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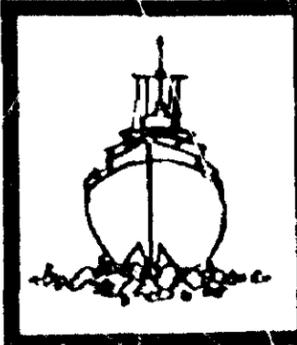


NATIONAL TRANSPORTATION SAFETY BOARD

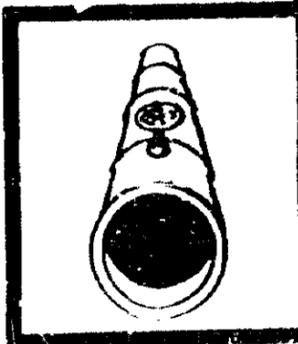
WASHINGTON, D.C. 20594



HIGHWAY ACCIDENT REPORT



**COLLISION OF WINNEBAGO
MOTOR HOME WITH
BRIDGE COLUMN**



NEAR MONROE, MICHIGAN

JULY 1, 1975

REPORT NUMBER: NTSB-HAR-76-2



UNITED STATES GOVERNMENT

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<p>16. Abstract On July 1, 1975, at 10:35 a.m., e.d.t., a Winnebago motor home traveling south on Interstate 75 ran off the highway and crashed near Monroe, Michigan. The motor home left the roadway, struck the end section of a guardrail, then struck a concrete bridge column, and caught fire almost immediately. The fire which destroyed the vehicle was fed by two 40-pound propane tanks which became detached from the vehicle. Of the 10 vehicle occupants, the driver and a passenger, neither of whom was wearing a seatbelt, were injured when they were ejected through the front of the vehicle. Seven persons perished in the subsequent fire and one was injured but escaped from the vehicle unassisted.</p> <p>The National Transportation Safety Board determines that the probable cause of the accident was the driver's failure to change lanes properly. The failure of the driver and a passenger to use their seatbelts prevented them from remaining in the vehicle, where they might have been able to rescue other passengers. The escape of propane from the two disconnected gas tanks added to the intensity of the vehicle fire.</p> <p>As a result of its investigation of this accident, the Safety Board made three recommendations concerning the use of seatbelts, motor home appliances, and propane supply systems.</p>			
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FOREWORD

This report is based upon an investigation by the National Transportation Safety Board under the authority of the Independent Safety Board Act of 1974. The Safety Board received information pertaining to its investigation from the Chrysler Motors Corporation, the Monroe County sheriff's department, the Michigan Department of State Highways and Transportation, the Michigan Department of State Police, the National Highway Traffic Safety Administration's Multidisciplinary Accident Investigation Team of the University of Kentucky, and Winnebago Industries, Inc.

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File No. SS-H-43

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20594

HIGHWAY ACCIDENT REPORT

Adopted: March 3, 1976

COLLISION OF WINNEBAGO MOTOR HOME WITH BRIDGE COLUMN
NEAR MONROE, MICHIGAN, JULY 1, 1975

SYNOPSIS

On July 1, 1975, at 10:35 a.m., e.d.t., a Winnebago motor home traveling south on Interstate 75 ran off the highway and crashed near Monroe, Michigan. The motor home left the roadway, struck the end section of a guardrail, then struck a concrete bridge column, and caught fire almost immediately. The fire which destroyed the vehicle was fed by two 40-pound propane tanks which became detached from the vehicle. Of the 10 vehicle occupants, the driver and a passenger, neither of whom was wearing a seatbelt, were injured when they were ejected through the front of the vehicle. Seven persons perished in the subsequent fire and one was injured but escaped from the vehicle unassisted.

The National Transportation Safety Board determines that the probable cause of the accident was the driver's failure to change lanes properly. The failure of the driver and a passenger to use their seatbelts prevented them from remaining in the vehicle, where they might have been able to rescue other passengers. The escape of propane from the two disconnected gas tanks added to the intensity of the vehicle fire.

FACTS

The Accident

About 10:15 a.m., e.d.t., on July 1, 1975, a 1972 Winnebago motor home was southbound on Interstate 75 (I-75) near Monroe, Michigan. There were three adults and seven children riding in the vehicle.

The motor home had traveled in the left lane at 50 to 55 mph for 10 or 15 minutes. During this time other motorists saw it sway from side to side and 2 to 3 feet over the broken white centerline. One motorist directly behind the motor home had engaged his left turn signal so that if the motor home driver saw it in his rearview mirror, he might move over into the right lane. Vehicles were passing the motor home on the right. Several times the motor home almost sideswiped these passing vehicles.

As one driver passed the motor home on the right, he blew his horn and motioned to the motor home driver to move over to the right lane. Another driver behind the motor home saw its brake lights come on

momentarily, followed by a right turn signal. Two more cars passed the motor home on the right. About 600 feet from the end of a guardrail (See Figures 1 and 2.), the motor home started to move from the passing lane to the right travel lane. The motorist who was following directly behind the motor home in the left lane started to pass on the left. He saw the motor home driver look in his left rearview mirror as the vehicle started to leave the road. About this point, a northbound truckdriver saw the motor home driver looking to his right and behind with only his left hand on the steering wheel. Also about this point, the two surviving passengers of the motor home heard the driver's son, seated in the right front seat, yell, "Watch out, Dad."

The vehicle crossed onto a 10-foot paved shoulder, continued to the right onto a downward sloping, 5-foot strip of gravel and grass, and the right wheels entered a small ditch. The motor home traveled along the ditch for 122 feet before the left front of the vehicle struck the blunt end of a guardrail, causing the left front of the vehicle to lift up slightly. (See Figure 3.) The motor home continued along the ditch behind the guardrail for another 48 feet, where it struck a concrete bridge column of an overpass and came to rest 9 1/2 feet beyond and against a second column. (See Figures 4 and 5.) The first column penetrated about 26 inches into the right front of the motor home, and about 12 feet toward the rear. Within seconds of the impact, a fire started underneath the chassis on the right side, about 12 feet to the rear.

Witnesses who were behind the motor home did not see the brake lights come on at any time after it left the highway. They described the motion of the vehicle as one smooth arc from the left lane to the impact with the guardrail. They did not see the driver make any attempt to avoid the accident, either by braking, steering, or slowing the motor home.

At impact, the driver and a passenger who was seated at a dinette table behind the driver were ejected through the front of the vehicle. They were not using the available seatbelts. They both survived. A third passenger escaped from the motor home through an opening which had been torn in the right side of the vehicle. He was burned, but he survived.

A witness, who had been following 500 feet behind the motor home, stopped his automobile and approached the burning vehicle. He stated that he attempted to enter the front of the vehicle, but the heat of the fire prevented him from doing so. As he looked inside the vehicle, he saw two passengers sitting upright in a seat facing him. The fire had not reached them. As the flames progressed and started to engulf them, one of these passengers attempted to get out of her seat but she appeared to be restrained in some way.

