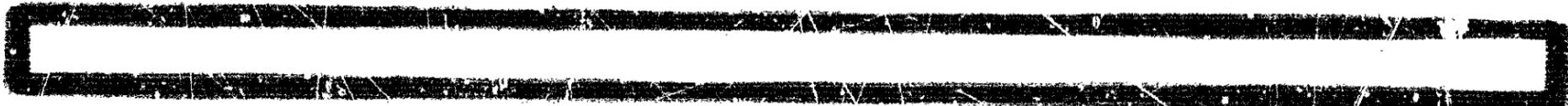
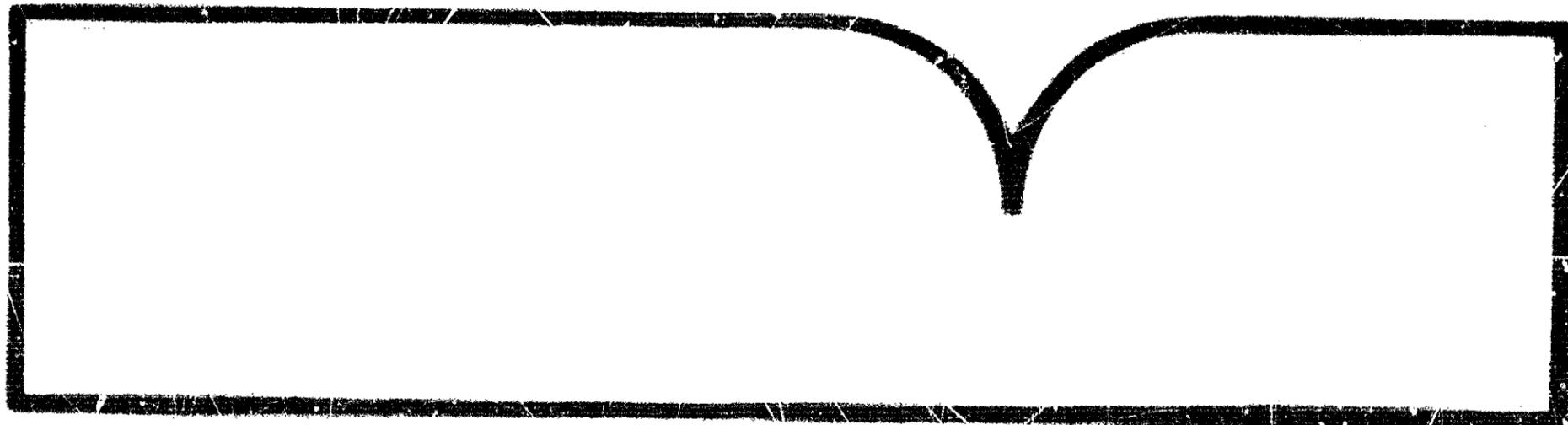


PB86-916 202

Highway Accident Report - Multiple Vehicle
Collision and Fire, U. S. 13 near Snow Hill
North Carolina, May 31, 1985

(U.S.) National Transportation Safety Board.
Washington, DC

5 Aug 86



U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

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16. Abstract About 3:20 p.m. on May 31, 1985, a northbound Military Distributors of Virginia, Inc., tractor-semitrailer collided with two southbound vehicles on a curve on U. S. 13, about 2.3 miles south of Snow Hill, North Carolina. The first collision on the two-lane, undivided highway was with a 1982 schoolbus operated by the Greene County (North Carolina) Board of Education. After this collision, the Military Distributors vehicle continued northbound and struck a tractor-semitrailer loaded with shelled corn, which had been following the schoolbus on the two-lane highway. During the collision with the grain truck, the Military Distributors semitrailer separated from its tractor, continued northbound, and overturned onto its right side in the northbound lane. The rear of the grain truck's semitrailer remained on the highway and was struck by a passenger automobile. After the collisions, the Military Distributors tractor, the grain truck's tractor, and the front of the grain truck's semitrailer caught fire. The weather was clear and the pavement was dry. The Military Distributors truckdriver sustained fatal injuries. Of the 27 schoolbus passengers (ages 5 to 13 years), 15 sustained minor or moderate injuries, 10 sustained serious or severe injuries, and 2 received critical injuries. Six of the passengers died. The schoolbus driver, the grain truck driver, and the driver and passenger in the automobile sustained minor injuries.					
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The National Transportation Safety Board determines that the probable cause of this accident was the failure of the driver of the Military Distributors of Virginia, Inc. truck to keep his vehicle to the right of the highway centerline because of inattention due to a momentary lapse of alertness, falling asleep, or an epileptic seizure.

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**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

HIGHWAY ACCIDENT REPORT

Adopted: August 5, 1986

**MULTIPLE VEHICLE COLLISION AND FIRE
U. S. 13 NEAR SNOW HILL, NORTH CAROLINA
MAY 31, 1985**

SYNOPSIS

About 3:20 p.m. on May 31, 1985, a northbound Military Distributors of Virginia, Inc., tractor-semitrailer collided with two southbound vehicles on a curve on U. S. 13, about 2.3 miles south of Snow Hill, North Carolina. The first collision on the two-lane, undivided highway was with a 1982 schoolbus operated by the Greene County (North Carolina) Board of Education. After this collision, the Military Distributors vehicle continued northbound and struck a tractor-semitrailer loaded with grain, which had been following the schoolbus on the two-lane highway. During the collision with the grain truck, the Military Distributors semitrailer separated from its tractor, continued northbound, and overturned onto its right side in the northbound lane. The rear of the grain truck's semitrailer remained on the highway and was struck by a passenger automobile. After the collisions, the Military Distributors tractor, the grain truck's tractor, and the front of the grain truck's semitrailer caught fire. The weather was clear and the pavement was dry. The Military Distributors truckdriver sustained fatal injuries. Of the 27 schoolbus passengers (ages 5 to 13 years), 15 sustained minor or moderate injuries, 10 sustained serious or severe injuries, and 2 received critical injuries. Six of the passengers died. The schoolbus driver, the grain truck driver, and the automobile driver and passenger sustained minor injuries.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the driver of the Military Distributors of Virginia, Inc. truck to keep his vehicle to the right of the highway centerline because of inattention due to a momentary lapse of alertness, falling asleep, or an epileptic seizure.

INVESTIGATION

The Accident

On May 31, 1985, a schoolbus operated by the Greene County (North Carolina) Board of Education, followed by a tractor-semitrailer transporting grain (shelled corn), a passenger automobile, and an empty straight truck, was proceeding southbound around a curve on U.S. 13, about 2.3 miles south of Snow Hill, North Carolina. The weather was clear and the pavement was dry. The driver of the schoolbus stated that her vehicle was traveling at 32 mph and that she saw a northbound tractor-semitrailer traveling toward her vehicle around the curve in the northbound lane of the two-lane, undivided highway. She did not remember seeing the truck after that time.

About 3:20 p.m., a northbound tractor-semitrailer operated by Military Distributors of Virginia, Inc. (MDV) collided with the schoolbus. The collision with the MDV truck created an opening in the left front sidewall of the schoolbus body, and tore out the restraining barrier and first three rows of bench-type seats behind the driver on the left

side of the schoolbus. It was reported that the occupants of these seats, as well as most of the other occupants across the aisle from the opening, were ejected onto the roadway or the southbound shoulder during the collision. The schoolbus came to rest facing east on the southbound shoulder. (See figure 1.)

Following the collision with the schoolbus, the MDV truck continued northbound and collided with a tractor-semitrailer carrying grain. The driver of the grain truck stated that he had been traveling directly behind the schoolbus for about 1 1/2 to 2 miles, and that he saw the northbound tractor-semitrailer cross over the highway centerline and collide with the schoolbus. He also stated that he was trying to steer toward the ditch on his right when the MDV tractor collided with his vehicle.

The MDV tractor overturned onto its right side and the MDV tractor and the grain truck's tractor came to rest partially off the southbound lane of the highway, about 50 feet north of the final rest position of the schoolbus. (See figure 2.) The MDV semitrailer separated from the tractor, continued northbound, and overturned onto its right side in the northbound lane, spilling some of its cargo of pickles onto the highway.

The rear of the grain truck's semitrailer remained in the southbound lane of the highway and was struck by a passenger automobile. (See figure 3.) The driver of the automobile stated that he was driving his vehicle immediately behind the grain truck before the collision and that when the grain truck stopped he "panicked" and ran into the rear of the grain truck's semitrailer.

The driver of a straight truck stated that he was traveling directly behind the grain truck immediately before the collision (which differs from the statement made by the driver of the passenger automobile), and that he saw the northbound MDV truck cross the centerline and collide with the schoolbus. He further stated that after he witnessed this collision, he steered his vehicle onto the right shoulder of the highway and stopped, and the passenger auto then passed his vehicle on the left and ran into the rear of the grain truck. The straight truck did not collide with any vehicle involved in this accident.

After the collisions, the MDV tractor and the grain truck's tractor and semitrailer caught fire. The driver of the straight truck reported that he saw the grain truck's battery, which before the collision was mounted outboard of the grain truck-tractor's left longitudinal frame rail between the cab and the first drive axle, "explode" and start the fire. The MDV tractor and the grain truck-tractor were destroyed in the fire, and the grain truck semitrailer sustained fire damage to the left front. The schoolbus, the passenger auto, the straight truck, and the MDV semitrailer were not involved in the fire. (See figure 4.)

The MDV truckdriver remained inside the tractor and sustained fatal injuries. Of the 17 schoolbus passengers (ages 5 to 13 years), 15 sustained minor or moderate injuries, 10 sustained serious or severe injuries, and 2 received critical injuries. Six of the schoolbus passengers died. The schoolbus driver, the grain truck driver, and the automobile driver and passenger sustained minor injuries.

Emergency Response

The driver of the straight truck reported that after he pulled his vehicle onto the southbound shoulder and stopped, he ran east across the highway around the MDV semitrailer and then ran south back across the highway toward the schoolbus. As he was passing the grain truck, he saw the grain truck driver get out of his truck through the left

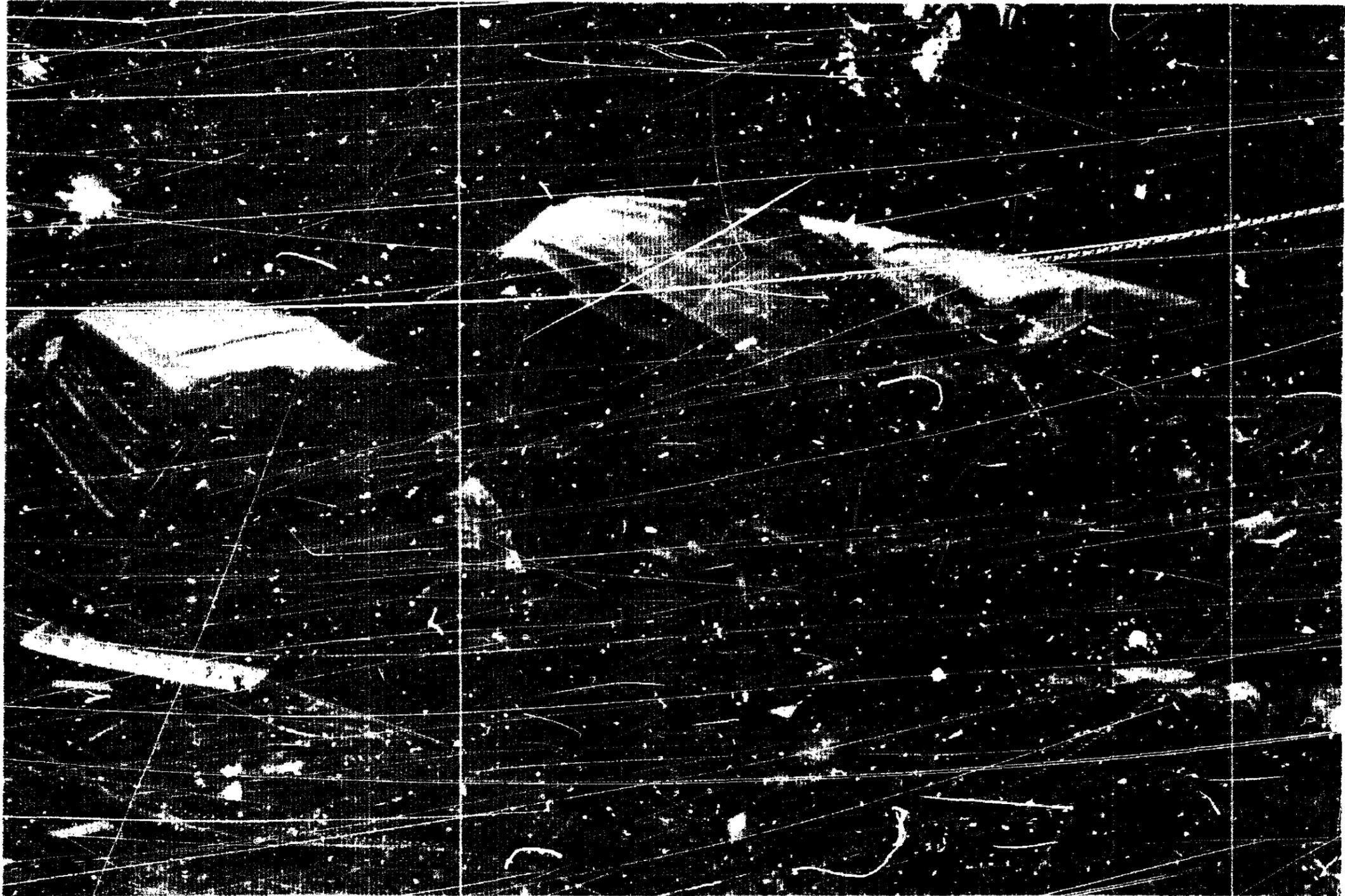


Figure 1.--Greene County Schoolibus.
(Photo courtesy of the Goldsboro News Argus.)

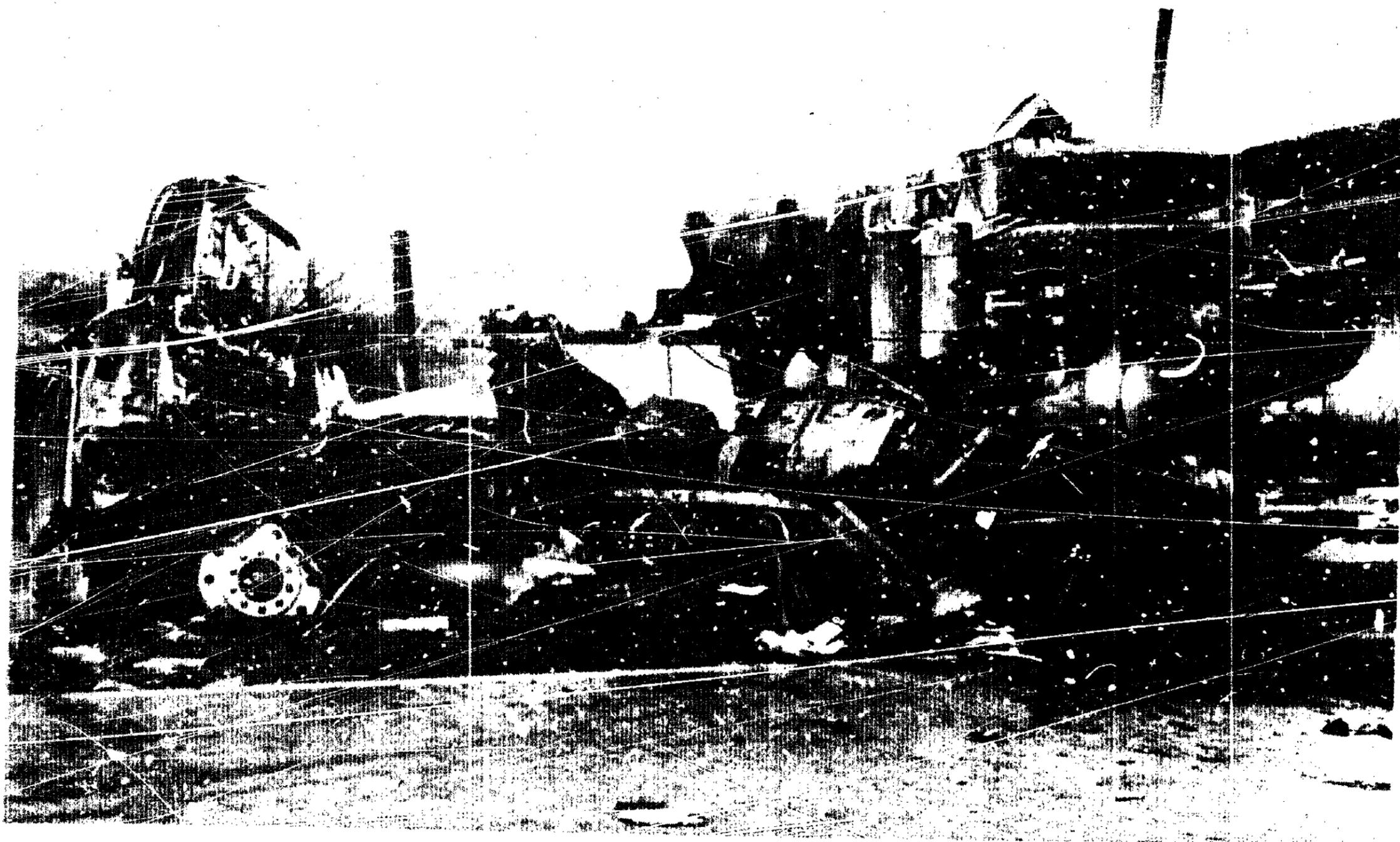


Figure 2.--Grain truck and MDV tractor (overturned).
(Photo courtesy of the Goldsboro News Argus.)

