

ENSURING RAILROAD TANK CAR SAFETY

About 115,000 railroad tank cars operating in the United States are used to ship bulk liquids and gases regulated by the U.S. Department of Transportation because their contents are flammable, corrosive, poisonous, or pose other hazards if accidentally released. These materials—including industrial acid, fertilizer, fuel, and alcohol—are essential to manufacturing, agriculture, and other sectors of the economy.

To ensure the safety of tank cars, DOT and industry have taken steps to enhance both the tank car and the environment in which it operates. These efforts have been highly successful. Each year tank cars make about 1 million trips carrying hazardous materials. Accidental releases occur approximately once out of every 1,000 shipments, resulting in about 1,000 releases each year. The majority of these releases are small spills and leaks that are the result of defective or poorly secured valves and other tank fittings. Fatal releases are especially rare. Since 1980 one person has died as a result of a tank car accident.

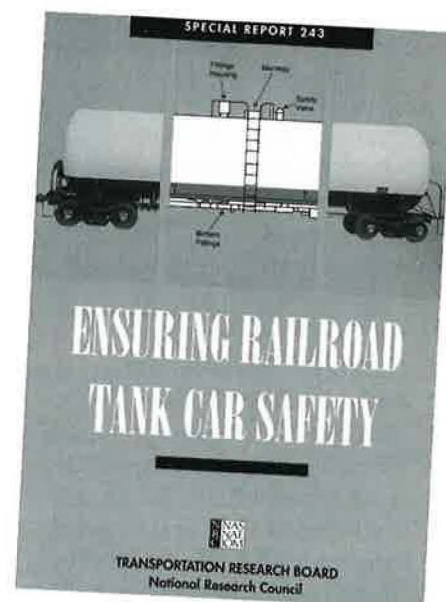
Tank cars have not always performed as well. From 1965 to 1980 more than 40 people were killed in tank car accidents. Many involved damage to pressure tank cars carrying flammable gases. Often the ends, or heads, of these tank cars were punctured by the couplers of adjoining cars during car switching operations or train derailments. These incidents sometimes resulted in massive fires that engulfed adjacent tank cars carrying flammable gases, setting off a chain reaction of fires and explosions. In several cases flammable gas cars heated by fire ruptured violently after firefighters and other emergency responders had arrived at the scene.

As a result of these incidents, puncture protection devices, consisting of steel plates placed in front of the tank heads, were required on flammable gas cars to

shield the tank ends from impacts during derailments and other crashes. To prevent fire-induced tank ruptures, special heat-resistant tank insulation systems, known as thermal protection, were required on flammable gas cars. As an additional safeguard, special coupler-restraint systems, called double-shelf couplers, were installed on all tank cars carrying hazardous materials. These devices, which provide more secure interlocking of tank cars with adjoining cars, help prevent collisions during coupling and rollover damage during derailments.

Today about two-thirds of pressure tank cars—which account for about 40 percent of tank cars used in hazardous materials service—are equipped with head protection, and about half are equipped with thermal protection. All tank cars in hazardous materials service have double-shelf couplers. The advent of these safety devices helped bring about sharp declines in tank punctures, ruptures, and resultant fatalities. Punctures dropped by more than 90 percent after head protection systems and double-shelf couplers were installed on flammable gas cars starting in the late 1970s. Tank ruptures also declined dramatically after the installation of thermal protection. At the same time punctures and other types of accident damage declined among tank cars not equipped with head protection, because of the widespread use of double-shelf couplers and improvements in the railroad operating environment and tank car handling and loading practices.

Major classes of tank cars not equipped with head protection include nonpressure cars—which carry liquids and account for about 60 percent of tank cars in hazardous materials service—and pressure cars that carry nonflammable and nonpoisonous gases. The materials carried in these cars are generally less volatile and threatening than are the flammable and poison gases. Yet these tank cars and materials are some-



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times involved in serious incidents. During the past 10 years several incidents involving nonpressure tank cars have resulted in injuries, community evacuations, environmental contamination, and other adverse consequences. These incidents led the National Transportation Safety Board and others to question some of the procedures used by government and industry in ensuring the safety of tank car designs and to call for head protection to be required on more types of tank cars.

In the 1990 Hazardous Materials Transportation Uniform Safety Act, Congress called for an examination of the tank car design process and an assessment of whether head shields should be required on all tank cars carrying hazardous materials. To conduct the study, TRB convened a committee of experts in tank car design, chemical and mechanical engineering, transportation and hazardous materials safety, chemi-

cal shipping, railroad operations and labor, and transportation economics and regulation.

After reviewing tank car incident data, the committee concluded that trends in tank car safety are good and found no indication of safety problems emerging that might alter these trends. After examining the system for ensuring tank car safety, which consists of government and industry standard setting, research, and enforcement activities, the committee concluded that the system is fundamentally sound and comparable with those used for other vehicles and containers that require high levels of safety assurance. The committee concluded, however, that new safety demands—resulting from changes in public safety expectations, the environment in which tank cars operate, and the types of materials shipped in tank cars—warrant further improvements in procedures for ensuring tank car safety. The following measures were recommended:

- *Improve DOT and industry cooperation to identify critical safety needs and goals and take action to achieve them.* DOT and industry have vital roles in ensuring tank car safety. Each monitors tank car condition and safety performance in the field, investigates prospective safety improvements, and sets standards for tank car design, maintenance, and operations. The committee concluded that DOT and industry need to develop better relationships and procedures for preventing safety problems instead of reacting to them as they occur. Recommendations call for improving procedures for sharing information and expectations about long-term safety needs and goals and for planning and committing to specific actions to achieve them.

- *Improve the implementation of industry design approval and certification functions and federal oversight procedures.* Like many agencies responsible for the safety of transport vehicles and containers, DOT depends on industry to ensure broad compliance with design standards and good practices. In this regard, the Association of American Railroads' Tank Car Committee (TCC), which is composed of representatives of railroads, tank car sup-

pliers, and shippers, is authorized to review and approve tank car design drawings; methods of construction and repair; and other aspects of tank car design, maintenance, and construction. Recommendations call for DOT to provide a clearer explanation of the TCC's approval authorities and government's oversight responsibilities and to work with industry to ensure that TCC is able to devote sufficient time and resources to those activities of greatest importance to safety.

- *Strengthen the information and criteria used in assessing the safety performance of tank car design types and assigning materials to tank cars.* DOT sets design criteria for the dozens of tank car design types. The hundreds of hazardous materials regulated by DOT are subject to restrictions on the type of tank car in which they can be transported. Correct assignment of hazardous materials to design types requires a thorough understanding of the safety performance of each design and the physical, chemical, and hazard characteristics of the materials shipped in tank cars. Recommendations call for DOT to develop more comprehensive information and criteria for evaluating the safety performance of individual tank car design types and the hazard characteristics of the many different kinds of hazardous materials.

In considering the need for head protection on all tank cars in hazardous materials service, the committee concluded that head protection is essential for tank cars carrying materials with the greatest potential to harm humans and the environment if released, but concluded that a requirement for head protection on all tank cars in hazardous materials service is not warranted by the information currently available. Because a small portion of tank car releases is caused by damage to tank car heads and because there is wide variation in the types of hazards posed by the materials shipped in tank cars, the committee concluded that further requirements for head protection must be carefully targeted. By developing better information on the safety performance of individual tank car design types and the hazard characteristics of the materials shipped in them, as

recommended, the committee believes DOT will have a stronger technical basis for identifying those instances in which additional safety features such as head protection are warranted and for reassigning materials to safer tank car design types when necessary.

Committee for the Study of the Railroad Tank Car Design Process

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