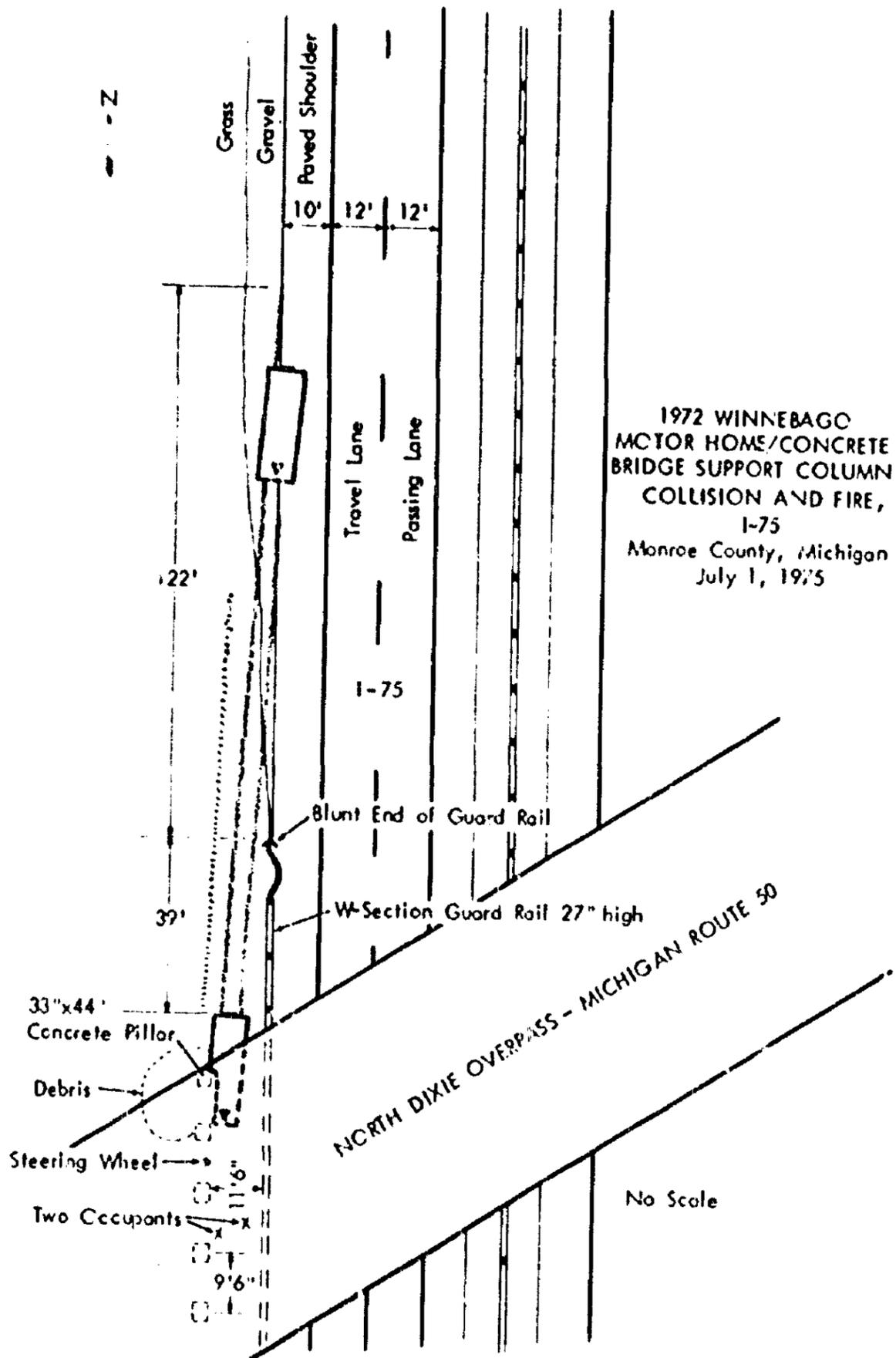


Figure 1. Accident sketch.

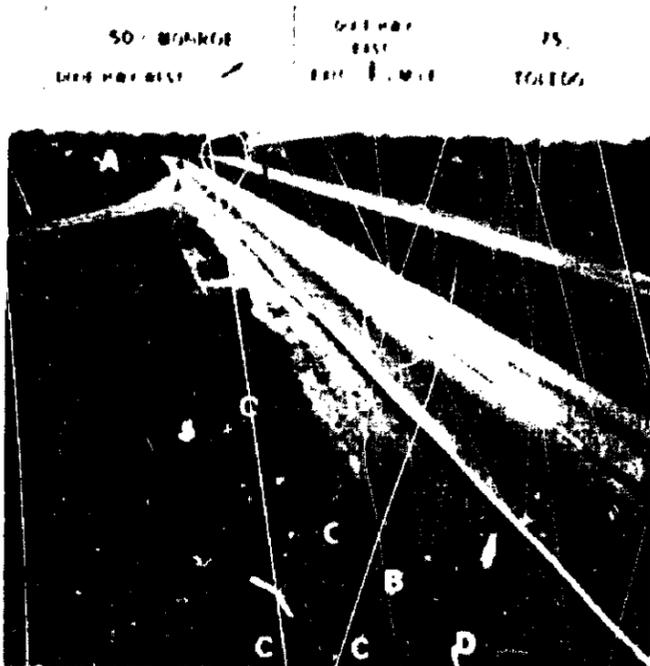


Figure 2. Approach of motor home to accident scene
A - sign 400' from guardrail post; B - guardrail post (1-section of guardrail missing); C - tire tracks; D - repaired guardrail (note blunt end).

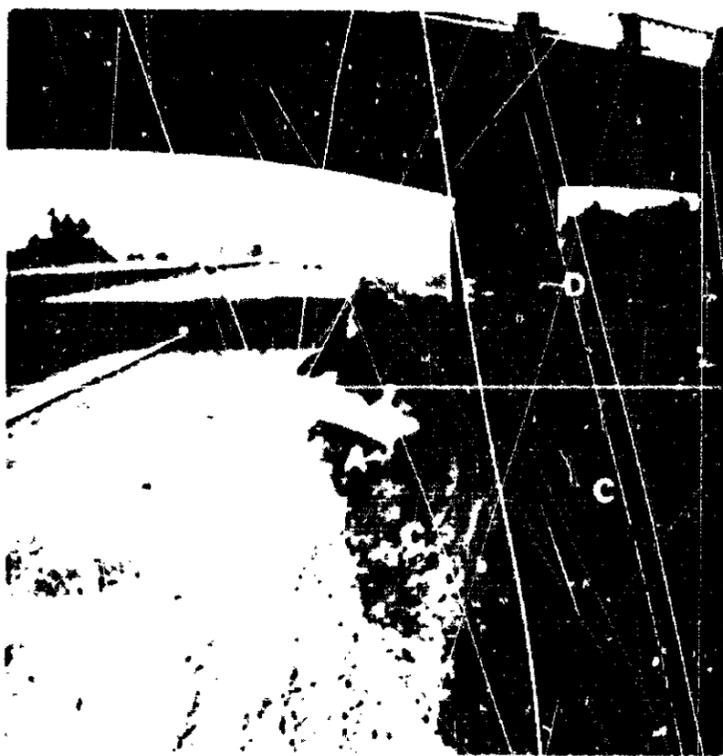


Figure 3. Damage to guardrail and bridge
A - bent guardrail post; B - bent guardrail (1 12' 6" section); C - tire tracks; D - first bridge column; E - second bridge column.



Figure 4. Final position of motor home
A - first southbound bridge column;
B - front of vehicle; C - refrigerator.



Figure 5. Final position of motor home against first
(A) and second (B) southbound columns of
bridge; (c) propane tank (D) front of
motor home (E) door.

Within 2 to 4 minutes after the impact, the burning vehicle erupted into a ball of flames. One witness reported that he heard an explosion before he saw the ball of flames. Another witness saw, for an instant, a large blue flame on the left side and above the vehicle as he approached it from the rear. The driver of the motor home recalled two explosions that occurred about 10 feet above the ground and on the left side of his vehicle. As the vehicle burned, witnesses heard up to four explosions. These witnesses believed that the explosions occurred at the center of the vehicle's right and left sides and rearward. One explosion propelled a small metal utility door from the center of the motor home's left side, across the median, and into the northbound lanes of I-75. Several witnesses reported hearing whistling or hissing sounds, followed by flashes of flame, as the vehicle burned.