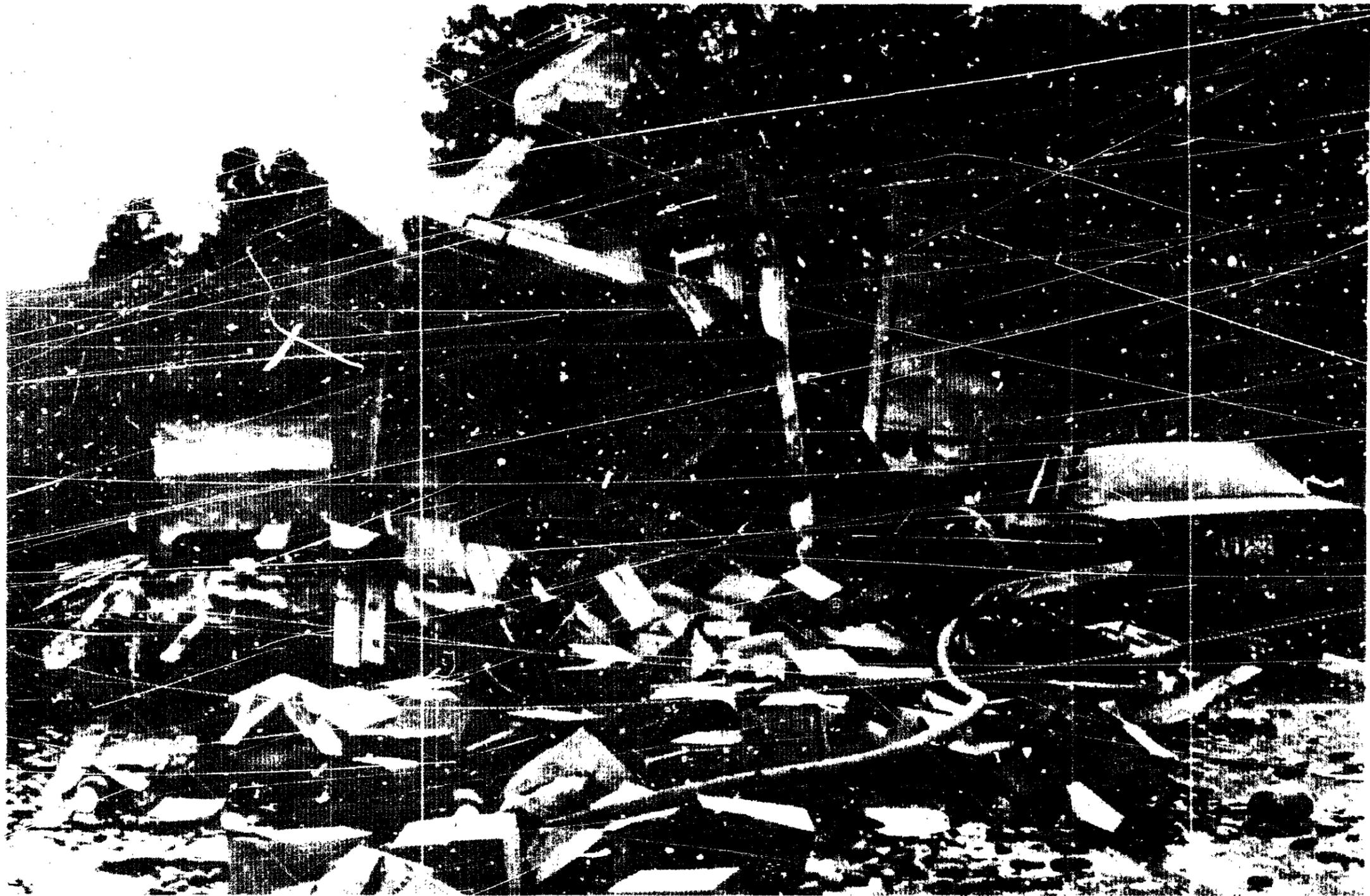


Figure 3.--MDV semitrailer (overturned) at left.
Rear of grain truck and auto at right.
(Photo courtesy of the Goldsboro News Argus.)

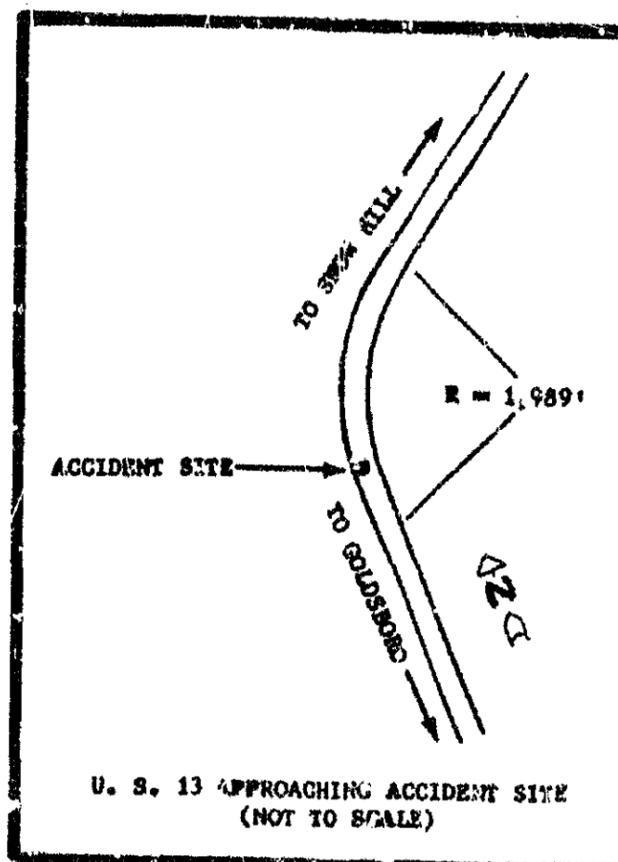
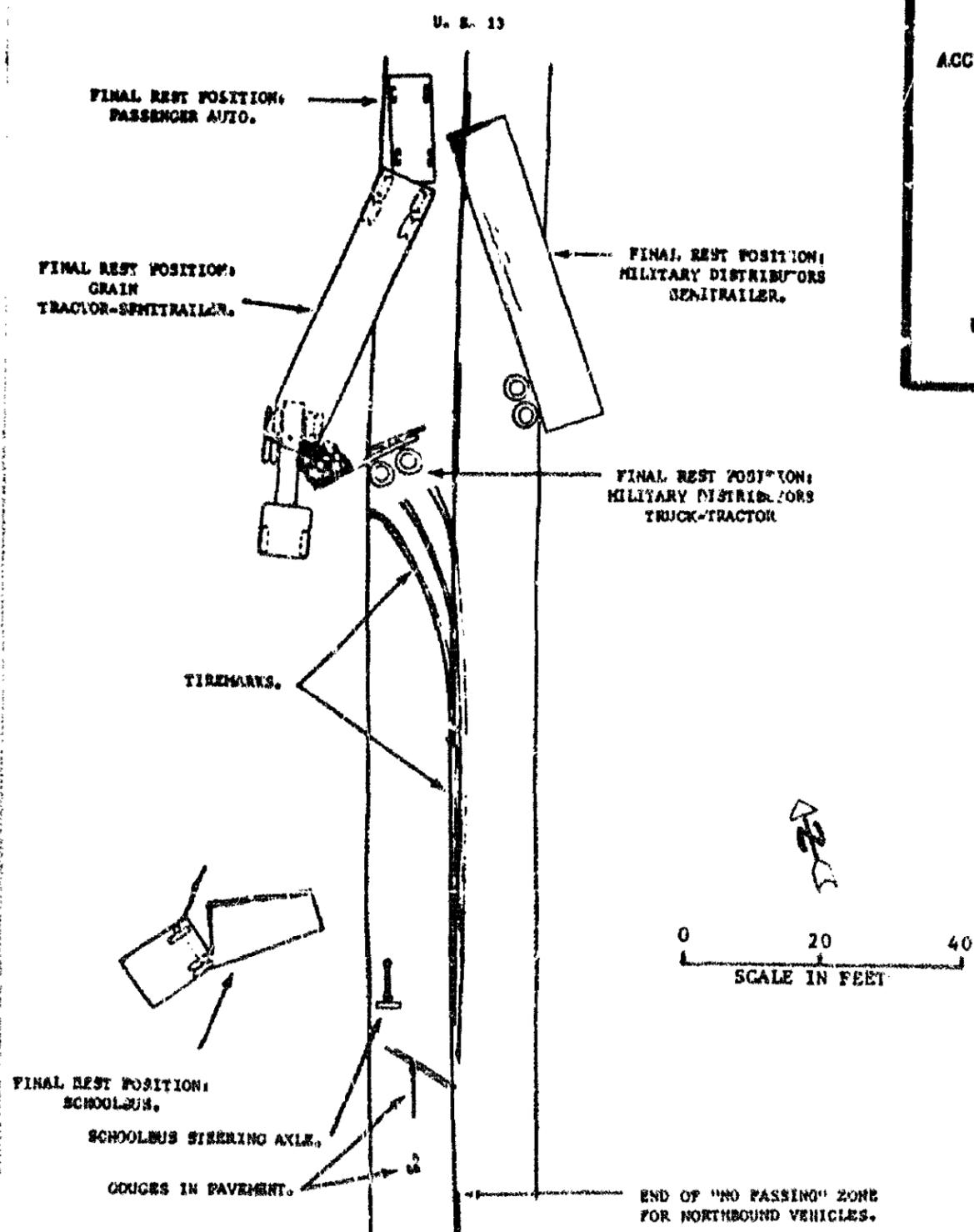


Figure 4.--Plan view of accident site.

door. This statement differs from information supplied by the grain truck driver, who stated that he believed he was ejected from his vehicle during the collision.

	<u>Drivers</u>	<u>Passengers</u>	<u>Total</u>
<u>Fatally Injured</u>			
Unsurvivable (AIS-6)	1	0	1
Critical (AIS-5)	0	2	2
Severe (AIS-4)	0	4	4
Subtotal	1	6	7
<u>Nonfatally Injured</u>			
Critical (AIS-5)	0	0	0
Severe (AIS-4)	0	3	3
Serious (AIS-3)	0	3	3
Moderate (AIS-2)	0	7	7
Minor (AIS-1)	3	9	12
Uninjured (AIS-0)	0	0	0
Subtotal	3	22	25
Total	4	28	32

Note: Historically the Safety Board has used the International Civil Aviation Organization (ICAO) criteria to classify severity of personal injury in all modes of transportation accidents. Based on these criteria, the schoolbus driver sustained minor injuries, 8 schoolbus passengers sustained minor injuries, 13 serious injuries, and 6 fatal injuries; the MDV truck driver sustained fatal injuries; the grain truck driver, and the automobile driver and passenger sustained minor injuries.

It could not be determined how many children were ejected during the crash, or how many exited the schoolbus after it came to rest. The driver of the straight truck reported that when he approached the schoolbus, about 20 children were already outside the schoolbus, two of the children were not moving, and several were unconscious or semiconscious and unable to walk. He reported that he ushered the children who were able to walk south away from the schoolbus on the west side of the highway. By that time, passersby had started to assist with the evacuation of the rest of the children. The schoolbus driver and the other occupants who were still inside the schoolbus were evacuated either through the opening on the left side caused by the collision or through the rear emergency exit door, which was opened by a passerby assisting in the evacuation.

The Greene County Communications Center at Snow Hill received initial notification of the collision at 3:20 p.m. Officers for the North Carolina Highway Patrol arrived at the scene within minutes after the initial report. The Snow Hill Volunteer Fire Department was the first fire unit on the scene, and the fire was brought under control in about 20 minutes.

Mutual aid assistance was requested for ambulances, and 23 ambulances responded to the scene from Greene, Pitt, Lenoir, Wilson, and Wayne counties. The Greene County Fire Marshall coordinated the overall emergency response.

Triage for the accident victims was initially performed by firefighting personnel from the Shine (North Carolina) Volunteer Fire Department. Personnel from the Snow Hill Medical Clinic arrived at the scene and assisted in the on-scene treatment of the injured.

The MDV truckdriver and three schoolbus passengers were dead at the scene. All of the injured were removed from the scene by 4:20 p.m. The driver and occupant of the passenger automobile were transported to the Snow Hill Medical Clinic in a private automobile, where they were treated for minor injuries and released. Two schoolbus passengers were transported from the scene by helicopter to Pitt County Memorial Hospital in Greenville, North Carolina, where one of them died at 11:22 p.m. that night. The grain truck and schoolbus drivers and 22 passengers from the schoolbus were transported by ambulances to Wayne County Memorial Hospital in Goldsboro, North Carolina. One schoolbus passenger died in the hospital receiving room at 5:37 p.m. Three schoolbus passengers were not treated at Wayne County Memorial Hospital but were transported by helicopter to Duke University Medical Center in Durham, North Carolina; one of these passengers died on June 3, 1985. The schoolbus driver and 10 schoolbus passengers were admitted to Wayne County Memorial Hospital for treatment and/or observation. The grain truck driver and six schoolbus passengers were treated for minor injuries at the hospital and released. One child returned the next day for additional treatment. Two schoolbus passengers required no medical treatment away from the scene.

Military Distributors Truckdriver Information

Employment History.--The 27-year-old truckdriver had been employed by MDV since March 1981, first as a warehouseman, and then as a truckdriver starting in June 1983. Although he first worked in the MDV warehouse, when he applied for a job with MDV, he applied for a truckdriver position. His employment application, completed on March 5, 1981, contained the question "Do you have any physical condition which may limit your ability to perform the job applied for?" The truckdriver answered "no" to this question.

The only record of any disciplinary action in the truckdriver's MDV personnel file was a written warning given in June 1981 for reporting late to work twice in one week. Before he was employed by MDV, he had worked for other employers as a welder, a carpentry helper, a carpet installer, and a lift truck operator.

Medical Information.--On June 30, 1976, while the MDV truckdriver was still a minor and a military dependent, he was treated at the Portsmouth, Virginia, Naval Regional Medical Center (NRMC). His NRMC medical records indicate that he reported that he had fallen down a flight of stairs and sustained a head injury about 2 months before the visit to the medical facility. He then had experienced a seizure during which he had bitten his tongue while he was unconscious. He also reported he had been experiencing muscle contractions which he could not control. The NRMC performed an electroencephalogram (EEG) which was judged to be abnormal, and he was diagnosed as having a seizure disorder. The medical examiner prescribed phenobarbital in 32 milligram (mg) doses to be taken three times daily, and recommended no motor vehicle driving for 6 months.

In February 1977, the truckdriver was told he could resume driving his personal vehicle if he had a normal EEG. Although the treating physician requested another EEG, a copy of the followup EEG is not included in the record. The last entry in his medical record with the NMRC, made on July 28, 1977, indicates that his EEG was normal, the seizure disorder was controlled, and the prescribed dosage of 32 mg of phenobarbital three times daily was to be continued.

On July 31, 1978, the truckdriver was examined at a civilian medical clinic and was diagnosed as having post-traumatic epilepsy. Thirty mg of phenobarbital, to be taken three times daily, was prescribed. On January 18, 1979, he re-visited the clinic complaining that he had been experiencing back pain and tremors when he was concentrating or when he was nervous. He requested medication to control his tremors so he could hold a job. The prescription for phenobarbital was continued.

On September 17, 1979, the truckdriver visited the clinic again. He reported that without medical advice he had reduced his phenobarbital medication from three times daily to only once in the morning, and volunteered that he had ignored the advice of his physician at the NMRC and had resumed driving his personal vehicle prior to February 1977.

His physician referred the truckdriver to a specialist and on September 20, 1979, he was given another EEG, which showed epileptiform activity consisting of spike and high amplitude wave formations, indicative of a seizure disorder.

During the September 17 visit, he requested that his regular physician perform a medical examination required by the U.S. Department of Transportation (DOT) to determine his physical qualifications to operate a commercial vehicle in interstate commerce so that he could attend a truckdriver training school. The medical history section of the examination form noted that the truckdriver had a history of seizures, fits, convulsions, or fainting. His regular physician, aware of the truckdriver's seizure disorder, did not sign the certificate to certify that the truckdriver was qualified to operate commercial vehicles in interstate commerce, and the unsigned certificate remained in the physician's files. During visits to his regular physician in March and December 1984 the truckdriver reported to his physician that he was taking 30 mg of his medication twice daily.

On September 29, 1984, a physician employed by MDV gave the accident truckdriver and the other 11 truckdrivers employed by MDV medical examinations to determine their physical qualifications to drive commercial vehicles in interstate commerce. The examinations were given at the MDV headquarters in Norfolk, Virginia. The examining physician reported that he had never seen the accident truckdriver either before or after the examination. The medical history section of this record of physical examination shows no history of seizures, fits, convulsions, or fainting. The only toxicological test performed during this examination was a urine test for specific gravity, and for the presence of albumin and sugar, which was negative. The examining physician signed the truckdriver's medical examiner's certificate, showing that he was physically qualified to operate commercial vehicles in interstate commerce, on the date he was examined. There is no evidence that the truckdriver had ever previously been certified as being qualified to operate commercial vehicles in interstate commerce.

A friend of the truckdriver who worked in the MDV warehouse reported that about a year before the accident he was in the truckdriver's home and noticed a bottle of pills in a drawer. The truckdriver told him the pills were "to keep him from being 'hyper.'" The friend also reported that about 4 months before the accident he was in a bar with the truckdriver, along with the truckdriver's sister and girlfriend, and that the truckdriver left the bar and became involved in a fight outside. When the friend left the bar, he saw the truckdriver being restrained by the police, at which point both the truckdriver's sister and his girlfriend pleaded with the police not to send the truckdriver to jail without his pills. After the incident, both women pleaded with the friend not to tell MDV about the truckdriver's "medical problems." His sister admitted that the truckdriver had had seizures "a few times." When the friend asked the truckdriver about this incident later, the truckdriver denied that he had epilepsy.

The truckdriver's mother and stepfather were interviewed on June 4, 1985. They reported that the truckdriver did not smoke tobacco or drink coffee, that he used alcohol only occasionally, that he had no chronic health problems and had never had a head injury. The only health problems they mentioned were that he had had a foot operation when he was a child, and that he had experienced ear infections recently.

The truckdriver's housemate was interviewed twice. During the first interview in person on June 5, 1985, she reported that she had no knowledge of any chronic medical disorder or prescription drug usage by the truckdriver. Concerning the truckdriver's lifestyle, she reported that he had been living with her and her 5-year-old daughter for 2 years, that he frequently slept during the day when he had to work at night, and that he often went to work with only 3 to 4 hours sleep. She reported that the truckdriver told her that if he got sleepy while driving he would pull over and sleep on a pillow across the steering wheel of his truck. He did not smoke tobacco, but did drink coffee before going to work. She also reported that he had not complained recently about any illnesses or discomfort other than that he had pulled a muscle in his back, which had caused him discomfort for a few days. He did not have a regular doctor, but had recently visited her doctor in Norfolk, Virginia, to obtain medication for an ear infection.

After the truckdriver's medical history showing a history of epilepsy was obtained, his housemate was re-interviewed by telephone on July 1, 1985. During this interview, his housemate admitted she knew of the truckdriver's epilepsy and stated that the truckdriver's mother had requested that she deny any knowledge of the condition. She said that she had never seen the truckdriver experiencing a seizure or displaying any tremors, and that to her knowledge he had not had a seizure since 1980 when he said he had stopped taking his medication for 4 or 5 days while living in West Virginia. She said that he had told her that he had stopped taking the pills at that time because he did not like being addicted to anything, and that he would know when he was about to have a seizure.

