

Log H-561A



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Date: October 15, 1991

In reply refer to: H-91-34

Mr. Travis P. Dungan
Administrator
Research and Special Programs Administration
U.S. Department of Transportation
400 7th Street, S.W.
Washington, D.C. 20590

About 3 a.m. Pacific standard time on February 13, 1991, a tractor-semitrailer (cargo tank) overturned as the vehicle was traveling on a main urban roadway in Carmichael, California.¹ At the time of the accident, the cargo tank contained about 8,800 gallons of automotive gasoline that was being transported by intrastate delivery to a service station. Gasoline from the cargo tank spilled into a nearby drainage ditch and entered the underground drainage system. Gasoline vapors ignited from an undetermined ignition source, and the fire flashed back and engulfed the overturned cargo tank. In addition to the total loss of the tank truck, its cargo, and two parked cars, four homes and their contents were destroyed or heavily damaged by fire, and the residents from a 2-mile-square area were evacuated. Total property damage and cleanup costs were estimated at nearly \$1 million. There were three minor injuries.

Based on its investigation of the accident, the Safety Board concluded that the gasoline was released through an opening in the manhole cover for the front compartment of the cargo tank, most likely after a liquid-level sensor was dislodged by a dynamic surge of the gasoline cargo.

The cargo tank involved in the accident was a Department of Transportation (DOT) specification MC 306. Prior to 1989, general design and construction standards for MC 306 cargo tanks were provided in 49 CFR Part 178. Section 178.341-3 required the manhole and fill-opening covers for each compartment of a cargo tank to be designed and constructed to withstand internal fluid pressures of 9 psig without permanent deformation. There were no requirements to test the manhole covers with devices such as the liquid-level sensors mounted on the manhole cover, or to test the liquid-level sensors independently.

¹ The accident report contains more detailed information: "Overturn of a Tractor-Semitrailer (Cargo Tank) With the Release of Automotive Gasoline and Fire, Carmichael, California, February 13, 1991," Hazardous Materials Accident Report NTSB/HZM-91/01.

In June 1989, the Research and Special Programs Administration (RSPA) amended the regulations pertaining to the design, manufacture, operation, and maintenance of all DOT specification highway cargo tanks.² RSPA noted in the preamble published with the final rules that the amendments fundamentally changed the design and construction for new bulk liquid cargo tanks. Bulk liquid cargo tanks constructed under the new rules will be designated as specification DOT 406, DOT 407, and DOT 412 and will replace the existing MC 306, MC 307, and MC 312 cargo tank specifications. Consequently, the design and construction standards for the MC 306, 307 and 312 cargo tanks were superseded by the 1989 amendments. In response to petitions for reconsideration filed as a result of the June 1989 amendments, RSPA published a subsequent final rule in September 1990³ to address these petitions for reconsideration. The 1990 amendments delayed the effective date of the 1989 amendments, which establish standards for the new DOT 400 series cargo tanks, and all subsequent amendments until December 31, 1990. Further, the 1990 amendments, under Section 49 CFR 180.405, provide a transition period during which the continued construction of new MC 306, 307, and 312 cargo tanks is authorized between December 31, 1990, and August 31, 1993; these newly constructed tanks must meet the specifications for the MC 306, 307, and 312 cargo tanks that were in effect just prior to the effective date of the 1989 amendments.

The 1989 amendments included design standards for manhole covers for DOT 406, 407, and 412 cargo tanks. Under 49 CFR 178.345-5, each manhole cover must be: (1) capable of withstanding, without leakage or permanent deformation that would affect its structural integrity, a static internal fluid pressure of at least 36 psig, or cargo tank pressure, whichever is greater; (2) fitted with a safety device that prevents the cover from opening fully when internal pressure is present; and (3) secured with fastenings that will prevent opening of the covers as a result of vibration under normal transportation or shock impact during a rollover accident on the roadway when the fill cover is not struck by a substantial obstacle. This section requires that vents on the manhole cover must be blocked when the manhole cover is tested. There is no requirement, however, that manhole covers be tested with accessory devices installed, or that any accessory devices meet any testing standard.