Rescue squads from Monroe and from Frenchtown County arrived promptly at the accident site; however, seven occupants, who did not escape from the vehicle, died.

Several weeks after the accident, the motor home driver stated, "So it was very uneventful and [sic] until all of a sudden we hit the grass area. I cannot with any accurateness tell you just how we got off the road. It happened quickly. I recall changing lanes apparently from the left lane to the right lane and probably didn't make the necessary adjustment. That's just about all I know."

The driver also stated that before the vehicle hit the guardrail, he applied the brakes, got out of his seat, and attempted to pull his son away from the projected impact area with the bridge column, but he was unsuccessful.

Accident Site

The accident occurred along the southbound lanes of I-75 at the North Dixie overpass (Michigan Route 50) near Monroe, Michigan. (See Figure 1.) In that area, I-75 consists of four 12-foot divided lanes, two northbound and two southbound. The northbound and southbound lanes are separated by a 40-foot median which includes a 5-foot gravel shoulder on each side and a 30-foot grass area. Two W-beam guardrails are located in the median -- one for each direction of travel. The outer edges of the highway are bounded by a 10-foot paved shoulder, about 3 feet of gravel, and grass.

The North Dixie overpass traverses I-75 in an east-west direction. The overpass is supported by 33- by 44-inch concrete columns. The columns struck by the motor home are located 21 feet 8 inches from the edge of the right southbound lane and are 9 feet 6 inches apart. A 27-inch-high W-beam guardrail is located 10 feet from the edge of this lane between the bridge columns and the road. The guardrail is attached to 6- by 4-inch steel I-beam posts which are spaced on 12-foot 6-inch centers. The

guardrail begins 48 feet north of the first column of the bridge. The north and south ends of the guardrail were not turned down and secured to the ground.

There is a side slope from the edge of the southbound lane toward the bridge columns. At the base of the bridge columns, the ground is about 12 to 16 inches lower than the surface of the right shoulder.

Highway department records show that the guardrail was installed during 1966 in accordance with standards then in effect. This included leaving the ends of the guardrail exposed rather than turned down and buried in the earth. 1/

In June 1975, a contract was let to widen this section of I-75 and to replace the present guardrail with a double W-beam type. This design, developed by the Michigan State Highway Department, consists of W-beams installed one above the other and results in a ground-to-top-of-guardrail height of 32 inches. The leading end of the guardrail is flared away from traffic and terminates with a cable anchorage and a buffer end section with an 11-inch radius. The end section is the same height as the rest of the guardrail.

Environmental Factors

The road was dry, level, straight, in good repair, and had a posted speed limit of 55 mph. There were no obstructions to the driver's visibility.

Detroit Metropolitan Airport, about 20 miles north of the accident area, recorded at 10:53 a.m., e.d.t.,: "visibility 15 miles, temperature 80°F, wind 12° at 5 knots."

Marks on the Roadway and Damage to the Bridge Columns

There were no skidmarks or tiremarks found on the highway.

Two tire tracks were found in the gravel and grass to the right of the southbound shoulder. These tracks led to the point of impact with the guardrail end section and the first bridge column struck by the motor home. The right tire track was about 161 feet long and the left about 112 feet long.

1/ A Policy of Geometric Design of Rural Highways, 1965, American Association of State Highway Officials (adopted by Federal Highway Administration), states that "Another consideration in the terminal treatment of guardrail is that the rail end should be located sufficiently in advance of the theoretical need, in combination with adequate offset, to minimize the possibility of a vehicle running behind the guardrail and becoming involved in the very hazard which the guardrail is intended to eliminate."

The north end post of the guardrail was forced downward and the end section of the W-beam was deformed inward and had scrape marks on it. (See Figures 2 and 3.)

The first concrete bridge column was chipped by impact with the motor home and blistered by heat. (See Figure 3.) The second column had scrape marks at its base and was blackened from fire.

Vehicle Inspection

Inspection of the motor home revealed no mechanical defects that could have caused the driver of the motor home to drive off the road.

Examination of the propane system revealed that the gas regulator was missing and that there was some copper tubing attached to the hand valves on each tank, which were open. The driver later confirmed that the tanks were open to supply propane to the refrigerator, which was operating at the time of the accident.

The inspection revealed that:

-The outer walls and interior components (rugs, seats, beds, cabinets, miscellaneous clothing, and other wood fixtures) were destroyed by the fire. (See Figure 4.)
-The sink, refrigerator, stove, and oven were dislodged and distorted. The refrigerator was found leaning against a bridge column. (See Figure 4.)
-The front bumper was dented on the left side near its bottom, 8 1/2 inches from the outside leading edge. (See Figure 6.) The left front fender well, behind the left front tire, was not damaged. The right side of the front bumper was deformed rearward 90° at the junction of the ladder frame and bumper. (See Figure 7.) The rear bumper was not damaged.
-The two 40-pound propane tanks were found detached from their sealed compartment. (See Appendix C.) One of the tanks was found to the right rear of the motor home about 6 feet from the right side frame rail of the vehicle. (See Figure 5.) The second tank was found near the compartment, underneath the chassis. The compartment floor was destroyed by the fire. The tanks maintained their structural integrity and were damaged only slightly. (See Figure 8.) The valves on both tanks were found open.
-A 43-gallon fuel tank was attached to the right outside of the frame near the center of the motor home body. The tank was supported by two steel channels and was secured by two metal straps to the frame. The supporting channels



Figure 6. Damage to left front bumper of motor home (A)



Figure 7. Damage to right front bumper of motor home.

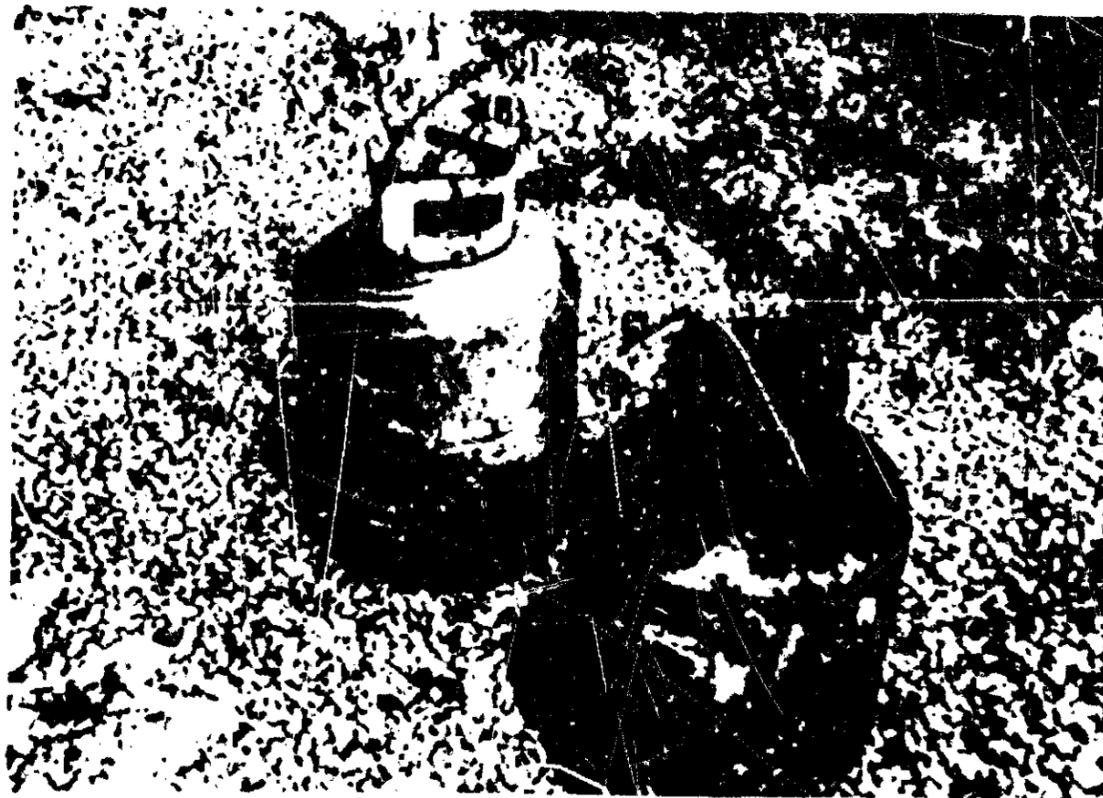


Figure 8. Propane tanks from motor home; (A) damage; (B) hand valves; (C) copper tubing.