She reported that he always took one pill in the morning, and one at night before going to bed, and that he left the prescription bottle at home while he was working. If he knew he was going to be away from home for more than 12 hours, he would keep one pill in his wallet with his driver's license. She stated he was very responsible about taking his medication.

Examination of the truckdriver's medical records showed that from August 7, 1979, to July 5, 1984, the prescription for the phenobarbital was issued 10 times by his physician: once in a 90-pill (30-day) supply; five times in a 200-pill (66.6-day) supply; once in a 400-pill (133.3-day) supply; and three times in a 600-pill (200-day) supply. (See

appendix B.) In most cases, the truckdriver probably did not pick up the total number of pills prescribed all at once, but rather obtained them in smaller quantities over a period of time. For example, the last time his prescription was issued on July 5, 1984, a maximum of 400 thirty mg pills was prescribed. The records of the pharmacy where the prescription was filled indicate that the truckdriver obtained his prescribed total of 400 pills on four separate occasions-- he obtained 100 pills each on July 5, August 27, October 23, and December 10,

Training.--On September 11, 1981, the truckdriver successfully completed a 6-week truckdriver training course at the Tidewater Community College in Portsmouth, Virginia. An instructor at that training facility reported that a physical examination is required for entry to the course, but that there was no medical examiner's certificate on file for the MDV truckdriver. The instructor stated that the truckdriver may have asked for the medical examination certificate at the close of the course so he could give it to his employer. The instructor also reported that the truckdriver's "over-the-road" performance was satisfactory, his classroom grade was 95%, and that his performance on a written test on DOT regulations was "very satisfactory."

Licensing Information.--The truckdriver held a Virginia class A license authorizing the operation of large commercial vehicles. The license was originally issued on June 14, 1983, and the license application in use by Virginia at that time contained a question asking if the applicant had a visual, physical, or mental condition that impaired his ability to drive. The truckdriver answered "no" to this question. The truckdriver applied for renewal of this license on May 8, 1985. Virginia had revised its license application form, and this application contained the question "Have you ever had a seizure or blackout, or do you have a visual, mental, or physical condition which requires that you take medicine or use special equipment in order to drive?" The truckdriver answered "no" to this question and certified that the information given was true and correct by signing the application. Virginia renewed the license on May 10, 1985.

Driving Record.--From June 6, 1977, to the date of the accident, the truckdriver had nine convictions on his Virginia driving record, including four for speeding, two for failure to obey traffic signals, one for reckless driving, one for following too closely, and one for operating an uninspected vehicle. He had been involved in two accidents, both of which occurred in February 1985. One accident occurred while the truckdriver was operating his personal vehicle. According to the police report, there were no injuries and \$825 property damage. This accident resulted in the driver of the other involved vehicle being cited for improper passing. The other accident occurred while he was operating an MDV vehicle when he struck another vehicle in the rear. According to the police report, there were no injuries and \$700 property damage. The truckdriver was not issued a traffic citation as a result of this accident.

Activities Prior to the Accident.--Information concerning the truckdriver's activities during the days before the accident was obtained by interviewing his housemate and officials from MDV. According to these sources, the truckdriver was off duty on May 25, 26, and 27. On the 25th, he had a picnic with his family, on the 26th he went target shooting with friends, and on the 27th he went to the beach and then helped a friend build a garage. At 5 a.m. on May 28 he reported for work at MDV and drove from Norfolk, Virginia, to Virginia Beach. He returned to Norfolk at noon and went off duty until 5 p.m. From 5 p.m. on May 28 until 3 a.m. on May 29, he drove on trips between Norfolk, Hampton, and Virginia Beach. He then went off duty and his housemate reported that he stayed at home the remainder of the 29th, where he rested and worked on his personal vehicle.

On May 30 he reported for duty at 4:15 a.m. and drove from Norfolk to Fort Lee in Petersburg, Virginia. He returned to Norfolk about 2:45 p.m. and went off duty for the remainder of the day. His housemate reported that he took one pill after he arrived home from work. He ate a late supper and went to bed at 10:30 p.m., knowing that he was to report for work in 1 1/2 hours. He awoke at midnight and called the MDV warehouse and asked the person on duty to punch his time card because he was going to be late. His housemate did not know if he took a pill before leaving for work. He arrived at work at 12:30 a.m. on May 31, loaded the truck, and left Norfolk about 1 a.m. en route to Fort Bragg, near Fayetteville, North Carolina. He arrived at Fort Bragg about 5:30 a.m. and went off duty for about 2 hours. MDV officials estimated that he probably finished making his first delivery at Fort Bragg about 9 a.m. He then made two more deliveries at Fort Bragg, the times of which are unknown.

The next contact with the truckdriver was at about 12:30 p.m. when he called the MDV traffic manager and informed him that he was at a truck stop on U.S. 301, which the traffic manager believed to be near Fort Bragg. The traffic manager told the truckdriver he was to pick up a load in Faison, North Carolina. The truckdriver informed the traffic manager that he was going to take the remaining 1/2 hour of his lunchtime off duty, and would then drive to Faison. About 2:15 p.m. MDV had its last contact with the truckdriver when he called the traffic manager from the pickup point in Faison and told him that he was loaded and was leaving to return to Norfolk. The accident occurred about 1 hour 5 minutes later.

According to this reconstruction of the MDV truckdriver's activities, he had been on duty a total of about 12 hours, about 7 of which had been driving, since the last time he had 8 or more hours off duty. During the 36 hours before the accident, from about 4:15 a.m. on May 30 to the time of the accident, the driver had about 1 1/2 hours sleep. (See appendix C for information on the other involved drivers.)

Vehicle Information and Damage

Schoolbus.--The 48-passenger schoolbus was manufactured in 1982 with a Ford Motor Company chassis and a body constructed by Thomas Built Buses, L.P. (Thomas). The schoolbus was owned and operated by the Greene County (North Carolina) Board of Education. The 8-foot-wide, 2-axle schoolbus was equipped with a gasoline engine and a 4-speed automatic transmission. The manager of the Greene County schoolbus maintenance facility reported that the schoolbus was governed to operate at a maximum speed of between 30 and 35 mph.

The schoolbus was equipped with padded restraining barriers on each side of the bus in front of the first row of seats and eight rows of padded bench-type seats on each side of the center aisle. The inboard (aisle) side of these seats was equipped with two seat legs which were attached to a section of the metal "C" channel floor of the schoolbus body by means of a bolt and a screw through a flat collar flange welded on the bottom of each seat leg. The outboard sides of these seats' frames were attached to the interior sidewall of the schoolbus body by a bracket with two bolts. The driver's seat was equipped with a lapbelt; the passengers' seats were not equipped, nor were they required to be equipped, with lapbelts.

The collision tore the schoolbus steering axle away from its mountings to the front suspension, and the steering axle came to rest on the highway parallel to the highway edgeline. (See figure 4.) The postaccident inspection disclosed severe abrasion and asphalt deposits on the left drag link of the schoolbus steering axle assembly at its point of

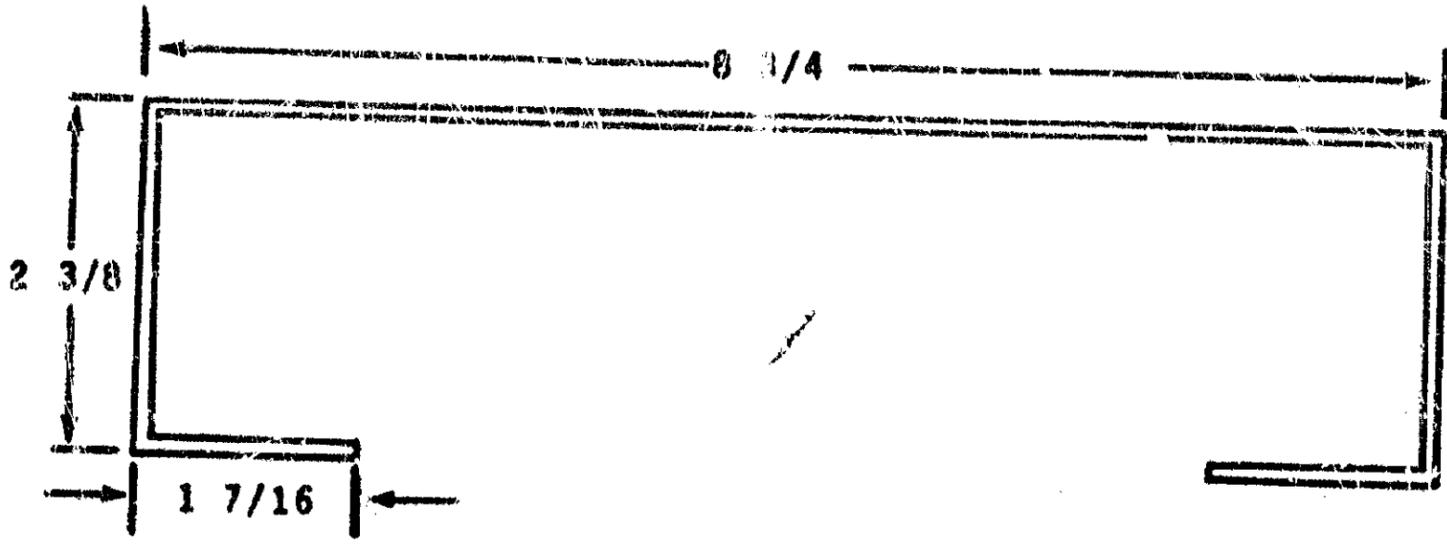
attachment to the tie rod. Based upon measurements taken of a similar schoolbus, the pre-accident location of this drag link/tie rod connection was from 10 to 14 inches inboard of the outside left edge of the schoolbus, depending on whether the steering was turned full right or full left. The left 14 inches of the schoolbus front bumper was bent rearward almost 90 degrees, and collision damage continued rearward 19 feet along the left side of the schoolbus through the engine compartment and the schoolbus body to the drive axle. The outboard tire of the left drive wheel dual wheel assembly was torn off its rim.

The collision peeled back 13 feet of the left sidewall of the schoolbus body from the dashboard to the left drive wheel, and the restraining barrier and the first three bench seats behind the driver were torn out of the schoolbus body. The fourth bench seat behind the driver was torn loose from its attachments to the schoolbus interior. The inboard legs of the fourth bench seat on the driver's side were bent aft almost flush with the floor and its outboard wall attachment bolts were torn from their sidewall mountings. This seat and all other seats remained inside the schoolbus body. The seats in rows 5 through 8 on the left side all remained firmly attached to the schoolbus floor. The seatbacks of the fifth, sixth, and seventh seats on the left side were displaced forward 9, 6, and 7 inches respectively. There was no damage to the eighth seat on the left side.

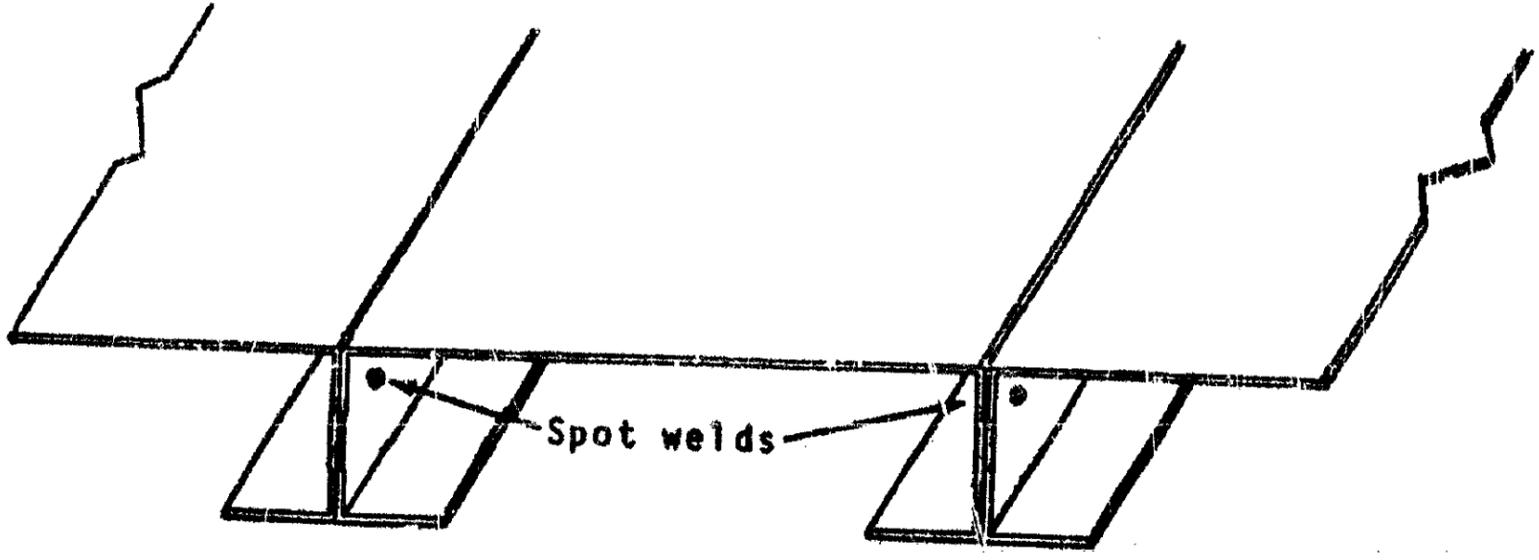
The front restraining barrier on the right side of the schoolbus remained firmly attached, but the upper inboard corner of the barrier was displaced forward 8 inches. The first seat on the right side was undamaged; the top of the seatback of the second seat on the right side was displaced 2 inches forward. The rear of the seat cushion frame on the third seat on the right side was indented about 1/2 inch forward and the seatback of this seat was displaced 3 inches forward. The rear leg of the fourth seat was bent rearward, the front leg separated from its attachment to the floor, and the seat cushion was displaced 6 inches forward and 7 inches downward at the aisle. The seatback of the fifth seat was displaced forward 5 inches; the seats in the seventh and eighth rows on the right side were undamaged; however, there was blood on the front of the seatback of the seat in the seventh row.

The schoolbus floor consisted of 0.075-inch-thick steel material bent into C-shaped channels. These channels were joined together by an exterior steel "cap" around the outside perimeter of the floor, by welds along the flanges at each end, by welds on the underside of the floor structure about 2 1/2 inches long located about 14 inches inboard of the outside edge of the floor structure, and by 12 spot welds 1/2 inch in diameter and about 6 5/8 inches apart near the center of the flanges on each channel. (See figure 5.) The collision separated two of these floor channel sections at the floor joint located near the seat legs of the fourth row of bench seats in front of the schoolbus drive axle. The floor separation created a triangular opening across the schoolbus floor which measured about 45 inches wide at the left sidewall. The schoolbus floor was crushed inboard about 7 inches immediately in front of this opening. The floor was relatively undamaged behind this opening and was 98 inches wide. (See figures 6 and 7.) The schoolbus driver reported that there were no defects in the vehicle she was driving, and a postaccident examination of the vehicle did not disclose any defects.

MDV Tractor-Semitrailer. --The MDV vehicle was a 1984, three-axle International Harvester truck-tractor operated in combination with a two-axle Utility van semitrailer. The 95.5-inch-wide tractor was equipped with a diesel engine and a seven-speed manual transmission, and all wheels of the five-axle vehicle combination were equipped with air-mechanical brakes.



Side view of C-shaped channel section.
Dimensions are in inches.



Side view of three C-shaped channel sections welded together.

Figure 5.--Schoolbus floor construction.



**Figure 6.--Opening in schoolbus floor.
(Photo courtesy of the Goldsboro News Argus.)**

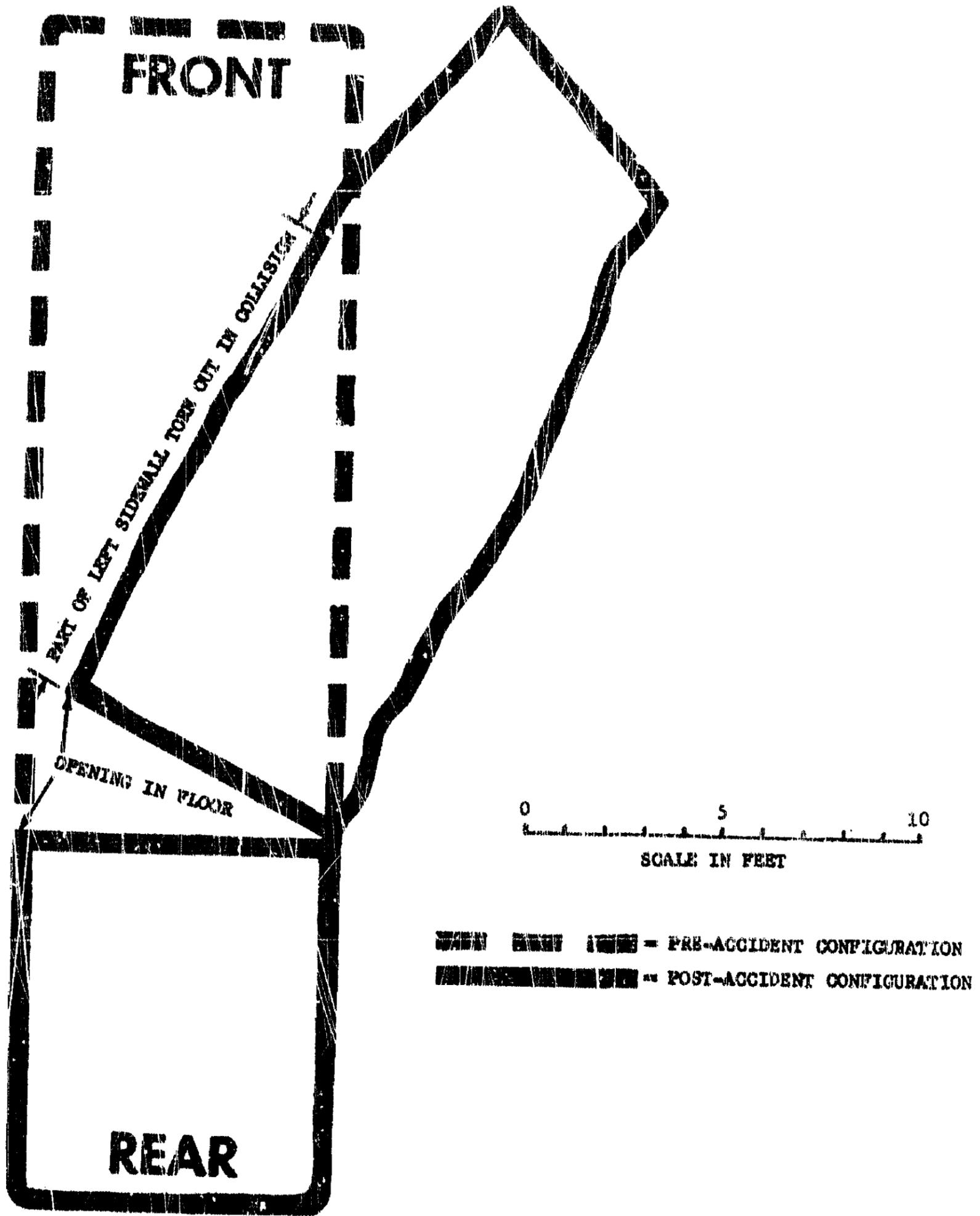


Figure 7.—Deformation of schoolbus body at floor level

The steering axle of the MDV truck-tractor was torn away from the chassis and came to rest parallel to the left longitudinal frame member of the grain truck behind the grain truck's cab. (See figure 2.) A postaccident inspection of the steering box attached to the outboard side of the left longitudinal frame member indicated that this part still functioned and could be turned freely by hand.

