



# National Transportation Safety Board

Washington, D.C. 20594  
Safety Recommendation

Date: JUL 1 1991

In reply refer to: R-91-20

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The Safety Board's past investigations of railroad accidents revealed several safety issues concerning the transport of hazardous materials. As a result of those investigations and the Board's subsequent safety recommendations, several agencies and organizations took various actions to bring about improvements in the safe transport of hazardous materials by rail. Results of the Board's recent safety study indicate, however, that improvements are still needed in the protection provided by some tank cars for certain products transported in them.<sup>1</sup>

## Performance of DOT-111A Tank Cars Involved in Accidents

Although DOT<sup>2</sup> specification 111A tank cars generally do not contain protection similar to that of the DOT-105, -112, and -114 tank cars, they are, nevertheless, used to carry hazardous materials that can pose a substantial danger to life, property, and the environment.<sup>3</sup> Further, because the shells of DOT-111A tank cars are thinner than the shells of DOT-105, -112, and -114 tank cars, the DOT-111A tank cars are more susceptible to

<sup>1</sup> National Transportation Safety Board. 1991. Transport of hazardous materials by rail. Safety Study NTSB/SS-91/01. Washington, DC. 187 p.

<sup>2</sup> U.S. Department of Transportation.

<sup>3</sup> The DOT-111A tank cars, which are still being manufactured, are general service, non-pressure tank cars made of steel, nickel, or aluminum. Generally, DOT-111A tank cars are non-insulated, have bottom outlets and multiple fittings, and do not have jacketed thermal protection or head shields. Thermal protection and head shields are required on most DOT-105 tank cars, as well as on DOT-112 and -114 tank cars.

damage than are DOT-105, -112, and -114 tank cars, even when those tank cars are not protected by head shields and thermal protection.<sup>4</sup>

The inadequacy of the protection provided by DOT-111A tank cars for certain dangerous products has been evident for many years in accidents investigated by the Safety Board. The release of products from the DOT-111A tank cars observed in those investigations were also observed in the 45 rail accidents (hereinafter called cases) investigated by the Safety Board from March 1988 through February 1989 as part of its recent safety study.<sup>5</sup> These 45 cases involved 149 tank cars: 84 cars (57 percent) were DOT-111A tank cars, 32 cars (21 percent) were DOT-105 tank cars, 29 cars (19 percent) were DOT-112/114 tank cars, and 4 cars (3 percent) were other specifications.

Of the 61 DOT-105, -112, and -114 tank cars involved, 14 tank cars (23 percent) released products: 11 leaked (18 percent), and 3 ignited or exploded (5 percent). The products were released as a result of head punctures or failures in two of the tank cars and shell punctures or failures in five (a total of 11 percent).

Of the 84 DOT-111A tank cars involved, 46 tank cars (54 percent) released product: 31 leaked (37 percent), and 15 ignited or exploded (18 percent). The products were released as a result of head punctures or failures in 5 of these tank cars, and shell punctures or failures in 13 (a total of 22 percent).

These data indicate that 23 percent of the DOT-105, -112 and -114 tank cars involved in the 45 cases released product whereas 54 percent of the DOT-111A tank cars released product. Further, the rate at which the DOT-111A tank cars experienced head or shell puncture or failure was also double that of the DOT-105, -112 and -114 tank cars. Although the cases were not selected on a basis such that they are statistically representative of hazardous materials accidents, the rate of failure of the DOT-111A tank cars (double that of the non-DOT-111A cars) strongly suggests that DOT-111A tank cars do not provide as much protection for their products in accidents as do the DOT-105, -112, and -114 tank cars.

The 46 DOT-111A tank cars that released hazardous materials were transporting 24 different products, 12 of which (a) could cause serious injury, temporary or long-term, from brief exposure even when medical attention is promptly given; and/or (b) are highly flammable at ambient temperature conditions.

Safety risks posed by the release of hazardous materials from DOT-111A tank cars are illustrated by the accident in Helena, Montana, on February 2,

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<sup>4</sup> DOT-111A tank cars have a minimum shell and head thickness of 7/16 inch; DOT-105, -112, and -114 tank cars have shells and heads with a minimum thickness of 9/16 inch.

<sup>5</sup> The locations of the accidents comprising the 45 cases are identified in the safety study report (NTSB/SS-91/01).