were deformed rearward. The tank was disengaged from the frame and fuel lines and it was buckled and crushed toward the center. (See Figure 9.) A 20-gallon auxiliary fuel tank located at the right rear corner of the motor home was not damaged except for a broken fuel line. (Appendix A, Description of the motor home and its loading. Appendix B, Description of the motor home's appliances, their methods of operation, and their fuel sources. Appendix C, Construction details and securement of the motor home's appliances. Appendix D. Additional vehicle damage.)

Vehicle Driver

The 37-year-old driver held a valid State of Illinois driver's license. Illinois Motor Vehicle Department records reveal one conviction for disobeying a "No U-Turn" sign in 1972. There was no record of any previous accidents.

The motor home was purchased new in 1972 and the driver had driven it on three round trips -- from Detroit to Iowa, from Detroit to Alabama, and from Detroit to Philadelphia.

Two days before the trip, the driver arranged for a dealer representative to inspect the motor home because he was not satisfied with the



Figure 9. Damaged right side fuel tank of motor home.

way it handled. Also he wanted to assure himself of the proper operation of the motor home's appliances. The dealer's representative went through the motor home with the driver and showed him how to operate the appliances. The representative checked the system and found no leaks. The driver complained that the steering column was loose where it was attached to the dash. The representative told the driver how to tighten the steering column and the driver had it tightened. When the driver drove the vehicle the next day, he stated "...that it [the motor home] drove like a sports car...it handled beautiful."

The day before the accident, the driver drove the motor home 140 to 150 miles around the Detroit area to familiarize himself with it. A neighbor who also drove it that day concluded that there was nothing unusual about the handling of the motor home.

In addition the driver had concerns about the operation of the refrigerator. The driver later stated that the refrigerator was the only appliance operating on propane as the vehicle was traveling down the highway. He stated that "...we should have then cut off the [propane] tanks and put it [the refrigerator] on the generator which was running anyhow for the air conditioning." The driver believed that if the propane tanks had been shut off, the flames would not have consumed the vehicle and there might have been more time to rescue the passengers.

The third concern of the driver was escape from the motor home, which was manufactured with only one door, located on the right side toward the front of the vehicle. Consequently, the night before the accident, the driver discussed escape problems and procedures with his son. The driver reasoned that should an accident occur and the door become blocked, he and his son would be inside the vehicle to kick out the windows and help passengers to escape.

Vehicle Passengers

The motor home passengers consisted of two adult females, one adult male, and seven children ranging in age from 6 to 17 years. (See Figure 10.)

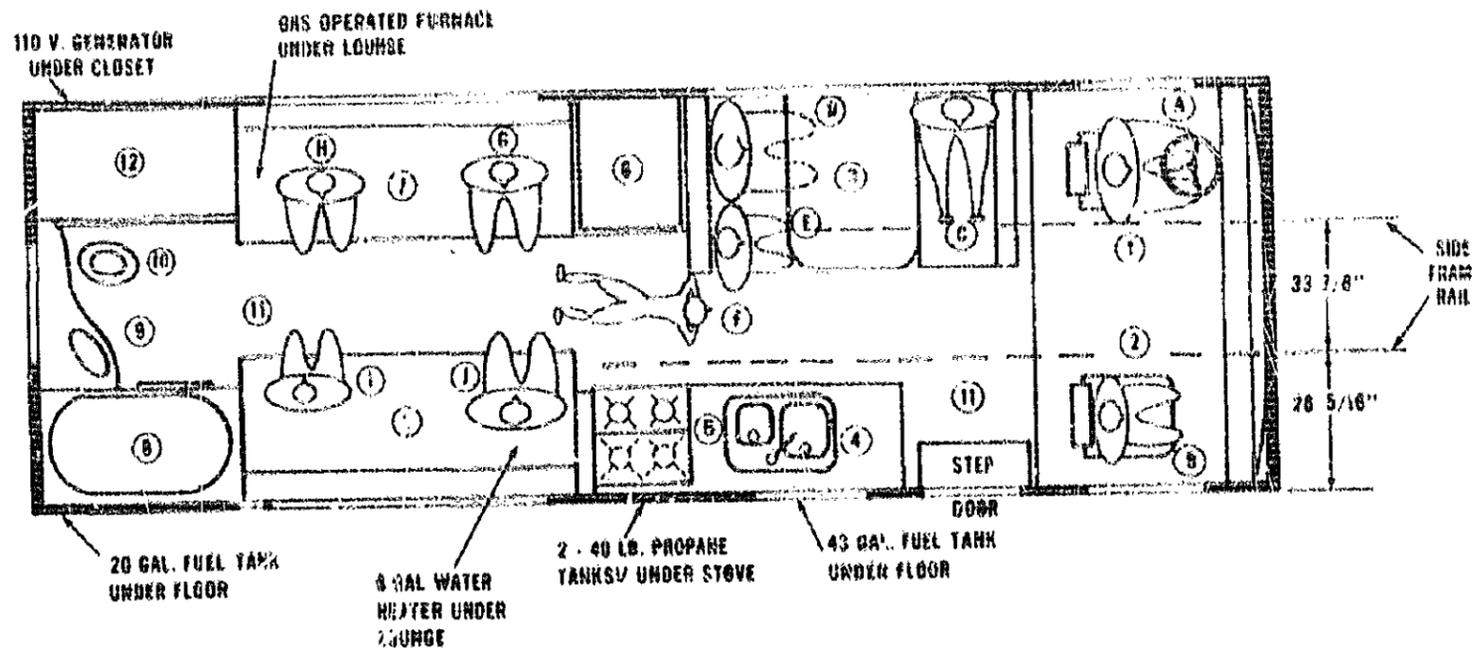
The driver (A) was not wearing his seatbelt and was ejected through the front of the vehicle. The driver stated that passenger B had a seatbelt on 20 to 30 minutes before the crash, but he could not recall if B's seatbelt was on at the time of the crash. Passenger C was sitting with his back toward the side wall with his feet on the seat; he did not have a seatbelt on and also was ejected out of the front of the vehicle. The driver recalls that passenger D had a seatbelt on when the trip started and may have had it on at the time of the accident. He could not recall if passenger E had a seatbelt on. Passenger F was lying on the floor between the refrigerator and stove, and apparently was trapped under the refrigerator after the crash. Passenger J left the vehicle through an opening which had been torn in the right side of the vehicle, near the place where he was sitting. He did not have a seatbelt on, nor did occupants G, H, and I, because their positions were not equipped with them.