No meaningful postaccident inspection of the controls in the cab of the MDV tractor could be performed because the cab was destroyed in the fire. The postaccident inspection of the transmission indicated that the transmission was in seventh gear at the time of the accident. The manufacturer reported that operation in that gear within the recommended engine rpm ranges would result in a speed of between 44 and 60 mph.

The front of the MDV semitrailer was torn out from the roof to the floor, and the upper half of the fifth wheel plate was torn out of the floor and remained attached to the truck tractor. The first 6 feet of the left front side was crushed rearward, and there were yellow paint transfers along the first 27 feet of the left side of the 45-foot-long semitrailer.

Grain Tractor-Semitrailer.---The grain truck was a 1985 three-axle GMC truck-tractor operated in combination with a 42-foot-long two-axle bottom-dump grain trailer. Collision damage to the grain truck tractor was confined to the left 8 inches of the tractor cab, the left steering axle wheel, the left saddle-mounted fuel tank, and the battery bracket. No pre-accident defects on this vehicle were reported.

Passenger Auto.---The passenger auto was a 1981 Dodge Challenger. Collision damage to this vehicle was confined to the front bumper, grill, and hood. No pre-accident defects on this vehicle were reported.

Highway Information

The accident occurred on U. S. 13 about 2.3 miles south of Snow Hill, North Carolina. At the accident site, the north-south highway curves to the right for northbound vehicles, and the curve's radius is about 1,089 feet at the highway centerline. The highway consists of two 12-foot-wide asphalt driving lanes, with 10- to 12-foot-wide unimproved shoulders and a slight downgrade for northbound vehicles. Sight distance at the scene is about two-tenths of a mile ahead and the speed limit is 55 mph for both northbound and southbound vehicles. A solid yellow line marks the southbound lane as a "no passing" zone throughout the accident site. The northbound lane as it approaches the accident site is marked as a "no passing" zone. This "no passing" pavement marking ends south of the accident site. (See figure 8.)

The first highway evidence attributed to the accident was three gouges in the southbound lane. The center of these gouges was 32 inches north of the northern end of the northbound "no passing" zone pavement marking and 77 inches west of the pavement center. Additional gouges were found starting about 15 feet north of the northern end of the northbound "no passing" pavement marking.

When Safety Board investigators arrived at the scene the day after the accident, no tire marks were visible on the pavement at the accident site. The North Carolina Highway Patrol furnished photographs of the accident site taken while the vehicles were still in place. These photographs showed three striated tire marks beginning about 18 feet north of the northern end of the northbound "no passing" pavement marking in the



Figure 8.--View of accident site for northbound vehicles.
Auto is parked by gouge marks.

northbound lane and about one foot east of the center of the highway. These marks widened as they continued northbound and crossed the centerline into the southbound lane about 50 feet north of where they began. In the southbound lane, the marks led up to within about 4 feet of the tires of the MDV truck tractor at its final rest position, overturned on its right side. One tire mark ended at the right edge of the pavement in the southbound lane. (See figure 4.)

Medical and Pathological Information

An autopsy of the MDV truckdriver was performed on June 1, 1985, by a forensic pathologist for the East Carolina School of Medicine in Greenville, North Carolina. He determined that the cause of death was a crushing impact to the chest with aortic laceration and massive hemorrhage. Additional injuries noted included multiple rib fractures, a lacerated left lung, contusions to the heart, jejunum, and descending colon, and extensive postmortem incineration of the body.

The postmortem examination disclosed that the MDV truckdriver's right coronary artery was essentially nonfunctional; the vessel was tiny, short, and incomplete. The left circumflex artery was, however, about twice the normal expected caliber and in the opinion of the medical examiner compensated for the inadequate right coronary artery. The medical examiner concluded that "Effective cardiac action was present in the dying process, as evidenced by vital responses, and a cardiac arrhythmia is not considered probable."

Tests performed on a blood sample obtained from the MDV truckdriver's body disclosed that the blood contained 3.0 milligrams per liter (mg/L) of phenobarbital, and 6.0 micrograms per liter of carboxylic acid metabolite of delta-9 tetrahydrocannabinol (THC). No other drugs or alcohol were detected in the blood. The medical examiner concluded that "The phenobarbital level in blood is clearly sub-therapeutic, . . . and an initiating seizure episode cannot be ruled out."

The six schoolbus passengers who died were seated on the left side behind the driver; two in the first seat, two in the second seat, and one each in the outboard seats of the third and fourth rows next to the left sidewall. Their injuries included multiple fractures (including skull fractures), internal injuries, limb amputations, and severe lacerations. All six surviving students who were either seriously or severely injured were seated in the first five rows of the schoolbus; these students sustained fractures, lacerations, and some moderate internal injuries, abrasions, and contusions. (See figure 9.)

The schoolbus driver stated that she was wearing her lapbelt at the time of the collision. It was not determined if the MDV truckdriver and the grain truckdriver were wearing their available lapbelts at the time of the collision. The driver of the passenger automobile stated that he and the other occupant were not wearing their available lap and shoulder belts.

Federal Motor Carrier Safety Regulations

As a motor carrier operating in interstate commerce, MDV is subject to the requirements of the Federal Motor Carrier Safety Regulations (FMCSR) contained in Title 49, Code of Federal Regulations, Parts 390 to 399. Section 391.41(b)(8) of these regulations states that a person is physically qualified to drive a motor vehicle if that person "has no established medical history or clinical diagnosis of epilepsy or any other condition which is likely to cause loss of consciousness or any loss of ability to control a motor vehicle."

Although the regulations do not specify what, if any, toxicological tests are to be performed by an examining physician, section 391.43(c) of the FMCSR, "Instructions for Performing and Recording Physical Examinations," states that a "history of certain defects may be cause for rejection or indicate the need for making certain laboratory tests or a further, and more stringent, examination."

The FMCSR do not contain a rule prohibiting the falsification or omission of medical information by an applicant truckdriver.

Part 395 of the FMCSR establishes limitations with respect to maximum driving and on-duty time for interstate commercial vehicle drivers. Section 395.3 provides that no motor carrier shall require or permit a driver to:

- a) Drive more than 10 hours since a driver's last 8 or more hours off duty.
- b) Drive for any period after having been on-duty 15 hours since a driver's last 8 or more hours off duty.
- c) Remain on duty more than 60 hours in any 7 consecutive day period.

LEGEND

AIS* SEVERITY CODE

- AIS-0 NO INJURY
- AIS-1 MINOR
- AIS-2 MODERATE
- AIS-3 SERIOUS
- AIS-4 SEVERE
- AIS-5 CRITICAL
- AIS-6 MAXIMUM INJURY; VIRTUALLY UNSURVIVABLE

M-10; AIS-X
 ↑ ↑ ↑
 SEX AGE SEVERITY

*AMERICAN ASSOCIATION FOR
 AUTOMOTIVE MEDICINE;
 ABBREVIATED INJURY SCALE

● = FATALLY INJURED
 ○ = SURVIVED

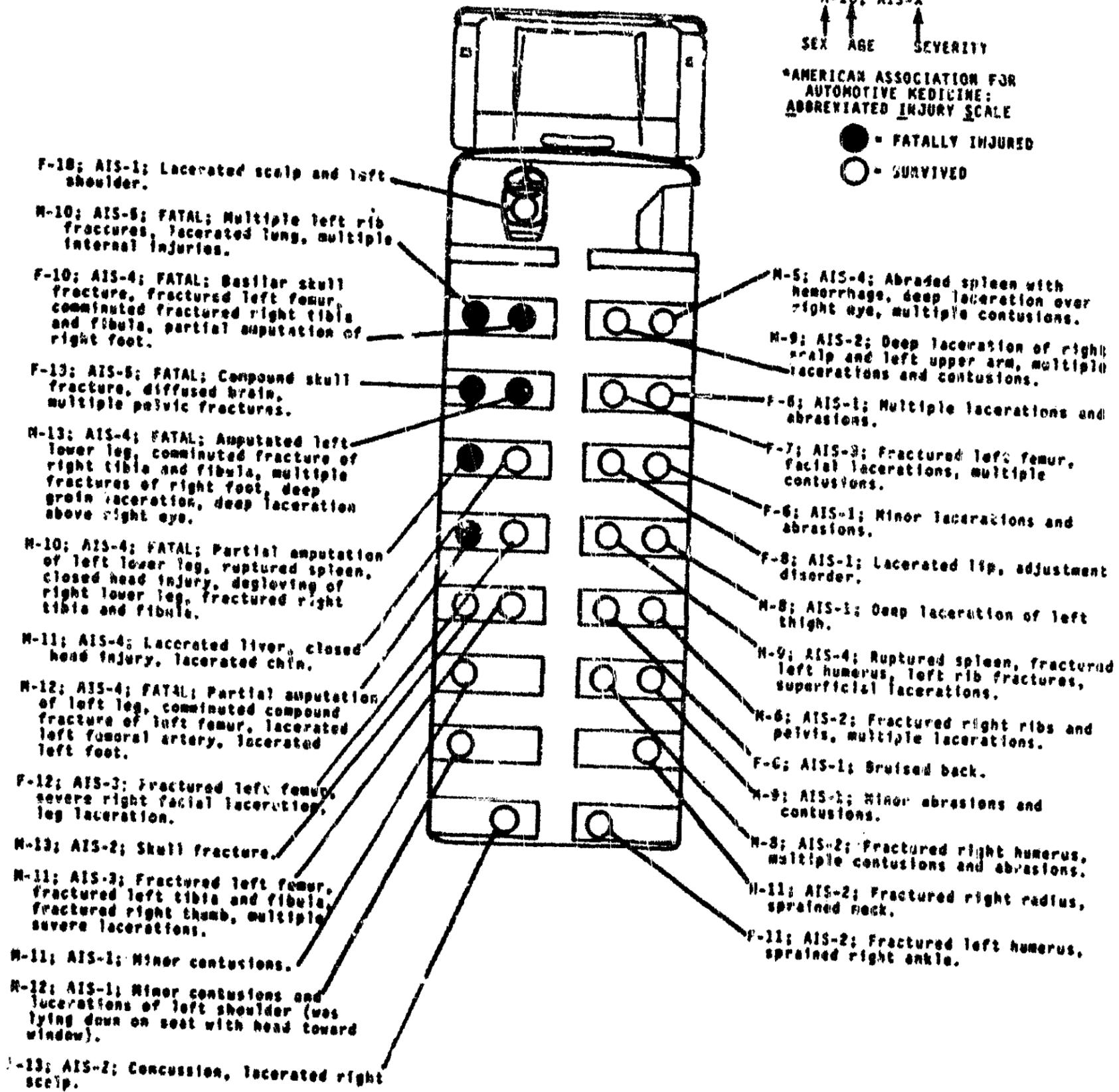


Figure 9.--Schoolbus occupant seating and injury chart.

Motor Carrier Operations

Military Distributors of Virginia, Inc., is a private motor carrier that conducts operations in 12 eastern States transporting foodstuffs to stores located on United States military reservations.

On September 12, 1984, the Virginia Motor Carrier Safety Office of the Federal Highway Administration completed a safety management audit of MDV's interstate motor carrier operations. This audit disclosed recordkeeping violations of Part 391 of the FMCSR relating to maintenance of driver qualification files. The MDV Manager of Trucking Operations reported that as a result of this audit, he required all MDV truckdrivers to retake written tests, driving tests, and medical examinations required by the FMCSR to bring MDV motor carrier operations into compliance with the regulations.

On September 13, 1984, the accident truckdriver took a written test on the FMCSR which consisted of 57 multiple choice questions. The truckdriver answered 41 questions correctly, including question 9, which stated:

9. 391.41(b)(8) Persons who have ever had epilepsy:

1. () cannot drive unless another driver is along.
2. (X) cannot drive.
3. () cannot drive on long runs.
4. () cannot drive without monthly medical examinations.

Federal Motor Vehicle Safety Standards

The schoolbus involved in this accident was manufactured after April 1, 1977. Therefore, it was required to meet several Federal Motor Vehicle Safety Standards (FMVSS) promulgated by the National Highway Traffic Safety Administration (NHTSA), including two related to schoolbus body joint strength and schoolbus passenger seating and crash protection.

FMVSS 221, Schoolbus Body Joint Strength, requires that an inside or outside body panel of a schoolbus be fastened so that the body panel joint is capable of holding the body panel to the member to which it is joined when subjected to a force of 60 percent of the tensile strength of the weakest joined body panel. The purpose of this standard is to reduce deaths and injuries resulting from the structural collapse of schoolbus bodies during crashes.

The rule defines the term "body panel" as a body component used on the exterior or interior surface to enclose the schoolbus' occupant space, and defines "body panel joint" as the area of contact or close proximity between the edges of a body panel and another body component, excluding spaces designed for ventilation or another functional purpose, and excluding doors, windows, and maintenance access panels. (See appendix D.)

FMVSS 221 does not specify the minimum strength of a schoolbus body panel joint. The required strength of any body panel joint subject to FMVSS 221 depends upon the strength of the weakest material joined. It is therefore possible to have a relatively strong material, such as steel, joined to a weaker material, such as wood, and FMVSS 221 would require the strength of the joint to be 60 percent of the strength of the wood.

On March 30, 1977, in response to a request to interpret how the joint strength requirement of FMVSS 221 applied to schoolbus floor joints, the NHTSA Associate Administrator for Motor Vehicle Programs wrote to Carpenter Body Works, Inc. (a manufacturer of schoolbuses) and advised:

The floor panels were described as having edges which are bent downward to form right angles and are attached to each other at these right angle legs some distance below the crease formed by the bend. It was agreed that these are body panel joints which must meet the requirements and would generally be tested using opposing tensile forces acting in planes that are parallel to the direction of the right angle legs.

FMVSS 222, Schoolbus Passenger Seating and Crash Protection, establishes occupant protection requirements for seats and restraining barriers for schoolbuses. The purpose of this standard is to reduce the number of deaths and injuries resulting from the impact of schoolbus occupants with structures within the vehicle during crashes and sudden driving maneuvers. FMVSS 222 provides for occupant crash protection through the use of strengthened, closely spaced, and padded seatbacks, and padded restraining barriers installed in front of the first row of seats in large schoolbuses.

NHTSA Tests of Thomas Floor Panel Joints

After FMVSS 221 became effective in 1977, NHTSA began routinely testing all manufacturer's schoolbuses to determine if they complied with the standard. Since early 1980 various offices of the NHTSA have communicated with Thomas about the compliance with FMVSS 221 of the floor panel joints in their schoolbuses. During this time NHTSA contractors calculated and tested the strength of the floor panel joints. 1/ NHTSA repeatedly requested information from Thomas in Certified Information Requests (CIR) 2262, 2416, and 2527, that would demonstrate compliance of the floor panel joints with FMVSS 221 because the tests and calculations indicated the floor panel joints did not comply with the requirements of the standard. 2/ These tests and calculations yielded floor panel joint strengths ranging from 24 to 73 percent of that required by FMVSS 221. Thomas repeatedly replied to the NHTSA requests for data that the floor panel joints in question were structural joints, not body panel joints and therefore not subject to the requirements of FMVSS 221. 3/ However, NHTSA officials indicated to Thomas that the floor panel joints in question were indeed subject to FMVSS 221. 4/

After reviewing its test reports and Thomas' responses to the NHTSA CIRs 2262, 2416, and 2527, NHTSA's Office of the Chief Counsel notified Thomas, on June 31, 1985, that it was terminating the investigations of the apparent floor joint failures without further action. The letter did not give any reason(s) for the termination.

1/ Report No. 221-MS-79-05-TR-05, National Highway Traffic Safety Administration, "School Bus Body Joint Strength, FMVSS 221, 1979 Thomas School Bus, 78 Passenger," February 1980, p. 58; Report No. 221-MS-80-04-TR-04, National Highway Traffic Safety Administration, "School Bus Body Joint Strength, FMVSS 221, 1980 Thomas School Bus, 65 Passenger," February 1981, p. 36; Report No. 221-MS-81-06-TR-06, National Highway Traffic Safety Administration, "School Bus Body Joint Strength, FMVSS 221, 1981 Thomas School Bus, 42 Passenger," March 1982, p. 40.

2/ Letters from National Highway Traffic Safety Administration to Thomas Built Buses, Inc., dated April 10, 1980, April 6, 1981, and June 15, 1982.

3/ Letters from Thomas Built Buses, Inc., to National Highway Traffic Safety Administration dated May 30, 1980, April 30, 1981, and July 16, 1982.

4/ Letter from National Highway Traffic Safety Administration to Thomas Built Buses, Inc., dated December 2, 1980.

In August 1982, the NHTSA Office of Vehicle Safety Compliance discontinued its program of testing schoolbus floor joints.

NTSB Tests of Thomas Floor Panel Joints

The methods and the materials used to fabricate the floors of the schoolbuses that had been tested by NHTSA were similar to the method and the material used to fabricate the floor of the schoolbus involved in the Snow Hill accident. Safety Board investigators obtained undamaged sections of the floor of the schoolbus involved in the Snow Hill accident. These specimens were forwarded to the National Bureau of Standards (NBS) to determine the strength of the material used in the floor and the strength of the floor joints.