1989. Two aluminum DOT-111A tank cars containing hydrogen peroxide (a strong oxidizer) and one steel DOT-111A tank car containing acetone and isopropyl alcohol (in dual compartments) were severely damaged and released their products. Fire and explosions resulted, dispersing fragments of one of the aluminum tank cars as far away as 1/2 mile. About 3,500 persons were evacuated, 2 persons were injured, and damage and cost of cleanup exceeded \$6 million.<sup>6</sup>

The Safety Board's investigation determined that the steel DOT-111A tank car sustained a head puncture; the investigation also concluded that one of the aluminum DOT-111A tank cars probably was punctured during the collision and derailment, but the disintegration of the tank car from the explosion precluded an exact determination of the number and locations of the punctures.

As a result of the Helena accident, the Safety Board issued the following safety recommendation to the Research and Special Programs Administration (RSPA):

R-89-80

Evaluate present safety standards for tank cars transporting hazardous materials by using safety analysis methods to identify the unacceptable levels of risk and the degree of risk from the release of a hazardous material, then modify existing regulations to achieve an acceptable level of safety for each product/tank car combination.

On June 13, 1990, the DOT replied that a working group, comprising representatives of the RSPA and the Federal Railroad Administration (FRA), has developed a course of action to address the Safety Board's concerns: a safety analysis will be initiated using "deterministic risk analysis methods" to classify high-risk materials and to analyze postaccident histories. Upon completion of the effort, the RSPA and the FRA will review the results of the analysis to determine if rulemaking action is necessary to shift the transport of hazardous materials to improved tank cars. Based on the response from the DOT, the Safety Board classified Safety Recommendation R-89-80 as "Open--Acceptable Response." The need for evaluating present safety standards for tank cars that transport hazardous materials is so important that the Safety Board has placed Safety Recommendation R-89-80 to the DOT on its "Most Wanted" list of safety improvements.<sup>7</sup>

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<sup>6</sup> National Transportation Safety Board. 1989. Collision and derailment of Montana Rail Link freight train with locomotive units and hazardous materials release, Helena, Montana, February 2, 1989. Railroad Accident Report NTSB/RAR-89/05. Washington, DC. 112 p.

<sup>7</sup> In October 1990, the Safety Board adopted a program to identify the "Most Wanted" safety improvements. The purpose of the Board's "Most Wanted" list, which is drawn up from recommendations previously issued, is to bring special emphasis to the safety issues the Board deems most critical.

While the Safety Board is extremely concerned about the level of protection provided by tank cars which transport materials that are potentially hazardous to human life and property, the Board is also concerned about the level of protection provided to the hazardous materials that can harm humans through deleterious effects on the environment. According to the Association of American Railroads (AAR), the railroad industry has recognized this issue and, in conjunction with the chemical and tank car industries, is developing a "quantitative risk assessment methodology" that incorporates chemical risks to the environment as well as other risks. The industries have also developed a list of hazardous materials that, because of their potential to contaminate soil and ground water, would be candidates for early action for improved packaging. The list includes products released in accidents investigated by the Safety Board, such as perchloroethylene, cyclohexane, and xylene; however, action for improved packaging has not been initiated. Further, the U.S. Environmental Protection Agency has identified perchloroethylene and xylene as being among the hazardous materials most likely to cause a serious threat to human health and has banned land disposal of materials contaminated with perchloroethylene, xylene, and cyclohexane.<sup>8</sup> Because the release of hazardous materials can also threaten health through contamination of the environment, the Safety Board believes that environmental hazards also should be considered in the risk analysis.

#### Action Needed

Rulemaking activity for tank cars is currently underway by the RSPA: Performance-Oriented Packaging Standards (Docket HM-181) and Specifications for Tank Car Tanks (Docket HM-175A). Both rulemaking actions address the protection needed for some hazardous materials now being transported in DOT-111A tank cars. Additional rulemaking will probably be needed after the DOT completes its deterministic risk analysis (in response to Safety Recommendation R-89-80). However, the Safety Board is concerned that it may take several years until final rules are issued as a result of Docket HM-175A and even longer until final rules are issued in response to Safety Recommendation R-89-80. Thus, the Board is concerned that, in the interim, many hazardous materials that pose severe threats to public safety will continue to be transported in tank cars with inadequate protection.