The motor home had only 6 seatbelted positions, but it was occupied by 10 persons. There are no Federal or manufacturer's requirements limiting the number of passengers in a motor home. However, seats that are not to be occupied when the vehicle is in motion are so labeled by the manufacturer.

Passengers B, D, E, F, G, H, and I did not escape from the burning vehicle. The cause of death was listed by the medical examiner as "asphyxiation, smoke and flame inhalation."

Tests

At the request of the Safety Board, the vehicle manufacturer performed braking and deceleration tests. The tests were conducted using a 1973 Winnebago motor home. They showed that on a level roadway, the vehicle required 200 feet to coast down from 55 mph to 50 mph. They also showed that after the brakes were applied, the vehicle required 185 feet to stop on asphalt from 55 mph; 158 feet to stop on grass from 50 mph; and 189.4 feet to stop on gravel from 55 mph.



CONSTRUCTION DETAILS

The motor home chassis has 2 inch by 12 gauge steel crossmembers welded at 90° to the side frame rails. The floor of the motor home consists of a top layer of 5/16-inch marine plywood, a 3/4-inch layer of styrofoam, pine or plywood (depending on where each material is needed in fabrication) another 5/16 inch layer of marine plywood and a .019-inch aluminum sheet under layer. The side walls consist of an inner layer of paneling (0.52 inches) a center layer of styrofoam (1 1/2 inches) and a 0.024 inch outer layer of aluminum.

GUIDE TO FLOOR PLAN

- (1) Driver's seat (2) Co-Pilot seat (3) Dinnette
- (4) Stainless steel sink (5) Gas stove with eye level oven (6) 7 cubic foot gas/electric refrigerator (7) Lounge (8) Tub shower combination (9) Lavatory (10) Toilet (11) Shag carpet (12) Closet

GUIDE TO SEATING PLAN

- (A) Male, 37, 6' 2 1/2", 255 lbs, ejected; (b) Male, 13, 5' 5", 125 lbs (C) Male, 17, 5' 10", 135 lbs, ejected; (D) Female, 34, 5' 4", 130 lbs; (E) Female, 6, 3' 8", 70 lbs; (F) Male, 14, 5' 3", 110 lbs; (G) Male 11, 5' 9" 90 lbs (H) Male, 9, 4' 6" 90 lbs; (I) Female, 51, 5' 3" 135 lbs; (J) Male, 8, 4' 5", 70 lbs, exited vehicle unassisted

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Figure 10. Construction details, floor and seating plan of motor home.

ANALYSIS

The Accident

When the driver realized that his vehicle was off the road, he had 1.5 seconds (122 ft/80.7 ft per sec) to react before the vehicle struck the end of the guardrail. This was not enough time for the driver to comprehend the situation, make a decision, and take evasive action. Although the driver stated that he braked before impact with the guardrail, it could not be determined if he actually did; however, any braking had minimal effect.

The lack of significant damage to the left front bumper and the lack of damage to the left front wheelwell's sheet metal suggest that the vehicle did not decelerate much when it struck the guardrail's end post. Since the driver left his seat after impact with the guardrail, the vehicle could not have been braked from that point to impact with the bridge column. Therefore, the speed of the motor home when it struck the bridge column was probably between 34 and 43 mph. This speed range was calculated by the Safety Board based on the tests performed by the vehicle manufacturer.

When the driver got out of his seat to pull his son away from the primary impact area, he relinquished control over the vehicle and placed himself in a more likely position to be ejected through the front of the vehicle.

The impact forced the motor home's appliances forward and inward. It is possible that they blocked the exits of the two passengers seated at the dinette table. Also, it is possible that these passengers were seat-belted and could not release the seatbelts because of shock.

The crushing of the fuel tank and the damage to the propane system resulted in the release of fuels that eventually ignited and consumed the motor home. The ignition source for the fire could not be determined, although possible sources were broken electrical circuits or sparks from the crash.

Based on the mechanical inspection of the vehicle, the Safety Board concluded that the vehicle did not malfunction.

Driver Familiarity with the Vehicle

The swaying of the motor home indicates that the driver was encountering difficulty in handling it. There were no reported crosswinds that could have caused the swaying.

The actions of the drivers around him finally influenced the motor home driver to change lanes.

Apparently the driver looked in his mirrors too long, because he drove across the travel lane, the paved shoulder, and the gravel and he did not realize he was off the highway until he drove over the grassy area. Given the size of the vehicle, it is natural that the driver would look in the rearview mirrors longer than he would in a smaller vehicle to assure himself that the travel lane was clear.

The driver was somewhat familiar with the motor home since he drove it on three relatively long trips during a 3-year period and he refamiliarized himself with it the day before the accident. However, recent data indicates that the driver was much less experienced than almost three-fourths of motor home drivers.^{3/} The last cross-country trip the driver took was in the summer of 1974 -- 1 year before the accident. It is doubtful that he could have retained any inherent feel for the handling of the vehicle over that time period. The driver obviously realized this problem when he set aside one day to "get used to the vehicle." This selfimposed training was an astute decision on the part of the driver and showed a conscientious effort on his part to learn about the vehicle he was going to operate.

Use of Seatbelts

The benefits of seatbelts are well known and probably would have (1) kept the driver inside the vehicle, (2) reduced his injuries, and (3) kept him behind the wheel, where he could have exercised some control of the vehicle after impact with the guardrail. Had he remained inside the motor home, he could have aided those who were trapped. The same is true of the passenger seated behind the driver, who also was ejected. This passenger was seated across the table from the two passengers who became trapped in some way and perished in the fire. Either of the two ejectees might have been able to aid those two passengers, because they all were seated close together. Also, the ejectees might have been able to move the refrigerator that blocked the path of the five passengers in the rear.

This accident demonstrates that seatbelts must be used by motor home drivers because they have a responsibility not only to themselves but also to any passengers in the vehicle. This driver was responsible for the safety of 10 individuals, including himself.

Safety Aspects of Flammable Fuel Supply Systems for Motor Home Appliances

The impact of the motor home with the bridge column resulted in displacement of the propane tanks and detachment of the propane regulator. Once the regulator became detached, the propane was released under:

^{3/} 1974 Recreational Vehicle Consumer Study, Bureau of Business Research, Indiana State University, Terre Haute, Indiana, May 1974, page 155: 24.6 percent of motor home drivers drive between 0 - 3998 miles/year and 72.3 percent between 3998 - 19998 miles/year.

pressure. The rapid escape of the propane as it left the copper tubing attached to the propane tanks could have resulted in the hissing sounds heard by witnesses.

It could not be determined if the propane tanks found under the motor home chassis were emitting propane into the motor home or underneath its floor. If propane was being emitted into the motor home, where it eventually ignited, this would explain some of the explosions and the large blue flame above the motor home. If the propane was being emitted underneath the vehicle, it would have fed the gasoline fire already present.

One propane tank was propelled to the right rear of the motor home in the primary fire. Escaping propane from its tank could have accumulated and ignited in one flash. This would explain the flaring up of the vehicle into the ball of flames observed by witnesses. It is clear, however, that the release of the propane contributed to the fire which destroyed the motor home.

One approach that would prevent the release of propane, should damage to the system occur, would be to close the valves on the tanks when the motor home is in transit, as recommended by the manufacturer in the motor home owner's manual. This would prevent the use of propane-operated appliances.

While the vehicle is in transit, the appliances could be operated on electrical current supplied by the motor generator or storage battery. The manufacturer of this motor home supplies a refrigerator that can be operated on propane, electricity from a motor generator, or low voltage from an automotive storage battery. It is technically possible to design other appliances to have the same electric/gas options. Propane could be used during stops, when it might not be desirable to use a motor generator or to use storage batteries which deplete quickly.