Two specimens were used to determine the tensile strength of the steel in the C-shaped channel sections of the schoolbus floor. Based on the tests, the minimum tensile strength of the 0.075-inch-thick steel floor material was calculated to be 54,850 pounds per square inch (psi). Thus, the minimum strength of the floor panel joint required by FMVSS 221 would be 32,910 psi (.60 times 54,850).

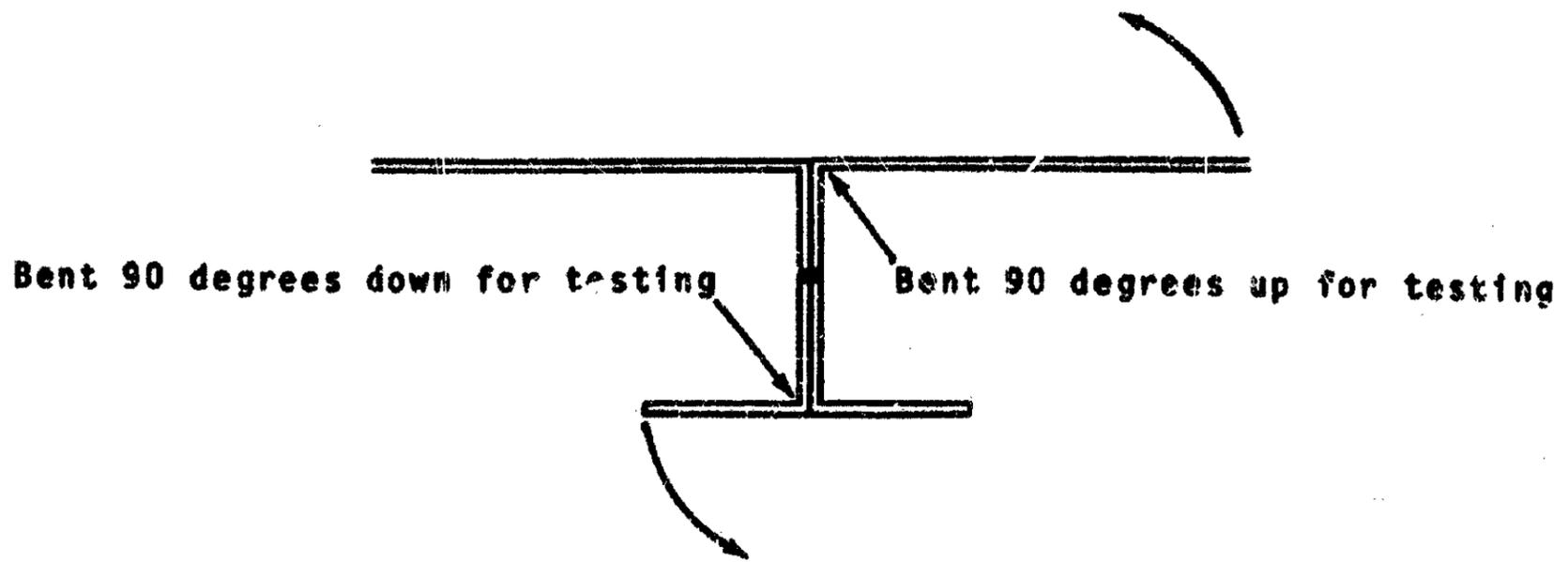
FMVSS 221 recommends test specimens 48 inches long and 8 inches wide at the center of the reduced specimen; however, it was not feasible to fabricate floor joint specimens 48 inches long because of the design of the floor. Therefore, three rectangular specimens 8 inches wide and about 9 inches long were fabricated with the flange joint to be tested located in the center of and parallel to the ends of the long dimension.

FMVSS 221 also requires a random selection of test specimens. However, because the spot welds in the flanges in the flooring were about 6 5/8 inches apart, it was possible that one or more of the test specimens could have included only one spot weld in any 8-inch section. Safety Board investigators directed the NBS to prepare test specimens that included two of the spot welds in each 8-inch specimen to ensure that each specimen was as strong as possible.

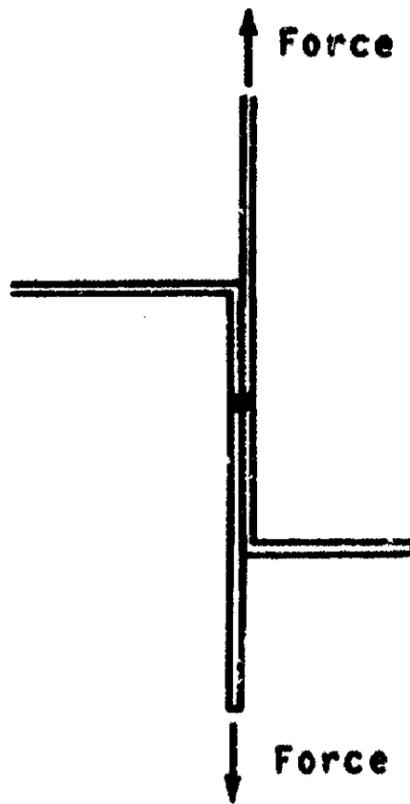
The procedure used to test the strength of the joint in the floor structure of the schoolbus involved in the Snow Hill accident was different from the test procedure used by NHTSA in its tests performed in February 1981 and March 1982. In the NHTSA tests, the configuration of the joint was modified by bending the specimen so that the joint was subjected to shearing forces.

The Safety Board test procedure did not involve a modification of the floor panel joint configuration. The floor panel joint was mounted in a test fixture which applied equal and opposite forces to each floor panel subjecting the joint to peeling forces. (See figure 10.)

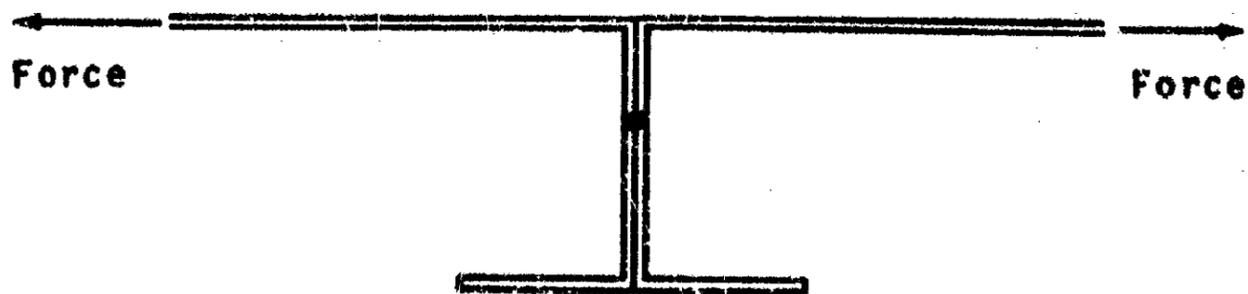
Safety Board tests of three floor joint specimens from the Snow Hill accident schoolbus determined that the first floor joint specimen failed at 1,328 pounds; the second specimen failed at 1,226 pounds; and the third joint specimen failed at 1,214 pounds. The strength of the strongest joint specimen tested (2,213 psi) was 7 percent of the strength required for the floor joint to meet the joint strength requirement of FMVSS 221.



NHTSA modification of floor joint before testing.



NHTSA test procedure.



Safety Board test procedure.

Figure 10.--NHTSA and Safety Board floor joint strength test procedures.

ANALYSIS

The Accident

The qualifications of the schoolbus driver, the grain truck driver, and the passenger automobile driver, as well as the weather and the condition of the highway, did not contribute to this accident. The Safety Board has no evidence indicating that a mechanical defect in any of the involved vehicles caused or contributed to the accident.

Damage to the left front of the schoolbus bumper indicates that the left 14 inches of the bumper collided with the left 14 inches of the MDV truck tractor. After this initial collision, the two vehicles side-swiped each other, and as the MDV vehicle continued northbound, it peeled the "cap" surrounding the schoolbus floor and the left sidewall away from the rest of the schoolbus body, exposing the ends of the steel C-shaped channel sections which made up the interior of the schoolbus floor. After the initial front-to-front impact, the most rigid schoolbus structure encountered by the MDV vehicle during the collision sequence was the rear axle of the schoolbus on the left side. The force of this secondary impact tore the left outside dual tire off its rim and caused an adjacent floor panel joint to separate across the entire interior width of the schoolbus.

The severe abrasion and the asphalt deposits found on the schoolbus' left drag link at its attachment to the tie rod indicate that the three gouges found in the southbound lane of the highway located 32 inches north of the northern end of the northbound "no passing" zone and 77 inches west of the pavement center were probably made when the collision with the MDV vehicle forced the left drag link and adjacent underbody components down into the pavement surface. The pre-accident position of the drag link was from 10 to 14 inches inboard of the extreme left edge of the schoolbus; therefore, at the time the drag link gouged the pavement surface, the left edge of the schoolbus was about 5.2 to 5.5 feet from the highway centerline, and the right front side of the 8-foot-wide schoolbus was about 1.2 to 1.5 feet off the highway on the southbound shoulder.

This evidence indicates, and the Safety Board concludes, that the driver of the schoolbus started to make an evasive steering maneuver to the right immediately before the collision, and that in order for the 95.5-inch-wide MDV tractor to collide with the left 14 inches of the schoolbus bumper, the MDV tractor would have had to be about 6.5 feet over the highway centerline into the southbound lane at the time of the collision.

The left-front-to-left-front collision with the MDV vehicle caused the schoolbus to rotate counterclockwise to its final rest position off the southbound shoulder of the highway. The collision also caused the truck tractor of the MDV vehicle to rotate counterclockwise, which in turn loaded the tires on the right side and unloaded the tires on the left side of the MDV tractor as the MDV vehicle continued northbound. The striated tire marks visible in photographs of the accident scene, which began about 15 feet north of the gouges and about 1 foot to the right of the highway centerline, and which continued to within about 4 feet of the final rest position of the overturned MDV truck tractor, were therefore made by the steering and drive axle tires on the right side of the MDV tractor.

Since these marks started about one foot east of the center of the highway, at the point where the MDV tractor started leaving these marks, the left side of the MDV tractor was about 7 feet over the highway centerline into the opposing lane. The widening of these marks indicates that, as the MDV vehicle continued northbound, the degree of the rotation increased. At the points where these tire marks ended, the angle between the

ends of the tire marks and the highway centerline indicates that the MDV truck tractor had rotated about 120° to the left of the vehicle's pre-accident path. The right front of the MDV tractor therefore collided with the left-front 8 inches of the grain truck's tractor. This right-front-to-left-front collision caused the MDV tractor to overturn onto its right side.

The tire mark which ended at the right southbound pavement edge is attributed to the MDV tractor's right steering axle tire. Since this mark continues to the pavement edge, this tire was still in contact with the roadway surface. Therefore, the MDV tractor had not overturned at the time the right steering axle tire left the paved surface of the highway. The MDV tractor's collision with the grain truck tractor therefore occurred off the highway surface. The evidence indicates, and the Safety Board concludes, that the driver of the grain truck took evasive action before his vehicle collided with the MDV tractor and had driven his tractor off and to the right of the southbound lane when the collision occurred.

Driver Alertness, Sleep Deprivation, and Fatigue

Research has shown that the frequency of accidents increases disproportionately after about 7 hours of driving or 8 to 9 hours of total duty time. A condition of extreme sleep deprivation, which was defined in a 1972 Bureau of Motor Carrier Safety study 5/ as a period of from 24 to 36 hours without sleep, can "have deleterious effects upon driving performance."

The MDV truckdriver's housemate reported that the night before the accident, the truckdriver had only 1 1/2 hours sleep. There is no evidence to indicate that the truckdriver had obtained any additional sleep during the day of the accident after he reported for duty. At the time of the accident, the truckdriver had been on duty about 12 hours, 7 of which were actually spent driving. Based upon the available evidence, the truckdriver had only about 1 1/2 hours sleep during the 36 hours before the accident. The evidence indicates, and the Safety Board concludes, that the MDV truckdriver was experiencing significant fatigue from sleep deprivation at the time of the accident.

Motor Carrier Operations

There is no evidence to indicate that responsible officials at MDV were aware of the truckdriver's seizure disorder or that they were failing to exercise adequate supervision of the MDV truckdrivers' hours of service. Based upon the reconstruction of the truckdriver's activities on the day of the accident, it appears that the truckdriver was not driving in violation of any DOT hours of service rules at the time of the accident. Assuming that he was driving to Norfolk to go off duty for a minimum of 8 consecutive hours when he arrived there, the trip he was driving at the time of the accident could have been completed within the maximum time permitted by DOT hours of service rules.

Medical and Pathological Factors

There is no evidence to indicate whether or not either of the two accidents involving the MDV truckdriver in February 1985 were seizure-related.

5/ "A Study of the Relationships Among Fatigue, Hours of Service, and Safety of Operations of Truck and Bus Drivers," U.S. Department of Transportation, Federal Highway Administration, Bureau of Motor Carrier Safety, 1972.

The pathologist who performed the postmortem examination of the MDV truckdriver discovered that the right coronary artery was essentially nonfunctional, but he concluded that the left circumflex artery, which was twice the expected caliber, compensated for this inadequacy. He also concluded that effective cardiac action was present during the dying process. The Safety Board believes that the MDV truckdriver did not suffer a heart attack, and that the essentially nonfunctional right coronary artery was not a factor in the accident.

Postmortem blood analysis revealed the presence of carboxylic acid metabolite of delta-9 tetrahydrocannabinol (THC). THC is the psychoactive compound found in marijuana. Once THC is absorbed in the blood stream, it is metabolized by enzymes in the liver into other compounds. Further metabolism produces the carboxylic acid metabolite (carboxy), which is not psychoactive. The finding of carboxy metabolite without the presence of any psychoactive components of THC indicates marijuana consumption about 2 to 4 days before the accident. Since no psychoactive THC components were found in the truckdriver's blood, the Safety Board believes that marijuana consumption was not a factor in this accident.

In 1978, the MDV truckdriver had sustained a head injury and subsequently sought medical care after having a seizure. Phenobarbital was prescribed to control his seizure disorder, and this prescription remained at about the same level (32 or 30 mg three times per day) for the entire period he was treated.

The Plan for Nationwide Action on Epilepsy by the U. S. Department of Health, Education, and Welfare (HEW) reports:

With epilepsy, as with other chronic conditions for which people must take medications regularly even though the need for and benefits from medication are not obvious, consistent use of medication is a significant problem. Its severity has been documented by blood level studies of anticonvulsant medications which show that at least one-third of the patients with epilepsy do not achieve seizure control because of their failure to take medication as directed. ^{6/}

In 1979, the MDV truckdriver admitted to his physician that he did not always take his medication in the dosage which was prescribed. He had told his housemate that, in 1980, he had a seizure when he completely stopped taking his medication because, he said, he objected to being dependent on drugs.

Other facts in the truckdriver's prescription renewal records indicate that he probably did not take the prescribed dose of his medication. The truckdriver's phenobarbital prescription renewal record indicated that during the 5 3/4-year period from August 1979 to the date of the accident, he had been supplied with 3,290 pills which, if he took three a day as prescribed, would have been an amount sufficient for about 3 years. (See appendix B.)

It is not known whether the truckdriver's supply of pills was used up at the time of the accident; the presence of some phenobarbital in his blood at the time of his death may or may not have been from the last pill in his supply. By assuming that the phenobarbital in the driver's blood at the time of the accident was from the last pill in his supply, it was calculated that the maximum average number of pills he took over the 2,124-day period from August 7, 1979, to the date of the accident was 1.5 pills per day.

^{6/} U. S. Department of Health, Education, and Welfare, "Plan for Nationwide Action of Epilepsy," Volume 1, p. 134, publication no. 78-276, 1977.

On December 10, 1984, the truckdriver received the last refill of 100 pills of the prescription which his physician had authorized on July 5, 1984. Assuming that this supply was obtained when his previous supply was nearly exhausted, and that he took three pills per day as prescribed, this last supply would have been exhausted by January 19, 1985. If the truckdriver reduced his dosage to only one pill per day, the supply would have lasted until about March 18, 1985. Even if he had a few additional pills from an earlier refill, the Safety Board believes that the truckdriver was probably on the average taking less than one pill per day during the 6-month period before the accident.

Although it is possible that the truckdriver obtained refills to his medication from unknown sources, the fact that the truckdriver's housemate reported that he had used her doctor to obtain medication for a recent ear infection leads the Safety Board to believe that the truckdriver did not have another personal physician through whom additional renewals of his phenobarbital prescription could have been obtained.

The "half-life" of a drug is a complex pharmacokinetic property that, described simplistically, refers to the amount of time required for half a drug dosage to be eliminated from the body. Drugs with long half-lives (greater than 24 hours) tend to accumulate when taken daily. Repeated administration of any drug at intervals shorter than four times its half-life (the time necessary for complete elimination) will result in drug accumulation. ^{7/}

Phenobarbital has a half-life of from 2 to 6 days, depending on several factors including the person's general metabolism, the amount of rest obtained, food intake, the type of work performed, and the presence of other drugs. In an experiment in which volunteers took a single 30 mg oral dose of phenobarbital, the average peak serum concentration was about 0.7 mg/L. When a single 30 mg daily oral dose of phenobarbital was taken for 21 consecutive days, the average peak serum concentration was found to be 8.1 mg/L. ^{8/}

A postmortem blood test revealed only 3.0 mg/L phenobarbital in the truckdriver's blood. If the truckdriver had been taking even 30 mg of phenobarbital daily, it is reasonable to expect that the phenobarbital level would have been closer to the experimental finding of 8.1 mg/L because the drug would have accumulated in his body during the preceding month. For the level of phenobarbital to have fallen to 3.0 mg/L, the truckdriver must have taken fewer than one 30 mg pill per day for some period prior to the accident.

It is possible that the truckdriver had completely exhausted his supply of pills and that the phenobarbital present at the time of his death was an accumulation of the drug when it was being regularly taken. If this was the case, it is possible to estimate the approximate number of days he might have gone without any medication by using the half-life of 2 to 6 days for the drug. If the half-life of the drug in the truckdriver's system was 2 days, the truckdriver may not have taken any medication for 2.8 days, and if the half-life was 6 days, the truckdriver may not have taken any medication for 8.5 days.

^{7/} Thomas Roth and Timothy Roehrs, "Determinants of Residual Effects of Hypnotics," *Accident Analysis and Prevention*, Volume 17 (4), 1985, pp. 291-296.

