National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: H-02-23 through -25

Honorable Ellen G. Engleman
Administrator
Research and Special Programs Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

About 2:15 p.m., central daylight time, on May 1, 2001, a northbound tractor, in combination with a semitrailer that had horizontally mounted cylinders filled with compressed hydrogen, which is a flammable gas, struck a northbound pickup truck that had veered in front of the tractor-semitrailer on U.S. Highway 75, 2 miles south of Ramona, Oklahoma. According to witnesses, the tractor-semitrailer then went out of control and overturned while continuing along the highway. It went off the road to the east and traveled 300 more feet before it stopped. During the process, some of the cylinders, valves, piping, and fittings at the rear of the semitrailer were damaged and released hydrogen. The hydrogen ignited and burned the rear of the semitrailer. In the meantime, the pickup truck had also run off the road. The pickup truck's fuel line ruptured, resulting in the truck being destroyed by fire.

As a result of the accident, the truckdriver was killed, and the driver of the pickup truck was seriously injured. Residents of five homes in the vicinity of the accident were asked to evacuate, and the highway was closed for more than 12 hours. Damage, cleanup, and lost revenues were estimated at $155,000.[1]

The National Transportation Safety Board determined that the probable cause of the May 1, 2001, collision and subsequent fire involving a tractor-semitrailer and a pickup truck in Ramona, Oklahoma, was the failure, for unknown reasons, of the pickup driver to control her vehicle. Contributing to the severity of the accident were the inadequate protection and shielding of the cylinders, valves, piping, and fittings and the inadequate securement of cylinders on the semitrailer.

Under the hazardous materials regulations (49 *Code of Federal Regulations* [CFR] 173.301), protection for valves and rupture disks for U.S. Department of Transportation specification cylinders horizontally mounted on semitrailers must be designed to "withstand a

[1] For additional information, see forthcoming Hazardous Materials Accident Report--*Release and Ignition of Hydrogen Following the Collision Between a Tractor/Semitrailer with Horizontally Mounted Cylinders and a Pickup Truck Near Ramona, Oklahoma, May 1, 2001* (NTSB/HZM-02/02).

force equal to twice the weight involved with a safety factor of four, based on the ultimate strength of the material used." Although the Research and Special Programs Administration (RSPA) has not issued a formal written interpretation of this requirement, RSPA staff has advised the Safety Board that the requirement applies only to a rear-end strike to the semitrailer. Many semitrailers have extended rear bumpers, and such bumpers may offer protection from rear strikes, but they afford no protection from the side and top forces that are typically encountered in a rollover accident.

The regulations do not specify whether the valves, piping, and fittings must be enclosed and shielded by a protective structure; and the regulations do not explain whether other options for protection, such as recessed valves and fittings, are acceptable. This lack of specificity in the regulations led one manufacturer of semitrailers with horizontally mounted cylinders to believe that the cabinet that encloses the valves, piping, and fittings is designed to protect them from being sheared or broken off. A second manufacturer believes that an extended rear bumper fulfills the requirements to protect valves and fittings. Another manufacturer stated that the cabinet must be constructed to comply with the requirements that apply to portable gas cylinders. There is no clear and concise requirement in the hazardous materials regulations that addresses the protection of valves and fittings from forces in a rollover accident. The absence of RSPA guidance has created differing perceptions within the industry about what is actually required for protecting valves, piping, and fittings on a semitrailer with horizontally mounted cylinders.

Because of the ambiguities of the existing regulations and the various interpretations among the manufacturers of the vehicles, the Safety Board concluded that the hazardous materials regulations do not provide sufficient and clear requirements for protecting cylinders and valves, piping, and fittings of cylinders that are horizontally mounted on semitrailers. Consequently, the hazardous materials regulations must address the multidirectional forces that these cylinders, valves, piping, and fittings may experience in a rollover accident. Therefore, the Safety Board believes that RSPA should modify 49 CFR 173.301 to clearly require that valves, piping, and fittings for cylinders that are horizontally mounted and used to transport hazardous materials are protected from multidirectional forces that are likely to occur during accidents, including rollovers.

Also, cylinder 3 on the accident vehicle was fractured by overstress resulting from the initial impact of the front of the cylinder on the roadway or terrain during the rollover of the vehicle, and the cylinder was ejected from the semitrailer. The cylinder was particularly vulnerable to absorbing the initial impact with the roadway or ground because its body extended beyond the top and side edges of the semitrailer's bulkheads. The hazardous materials regulations are silent regarding the protection and shielding of horizontally mounted cylinders on semitrailers from initial impact during rollover accidents. According to the manufacturers of semitrailers with horizontally mounted cylinders, the accident semitrailer was typical of other semitrailers in service. Consequently, the Safety Board concluded that because horizontally mounted cylinders on semitrailers typically extend beyond the envelope of the bulkheads, the cylinders are exposed and vulnerable to initial impact with the roadway or terrain during rollover accidents and are at increased risk of damage, failure, and ejection. Therefore, the Safety Board believes that RSPA should require that cylinders that transport hazardous materials and are horizontally mounted on a semitrailer be protected from impact with the roadway or terrain to reduce the likelihood of their being fractured and ejected during a rollover accident.

The emergency responders who are first to arrive at an accident scene often use the *North American Emergency Response Guidebook* as their first reference. The first responders to the Ramona accident used the book and referred to the guide for hydrogen. However, the guide did not provide complete information about the unique properties of hydrogen, specifically that hydrogen burns with an invisible, or almost invisible, flame. The guide also contained generic information about chemical properties, such as vapors sinking to the ground, which do not apply to hydrogen.

Incomplete or inaccurate information in the guidebook may lead first responders to take measures that endanger them. The Safety Board concluded that although the incomplete or inaccurate information about hydrogen in the *North American Emergency Response Guidebook* was not a factor in this accident, there is the possibility that the lack of information could increase the risk to emergency response personnel.

Consequently, the Safety Board believes that RSPA should revise the information about hydrogen in the *North American Emergency Response Guidebook* so that it specifically identifies the unique chemical and flammability properties of hydrogen.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the Research and Special Programs Administration:

> Modify 49 *Code of Federal Regulations* 173.301 to clearly require that valves, piping, and fittings for cylinders that are horizontally mounted and used to transport hazardous materials are protected from multidirectional forces that are likely to occur during accidents, including rollovers. (H-02-23)
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> Require that cylinders that transport hazardous materials and are horizontally mounted on a semitrailer be protected from impact with the roadway or terrain to reduce the likelihood of their being fractured and ejected during a rollover accident. (H-02-24)
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> Revise the information about hydrogen in the *North American Emergency Response Guidebook* so that it specifically identifies the unique chemical and flammability properties of hydrogen. (H-02-25)

Please refer to Safety Recommendations H-02-23 through -25 in your reply. If you need additional information, you may call (202) 314-6177.

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

Original Signed

By: Carol J. Carmody
Acting Chairman