DEPARTMENT OF TRANSPORTATION

Research and Special Programs Administration

49 CFR Parts 173, 177, and 178

[Docket No. HM-183, Advance Notice No. 82-5]

Design, Maintenance, and Testing of MC-306 Cargo Tanks

AGENCY: Materials Transportation Bureau, Research and Special Programs Administration, DOT.

ACTION: Advance notice of proposed rulemaking (ANPRM).

SUMMARY: This publication invites comments on the feasibility of reducing the risk of unintentional release of liquid hazardous materials from MC-306 type cargo tanks in overturn accidents. The MC-306 type cargo tank is the major highway transport vehicle used for the movement of flammable and combustible liquids. The MC-306 type cargo tank category includes, for the purposes of this ANPRM, MC-300, MC-301, MC-302, MC-303 and MC-305 cargo tanks. Two reports prepared by Dynamic Science, Inc., Phoenix, Arizona, under contract to DOT, have shown that MC-306 type cargo tanks when used to transport flammable liquids, will release a substantial amount of product and present a significant fire risk when involved in overturn accidents. The Materials Transportation Bureau (MTB) and the Bureau of Motor Carrier Safety (BMCS), Federal Highway Administration, are examining the adequacy of existing regulations and the advisability of making regulatory changes on MC-306 type cargo tanks.

DATE: Comments must be received on or before October 20, 1982.

ADDRESS: Dockets Branch, Materials Transportation Bureau, U.S. Department of Transportation, Washington, DC 20590. Comments should identify the docket and be submitted, if possible, in five copies. The Dockets Branch is located in Room 8426, Nassif Building, 400 Seventh Street, SW., Washington, DC. Office hours are 8:30 a.m. to 5 p.m., Monday through Friday.

FOR FURTHER INFORMATION CONTACT:
J. J. Fulnecky, Chief, Hazardous Materials Branch, Bureau of Motor Carrier Safety, Federal Highway Administration, 400 Seventh Street, SW., Washington, DC 20590, (202)-426-0033 or 426-0034.

SUPPLEMENTARY INFORMATION: The MC-306 type cargo tank is the major highway transport vehicle used for the movement of flammable and combustible liquids. The MC-306 type cargo tank category includes MC-300, MC-301, MC-302, MC-303, and MC-305 cargo tanks. Statistics indicate that when this type cargo tank is in an accident, a high incidence of product leakage occurs in an overturn situation.

In a 1975 BMCS analysis of incident and accident reports resulted in a decision to formalize a "Tank Integrity Program." The program's main objective was to determine how cargo tank incident causation could be identified and mitigated. A two-phase program was undertaken to accomplish this objective. Phase I of the program called for a review of existing research and a thorough analysis of multi-source accident bases. The Phase II effort was to provide for crash testing of cargo tanks and was to be predicated on Phase I results.

A contract to perform Phase I was awarded to Dynamic Science, Inc., Phoenix, Arizona. The contractor reviewed existing research and accident data, conducted field investigations and evaluated current specifications. The results of this review were inconclusive because the existing accident data were not sufficiently comprehensive. Accordingly, the contract was modified to have the contractor conduct tests to determine if the current tank designs provided adequate protection to prevent leakage of cargo in overturn situations. Three tests were performed to complete this task: (1) A static vertical guard loading test; (2) a static horizontal pipe loading test; and (3) a tipover test. These tests were conducted using MC-305 and MC-306 cargo tanks.

The static vertical guard loading test was conducted on a 1971 MC-306 cargo tank. Major leaks developed at all hatch cover vent/check valves, at one hatch cover seal, and at one discharge vent valve when the vehicle was rotated upside down with only 10 percent of the full load in the tank. After sealing these leaks, the actual vertical roof loading test was conducted at two times its load weight with no subsequent leakage or damage to the tank structure.

Static horizontal pipe loading tests were conducted on both a 1971 MC-306 and a 1966 MC-305 cargo tank. The pipe elbows failed at the shear section, as designed. A hairline crack developed at a weld on the MC-306 cargo tank resulting in a slight cargo leakage. The valves located upstream of the shear section on the MC-305 cargo tank were unseated and resulted in a major cargo release.