Another way to operate the appliances safely would be to insure an automatic shutoff of the propane should the supply system be damaged in any way. Such a system would allow the use of propane to operate appliances, but should the tanks become detached from the vehicle or the gas service lines become severed, a fail-safe valve ^{4/} on the propane tank would shut off the flow of gas.

^{4/} Fail-safe valves and quick disconnect valves have been developed for use on military aircraft fuel systems. These valves separate and seal under crash loads. The purpose of these valves is to prevent rupture of the fuel tank, hoses, or fitting components by placing a "safety fuse" in the load path. See USAAMRDL Technical Report 71-22, Crash Survival Design Guide, revised October 1971, Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Virginia, p. 274.

If the tank were subjected to fire, eventually the safety relief valve would open to prevent an explosion; this would release propane and contribute to the fire. However, the time required for the relief valve to operate might be adequate for escape purposes. In this accident, two of the passengers were observed alive during the early stages of the fire. Additional escape time may have allowed them to free themselves or overcome the shock of their injuries or provide time for rescue. Had the fire been less intense, the rescuer who saw them might have been able to save them.

The recreational vehicle industry has construction standards (heating, plumbing, electrical, fire, and life safety) for recreational vehicles. ^{5/} Some of the standards specify requirements for the propane container valves, accessories, and safety relief devices. However, there are no requirements that apply to the stoppage of propane gas should the propane regulator or service lines become damaged. Therefore, it would be desirable for the recreational vehicle industry to effect safety improvements that would prevent utility fuels such as propane from fueling or feeding fires in accidents.

Securement of Recreational Vehicle Appliances

When the left front wheel of the motor home ran up and over the guardrail post, a lateral load was placed on the left side of the motor home. This force probably propelled the refrigerator out of its mounting and across to the right side of the motor home. After the accident, the top front of the refrigerator was deformed inward, which suggests that the damage occurred as the refrigerator was torn loose from its anchorage and hurled across the motor home. There is no evidence to indicate that the refrigerator came out of its wood mounting frame and fell against the bridge pillar as a result of the fire.

The facts of the accident illustrate why it is necessary to have appliances in recreational vehicles firmly anchored. First, detached appliances, because of their size, can block the main aisle of the motor home and prevent the escape of occupants. Second, they could cause incapacitating injuries, which also could prevent escape. Third, appliances should remain secured so they will not become detached from or damage their propane or electrical service lines. Propane could leak from a detached line and sparks from a damaged electrical line could ignite the propane and cause an explosion or a fire.

^{5/} Standard For Recreational Vehicles, Travel Trailers, Motor Homes, Truck Campers, Camping Trailers, National Fire Protection Association, (501C), Recreational Vehicle Institute (ANSI.A 119.2) and Trailer Coach Association, 1974.

The construction standards for recreational manufacturers states: "Every appliance shall be secured in place to avoid displacement." ^{6/} The appliances in the motor home involved in this accident met that standard because an individual could not pull the appliances free from their attachments and because they did not come free as a result of the vehicle's traveling down the highway. However, during the crash the refrigerator did come loose. The installation requirement does not specify how the appliances should be attached to the vehicle. Therefore, it is possible to meet the requirements by using several wood screws. This does not assure that appliances will remain in place during an upset or a crash.

Recreational manufacturers should examine various methods to secure appliances to recreational vehicles to ascertain the best methods.

Traffic Barriers

Apparently, contact with the guardrail had little effect on the subsequent path or deceleration of the vehicle. If the guardrail had been placed near the pier and flared away from the roadway as required by current standards, it is unknown what effect its design would have had in redirecting the vehicle away from the bridge piers.

CONCLUSIONS

1. There were no discernible mechanical defects in the motor home that would have caused the driver to lose control of the vehicle and drive off the road.
2. The driver apparently was having difficulty steering the motor home since witnesses saw it sway back and forth.
3. The driver was somewhat inexperienced in driving the motor home.
4. Although the driver stated that he braked before the vehicle hit the guardrail, physical evidence and witness testimony suggest that any braking was minimal.
5. The driver's and witness testimonies indicate that the driver was not looking forward while he changed lanes.
6. If the driver had changed lanes properly, the accident probably would not have occurred.
7. Had the driver and a passenger worn their seatbelts, they probably would not have been ejected and they might have been able to assist the other passengers to escape.

^{6/} Ibid.

8. The fuel for the initial vehicle fire was probably gasoline that escaped from the damaged fuel tank.
9. The ignition source for the gasoline fire could not be determined.
10. As a result of the impact, the propane tanks were displaced and the regulator and service lines became damaged; this resulted in the release of propane under pressure.
11. The absence of fail-safe shutoff valves on the propane tanks permitted the early escape of the propane, which contributed to the intensity of the fire.
12. The operation of propane-fed appliances in transit is unsafe because escaping propane could cause or contribute to a fire or explosion if the propane regulator or service lines become damaged.
13. The displacement of the refrigerator during the accident apparently trapped a passenger and possibly blocked the path of four passengers seated in the rear of the motor home, preventing their escape.
14. Better methods to secure appliances in recreational vehicles must be developed.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the accident was the driver's failure to change lanes properly. The failure of the driver and a passenger to use their seatbelts prevented them from remaining in the vehicle, where they might have been able to rescue other passengers. The escape of propane from the two disconnected gas tanks added to the intensity of the vehicle fire.

RECOMMENDATIONS

The Safety Board believes that the facts of this accident suggest the need for driver information about the hazards and potential hazards of recreational vehicles. In its Special Study, "Safety Aspects of Recreational Vehicles," the National Transportation Safety Board recommended that the National Highway Traffic Safety Administration:

1. Undertake a pilot program in cooperation with the Recreational Vehicle Industry Association to inform and educate purchasers and users of recreational-type vehicles regarding the hazards and potential hazards attending the use of such vehicles, and to provide positive guides to improving all aspects of safety in the use of such vehicles, through such means as organized public information programs, pamphlets, and manuals.

The Safety Board reiterates that recommendation.

In addition, the Safety Board submitted the following Safety Recommendations to the Recreation Vehicle Industry Association:

"Amend the Standard for Recreational Vehicles (A119.2) to require some method of assuring that the supply of propane be contained temporarily should the tank valves, regulators, or service lines become damaged.

"Conduct an engineering study through its membership to determine the best methods of securing appliances in recreational vehicles and amend the Standard for Recreational Vehicles (A119.2) to specify these methods.

"Conduct a safety campaign to emphasize to the occupants of motor homes the benefits of seatbelts, and urge manufacturers of motor homes to print information in the owner's manual stressing the benefits of seatbelts."

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ WEBSTER B. TODD, JR.
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

March 3, 1976

APPENDIX A

THE VEHICLE

The vehicle was a 6-passenger, D-24, Chieftain Model M40, 1972 Winnebago, with the following characteristics and equipment: Length, 24'5"; width, 7'9"; height, 10'1"; Dodge M-375 chassis; 159" wheel base; V-8/413-cubic-inch engine; 265 horsepower, 3-speed automatic transmission; power steering; automatic cruise control; power brakes; 12,000-BTU roof-mounted air conditioner; 5000-watt ONAN generator; tires, 7.50x17, 8-ply front and dual rear wheels; alternator, 60 amp/70 and 220 amp-hour batteries; twin gas tanks (63 gallon total); gross vehicle weight rating, 13000 lbs.; odometer reading at the time of the accident, 12,000. Six seatbelts were installed in the vehicle, one for the driver, one for the right front passenger, and four around the dinette table. Before the accident, the motor home was fueled with 63 gallons of gasoline and 80 pounds of liquid propane. The estimated loaded weight of the motor home was 11,240 pounds at the time of the accident.