^{8/} Baselt, R. C., "Disposition of Toxic Drugs and Chemicals in Man," 1982, Biomedical Publ, Davis, CA, p. 267

Several physicians consulted by the Safety Board advised that the standard maintenance dose of phenobarbital for the control of epileptic seizures is 60 to 200 mg per day, and that a reduction to 45 mg per day is "risky." The medical examiner who performed the postmortem examination of the truckdriver was of the opinion that the phenobarbital level in the truckdriver's blood was sub-therapeutic.

A "therapeutic" level of phenobarbital can be defined as a level sufficient to prevent seizures, and because the available evidence indicates that the truckdriver had been seizure-free since 1980, it could be argued that the reduced dosage was effective in preventing seizures in his case. However, all of the medical opinions available to the Safety Board indicate that a level of 3.0 mg/L of phenobarbital is well below the desired blood concentration generally accepted in practice as being therapeutic in preventing a seizure.

In its 1976 report concerning epilepsy and commercial vehicle driving, the DOT's Bureau of Motor Carrier Safety (BMCS) reported that the number of accidents caused by a driver having a seizure while driving is difficult to determine. The time spent driving a private motor vehicle constitutes only a small fraction of an individual's time and in only a minority of cases will a relapse occur while driving. Commercial vehicle drivers, who spend many continuous hours a day driving heavy vehicles under stressful conditions, experience physical and emotional stresses and strains that far exceed those of passenger car operators. Thus, physical requirements must be more strict for professional drivers. Emotional stress, fatigue, and exhaustion from overwork can increase the individual's tendency toward seizures and negate or exaggerate the effects of medication prescribed to control seizures. 9/

The truckdriver was late for work the day of the accident; this may have caused him stress at the start of his work day. During the several days before the accident, he had worked irregular hours with reporting and dismissal times, differing each day.

Truckdriver fatigue due to sleep deprivation, his irregular working hours, and possibly stress were all factors in this accident. Because of the presence of these factors, which can alter the effectiveness of medication, as well as the truckdriver's history of modifying his prescribed dosage of medication to control his diagnosed seizure disorder, and the presence of a very low level of phenobarbital in the truckdriver's blood at the time of his death, the Safety Board cannot rule out the possibility that the MDV truckdriver may have been incapacitated by a seizure at the time of the accident.

Driver Qualification and Licensing

The MDV truckdriver, by reason of his established medical history and clinical diagnosis of epilepsy, was not physically qualified under DOT rules to operate commercial vehicles in interstate commerce. In September 1984, in a written test on DOT rules administered by his employer, he correctly answered a question concerning the DOT prohibition against using epileptic drivers. The evidence indicates, and the Safety Board concludes, that the MDV truckdriver knew of the Federal rule that prohibits epileptics from driving interstate commercial vehicles.

9/ U. S. Department of Transportation, Bureau of Motor Carrier Safety, "Epilepsy and Commercial Motor Vehicle Driving," 1976, Revised 1978, p. 17.

State licensing requirements for drivers with seizure disorders vary considerably among the several States. Twelve States do not specify any seizure-free period before an applicant can be granted a license. The remaining States specify seizure-free periods ranging from 3 to 36 months. Regulations or statutes in several States provide for exceptions to the specified seizure-free period. Common exceptions include a documented pattern of strictly nocturnal seizures, of a prolonged aura (warning) of an impending seizure, or a physician's statement that a person who otherwise meets the seizure-free requirement had a seizure due to a physician-directed medication change and is now expected to remain seizure-free.

Another common requirement is the availability of restricted licenses. Such restrictions limit the licensee to daytime driving only, driving to and from work or within a certain distance from home, or driving only in an emergency.

With respect to licensing drivers to operate commercial vehicles, three States--California, Hawaii, and Oregon--have adopted the Federal rule and prohibit drivers with seizure disorders from driving commercial vehicles in intrastate commerce. Oregon-licensed drivers may apply for a waiver of this prohibition. In New Jersey and New York, bus drivers must meet Federal requirements, but the requirements to drive a large truck are the same as those to drive a personal automobile. Although South Carolina and Texas have not adopted the Federal requirements, persons with seizure tendencies are normally not approved for driving large trucks or passenger-for-hire vehicles. In 11 other States, in order to drive schoolbuses, large commercial trucks, or buses-for-hire, drivers with seizure disorders must meet special licensing requirements in addition to those necessary for driving an automobile.

In 32 States and the District of Columbia, the requirements of the agency responsible for the issuance of drivers' licenses authorizing the operation of schoolbuses, large trucks, or buses by drivers with seizure disorders are the same as the requirements for operating a personal automobile. (See appendix E.)

The American Medical Association (AMA) has recently completed a guide for physicians titled "Medical Conditions Affecting Drivers," which lists physiological and psychological disorders and discusses their significance to motor vehicle operator safety. This document, which was recently approved by the AMA's Council on Scientific Affairs, contains the following recommendations concerning alterations of consciousness:

No patient having epilepsy or narcolepsy should be considered to be medically qualified in Class I or Class II Categories.

The AMA defines Class I and Class II drivers as operators of passenger-carrying vehicles such as school, charter, city, intrastate and interstate buses, airport limousines and buses, and van pools having primary drivers; emergency equipment such as ambulances, fire engines and rescue vehicles; large, heavy articulated trucks and vehicles; and trucks transporting hazardous materials such as fuel chemicals, explosives and radioactive substances.

The AMA definition also includes operators of taxi cabs, large non-passenger-carrying vehicles; trucks, including single vehicles weighing more than 24,000 pounds and such vehicles towing trailers weighing less than 10,000 pounds. 10/

This position represents a change from the AMA's 1973 Guide, 11/ which directed the reader to consult DOT's standards for interstate truck and bus drivers, but did not discuss recommendations for commercial vehicle drivers engaged in intrastate commerce. The Safety Board commends the AMA for its revised guide to physicians and encourages it to make the widest distribution possible, when published, to advise physicians and patients alike regarding the medical conditions affecting safe driving.

The previously-mentioned DOT report 12/ states that the physical and emotional stresses placed on commercial vehicle drivers far exceed those of passenger car operators and concludes that physical requirements for professional drivers who spend more hours behind the wheel must therefore be more strict. In addition, the HEW report 13/ mentioned earlier indicates that at least 1/3 of the patients with epilepsy do not achieve seizure control because they fail to take medication as directed. Therefore, the available data indicates, and the Safety Board concludes, that the State licensing of drivers with diagnosed seizure disorders to operate large commercial vehicles poses an unnecessary hazard to the general public.

Reporting Seizure Disorders

The MDV truckdriver gave false answers to questions concerning his medical condition on his MDV truckdriver employment application in March 1981, on his Virginia truckdriver license application in June 1983, when he was physically examined in September 1984, and again when he applied for renewal of his Virginia Class A license 23 days before the accident in May 1985. The Safety Board concludes that the MDV truckdriver, by giving false answers to questions concerning his medical condition, deliberately concealed his epilepsy from his employer, the physician who performed his DOT-required physical examination in September 1984, and the Virginia licensing authority.

On February 24, 1983, near Willow Creek, California, a dump truck crossed the highway centerline and collided with a schoolbus. Two people were killed and 31 people were injured. The investigation disclosed that the driver of the dump truck had several medical problems, including loss of memory, dizziness, and loss of vision due to renal glycosuria (an abnormally large amount of sugar in the urine). As a result of its investigation of this accident, the Safety Board concluded that:

10/ Doege, F.C. and Engelberg, A.C. Eds., "Medical Conditions Affecting Drivers," American Medical Association, 535 North Dearborn Street, Chicago, Illinois, to be published in 1986.

11/ The American Medical Association, "Physician's Guide for Determining Driver Limitation," 1973.

12/ See footnote 9.

13/ See footnote 6.

The truckdriver did not properly advise his employer of all his medical problems. The truckdriver had two medical examinations between 1980 and 1982 . . . Neither examination uncovered any of the truckdriver's previous medical problems . . . By failing to volunteer this information, the truckdriver hampered the examining physician's ability to diagnose his medical problems accurately and their possible bearing on the truck driver's ability to work and drive. A review of Federal Motor Carrier Safety Regulation . . . indicates there are no provisions . . . prohibiting the falsification or omission of medical information . . . 14/

As a result of its investigation of the Willow Creek, California, accident, the Safety Board on December 5, 1983, recommended that the FHWA:

H-83-87

Revise Federal Motor Carrier Safety Regulation 49 CFR 391.43 to incorporate a provision, similar to that specified in 14 CFR 67.20(a) for airmen medical certification, which will prohibit the falsification or omission of medical information in connection with a medical certification physical examination.

In its May 24, 1985, response to this recommendation, the FHWA advised that a prohibition of falsification of information related to the medical certification of commercial drivers had been proposed in an advance notice of proposed rulemaking published in the Federal Register on January 23, 1985. As a result of this response, Recommendation H-83-88 is presently classified as "Open—Acceptable Action" pending adoption of an acceptable final rule by the FHWA.

Although a Federal rule that prohibits the falsification or omission of medical information may deter some driver applicants from this practice, the Safety Board believes that the medical community and the several States must take a more forceful approach to the problem.

According to the Epilepsy Foundation of America (EFA), nine States ^{15/} require any physician who diagnoses or treats a person with certain medical conditions to report that person's name, age, and address to a central state agency, usually the department of motor vehicles or public safety. The different State reporting requirements vary in the circumstances under which persons must be reported; e.g., all persons with epilepsy, or only those whose condition interferes with their ability to drive. The requirements also differ as to whether the intended use of the information is specified in the law, and as to the penalty, if any, for failing to report.

The most common penalty for failure to report, in those laws which provide for penalty(ies), is a fine ranging from \$5 to \$50. Indiana's law requires the reporting of "handicapped persons" to provide them with programs enabling them to achieve their maximum potential and the highest degree of independence possible. Illinois' law provides that, in order to be allowed to operate a motor vehicle, individuals with epilepsy must

14/ Highway Accident Report—"Collision of Humboldt County Dump Truck and Klamath-Trinity Unified District Schoolbus, State Route 96, Near Willow Creek, California, February 23, 1983" (NTSB/HAR-83/05).

15/ California, Connecticut, Delaware, Illinois, Indiana, Nevada, New Jersey, Oregon, and Pennsylvania.

authorize their physicians to report any change in their condition that would impair their ability to safely operate a motor vehicle. Pennsylvania's law states that a physician can be found negligent for failing to report a driver who later is involved in an accident.

The laws in Florida, Georgia, Kansas, Maryland, Minnesota, and Rhode Island specifically mention that physicians may voluntarily report persons whose condition would affect their ability to drive safely. Rhode Island and Minnesota specifically provide that physicians who report in good faith and exercise due care are immune from liability for their actions.

The EFA is opposed to mandatory reporting laws and instead favors a system of self-reporting in which the individual takes primary responsibility for the disorder and the limitations it poses. In the EFA publication, "The Legal Rights of Persons With Epilepsy," the foundation states:

Mandatory reporting laws result in violations of the confidential nature of the physician-patient relationship, and the possible erosion of this relationship. Proper diagnosis and treatment of epilepsy depend greatly upon the development of an honest, trusting, relationship between an individual and his physician. Accurate information concerning seizure activity is of critical importance. If a patient knows or fears that his doctor is obligated to report him to the state, he may withhold crucial information with potentially fatal consequences. 16

In Virginia, where the MDV truckdriver was licensed, and in the other 40 States and the District of Columbia that do not have a mandatory physician reporting requirement, the system used by the licensing agency to identify drivers with seizure disorders consists of a question on the license application which asks if the applicant has ever had a seizure, or some similar wording. If the truckdriver had truthfully answered the question on his Virginia application concerning seizures, he might have been given a restricted license requiring periodic medical reports. (See appendix E, footnote 27.)

However, even if he had given a truthful answer to the question and was subsequently granted a restricted Virginia license, he still was prohibited by Federal rules from driving in interstate commerce. The truckdriver's continued employment was contingent upon his maintaining a "valid" unrestricted Class A license. Thus, concealing his medical condition from the state licensing authority was necessary to accomplish that end.

In another accident on April 4, 1985, a 25-passenger van owned by a children's day-care center and transporting 12 six- and seven-year-old children was traveling eastbound on Schaumburg Road in Schaumburg, Illinois. Witnesses reported that the van swerved to the left, crossed the 16-foot-wide median, and collided head-on with a vehicle traveling westbound on Schaumburg Road. The driver of the westbound vehicle and one of the children in the van were killed, six children sustained serious or critical injuries, and five children sustained minor or moderate injuries. There were three children occupying the bench seat in the van immediately behind the driver; one of these children reported that just before the collision the van driver "laid down," the second child reported that the driver "went on her right side," and the third child reported that the driver fainted.

16 Epilepsy Foundation of America, 4351 Garden City Drive, Landover, MD 20785, "The Legal Rights of Persons With Epilepsy," Fifth Edition, May 1, 1985, p. 27.

According to medical records, the 24-year old van driver, who sustained serious injuries in the accident, had a medical history showing that she suffered from "blankouts," and was under the care of a neurologist who prescribed dilantin to control the disorder. The van driver's mother stated that the driver had not been taking her medication for about one week before the accident.

The driver of the van had been issued an Illinois Class A license on August 23, 1979, which was reissued on December 14, 1982. The license application contained the question "Do you have any disability which might cause you to suffer from periods of temporary loss of consciousness? (If answered "yes," a statement will be required from your physician and a medical agreement form must be filed.)" The driver answered "no" to this question.

The employment application used by the day-care center where the driver was employed contained a question that asked the applicant "Do you have any physical defect, disease, or disability?" The van driver answered "no" to this question on her employment application dated July 17, 1984. 17/

On February 23, 1986, an automobile collided head-on with an van occupied by the driver and 14 other persons on U. S. 192 about 1 1/2 miles west of Deer Park, Florida. Witnesses stated that before the collision, the automobile was traveling westbound in the eastbound lane of the two-lane, undivided highway. After the collision, the van overturned onto its right side and caught fire. Seven occupants of the van died from thermal burns and smoke inhalation, and the remaining eight occupants of the van sustained minor to serious injuries.

Medical records showed that the 27-year-old driver of the automobile, who was killed in the accident, had experienced seizures since 1978, and dilantin had been prescribed to control his seizure disorder. Toxicological tests performed after the accident indicated there was no discernible level of dilantin in the automobile driver's blood. The automobile driver had been issued a Florida driver's license in 1979. The license application asked if the driver ever suffered from epilepsy, fainting, or dizzy spells. The driver answered "no" to this question. 18/

The Safety Board concludes that systems that rely on voluntary self-reporting to identify drivers with seizure disorders are ineffective because it is unreasonable to expect that persons will voluntarily report that they have a seizure disorder and act against their own self-interest. The several States that do not have a mandatory physician reporting requirement should:

- 1) Require that any physician who diagnoses or treats any person with a seizure disorder report, as a minimum, the name, date of birth, and address of any such person to the central state driver licensing agency without delay.
- 2) Provide immunity from liability for physicians reporting information about patients with diagnosed seizure disorders.

Contrary to the views of the EFA, the existence of a mandatory reporting requirement may be beneficial for non-commercial vehicle drivers with seizure disorders. Although possession of a driver's license is usually viewed as a privilege rather than a

17/ NTSB Docket No. CH-85-H-0R18.

18/ NTSB Docket No. HY-480-86.

right, in the United States a driver's license is almost a necessity. The lack of a license may unnecessarily restrict where a person chooses to live, where s/he is employed, or other facets of a person's overall lifestyle. Because retention of a driver's license is so important, persons who may not otherwise do so may obtain proper medical supervision and may take prescribed medication as directed if they were aware that the issuance or retention of a driver's license was dependent upon their doing so.

Several States have programs to monitor persons with seizure disorders to ensure that they are receiving proper medical supervision, and several States require periodic medical examinations as a condition for retention of a driver's license. (See appendix E.) An effective system to identify persons with seizure disorders is an essential first step for any monitoring systems to be effective.

Survival Factors

The MDV vehicle tore out the left front restraining barrier, the first three bench seats, and the left sidewall of the schoolbus, and split the schoolbus floor open at the floor joint near the seat legs of the fourth row of seats. All schoolbus occupants who sustained injuries that were serious (AIS-3) or greater were seated in the first five rows of the schoolbus where crash forces were the greatest. All schoolbus occupants who were killed and the two occupants who were severely or seriously injured were seated in the first four rows at the left front of the schoolbus in the area that was penetrated by the MDV vehicle. The occupants of the first three bench seats on the left side of the schoolbus probably were ejected through the opening created in the left sidewall during the crash sequence. The occupants in the fourth bench seat on the left side probably also were ejected, either through the opening in the left sidewall or through the opening in the floor.

These occupants who were seated in the first four seats at the left front, and who were propelled forward and to the left by the force of the crash, were not protected from striking hard objects and/or being ejected after the MDV vehicle penetrated this space. The Safety Board concludes that in this accident, the crushing and penetration of the schoolbus body and the ejection of the restraining barrier and the first three seats at the left front of the schoolbus negated the occupant crash protection features of FMVSS 222 for the first four seats at the left front of the schoolbus.

Two occupants of the aisle seats in the second and fourth rows on the right side of the schoolbus sustained serious and severe injuries, respectively. These occupants experienced kinematics similar to those passengers seated in the first four seats on the left side of the schoolbus. The occupant in the second row may have been ejected through the opening created in the schoolbus' left sidewall, and the occupant in the fourth row may have been ejected either through the opening in the left sidewall or possibly even through the opening in the schoolbus floor.

The occupant seated in the aisle seat of the fifth row on the left side probably sustained his serious injuries when he struck either the seatback in front of him or the left sidewall of the schoolbus. The occupant of the front outboard seat on the right side probably sustained his severe injury when crash forces propelled him forward against the padded restraining barrier at the right front of the schoolbus.

The remaining schoolbus occupants sustained minor or moderate injuries. These injuries probably resulted from impacts with surrounding structures, such as the seatbacks, the sidewalls, and possibly other occupants when crash forces propelled them forward and to the left. Occupants of the aisle seats in the right rear of the schoolbus probably were thrown across the aisle into the seatbacks on the left side during the crash sequence.

The left side of the schoolbus floor was crushed inboard about 7 inches in front of the floor separation at the fourth row of seats. This amount of penetration was sufficient to allow the MDV truck to make contact with the seatcushion and seatback frames of the first three seats on the left side and to tear these seats from their mountings to the schoolbus body.

The Safety Board concludes that in this accident, because of the penetration of the schoolbus body and the amount of inward structural collapse, the first three bench seats probably would have been torn out of the schoolbus body even if the outboard side of these seats had been equipped with legs attached to the schoolbus floor instead of the bracket attaching the outboard sides of these seats to the sidewall.