Tipover tests were also conducted on both the MC-305 and MC-306 cargo tanks. There was considerable damage to the MC-305 cargo tank shell but no leakage from it. All of the dome covers leaked, however, and some leaks approached a rate of 15 gallons per minute. The partitions between compartments appeared to have broken, thereby permitting mixing of compartment contents. Major damage occurred on the right front corner of the MC-306 cargo tank shell. A 4-inch weld split along the front bulkhead-to-shell-seam. This permitted cargo leakage at the rate of 60 gallons per minute. Leakage would have occurred from the vents and valves, if these openings had not been deliberately sealed. The compartment partitions also broke through in this test.

The results of the tipover tests indicate a need to improve the Specification MC-306 cargo tank standards to reduce the likelihood of leakage in overturn accidents. Particular attention must be given to leakage from valves, vents, and manhole covers.

For a more detailed description of testing procedures, results and recommendations, see "Analysis of Cargo Tank Integrity in Rollovers" (contract number DOT-FH-11-9193). This document is available to the public through the National Technical Information Service (NTIS). NTIS Accession No. PB 279506.

The results of the Phase I testing indicated that while there are certain integrity problems with the cargo tank shell, the primary source of product leakage was from cargo tank openings. It was determined that the problem of product leakage from cargo tank openings was an area which warranted immediate attention. Consequently, Phase II, which was to be primarily aimed at testing cargo tank integrity, was postponed and the effort was focused on the cargo tank opening problem.

The contract to perform Phase II was awarded to Dynamic Science, Inc., Phoenix, Arizona, in October 1978. The contract had four objectives: (1) To assess present maintenance practices and requalification requirements as they affect a cargo tank's continuing product retention capability; (2) to assess existing specifications for manhole covers, fill covers, and other product retention items and identify specific items which represent potential leakage points in overturn accidents; (3) develop test procedures and engineering drawings for a simulator capable of testing manhole covers and other product retention devices in overturn situations; and (4) develop engineering recommendations to improve cargo tank product retention capabilities that can be incorporated into the cargo tank specification and qualification requirements of the Department of Transportation.

In order to assess carrier maintenance practices, a survey of 10 geographically separated carriers was performed. The survey included both large and small operations of five common and five private carriers. The basic findings of the survey were: (1) very little maintenance is done on critical components such as manholes, high capacity vents and breather vents; (2) scheduled maintenance frequency was an extreme variable; (3) structural maintenance was reported to be the most difficult, but components provided the most maintenance problems; (4) manholes, valve operators, adapters, and internal valves were identified as the tank components that required the most attention, repair, and replacement effort; and (5) shop inspection and repair systems were formally established and well supported by internal files which revealed that most maintenance is directed to power units and cargo tank running gear.

The carrier survey revealed that those components requiring the most maintenance effort had little maintenance performed on them. Field and laboratory testing was used to identify those cargo tank components that would be involved in preventing leakage in overturn accidents. Sixty-one cargo tanks with a total of 187 compartments were tested. The tanks were pneumatically tested to satisfy the requirements of 49 CFR 177.824 except that the test pressure was limited to one (1) psi to prevent damage to the tank structure. The tests were performed with the internal valves open and then with the internal valves closed. These tests identified leaks for all compartment system components except breather vents which were made inoperative in the manner required by 49 CFR 177.824(d)(1)(ii) when pressure tests are required. The primary sources of leakage were the manhole assembly, internal valve, high capacity vent, liquid level sensor, weld and shell cracks, vapor recovery shroud, cleanout opening and discharge outlet, adapter and manifold. Approximately 80% of the total leaks had top sources and 20% had bottom sources. The majority of the leaks in the manhole assembly were in the filler cover, fusible plug and dome cover.

Since breather vents were rendered inoperative during the field tests, no performance data could be obtained. Breather vents are usually located in the manhole filler cover which has been identified as a primary leakage source in overturn accidents. It was, therefore, necessary to test them under representative overturn conditions in order to accomplish a complete cargo tank compartment evaluation. A total of 119 breather vents of 16 different types were tested. The average leakage through the vent device was determined to be a steady stream of between ⅛ to ½ inch in diameter.

The field and laboratory testing provided data which indicated the sources from which leakage could be expected in cargo tank overturns. The static testing performed did not reveal the forces that accompany or induce leakage. Dynamic test data were necessary to determine the impact environment which produces leakage. To obtain the dynamic test data, a cargo tank compartment overturn simulator was designed and constructed. The simulator is capable of providing repeatable 90° and 180° tests without sustaining structural deformation. Two series of tests were performed using the overturn simulator.

