

6. There is no tendency for the impacting automobile to nosedive under the energy-absorbing unit or catapult over said unit.

7. In the event of an eccentric impact, the intrusion of the impacting automobile into the adjacent traffic lane is minimal.

8. The 62.27-kN (14 000-lb) service vehicle can be expected to suffer no damage during the crash, and adjacent lane intrusion by the truck is not a problem. The same service vehicle was used for all crash tests and suffered no damage.

#### ACKNOWLEDGMENT

This work was accomplished in cooperation with the Connecticut Department of Transportation and FHWA. The contents of this paper reflect my views, and I am responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the state or FHWA. This paper does not constitute a standard, specification, or regulation.

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*Publication of this paper sponsored by Committee on Maintenance Equipment.*

#### *Abridgment*

## Regulation of the Movement of Hazardous Cargoes on Highways

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This paper follows up on the work of an American Association of State Highway and Transportation Officials (AASHTO) task force that looked into the movement of hazardous materials on the highway and what states were doing about it. The current work reviews the AASHTO effort and supplements it with further field contacts. A number of conclusions are reached, and a series of recommendations for state action are offered. Principal conclusions are that the problem is serious but not major when compared with the total traffic safety problem. There are great similarities between safety problems for hazardous material and other traffic safety problems. The existence of many agencies at all official levels as well as in the private sector makes the problem more difficult, and therefore, the need for better communications is obvious. A final conclusion is that all states need adequate legislation, an administrative program, enforcement capability, an educational program, and incident-response capability. Recommendations to the states include the following: (a) adopt appropriate state regulations for motor carrier safety and highway

transportation of hazardous materials; (b) identify administrative elements that have responsibilities in the area, define the role of each, and develop effective communications among them; (c) develop an effective incident-response capability; (d) provide training for all personnel; (e) adopt a statewide policy on routing of hazardous materials; (f) institute a data collection system to provide information needed; (g) include hazardous materials considerations in bridge and highway design; (h) conduct a public information program; and (i) consider research in at least three other areas.

The transportation of hazardous materials on highways presents special problems from the standpoint of safety--not because the chance of an accident is greater but because the results of such an occurrence may be much more severe than in a more usual

type of accident and results may occasionally be catastrophic. Although the total number of deaths in accidents that involve hazardous materials is much less than 1 percent of all highway fatalities, the emotional, and therefore the political, impact of such accidents means that the problem demands major attention by responsible public officials.

The magnitude of the problem is difficult to determine with exactitude. The Materials Transportation Bureau of the U.S. Department of Transportation (DOT) states that highway carriers reported more than 12 000 incidents in 1976 and more than 13 000 in 1977 that involved hazardous materials. These totals represent more than 90 percent of incidents reported by all modes; thus, the important part played by highways is emphasized. The highway incidents reported resulted in 16 deaths in 1976 and 30 deaths in 1977 and from 500 to 600 injuries each year (1).

Note that incident and accident are not synonymous. An incident may be a leaking tank observed at a terminal or a barrel that has fallen from a moving truck. This terminology problem has the unfortunate effect of making it difficult to develop reliable figures on events that involve hazardous materials.

A study in Virginia suggests the extent of highway movement of hazardous materials. Based on surveys at 38 locations throughout the state, it was estimated that approximately 13 percent of all trucks were carrying some hazardous materials and that 10 percent were carrying quantities sufficient to require the use of placards under federal regulations. Nearly 65 percent of the hazardous materials transported were flammable or combustible liquids (2).

The growth of the problem in the transportation of hazardous materials and its increasingly catastrophic effects prompted the American Association of State Highway and Transportation Officials (AASHTO) in 1978 to appoint a task force on hazardous materials. This group was charged with investigating criteria for the movement of hazardous materials, determining what states were doing in regard to regulating such movements, and finding out what regulations and criteria for the control of such movements were in effect. For this purpose a questionnaire was sent to all states, and responses were eventually obtained from all but four.

Following tabulation of the questionnaire returns, a small project was undertaken under the National Cooperative Highway Research Program (NCHRP) to study information collected by the questionnaire survey and to prepare a report that analyzes the information, suggests appropriate actions that individual states could take based on the analysis, and recommends specific research needs to further resolve the concerns about highway transport of hazardous materials (3).

#### SURVEY RESULTS

As a result of the review of the questionnaire returns and other information gathered from contacts with officials and others, a number of conclusions have been drawn.

##### Safety of Transport of Hazardous Materials

The problem of safe transportation of hazardous materials is a very large one but, in relation to the total problem of transportation safety, it is not major. The total number of highway deaths from the transport of hazardous materials has been in the range of 20-30 a year, or less than 0.1 percent of the total traffic death toll. Unfortunately, the relationship must be stated in relatively imprecise

terms because more exact figures are not available--and that is part of the problem.

The potential for a hazardous materials transportation accident on the highway is roughly in proportion to the volume of truck traffic, with from 10 to 15 percent of trucks on the average carrying some form of hazardous material. Accident probability is related to exposure, and the case of hazardous materials is no exception.