Following its investigation of the 1985 derailment at Jackson, South Carolina, the Safety Board issued Safety Recommendation R-85-105 to the RSPA to require that all tank car shipments of hazardous materials with an isolation radius of 1/2 mile or more, as recommended by the U.S. Department of Transportation Emergency Response Guidebook, be transported in tank cars

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<sup>8</sup> 52 FR 12866-12874 (1987), 53 FR 41280-41285 (1988), and 40 CFR 268.35(a).

equipped with head shield or full tank head protection.<sup>9</sup> However, in replies to the safety recommendation, the RSPA pointed out that head protection might be beneficial for tank cars carrying a broader class of hazardous materials and that many products listed in the DOT Emergency Response Guidebook as requiring a 1/2-mile evacuation radius do not really require greater protection than that provided by DOT-111A tank cars. In its latest reply, dated April 1990, the RSPA indicated that an Advanced Notice of Proposed Rulemaking (Docket HM-175A) addresses head shield protection for new and existing tank cars that are used to transport critical hazardous materials such as flammable gases, certain non-flammable gases, reactive materials, and materials that are poisonous by inhalation. (These products currently may be transported in DOT-111A tank cars.) The RSPA indicates that it expects to issue a Notice of Proposed Rulemaking for Docket HM-175A in the summer 1991. Safety Recommendation R-85-105 is currently classified as "Open--Acceptable Response."

The Safety Board recognizes there is some merit in RSPA's position that use of the 1/2-mile-radius criteria (per the DOT Emergency Response Guidebook) may not be the most appropriate means to determine which hazardous materials need to be provided full head shield and thermal protection. The Safety Board believes that fulfilling the intent of Safety Recommendation R-89-80, which asks that the RSPA conduct a safety analysis, is the most appropriate way to determine how to properly protect hazardous materials for shipment by rail tank cars.

However, because of the substantial amount of time that will be required to fulfill the intent of Safety Recommendation R-89-80, the Safety Board believes that immediate action is needed to identify the most harmful materials (those that pose the greatest consequences) and to have these materials transported in stronger tank cars that are protected by head shields and thermal jackets. The RSPA believes, and the Safety Board agrees, that using the 1/2-mile-radius criteria in the DOT Emergency Response Guidebook is not the most appropriate method to determine the products that require greater protection than is provided by DOT-111A tank cars. Consequently, the Safety Board classifies R-85-105 as "Closed--Acceptable Action/Superseded" by Safety Recommendation R-91-11 to the RSPA, which calls for its leadership in establishing a working group, comprising appropriate agencies and industry organizations, to expeditiously improve the packaging and shipping of the more dangerous products through specific actions. The Safety Board urges the American Petroleum Institute to assist the RSPA in the establishment of the working group and to participate in its actions to improve the packaging of the more dangerous products.

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<sup>9</sup> National Transportation Safety Board. 1985. Derailment of Seaboard System Railroad train No. F-690 with hazardous material release, Jackson, South Carolina, February 23, 1985, and collision of Seaboard System Railroad train No. F-481 with standing cars, Robbins, South Carolina, February 25, 1985. Railroad Accident Report NTSB/RAR-85/12. Washington, DC. 42 p.

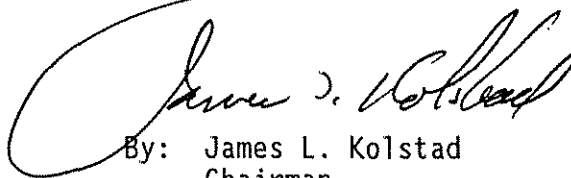
Therefore, as a result of the safety study, the National Transportation Safety Board recommends that the American Petroleum Institute:

Assist the Research and Special Programs Administration (RSPA) in the establishment of a working group--comprising the RSPA, the Federal Railroad Administration, the Association of American Railroads, the Chemical Manufacturers Association, the National Fire Protection Association, and your organization--to expeditiously improve the packaging of the more dangerous products (such as those that are highly flammable or toxic, or pose a threat to health through contamination of the environment) by (a) developing a list of hazardous materials that should be transported only in pressure tank cars with head shield protection and thermal protection (if needed); and (b) establishing a working agreement to ship the listed hazardous materials in such tank cars. (Class II, Priority Action) (R-91-20)

Also as a result of the safety study, the Safety Board issued recommendations to the Research and Special Programs Administration and Federal Railroad Administration of the U.S. Department of Transportation; Class I railroads and railroad systems; Guilford Transportation, Inc.; MidSouth Rail Corporation; the American Short Line Railroad Association; the Association of American Railroads; the Chemical Manufacturers Association; the National Fire Protection Association; the National League of Cities; the National Association of Counties; the International Association of Fire Chiefs; the International Association of Chiefs of Police; and the National Sheriffs' Association.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation R-91-20 in your reply.

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

  
By: James L. Kolstad  
Chairman

Member Burnett would classify Safety Recommendation R-85-105 as "Open--Unacceptable Response" because the RSPA has taken no positive action in response to the recommendation; Member Burnett believes the Safety Board should provide an alternative criteria to the isolation radius of 1/2 mile as stated in the recommendation.