the pressure relief valves from UTLX 643593 and the other four tank cars was only detected when the valves were disassembled and inspected. Consequently, the Safety Board believes that the FRA and the Research and Special Programs Administration should, with the assistance of the Association of American Railroads (AAR) and the Railway Progress Institute, evaluate the deterioration of pressure relief devices through normal service and then develop inspection criteria to ensure that the pressure relief devices remain functional between regular inspection intervals. They should also incorporate these inspection criteria into the DOT *Hazardous Materials Regulations*.

The Clymers accident also raised the issue of the adequacy of provisions addressing changes in product service for railroad tank cars. The Clymers investigation indicated that even when appropriate test intervals are established and followed, carriage of cargoes that chemically attack gaskets and O-rings in valves and fittings can undermine the integrity of valves and fittings. Data provided by Union Tank Car Company (the manufacturer of tank car UTLX 643593) indicated that ethylene propylene rubber is subject to chemical attack when it is exposed to monochlorobenzene (MCB) and naphthalene, a primary constituent of HAN 906 solvent.<sup>2</sup> The swelling, hardness, and brittleness of the ethylene propylene rubber O-rings in the pressure relief valves from UTLX 643593 and the four other tank cars that were tested likely resulted from exposure to the MCB in the TDI matter waste.

The addition of a new chemical constituent to a commodity approved for transportation in a tank car changes the chemical composition of that commodity and results in the exposure of gaskets and seals on the tank car to a new mixture. The concentration of a newly added chemical constituent may be sufficiently diluted as to present little or no risk of chemical attack to gaskets and seals, but the risk level can best be ascertained by tests or verification through technical literature that the new chemical constituent is compatible with the gaskets and seals on the tank car.

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<sup>2</sup> MCB and HAN 906 solvent were often in the TDI waste mixtures transported in tank cars such as UTLX 643593.

The AAR Manual of Standards for tank cars clearly places the responsibility on the shipper to ensure that the materials used for gaskets and valve seals are compatible with the lading and the service temperature. Under *49 Code of Federal Regulations* 173.31(a)(2), a tank car may be transferred from one specified commodity service (listed on the tank car's certificate of construction) to another only by the owner or with the owner's authorization. In addition, under *49 Code of Federal Regulations* 179.15, the pressure relief device on DOT class 111A tank cars must be made of materials that are compatible with the commodity being transported. Further, the FRA interprets the addition of new constituents to TDI to represent a change in service if the additional constituents substantially change the chemical makeup of the TDI or change the hazard class of the TDI.

The shippers that sent the TDI waste mixtures to the Essroc plant for disposal did not consider that the presence of MCB and HAN 906 solvents in the TDI waste mixtures might adversely affect the O-rings in the pressure relief valves and other gaskets on the tank cars used to store and transport these wastes. Consequently, the shippers did not find that the presence of these chemicals constituted a substantial change in product service from the transport of pure TDI. The investigation, however, showed that the presence of MCB and HAN 906 solvent in the TDI waste mixtures was sufficient to chemically attack the O-rings in the pressure relief valves on tank cars carrying TDI waste mixtures. Therefore, the Safety Board concluded that the transportation of the solvent blend wastes and TDI matter wastes in UTLX 643593 and the other tank cars approved for the transport of pure TDI constituted a change in product service that resulted in the transport of a commodity incompatible with components of the tank car.

The FRA's interpretation that a change in product service occurs when the chemical makeup is substantially changed is subjective and may account for the shippers' misinterpretations that the solvent blend wastes and TDI matter wastes were not "substantially different" from pure TDI. Although the criteria in the AAR Manual of Standards for tank cars and *49 Code of Federal Regulations* 179.15 seem clear that tank car valves and components must be compatible with the commodity being transported, the shippers' mistaken beliefs in this instance suggest that other producers that ship hazardous materials may hold similarly incorrect views regarding the interpretation of these criteria.

The Safety Board knows, for example, that other tank cars used for shipping both solvent blend wastes and TDI matter wastes are equipped with pressure relief valves with ethylene propylene rubber O-rings. The Safety Board does not know, however, whether the shippers using these cars have considered that the MCB and HAN 906 solvents in the TDI waste mixtures might adversely affect the O-rings in the pressure relief valves. Therefore, the Safety Board believes that the FRA should issue an advisory bulletin reminding shippers of hazardous materials that any time a change is made in the chemical constituents of hazardous materials shipped, they should verify the compatibility of all tank car components, such as valves and gaskets, with all of the commodities to be transported.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the Federal Railroad Administration:

Issue an advisory bulletin reminding shippers of hazardous materials that any time a change is made in the constituents of hazardous materials shipped, they should

verify the compatibility of all tank car components, such as valves and gaskets, with all of the commodities to be transported. (R-01-01)

Evaluate, with the assistance of the Research and Special Programs Administration, the Association of American Railroads, and the Railway Progress Institute, the deterioration of pressure relief devices through normal service and then develop inspection criteria to ensure that the pressure relief devices remain functional between regular inspection intervals. Incorporate these inspection criteria into the U.S. Department of Transportation *Hazardous Materials Regulations*. (R-01-02)

The Safety Board also issued safety recommendations to the Research and Special Programs Administration, the Association of American Railroads, the Railway Progress Institute, the Lyondell Chemical Company, the Olin Corporation, the Essroc Cement Corporation, and CP Recycling, Inc., and Affiliated Companies.

Please refer to Safety Recommendations R-01-01 and -02 in your reply. If you need additional information, you may call (202) 314-6170.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Carol J. Carmody  
Acting Chairman