Under these new regulations, manhole covers on all MC 306, 307, 312, and older MC series bulk liquid cargo tanks⁴ must be upgraded to meet the 36 psig standard by August 31, 1995. Under 49 CFR 180.405(g), owners of any MC

² Federal Register, Vol. 54, No. 111, dated June 12, 1989, page 24982.

³ Federal Register, Vol. 55, No. 174, dated September 7, 1990, page 37028.

⁴ MC 300, 102, 302, 303, and 305 cargo tanks were the precursors of the MC 306 tanks. MC 310 and 311 cargo tanks were the precursors of the MC 312. Although tanks of these specifications are no longer produced, many may still be in hazardous materials service.

series bulk liquid cargo tank must equip their cargo tanks with manhole covers that conform with 49 CFR 178.345-5.

As part of its investigation, the Safety Board calculated the dynamic force on the forward manhole compartment of the cargo tank involved in the Carmichael accident. The National Highway Traffic Safety Administration (NHTSA) has indicated that, based on front-end impact testing of new-model passenger cars with a fixed barrier, the elapsed time of the impact forces on a car is typically between 100 and 150 milliseconds (0.1 to 0.15 seconds). Although similar impact tests have not been conducted on commercial tractor-trailer trucks, this range of impact times provides the best available comparison of the impact time of the cargo tank in the Carmichael accident with a dirt embankment of the drainage ditch, which the cargo tank struck during the rollover. Although the dirt embankment likely provided some cushion to the cargo tank on impact in this accident (resulting in a longer impact impulse time), the possibility exists that an overturned cargo tank could, in similar circumstances, strike a rigid barrier such as a concrete retaining wall. Therefore, calculations of the dynamic forces provide a reasonable estimate of the forces that can be generated on the manhole covers. On the basis of the calculated impact speeds of the cargo tank with the dirt embankment, and of the elapsed impact times, the dynamic force per unit area on the forward manhole compartment was calculated to be between 20 and 50 psia. The calculations suggest that had the tank struck a concrete abutment, the manhole cover (and sensors) could have been subjected to pressures consistent with the static design requirements. However, in the case of the Carmichael accident, the liquid-level sensor may have failed to withstand a dynamic surge pressure significantly below the static design pressure of 36 psig (51 psia).

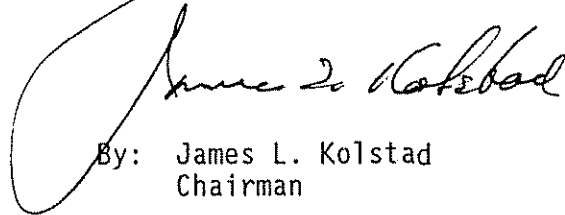
The recent revisions of the cargo tank design standards in 49 CFR are a major improvement in the standards. However, the new performance standard that applies to the manhole cover does not specifically address fittings or devices mounted on the manhole cover, and thus these fittings and devices are not required to be (and generally are not) tested for dynamic or static loads. The Carmichael accident demonstrates that the performance standard for loading should apply to the manhole cover as it will be configured during transportation. If load-testing cannot be accomplished with the manhole covers exactly configured, the fittings and devices mounted on the manhole cover should be independently designed and tested to meet the same design loads as the manhole cover itself. If the liquid-level sensors had been required to meet a performance standard comparable to the static loading standard for the manhole cover, the release of gasoline through the manhole cover on the accident vehicle may have been averted, thereby reducing the severity of the accident. The Safety Board believes, therefore, that the RSPA should require that all fittings and devices mounted on a manhole cover of cargo tanks meet the same performance standard to withstand the static internal fluid pressure as that required for the manhole cover.

Therefore, as a result of its investigation, the National Transportation Safety Board recommends that the Research and Special Programs Administration:

Require that all fittings and devices mounted on a manhole cover of cargo tanks meet the same performance standard to withstand the static internal fluid pressure as that required for the manhole cover. (Class III, Longer Term Action) (H-91-34)

Also as a result of its investigation, the Safety Board issued recommendations to the Federal Highway Administration and the National Highway Traffic Safety Administration of the U.S. Department of Transportation; the State of California; other States and U.S. Territories; and to Calzona Tankways, Inc.

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT concurred in this recommendation.



By: James L. Kolstad
Chairman