The padded seatbacks of the seats that remained attached to the schoolbus floor and sidewall and the barrier on the right front of the schoolbus performed as intended by FMVSS 222, School Bus Passenger Seating and Crash Protection; they were displaced forward without separating from their attachments to the schoolbus floor and sidewall when collision forces propelled the schoolbus occupants into them. The Safety Board concludes that the schoolbus seats outside the area penetrated by the MDV vehicle demonstrated the crashworthiness required by FMVSS 222.

Lapbelt Use and Federal Motor Vehicle Safety Standards

Since 1977, when new schoolbus safety standards relating to occupant protection were promulgated, NHTSA has required schoolbus manufacturers to use compartmentalization for occupant protection rather than requiring the installation of lapbelts for passengers in large schoolbuses. Compartmentalization is passive in that occupant-contactable impact zones are defined and an occupant is protected against injury by padding of the seatbacks and restraining barriers and by controlled bending of the seat back or restraining barrier in front of the occupant.

In this accident, the installation and use of lapbelts would not have prevented the six fatalities or the serious or severe injuries sustained by the occupants of the first four rows of seats on the left side of the schoolbus. Any protection that lapbelts may have afforded these occupants was negated by the penetration of the MDV truck into these occupant's space, resulting in their seats being torn loose from their anchorages. The surviving occupant of the aisle seat in the third row could have sustained more serious or even fatal injuries if a lapbelt had been installed and used. The occupant might then have been retained in his seat and crushed between the MDV vehicle and the left side of the schoolbus when this seat was torn out of the schoolbus body during the collision sequence. If the occupant(s) of the fourth bench seat on the left side had been lapbelted, the additional weight probably would have caused this seat, together with the occupants, to be ejected through the opening in the schoolbus floor during the crash sequence. This may have resulted in more severe, and possibly even fatal, injuries to the surviving occupant, who was seated in the aisle seat of the fourth row.

The installation and use of lapbelts probably would have mitigated the severe or serious injuries sustained by the two occupants seated on the aisle on the right side of the schoolbus. Crash forces probably propelled these two occupants out of their seats and toward the left front of the schoolbus at which time they probably sustained their more serious injuries.

The installation and use of lapbelts by those who sustained minor or moderate injuries would not have prevented these occupants from striking the windows, the sidewalls, the occupants seated next to them, or the seatback or barrier in front of them. These occupants would likely have sustained contusions, abrasions, and minor lacerations, and although the injuries may have been different, they probably would not have been less severe.

The Safety Board is conducting a series of special investigations of schoolbus accidents to look more closely at the issue of the real-world performance of schoolbuses in crashes and at the adequacy of the occupant crash protection afforded in schoolbuses built under current Federal Motor Vehicle Safety Standards. The study is ongoing at this time.

Federal Motor Vehicle Safety Standard 221

Calculations or tests performed by NHTSA contractors in 1980, 1981, and 1982, indicated that the floor joints of schoolbuses manufactured by Thomas failed to meet the joint strength requirements of FMVSS 221. Thomas has repeatedly taken the position that the floor panel joint is a structural joint and therefore is not subject to FMVSS 221. The NHTSA has historically disagreed with this position. The Safety Board believes that the NHTSA should amend FMVSS 221 so that it is clear that the standard applies to all body panel joints that enclose the occupant space even if they are structural.

The floor panel joint samples were subjected to peeling forces in the laboratory tests performed by the National Bureau of Standards to determine the Snow Hill schoolbus' floor joint strength. This method was used to test the strength of the Snow Hill schoolbus floor joints because peeling forces were the dominant type of forces experienced in this accident. Peeling forces were also the dominant forces sustained by another Thomas schoolbus whose floor panel joints separated after being struck by a train near Greenville, North Carolina, in May 1986. (This accident will be discussed later in this report.) The Safety Board believes that the tests conducted for the NHTSA in February 1981 and March 1982, in which shear forces were applied and in which a modification of the floor joint configuration was done before testing, were not as representative of the forces experienced in the Snow Hill and Greenville accidents as the tests performed by the Safety Board. However, tests using both methods indicate that the floor joint did not have sufficient strength to meet the joint strength requirement of FMVSS 221. FMVSS 221 is unclear as to which method of testing is required. The Safety Board believes that body panel joints should be tested in peel or tension unless they can only be tested in shear.

NHTSA has not performed, since August 1982, tests to determine the strength of floor panel joints manufactured by any schoolbus manufacturer. The Safety Board believes that such testing is important to demonstrate compliance with FMVSS 221. However, FMVSS 221 needs to be clarified as to the body panel joints which are included and as to the method of testing.

The intent of FMVSS 221 is to reduce deaths and injuries resulting from the separation of schoolbus bodies during crashes. FMVSS 221 should require that floor panel joints have strength adequate to withstand a reasonable amount of crash forces and retain the structural integrity of the passenger envelope.

The Safety Board has investigated one other accident and the NHTSA has data on another accident in which the floors of Thomas schoolbuses have separated. The Board also has investigated several other accidents (two of which will be described in this report) which involved schoolbuses not manufactured by Thomas but which were similar in many respects to the three accidents involving Thomas buses. However, the floors of the schoolbuses built by manufacturers other than Thomas did not separate.

On February 9, 1980, a 1979 66-passenger schoolbus with an International Harvester Corporation chassis and a Thomas body was struck at about the middle of the left side of its body by a train at a grade crossing near Two Harbors, Minnesota. ^{19/} After the impact, the schoolbus was carried about 300 feet down the railroad right-of-way. The schoolbus driver and one 14-year-old passenger sustained minor injuries.

Photographs show that a floor joint near the area of impact split apart, creating an opening about 6 inches wide on the left side of the schoolbus floor. No tests were performed to determine the strength of the floor joints in the schoolbus.

On May 21, 1986, a 1985 60-passenger schoolbus with an International Harvester Corporation chassis and a Thomas body was struck on the right side near the rear axle by a Norfolk and Southern freight train near Greenville, North Carolina. ^{20/} The speed of the train immediately before the collision was estimated to be about 45 mph.

The rear 6.3 feet of the schoolbus body, including the eighth, ninth, and tenth row bench seats on the right side and the ninth and tenth row bench seats on the left side, was torn loose from the longitudinal frame members and pushed to the left, creating an opening entirely across the rear of the schoolbus. (See figure 11.)



Figure 11.--Right rear of schoolbus.
Accident on May 21, 1986, near Greenville, North Carolina.

^{19/} NHTSA CIR File 2262.

^{20/} NTSB Accident No. ATL-86-FX-016.

Evidence suggests that one 11-year-old passenger sitting in the tenth seat row on the left side of the schoolbus fell or was ejected through this opening. This passenger sustained a broken bone in his right foot. The other eleven 10- to 14-year-old schoolbus passengers, all of whom were seated in the first six seat rows of the schoolbus and at least two seat rows away from the impact area, sustained minor cuts, sprains, or bruises. The 20-year-old schoolbus driver and the train crew were not injured.

The floor of the schoolbus separated in two places. One of the separations occurred at the floor joint located between the seat legs of the eighth row of seats in the area of maximum engagement and 5 feet behind the area of initial impact with the train. (See figure 12.) The other separation, a 2-inch-wide gap across the right 90 inches of the schoolbus floor, occurred at the floor joint located between the restraining barriers and the first row of bench seats. This separation, located at the front of the schoolbus, was 17 feet from the area where the train struck the side of the schoolbus. (See figure 13.)

On January 10, 1984, a westbound 1979 65-passenger schoolbus with an International Harvester Corporation chassis and a Wayne Corporation body collided head-on with an eastbound tractor-semitrailer operated by Branch Motor Express, Inc., on State Route 44 in Rehoboth, Massachusetts. The tractor-semitrailer had struck the schoolbus after colliding with a passenger car at a speed estimated to be 45 to 55 mph. The nature of the collision between the truck and the car was such that the tractor-semitrailer would probably have lost little of its momentum in the first collision. The tractor-semitrailer driver, the schoolbus driver, and one child occupying the left front seat were killed, and the remaining 14 schoolbus passengers sustained minor to severe injuries.

The left-front-to-left-front collision separated the schoolbus body from its chassis and the schoolbus overturned onto its roof. No body or floor panel separations were noted outside the area of impact and, as a result of its investigation of this accident, the Safety Board concluded that:

In this accident, exterior and interior panels separated only in the major impact area where they would be expected to separate because the crash forces exceeded performance requirements. The Safety Board concludes that the schoolbus body met the requirements of FMVSS 221. . . . 21/

On April 12, 1984, a 1980 64-passenger schoolbus with a Ford Motor Company chassis and a Blue Bird body was struck on the right side at the steering axle by a Chesapeake and Ohio Railway Company freight train near Carrsville, Virginia. The schoolbus driver died of injuries 5 days after the accident, and the 26 schoolbus passengers sustained minor to serious injuries.

The Safety Board's analysis of this accident determined that the train's speed at the time of the collision was about 44 mph, and that the force of the initial collision separated the chassis from the schoolbus body. After the initial collision, the schoolbus body rotated counterclockwise and the schoolbus was again struck by the train at the right rear. The schoolbus body then rolled over 270° to the right and came to rest on its left side. As a result of its investigation of this accident, the Safety Board concluded that:

21/ Highway Accident Report—"Collision of G & D Auto Sales, Inc., Tow Truck Towing Automobile, Branch Motor Express Company Tractor-Semitrailer, Town of Rehoboth Schoolbus, Rehoboth, Massachusetts, January 10, 1984" (NTSB/HAR-84/06).



Figure 12.--Floor separation near rear of schoolbus.

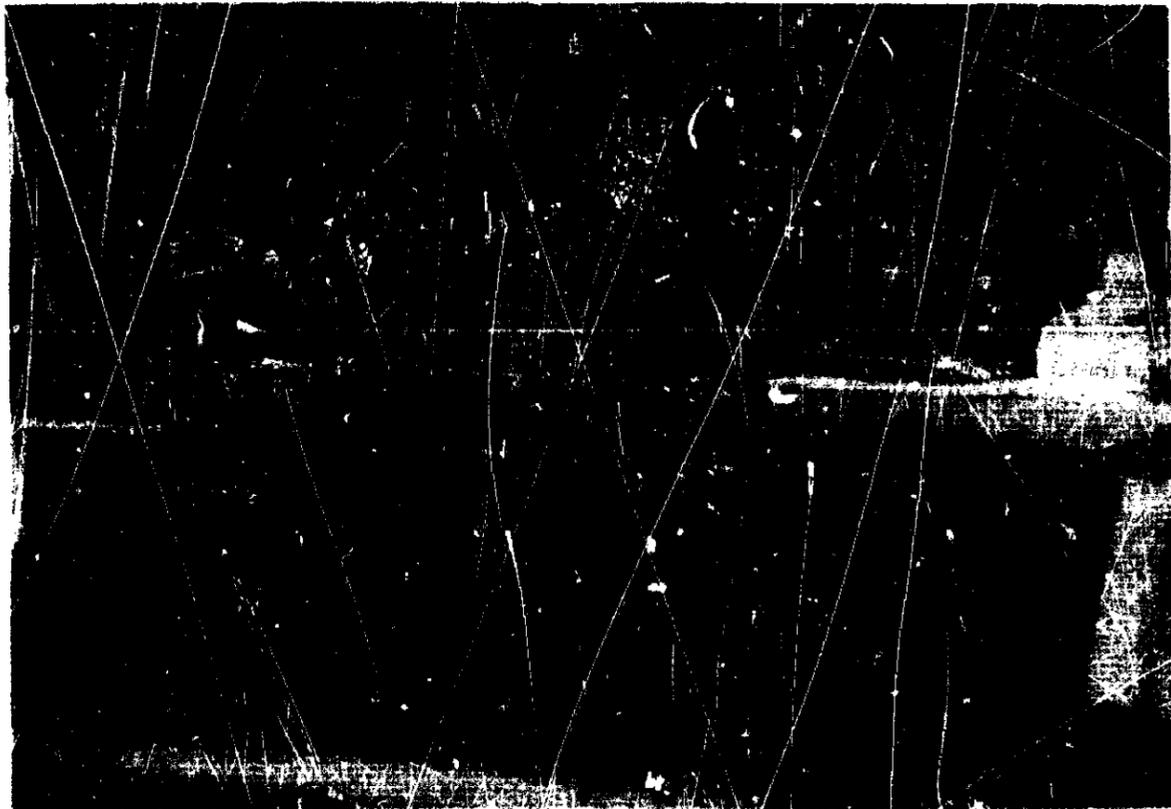


Figure 13.--Floor separation near front of schoolbus.

In this accident there was no interior body panel separation, and the only exterior body panel penetration noted was at the lower right rear of the bus where it collided with the train. This point of impact could not be expected to withstand the crash forces applied. The Safety Board concludes that the schoolbus body met the requirements of FMVSS 221 . . . 22/

The crashes of the Thomas schoolbus at Snow Hill and the Wayne Corporation schoolbus at Rehoboth, Massachusetts, both involved head-on collisions with large trucks at fairly high speeds. While the floor of the Thomas schoolbus separated, there were no exterior or interior body or floor panel separations away from the impact area noted in the Wayne schoolbus.

The Thomas schoolbuses at Two Harbors, Minnesota, and Greenville, North Carolina, and the Blue Bird schoolbus at Carrsville, Virginia, were struck by trains traveling at fairly high speeds. The floor of both Thomas schoolbuses separated near the impact area, and the floor of the Thomas schoolbus in the Greenville accident also separated at a location 17 feet away from the impact area. There were no interior body panel separations on the Blue Bird schoolbus, and the only exterior body penetration was at the right rear of the schoolbus body, at the impact area.

The accidents described above were similar in many ways, but they were not identical. Because of the complexity of the accidents, it was not feasible to calculate precisely the energies imparted to the floors of the schoolbuses in each of these accidents. Therefore, the Safety Board cannot definitively conclude that the floors of the non-Thomas schoolbuses would not have separated had these buses been involved in the accidents at Snow Hill, Greenville, and Two Harbors. However, Thomas-built schoolbuses are the only post-FMVSS 221 schoolbuses involved in accidents investigated by the Safety Board thus far where floor joint separations were noted, and tests performed showed that the joints of the Snow Hill schoolbus had only 7 percent of the strength required by FMVSS 221.

It may be argued that the crash forces experienced by the Thomas schoolbus bodies involved in the Two Harbors, Minnesota, and the Snow Hill and Greenville, North Carolina, accidents exceeded 60 percent of the strength of the floor material, and therefore the floor joints would have failed even if they had met the joint strength requirement of FMVSS 221. However, one of the floor joint failures on the Thomas schoolbus at Greenville occurred 17 feet away from the impact area, where the crash forces would have been substantially less than those experienced at the direct impact zone.

The Safety Board believes that the laboratory tests and the real-world crash data demonstrate that the floor panel joints of schoolbuses manufactured by Thomas need to be strengthened at least so that they meet the FMVSS 221 joint strength requirement.

22/ Highway Accident Report--"Collision of Isle of Wight County, Virginia, Schoolbus with Chesapeake and Ohio Railway Company Freight Train, State Route 615, near Carrsville, Virginia, April 12, 1984" (NTSB/HAR-85/02).

CONCLUSIONS

Findings

1. The qualifications of the schoolbus driver, the grain truck driver, and the passenger automobile driver, as well as the weather and the condition of the highway, were not contributing factors to this accident.
2. There is no evidence that a mechanical defect in any of the involved vehicles caused or contributed to this accident.
3. The driver of the schoolbus started to make an evasive steering maneuver to the right immediately before the collision with the Military Distributors truck.
4. The Military Distributors tractor was about 6.5 feet over the highway centerline into the southbound lane at the time it collided with the southbound schoolbus.
5. The grain truck driver made an evasive steering maneuver to the right before the collision with the Military Distributors tractor.
6. The Military Distributors tractor collided with the grain truck tractor on the shoulder of the southbound highway lane.
7. The Military Distributors truckdriver was experiencing significant sleep deprivation and fatigue at the time of the accident.
8. There is no evidence to indicate that responsible Military Distributors officials were aware of the truckdriver's seizure disorder or that they were exercising inadequate supervision of the truckdriver's hours of service.
9. The Military Distributors truckdriver did not suffer a heart attack, and his essentially nonfunctional right coronary artery was not a factor in the accident.
10. The Military Distributors truckdriver's marijuana consumption about 2 to 4 days before the accident was not a contributing factor.
11. In 1976, the Military Distributors truckdriver was medically diagnosed as having a seizure disorder and medication was prescribed to control it.
12. The Military Distributors truckdriver admitted to his physician that he did not always take his medication in the dosage prescribed.
13. The Military Distributors truckdriver probably did not take any of his prescribed seizure-control medication on the day of the accident, and may not have taken any medication for between 2.8 and 8.5 days before the accident.
14. The amount of seizure-control medication present in the Military Distributors truckdriver's blood at the time of the accident was insufficient to prevent a seizure. Consequently, a seizure cannot be ruled out.
15. The Military Distributors truckdriver knew of the Federal rule which prohibits interstate commercial vehicle driving by epileptic drivers.