The first series of tests were performed in the 90° overturn mode. The tests showed that significant leakage occurred on initial impact. Generally, test fluid was released on impact through the pressure actuated vent in the filler assembly. In liquid spray form, the test fluid covered an area approximately 15 feet to either side and above the simulator and 15–18 feet ahead of the manhole cover. For this series of tests, the average peak pressure at the manhole on impact was 15.6 psig.

The second test series consisted of both 90° and 180° overturns and included a fire test. The test results for this test series were identical to those of the first test series for all manhole assemblies with pressure actuated vents in the filler cover. The fire test was in a 90° overturn simulation with gasoline as the test fluid. On impact, the gasoline formed the spray pattern described above and ignition occurred at 838 milliseconds after impact. The resulting fireball had a maximum height of 21.1 feet, a maximum depth of 11.8 feet and a maximum width of 20.6 feet. Average temperatures recorded during the four seconds after impact were 1217°F at the manhole and 325°F fifteen feet in front of the manhole.

A meeting was held on Febrruary 19–21, 1980, to brief industry representatives on program results and obtain their input on possible regulatory changes which would cover the production and repair of cargo tanks and maintenance and operation of cargo tanks. The twenty-five people attending this meeting represented cargo tank and tank component manufacturers, carriers, repair agencies and trade organizations. In general, there was concurrence in changes that would result in overall safety and uniform practices. There was mostly nonconcurrence of changes that would require new designs or increased technical performance characteristics.

For more detailed information on Phase II results and recommendations see "Cost-Effective Methods of Reducing Leakage Occurring in Overturns of Liquid Carrying Cargo Tanks" and "Reducing Leakage Occurring in Overturns of Liquid Carrying Cargo Tanks" (Contract number DOT-FH-11-9494). These documents are available to the public through the National Technical Information Service (NTIS), NTIS Nos. PB 82-199936 and PB 82-198243, respectively.

Comments are solicited concerning the views, findings and recommendations of the contractor in the reports on Phases I and II cited above.

In view of the foregoing discussion on MC-306 type cargo tanks, comments are solicited on the following questions:

1. What design performance changes in manhole closures and venting devices are necessary to achieve the overturn integrity now required for MC-306 type cargo tanks?

2. Can the existing MC-306 type cargo tank fleet be retrofitted with improved manhole assemblies (manhole closure with or without PAV) without requiring changes in conventional 16 and 20 inch openings in compartment structures? If yes, please provide an estimate of the cost of installation per compartment.

3. It is possible to remove pressure-actuated venting (PAV) from manhole fill covers?

4. Would a requirement for visual inspection prior to each loading applicable to manhole closures, vents, valves and piping improve the cargo retention capability of MC-306 type cargo tanks?

5. Should 49 CFR 177.824 be revised to require that MC-306 type cargo tanks be pressure (pneumatic or hydrostatic) tested? if so, at what intervals?

6. Please provide an estimate of the cost of visual inspection and a pressure test (pneumatic and hydrostatic) on a MC-306 type tank.

7. Are the skills required to test, inspect, and verify the intergrity of these cargo tanks within the capabilities of currently employed carrier maintenance personnel?

8. What methods are presently used by cargo tank manufacturers to ensure that component parts are in compliance with the applicable DOT regulations?

9. Should the scope of this Docket be expanded to address the design and construction of the MC-306 cargo tank in its entirety?

On September 15, 1982, the Hazardous Materials Advisory Council (HMAC) will conduct a meeting in St. Louis concerning the matters raised under this docket. The MTB and BMCS have agreed to participate fully in the meeting to discuss various aspects of the ANPRM and to respond to questions. Also a representative of Dynamic Sciences, Inc. will review and discuss the contract reports mentioned above. A transcript of the meeting will be placed in the public docket. Persons interested in attending the meeting should contact HMAC, Suite 908, 1100 17th Street, N.W., Washington, D.C. 20036, (202) 223-1271, for futher details.

List of Subjects

49 CFR Part 173

Harzardous materials transportation, Packaging and containers, Cargo tanks.

49 CFR Part 177

Hazardous materials transportation, Packaging and containers, Cargo tanks.

49 CFR Part 178

Hazardous materials transportation, Packaging and containers, Cargo tanks.

Issued in Washington, D.C., on June 18, 1982.

Alan I. Roberts,

Associate Director for Hazardous Materials Regulation, Materials Transportation Bureau.

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