APPENDIX B

GAS SYSTEM AND APPLIANCES

The propane gas system furnishes gas to the range, oven, water heater, furnace, and refrigerator. The tanks are installed in a vapor-tight compartment. Access to the compartment is by means of an exterior utility door that has vents in it. (A typical installation is shown in Figure B1.) The tanks are equipped with shutoff valves and a gas regulator. The regulator reduces the variable tank pressure to a constant outlet pressure of 6.35 ounces, which is the pressure at which the gas is fed to the appliance.

The main gas supply system consists of 1 1/2-inch-diameter black iron pipe from which 3/8-inch diameter copper tubing is connected to the appliances.

With respect to operating the gas system, the Winnebago Motor Home Owners' Manual for 1972 states: "In some states you cannot travel with valves open, or through long tunnels. We suggest you shut off the tanks while traveling."

Stove and Oven

The stove and oven utilize pilot lights which run continuously. The pilot lights can be turned off with the oven control dial, which shuts off the gas to both the oven and the top burners. The pilot lights were turned off at the time of the accident.

Gas Furnace

The gas furnace is controlled by a wall thermostat. The gas burner on the furnace relights automatically. The pilot light that ignites the burner is lit by an electric coil. The furnace was not in operation at the time of the accident.

Refrigerator

The gas/electric refrigerator is powered either by gas or a 110-volt electric heating element. The heat generated by the flame or the electricity circulates the coolant in vapor form up through the condenser, where it is changed to a liquid. The liquid flows down through the freezing plate or evaporator on its way back to the generator, completing the cycle. When the liquid passes through the freezing plate, it is again changed into a vapor by heat absorbed from the food and cabinet area.

APPENDIX B

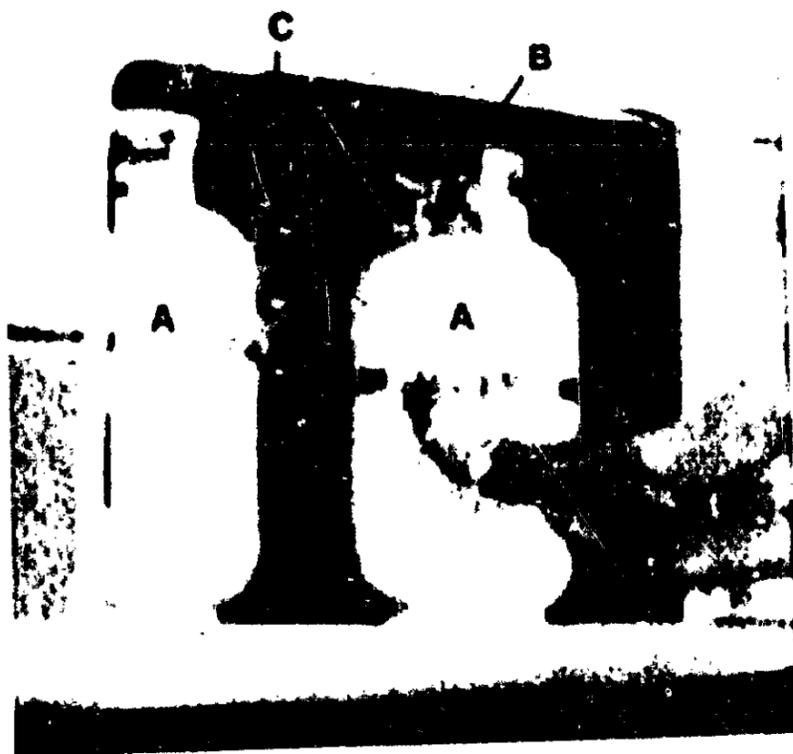


Figure B1. Typical LP-gas system installation
A - tanks B - hand valve C - regulator.

The pilot light on the refrigerator is located at the back of the unit and next to the side of the motor home. Access to the back of the refrigerator is by means of an outside utility door. The back of the refrigerator is vented to the atmosphere via the access door and a vent duct located near the top of the motor home. The owner's manual for 1972 cautions owners against the pilot light's being blown out and states: "The pilot light may blow out in strong sidewinds or as a result of the suction caused by passing vehicles."

Water Heater

The water heater can be operated by propane gas or a heat exchanger ("Motor-Aid") that transfers heat from the engine coolant system as the vehicle is driven. In the model of motor home involved in this accident, the water heater was of the heat exchanger type. When the vehicle's engine is off, the water heater operates on gas. Access to the water heater's controls is through a utility door outside the vehicle. With

APPENDIX B

regard to the operation of the unit, the owner's manual states: "The heater has not been designed for 'in motion' operations although it may work while the unit is moving along the highway. It is not uncommon for the pilot light to blow out."

Pilot Light Automatic Shutoff

Although the pilot lights of the various appliances may blow out, there is no danger of gas buildup because once a flame outage occurs, the gas to the pilot light is automatically shut off.