16. State licensing of drivers with diagnosed seizure disorders to operate large commercial vehicles poses an unnecessary hazard to the general public.
17. The Military Distributors truckdriver deliberately concealed his seizure disorder from his employer, the physician who performed his DOT-required physical examination, and the Virginia licensing authority by giving false answers to questions concerning his medical condition.
18. Systems which rely on voluntary self-reporting to identify persons with seizure disorders are ineffective because they assume a person will act against his/her own self-interest.
19. The use of legs attached to the schoolbus floor to secure the outboard side of the bench seats to the schoolbus body would not have prevented the first three seats of the left side of the schoolbus from being torn out of the schoolbus body in the collision.
20. The crushing and penetration of the schoolbus body at the left front negated the FMVSS 222 crash protection features for the occupants in the first four seats on the left side of the schoolbus.
21. Schoolbus seats and the restraining barrier outside the area of penetration demonstrated the crashworthiness required by FMVSS 223.
22. The installation and use of lapbelts would not have prevented the fatalities or the serious or severe injuries sustained by the surviving occupants of the first four seats of the left side of the schoolbus.
23. The installation and use of lapbelts probably would have mitigated the serious or severe injuries sustained by the two occupants seated on the side on the right side of the schoolbus.
24. Lapbelt use probably would not have lessened the severity of the injuries sustained by the schoolbus passengers who received minor or moderate injuries.
25. Tests performed by National Highway Traffic Safety Administration contractors and the National Bureau of Standards for the Safety Board indicate that the floor panel joints of the Thomas schoolbus did not meet the joint strength requirement of FMVSS 221.
26. FMVSS 221 is unclear as to whether body panel joints should be tested in tension, peel, or shear.
27. The Safety Board believes that body panel joints should be tested in tension or peel unless they can only be tested in shear.
28. FMVSS 221 should be clarified to include all body panel joints that enclose the occupant space even if they are structural.
29. Based on laboratory and real-world crash data involving schoolbuses built by three different manufacturers, the Safety Board believes that floor panel joints in schoolbuses manufactured by Thomas need to be strengthened to meet the requirements of FMVSS 221.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the driver of the Military Distributors of Virginia, Inc., truck to keep his vehicle to the right of the highway centerline because of inattention due to a momentary lapse of alertness, falling asleep, or an epileptic seizure.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations:

--to all States (except California and Hawaii) and the District of Columbia:

Prohibit the issuance of licenses for the operation of large commercial trucks and vehicles capable of transporting more than 10 passengers to persons with diagnosed seizure disorders. (Class II, Priority Action) (H-86-50)

--to all States (except California, Connecticut, Delaware, Illinois, Indiana, Nevada, New Jersey, Oregon, and Pennsylvania) and the District of Columbia:

Require physicians licensed to practice in your jurisdiction to report the name, address, and date of birth of any person diagnosed or treated for a seizure disorder to the central State driver licensing agency without delay. (Class II, Priority Action) (H-86-51)

Provide immunity from liability for physicians reporting information about patients with diagnosed seizure disorders. (Class II, Priority Action) (H-86-52)

--to the American Medical Association:

Inform your membership of the facts and circumstances of the accident on May 31, 1985, near Snow Hill, North Carolina, and urge physicians to emphasize to their patients with diagnosed seizure disorders to refrain from driving any vehicle until their seizure disorder is controlled, and to inform their patients of the Federal rule which prohibits the operation of a commercial vehicle in interstate commerce by a driver with a seizure disorder. (Class II, Priority Action) (H-86-53)

--to the National Highway Traffic Safety Administration:

Amend or clarify Federal Motor Vehicle Safety Standard 221 to require that body panel joints for schoolbus body structures be tested in tension or peel unless they can only be tested in shear. (Class II, Priority Action) (H-86-54)

Amend or clarify Federal Motor Vehicle Safety Standard 221 to include all body panel joints that enclose the occupant space. (Class II, Priority Action) (H-86-55)

Resume testing of schoolbus floor joints to ensure compliance with Federal Motor Vehicle Safety Standard 221. (Class II, Priority Action) (H-86-56)

--to Thomas Built Buses, L.P.:

Strengthen the floor panel joints of all newly-manufactured schoolbuses to ensure that they comply with the requirements of Federal Motor Vehicle Safety Standard 221. (Class II, Priority Action) (H-83-57)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ PATRICIA A. GOLDMAN
Acting Chairman

/s/ JIM BURNETT
Member

/s/ JOHN K. LAUSER
Member

Joseph T. Nall, Member, did not participate.

August 5, 1986

APPENDIXES

APPENDIX A

INVESTIGATION

Investigation

The National Transportation Safety Board was notified of this accident at 6:30 p.m. on May 31, 1985, by the news media.

A Highway Accident Investigator was dispatched from the Safety Board's Atlanta, Georgia, Field Office and arrived onscene at 3 a.m. on June 1, 1985. Highway Accident Investigators were dispatched from the National Transportation Safety Board Headquarters Office in Washington, D.C., and arrived onscene at 11:30 a.m. on June 1, 1985. Participating in the investigation were representatives of the North Carolina Highway Patrol, Military Distributors of Virginia, Inc., the Greene County (North Carolina) Board of Education, Thomas Built Buses, L.P. (formerly Thomas Built Buses, Inc.), International Harvester Corporation, and the Virginia Motor Carrier Safety Office of the Federal Highway Administration.

Deposition

There were no depositions taken or public hearings held in conjunction with this investigation.

APPENDIX B

THE MDV TRUCKDRIVER'S
PRESCRIPTION DRUG REFILL RECORD

<u>Date</u>	<u>Number of Pills Prescribed*</u>	<u>Number of Days Supply Was for**</u>	<u>Approximate Date New Prescription Would Be Needed**</u>
08/07/79	200	66.6	10/12/79
10/00/79	200	66.6	12/14/79
09/11/80	200	66.6	11/17/80
11/25/80	90	30	12/25/80
01/13/81	600	200	08/01/81
07/27/81	600	200	02/12/82
10/02/82	600	200	04/20/83
09/22/83	200	66.6	11/28/83
02/03/84	200	66.6	04/10/84
07/05/84	400	133.3	11/09/84
Totals	<u>3,290</u>	<u>1,096.3</u>	

Total number of days from 8/7/79 to 5/31/85 (accident date) = 2,124

*Truckdriver probably did not pick up the quantity indicated all at one time.

** Assuming truckdriver took three pills per day as prescribed, and that he renewed his prescription when his supply was or was nearly used up.

APPENDIX C

OTHER DRIVER INFORMATION

The 19-year-old schoolbus driver was a resident of Snow Hill, North Carolina, and had a valid North Carolina operator's license. She had been certified as qualified to operate schoolbuses by the North Carolina Division of Motor Vehicles on March 16, 1984.

The 58-year old grain truck driver was a resident of Farmville, North Carolina, and had a valid North Carolina license which qualified him to operate commercial vehicles.

The 19-year-old passenger car driver was a resident of Goldsboro, North Carolina, and had a valid North Carolina operator's license.

APPENDIX D

FEDERAL MOTOR VEHICLE SAFETY STANDARD 221

§ 571.221 Standard No. 221; School bus body joint strength.

§1. Scope. This standard establishes requirements for the strength of the body panel joints in school bus bodies.

§2. Purpose. The purpose of this standard is to reduce deaths and injuries resulting from the structural collapse of school bus bodies during crashes.

§3. Application. This standard applies to school buses with gross vehicle weight ratings of more than 10,000 pounds.

§4. Definitions. "Body component" means a part of a bus body made from a single piece of homogeneous material or from a single piece of composite material such as plywood.

"Body panel" means a body component used on the exterior or interior surface to enclose the bus' occupant space.

"Body panel joint" means the area of contact or close proximity between the edges of a body panel and another body component, excluding spaces designed for ventilation or another functional purpose, and excluding doors, windows, and maintenance access panels.

"Bus body" means the portion of a bus that encloses the bus' occupant space, exclusive of the bumpers, the chassis frame, and any structure forward of the forwardmost point of the windshield mounting.

§5. Requirement. When tested in accordance with the procedure of §6.

each body panel joint shall be capable of holding the body panel to the member to which it is joined when subjected to a force of 80% of the tensile strength of the weakest joined body panel determined pursuant to §6.3.

§6. Procedure.

§6.1 Preparation of the test specimen.

§6.1.1 If a body panel joint is 8 inches long or longer, cut a test specimen that consists of any randomly selected 8-inch segment of the joint, together with a portion of the bus body whose dimensions, to the extent permitted by the size of the joined parts, are those specified in Figure 1, so that the specimen's centerline is perpendicular to the joint at the midpoint of the joint segment. Where the body panel joint is not fastened continuously, select the segment so that it does not bisect a spot weld or a discrete fastener.

§6.1.2 If a joint is less than 8 inches long, cut a test specimen with enough of the adjacent material to permit it to be held in the tension testing machine specified in §6.3.

§6.1.3 Prepare the test specimen in accordance with the preparation procedure specified in the 1973 edition of the Annual Book of ASTM Standards, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

§6.2 Determination of minimum allowable strength. For purposes of determining the minimum allowable joint strength, determine the tensile

strengths of the joined body components as follows:

(a) If the mechanical properties of a material are specified by the American Society for Testing and Materials, the relative tensile strength for such a material is the minimum tensile strength specified for that material in the 1973 edition of the Annual Book of ASTM Standards.

(b) If the mechanical properties of a material are not specified by the American Society for Testing and Materials, determine its tensile strength by cutting a specimen from the bus body outside the area of the joint and by testing it in accordance with §6.3.

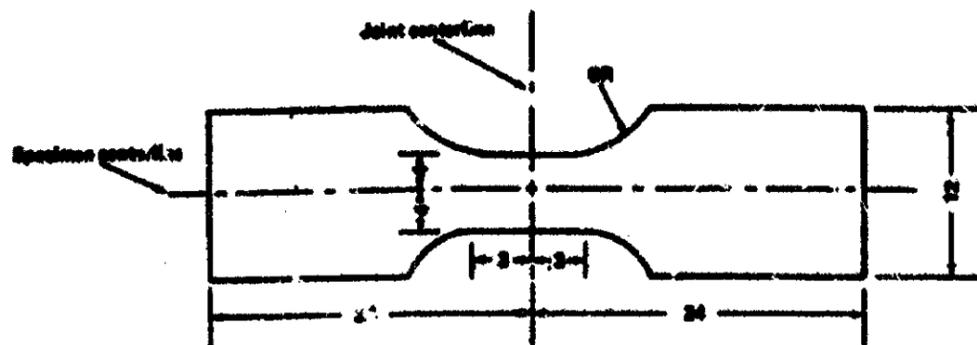
§6.3 Strength test.

§6.3.1 Grip the joint specimen on opposite sides of the joint in a tension testing machine calibrated in accordance with Method E4, Verification of Testing Machines, of the American Society for Testing and Materials (1973 Annual Book of ASTM Standards).

§6.3.2 Adjust the testing machine grips so that the joint, under load, will be in stress approximately perpendicular to the joint.

§6.3.3 Apply a tensile force to the specimen by separating the heads of the testing machine at any uniform rate not less than 1/8 inch and not more than 1/4-inch per minute until the specimen separates.

(41 FR 3072, Jan. 27, 1976, as amended at 41 FR 30027, Aug. 26, 1976)



All dimensions in inches

FIGURE 1

APPENDIX E

STATE DRIVER LICENSING REQUIREMENTS FOR
PERSONS WITH EPILEPSY *

STATE	SEIZURE-FREE PERIOD REQUIRED	REQUIRES SUBMISSION OF PERIODIC MEDICAL REPORTS	SPECIAL REQUIREMENTS FOR INTRASTATE TRUCK/BUS DRIVING
AL	12 Months	Annual	No
AK	6 Months	No	No
AZ	12 Months <u>1/</u>	No	No
AR	12 Months	No	No
CA	36 Months <u>2/</u>	No	Prohibited <u>3/</u>
CO	None	No	Yes <u>4/</u>
CT	3 Months	Yes	No
DE	None	Annual	No
DC	12 Months	Annual <u>5/</u>	No
FL	12 Months	No <u>6/</u>	No
GA	12 Months	No <u>7/</u>	Yes <u>7/</u>
HI	12 Months	No	Prohibited <u>3/</u>
ID	12 Months	No	No
IL	None <u>8/</u>	No	No
IN	None <u>9/</u>	No	Yes <u>9/</u>
IA	6 Months	Yes	No
KS	12 Months	No	No
KY	3 Months	No	No
LA	12 Months	No	No
ME	12 Months <u>10/</u>	No	No <u>10/</u>
MD	12 Months <u>11/</u>	No <u>6/</u>	Yes <u>11/</u>
MA	18 Months	Yes <u>12/</u>	No
MI	6 Months <u>13/</u>	No	Yes <u>13/</u>
MN	12 Months	No	Yes <u>14/</u>
MS	12 Months	No	No
MO	None	Yes	No
MT	6 Months	No	No
NE	None	No	Yes <u>3/</u>
NV	3 Months	No <u>6/</u>	No
NH	12 Months	No	No
NJ	12 Months	Yes <u>15/</u>	Yes <u>15/</u>
NM	None <u>16/</u>	No	No
NY	12 Months	No <u>17/</u>	Yes <u>17/</u>
NC	None	Yes	No
ND	12 Months	Annual <u>18/</u>	No
OH	None	Yes	Yes <u>19/</u>
OK	12 Months	Yes <u>20/</u>	Yes <u>20/</u>
OR	3 Months	No	Yes <u>21/</u>
PA	12 Months <u>22/</u>	No	No
RI	None	No	No
SC	6 Months	No	Yes <u>23/</u>
SD	18 Months <u>24/</u>	No	No
TN	None	No	No
TX	12 Months	No	Yes <u>23/</u>
UT	3 Months	Yes	Yes <u>25/</u>
VT	24 Months <u>26/</u>	Yes	No
VA	12 Months <u>27/</u>	Yes	No
WA	6 Months	No <u>6/</u>	No
WV	12 Months	No	No
WI	6 Months <u>28/</u>	Yes <u>28/</u>	Yes <u>28/</u>
WY	None	No	No

* Source: The Epilepsy Foundation of America, Inc., "The Legal Rights of Persons With Epilepsy," Fifth Edition, May 1, 1995, pp. 131 to 432.

FOOTNOTES

- 1/ In Arizona, a person with epilepsy may obtain a license if s/he has been seizure-free for one year if regularly on medication or two years if not on medication.
- 2/ In California, the Department of Motor Vehicles may waive the 3-year requirement if it feels the person's condition does not affect his/her ability to drive safely. In practice, California reportedly applies a one-year seizure-free period.
- 3/ Has adopted Federal DOT requirements.
- 4/ In Colorado, a medical certificate is required to operate commercial vehicles.
- 5/ In the District of Columbia, a physician's certificate shall be submitted annually until the patient has been seizure-free for 5 consecutive years at which time the physician's certificate is no longer required.
- 6/ Periodic medical reports may be required as a condition for issuance of a license.
- 7/ In Georgia, the Department of Public Safety may require periodic medical reports as a condition for licensing. Once a person has been seizure-free for a period of 3 years s/he is eligible for a license to drive vehicles over 24,000 pounds gross weight.
- 8/ In Illinois, the Vehicle Code specifically mentions epilepsy as a basis for denying a driver's license. An applicant with epilepsy will be granted a license, however, if s/he submits a doctor's statement certifying that s/he can safely operate a vehicle. The applicant may be issued a restricted license.
- 9/ In Indiana, an applicant who has experienced seizures within the last year may be granted a license if s/he presents a physician's statement that the epilepsy is controlled well enough by medication to make driving safe. A person who has been seizure-free for one year can obtain a license without a physician's certificate. Schoolbus drivers are required to be free from any mental, nervous, organic, or functional disease which might impair their ability to properly operate a schoolbus.
- 10/ In Maine, the 12-month seizure-free period may be reduced to 6 months with a neurologist's recommendation.

- 11/ In Maryland, a person who has been treated for epilepsy shall have his/her license application referred to the Medical Advisory Board of the Motor Vehicle Administration. A person may be considered for a license to drive cars, small trucks, and motorcycles if s/he has been seizure-free for 12 months. The person will be recommended for any class of license if s/he has had no episodes of alteration of consciousness for the preceding 3 years.
- 12/ In Massachusetts, periodic medical reports must be submitted for as long as the licensee is prescribed anti-convulsant medication, and in any case, for at least 2 years.
- 13/ In Michigan, a person must be seizure-free for one year to be licensed to drive buses or heavy trucks.
- 14/ In Minnesota, the standards for obtaining a truck license to drive intrastate are the same as those for obtaining a personal vehicle license. However, in order to drive a schoolbus, a person with epilepsy must be seizure-free for 5 years and off medication for 2 years.
- 15/ In New Jersey, the person must submit medical reports every 6 months for the first 2 years. Subsequent reports must be submitted annually. Bus drivers must meet DOT requirements. The standards for a license to drive a truck intrastate are the same as those for a personal vehicle license.
- 16/ While New Mexico's statutes and regulations do not specifically mention epilepsy as a basis for denying a license, the state's Medical Advisory Board has a policy that a person be seizure-free for the year immediately preceding the application date.
- 17/ In New York, a person shall not be required to submit periodic medical reports if s/he has been seizure-free without medication for one year or more. New York has adopted the DOT requirements for bus drivers only. The standards for a license to drive a truck intrastate are the same as those for a personal vehicle. However, the medical certification must include approval for driving vehicles other than passenger vehicles.
- 18/ In North Dakota, the annual reports are no longer required after the person has been off medication and seizure-free for 5 years.
- 19/ While not officially adopting the Federal regulations, Ohio will not issue a license to drive trucks intrastate to a person who may be subject to impairments of loss of consciousness.
- 20/ In Oklahoma, once the person has been seizure-free and off medication for two years, periodic reporting may be discontinued and a person may be considered for a chauffeur's or a commercial chauffeur's license.

21/ While Oregon has adopted the Federal regulations regarding the licensing of truck drivers, a person with epilepsy may be licensed for intrastate commerce by obtaining a waiver from the Public Utility Commissioner.

22/ In Pennsylvania, an applicant between the ages of 16 and 18 who is applying for his/her first license must be seizure-free for 2 years with or without medication.

23/ While South Carolina and Texas have not adopted the Federal requirements regarding the licensing of truck drivers, persons with seizure tendencies are normally not approved for large or passenger-for-hire vehicles.

24/ In South Dakota, a person may obtain a temporary license regardless of the amount of time s/he has been seizure-free by presenting a doctor's certification that the epilepsy is controlled by medication, the person is continuing to take medication, and the operation of a motor vehicle would not be inimical to public safety. A temporary license is reviewed every 6 months until the person has been seizure-free for 18 months.

25/ In Utah, after a 3-month seizure-free period an applicant can be issued a restricted license to drive a private vehicle. A license to drive "lighter trucks, taxis, small commercial vans, etc." is available to a person who has been seizure-free for a year. Once a licensee has been off medication for 3 years and seizure-free for 5 years s/he may obtain any sort of license.

26/ In Vermont, a person may obtain a conditional license if s/he has been seizure-free for 6 months and has a good prognosis for continued seizure control. At least once every 6 months such a person must submit a doctor's certification of freedom from seizures.

27/ Virginia's Division of Motor Vehicles will not issue a license to a person with a physical disability which will prevent him/her from safely operating a motor vehicle. It is the Division's policy, as recommended by its Medical Advisory Board, that a person be seizure free for 12 months before obtaining a license. A person who is on medication will be issued a restricted license which requires periodic medical reports.

28/ In Wisconsin, a person with epilepsy may obtain a temporary license if s/he has been seizure-free for 6 months. Physician's reports must be submitted at 6-month intervals for 2 years and yearly thereafter on the licensee's birthdate until the licensee has been free of seizures for a period of 10 years from the date of issuance of the license. A person with epilepsy may obtain a restricted license to drive trucks intrastate. A person with a history of epilepsy shall be considered for a schoolbus operator license if s/he has been off anticonvulsant medication and has had no seizures in the past 5 years.