##### Accident Prevention

Accident prevention efforts for hazardous materials transportation are no different from such efforts for general transportation. The prevention of an accident for a truck carrying a cargo of hazardous materials is basically no different because of the cargo. The difference is evident after an accident occurs, when the cargo may make the consequences of the accident more severe. It is also true that, because of the potentially more-severe consequences, it may be desirable to accentuate and expand the usual prevention techniques in an effort to reduce the likelihood of an accident. There is also a need for new and different activities related to response techniques, clean-up procedures, and similar matters.

##### Number of Agencies Involved

The great number of agencies involved in the management of hazardous materials transportation creates a major problem of coordination. At the federal level, at least the following agencies have a share of the responsibility and authority for the safe transport of hazardous materials on the highways:

1. DOT,
2. Materials Transportation Bureau,
3. Bureau of Motor Carrier Safety,
4. Environmental Protection Agency,
5. Nuclear Regulatory Agency,
6. Federal Emergency Management Agency, and
7. National Transportation Safety Board.

At the state level, the list is even longer, with as many as 10 agencies having some degree of involvement in some states. Other agencies enter the picture at the local level. To this confusing mass of official agencies must be added nonofficial groups that represent manufacturers, shippers, carriers, and users. Either as individual commercial enterprises or through a trade association, these groups have a legitimate concern as well as a responsibility to the public for safety of transportation.

There is a substantial need for better communications at all levels. The great number of agencies involved suggests immediately the need for communications. That the need exists was evident by a comparison of the questionnaire returns with responses to similar questions posed by the Bureau of Motor Carrier Safety of DOT. Discrepancies in the two sets of responses clearly indicate confusion and gaps of knowledge in some areas. When one responder answers that there are no regulations in a particular area and another cites chapter and section, the problem is quite apparent.

The need is for better communications among federal, state, and local agencies, as well as from the official agencies to shippers and carriers. In addition, the general public needs to be informed of the hazards as well as the safety of hazardous materials transportation.

##### State Safety Program

A complete package at the state level includes, at a

minimum, adequate legislation, an administrative program, enforcement capability, an educational program, and incident-response capability. A complete program means one designed to prevent the occurrence of accidents as well as to minimize the effects of an accident should one occur. Thus, adequate legislation includes rules for safe packaging and marking of hazardous cargoes as well as rules for safe driving of the vehicles, including requirements for both drivers and vehicles.

With a sound legislative base, a good administrative program can be developed. Rules must be enforced, otherwise they become empty threats ignored by all except the conscientious. Education becomes a necessary adjunct to enforcement. Finally, because accidents will occur, the ability to respond quickly and properly to an emergency is essential. Here the multiplicity of agencies can cause problems because there must be a clear assignment of responsibility and authority at the scene. Unless this is spelled out in advance, confusions, contradictions, and uncertainties will be likely to occur.

Any comprehensive program will cost money. Funding needs and possible sources of funds for one state are suggested in a study prepared by the California Highway Patrol in response to a legislative request (4).

Recognize that, in the larger sense, the problem is one shared by the states and the federal government, and the latter has important responsibilities that are not detailed here.

#### RECOMMENDATIONS

The following recommendations are directed toward state departments of transportation and highways, in view of the AASHTO background for the project. Some of the recommendations of necessity extend beyond the jurisdiction of these departments, and must be so considered. Not all of the recommendations will apply in every state because the states are in different stages of development in the matter of hazardous materials transportation. Each state will have to examine the recommendations against its existing program and decide whether further action is appropriate.

The recommendations are as follows.

##### Adopt Appropriate State Regulations

Adopt appropriate state regulations for motor carrier safety and for highway transportation of hazardous materials. In 20 percent of the states there are currently no state regulations that apply directly to the transportation of hazardous materials. In many others, regulations are not complete. Some existing regulations apply only to for-hire carriers or to vehicles in intrastate commerce. Exemptions are frequently granted to haulers of agricultural products, with the result that many vehicles that carry dangerous materials are not subject to any state regulation.

Title 49 of the Code of Federal Regulations contains very complete rules, not only for the safety of all motor carriers but also for hazardous materials transportation. Every state should examine its own rules to be sure that the applicable sections of Title 49 are in effect. State adoption of the appropriate sections will not only make it possible to enforce the rules in state courts, but the rules can also be made to apply to all vehicles and to all classes of carriers. By following the federal rules, consistency among the states will be achieved and shippers, carriers, and users will all benefit.

Questions have been raised about preemption by

the federal rules. This subject has been thoroughly explored by Lawrence W. Bierlein for the Illinois Department of Transportation, and preemption does not appear to be a bar to state action (5).

The recommended regulations establish rules for highway transportation of hazardous materials as well as basic rules for drivers and vehicles used for transporting all types of cargoes. As noted earlier, a hazardous cargo in traffic is subject to the same chance of accident as any other cargo, and it behooves the responsible authorities to provide the best possible drivers and vehicles for dangerous cargoes in view of the potential for severe consequences of an accident.