APPENDIX C

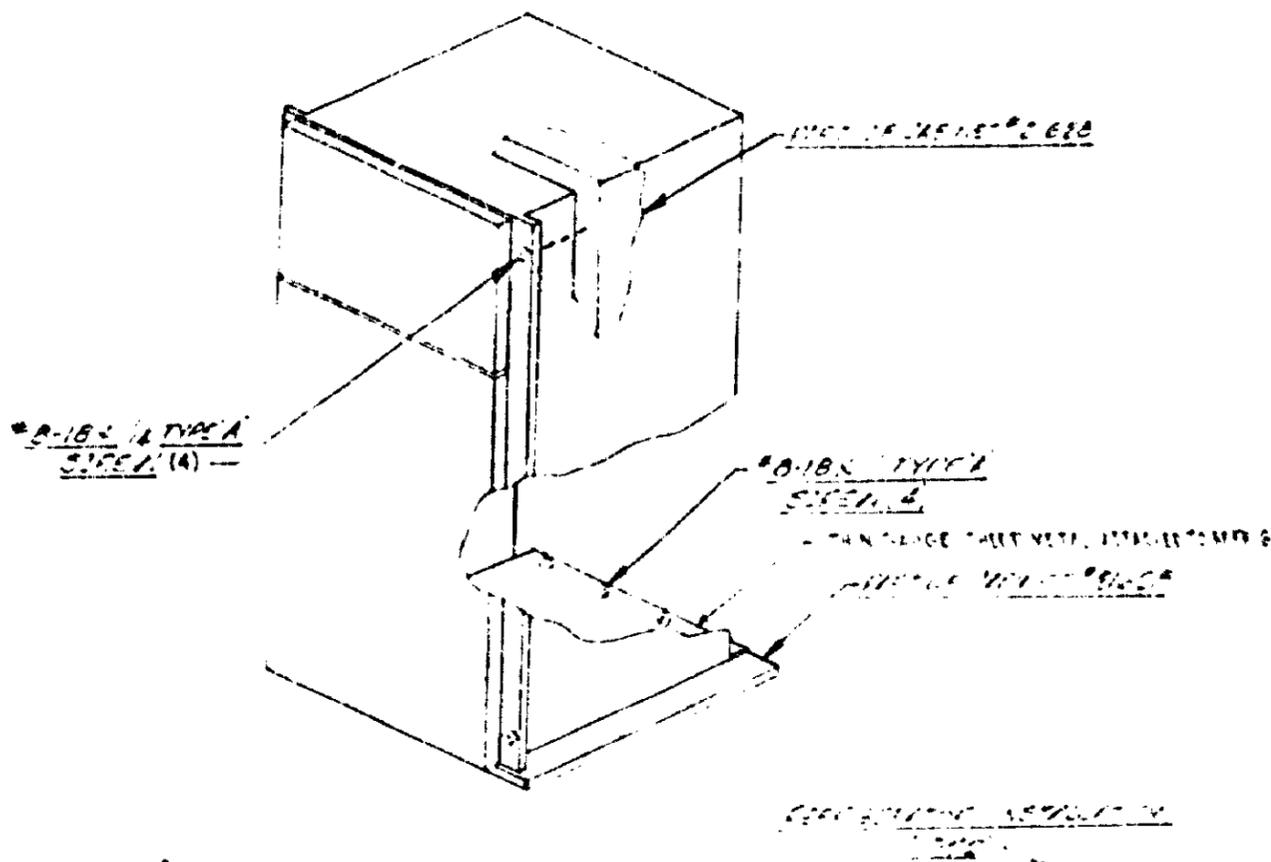
CONSTRUCTION DETAILS AND SECUREMENT OF MOTOR HOME APPLICANCES

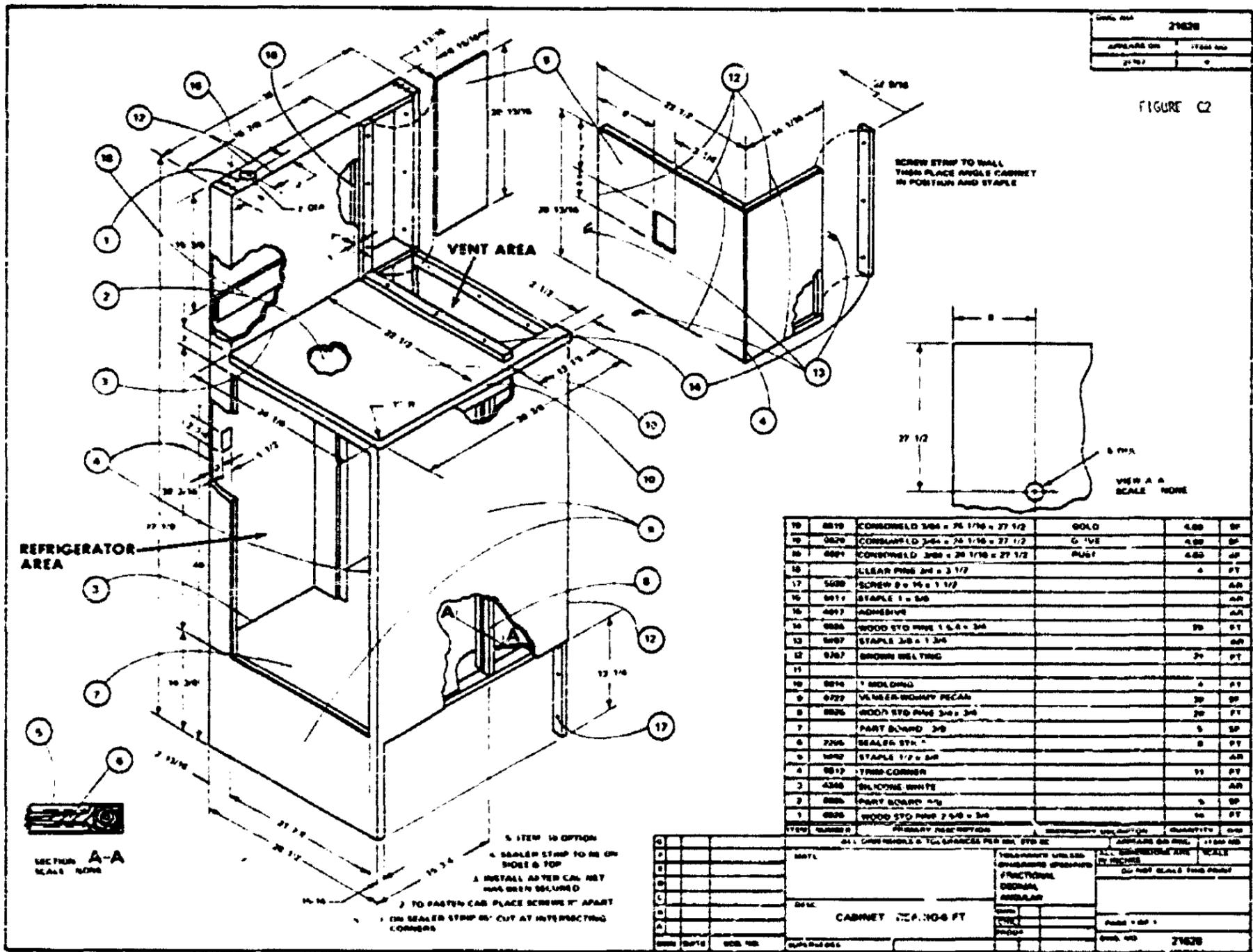
The refrigerator, stove, and sink in the motor home are contained within wooden cabinets which are constructed and installed by the manufacturer. The cabinets are attached to the interior of the motor home with wood screws.

The refrigerator cabinet is constructed so that the refrigerator is installed 14 3/8 inches above the surface of the motor home floor. The cabinet is attached to the motor home wall (plywood, styrofoam insulation inner panel and aluminum exterior skin) with a series of #8 15 by 1 1/2 inch screws. The front of the refrigerator is fastened to the cabinet with 4 #8 18 by 1/4-inch type "A" screws driven into the 3/4-inch wood frame. The base of the refrigerator is attached at the rear with 4 #8 18 by 1-inch type "A" screws driven through their gauge sheet metal attached to the refrigerator and into a 3/8-inch wood particle board. (See Figure C1. and C2.)

The cabinet for the stove and the sink is secured to the wall of the motor home with a series of #10 12 by 1 1/2-inch Phillips pan head screws. The base of the stove is attached to the cabinet with 4 #8 18 by 1 1/2-inch type "A" screws. The top of the stove is fastened to the wall of the motor home by means of a 1-inch by 2-inch by 10-inch metal bracket. The bracket secures the top of the stove to the wall by means of 11 #12 14 by 3/4-inch type "A" screws.

FIGURE C1





APPENDIX C

APPENDIX D

ADDITIONAL VEHICLE DAMAGE

-The rear bathroom apparatus was damaged by the fire and many portions melted.
-The driver's seat was still attached to the wood floor. Fabric and cushions were missing. The back of the seat was deformed forward and the entire assembly was loose at the floor mounting. Seatbelts were burned.
-The right front passenger's seat was dislodged from the floor anchoring and was burned. The back of the seat was deformed rearward almost to the full reclining position.
-The steering shaft had separated from the universal coupling of the manual steering gear case.
-The U-channel frame rail was damaged from the front bumper rearward to the transmission mounting brackets. The right front crossmember was twisted torsionally along its longitudinal axis. The left side lower flange was twisted near the spring hanger and was bowed 6 inches behind the spring hanger located on the ladder frame.
-The right front spring hangers were sheared off. The main leaf of the right front spring was buckled behind the center bolt near the rear spring hanger. Both U-bolts were fractured near at the angle bends. All rubber mounts and seals were destroyed by fire. The right side of the front axle was bent to the rear. The left front spring shackle was bent to the outside of the frame.
-The right rear spring shackle was broken.
-The 3/4-inch diameter hole in the shim plate, located between the right front leaf springs and front axle, was elongated.
-The Y-header pipes were separated from the front of the muffler.
-The auxiliary fuel tank had broken fuel lines.