##### Identify Areas of Responsibility Within States

Identify administrative elements in the state that have responsibilities in the area, define the role of each, and develop effective communications among them. In nearly all states, several agencies share the responsibility for the safe transport of hazardous materials. In few cases is there a clear-cut line of authority, with one agency identified as the lead agency. This is to some extent a reflection of the situation at the federal level and may not be fully resolved at the state level until it is at the federal level. Complicating the matter is the frequent breakdown in communications, even within the state, to say nothing of such failures between state and federal or between state and local agencies.

The three elements of this recommendation--identification, role definition, and communications--are so intertwined as to make them nearly inseparable. There is a pressing need to identify the many groups at both the state and local levels, and then to clearly and publicly determine the role of each. A means of communication must then be established so that each agency will know what the others are doing. Only in this fashion can order be brought out of the chaos that now exists in most states.

##### Develop Incident-Response Capability

Develop an incident-response capability that will minimize the effects of a hazardous materials accident. The ability to respond quickly, effectively, and safely to a hazardous materials incident of accident is a first order of business for any state. If such an event occurs, the burden of rapid and knowledgeable response falls on some public authority. Failure to act correctly in such an instance can exacerbate a situation, cause additional and unnecessary casualties, and bring about a public reaction that may be out of proportion to the results.

An adequate response effort requires trained personnel, available on a round-the-clock basis, who have proper equipment, and are alerted by a good communications system. Many horror stories can be told of incidents that involved untrained response personnel, some of whom lost their own lives as a result of lack of knowledge.

##### Provide Training for Administrative, Enforcement, and Response Personnel

The subject of hazardous materials is large, complicated, and generally strange to anyone who has not been closely involved in the matter. All those at the state level who have any part in the problem need to have special knowledge. This applies to administrative personnel, enforcement officers, and response personnel.

### Adopt a Statewide Policy on Routing of Hazardous Materials

Many local communities have established routing requirements for hazardous materials cargoes. Blanket prohibitions, sometimes imposed, create serious questions of restraints on commerce and necessary exemptions for local deliveries may make the restrictions ineffective.

The Federal Highway Administration has sponsored a research project to develop criteria for selecting routes for transportation of hazardous materials (6). Findings of this study should give guidance to the states in the formulation of reasonable policies. For the benefit of carriers as well as public safety, such policies should be as consistent as is legally and politically feasible within all incorporated areas of the state.

### Data Collection

Institute a method of data collection that will provide information on the frequency and causal factors of hazardous materials incidents and accidents. Currently, information in most states is not sufficient to determine, with any degree of accuracy, how many hazardous materials accidents occur, to say nothing of being able to determine causes or even contributing circumstances. It should not be too difficult to institute a proper collection system, either through the regular state accident-reporting mechanism or through the motor carrier accident-reporting system. Without such information, however, authorities have no accurate measure of the magnitude of the problem and no sound guidance as to appropriate remedial measures.

### Include Hazardous Materials Considerations in Highway and Bridge Planning and Design

Hazardous materials spills have obvious potential impacts on groundwater supplies, wildlife, and vegetation. These threats to drinking water sources and to aquatic ecosystems may be lessened if attention is given to the problem during the planning and design phases of highway and bridge projects.

### Conduct a Public Information Program

Conduct a public information program to explain transportation of hazardous materials to the general public. The public is poorly informed about transportation of hazardous materials, and a public information program is needed to explain the situation--not only to allay unnecessary fears but also to alert people to the actual dangers that can exist if an accident happens. Although not all perceived dangers are real, the public does not always recognize actual dangers when they are present, and unnecessary casualties have resulted. A good public information program could save lives.

### Further Research

Consider further research in at least three areas. Determine the best pattern for administrative orga-

nization at the state level and how this can be fit into existing state organizational structures, which differ widely. A study of current organizational patterns and relative advantages and disadvantages could lead to recommendations for the most-effective way to generate an effective hazardous materials program.

Develop a training program geared to state needs in administration, enforcement, and emergency response. Couple this with the devising of a practical method of making this available to state and local personnel.

Undertake a comprehensive study of risk analysis methodology and its application to current problems, including route and mode selection. The need for a state-of-the-art study of risk analysis methodology has been identified as a major issue, and this proposal merely goes one step further in suggesting that there could be immediate use in route selection and in comparing hazards by mode. It has been suggested that increased enforcement in the highway field might shift some cargoes to the railroads. At present there is probably not sufficient information to know whether this would be beneficial or harmful from the overall safety standpoint.

### ACKNOWLEDGMENT

This paper is based on work performed under NCHRP project PR 20-7, T-16, financed by the Federal Highway Administration and AASHTO and managed by TRB.

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*Publication of this paper sponsored by Committee on Transportation of Hazardous Materials.*