



# National Transportation Safety Board

Washington, D. C. 20594

## Safety Recommendation

LDGH-0538E

Date: November 29, 1989

In reply refer to: H-89-45

Honorable Thomas D. Larson  
Administrator  
Federal Highway Administration  
Washington, D.C. 20590

On August 13, 1985, a 1981 GMC Astro two-axle, 130-inch wheelbase truck tractor, was southbound on U.S. Highway 81 near Decatur, Texas, pulling two empty 27-foot van trailers. The combination unit was operated by Whitfield Tank Lines, Inc., of Phoenix, Arizona. The combination unit, traversing an approximate 3-percent downgrade at a driver-estimated speed of 60 mph on a straight section of wet roadway, approached the tangent point of a vertical curve, when the driver reduced pressure on the throttle. The tractor, being operated with a three-stage Jacobs engine retarder<sup>1</sup> set at its maximum efficiency position, began an immediate clockwise rotation. The combination unit rotated right approximately 120°, left the roadway from the right shoulder, skidded across the gravel and grass roadside material, and dropped into a depressed concrete drainage structure. From the drainage structure, the tractor continued for 160 feet, rose about 20 feet up a dirt embankment, and finally came to rest facing north. The semitrailer remained upright throughout the sequence. The rear trailer, attached to the semitrailer by a converter dolly, tracked along the side slope of the embankment and overturned on its left side.<sup>2</sup>

The accident resulted in serious injuries to the unrestrained driver. The tractor received substantial damage while moderate damage was noted at the rear and right side of the semitrailer. The converter dolly was twisted due to the overturn, and the rear trailer was moderately damaged.

<sup>1</sup>An engine retarder uses the engine itself to aid in slowing and controlling the vehicle. When activated, the engine retarder alters the operation of the engine's exhaust so that the engine works as a power-absorbing air compressor; however, this provides a retarding action only to the tractor drive wheels. The engine retarder is not a substitute for the service braking system. The vehicle's service brakes must be used to bring the vehicle to a complete stop. This then results in retarding action only on the tractor wheels and can unbalance the linear direction of the tractor-trailer combination.

<sup>2</sup>Highway Field Report--1981 GMC Astro Jackknife and Loss of Control, near Decatur, Texas, August 13, 1985 (NTSB-FTW-85-H-TR38).

The National Transportation Safety Board noted that the tire travel paths of the highway appeared to be extremely polished. The Texas Department of Highways and Public Transportation indicated that U.S. Highway 81, in the general accident area, had an average skid number of 20 in the outside lane. Skid numbers for the individual wheel paths in the outside lane were not available. There were no "Slippery When Wet" warning signs in the accident area. Additionally, a light rain had just begun falling minutes before the accident; local weather records indicated that this was the first rain in over 40 days. Consequently, the polished pavement was even more slippery under these circumstances. A postcrash inspection of the GMC tractor showed that its tires had adequate tread depth and the proper tire pressure.

According to the driver, the first sign of instability was a fast and immediate jackknife just as he released pressure from the throttle. The driver stated that he did not use the tractor service brake at any time. This statement was supported by a witness, traveling behind the combination unit, who stated that he never saw any brake lights illuminate on the combination unit. Additionally, there were no indications of brake application found on the travel surface of the roadway, the shoulder, or the roadside material.

Safety officials at Whitfield Tank Lines, Inc., stated that the company maintained no policy, either written or verbal, that dictated the use of retarders under varying road conditions. The driver in this accident stated that it was his personal policy to operate the engine retarder at its maximum power setting all of the time--under all conditions of loading and in all weather conditions.

The Jacobs Manufacturing Company (the maker of the engine retarder) lists several cautions about retarder operation under slippery or wet road conditions in their Professional Driver Techniques and Owner's Manual. The major caution, with respect to the retarder's operation on slippery surfaces, warns that the driver should not use the retarder until he is sure that his truck is maintaining traction without its use, and then to use the lower power settings on the retarder. Progressively higher power settings should not be used until it is established that the vehicle is maintaining traction in the lower settings. The manual warns, "If the tractor drive wheels lock or there is a fishtail motion, immediately turn off the master switch and don't turn the Jake Brake on until road conditions improve."

There was no evidence to indicate that the truck driver involved in the accident near Decatur, Texas, ever had access to a Jacobs engine brake manual.

In another directional control accident on Interstate Highway 20 near Mineral Wells, Texas, on April 3, 1986, a similar problem of engine retarder misuse occurred.<sup>3</sup> In this accident, a 1981 cab-over-engine Freightliner was pulling an improperly loaded (90 percent of the load weight was on the trailer axles), two-axle semitrailer west on I-20 during heavy rainfall. The combination unit was traveling at a driver-estimated speed of 55 mph when the unit traversed an area of irregular pavement surface, jackknifed out of control, and overturned. Again, it was discovered that the driver was operating his three-stage Jacobs engine retarder in its maximum efficiency setting.

<sup>3</sup>Highway Field Report--1981 Freightliner Jackknife and Overturn, near Mineral Wells, Texas, April 3, 1986 (NTSB-FTW-86-H-TR09).

On May 5, 1986, a different type of truck accident occurred near Boulder, Colorado, that involved a different type of misuse of the Jacobs engine retarder.<sup>4</sup> A 1976 conventional Kenworth tractor was pulling a loaded 40-foot tanker semitrailer in mountainous terrain on State Highway 119. The driver was traversing an approximate 6-percent downgrade in fifth gear at 30 to 35 mph. At some point in the descent, the driver failed an attempted downshift, stalled the engine, and left the transmission in neutral. The unit sped out of control, drove through a guardrail, and fell 35 feet before coming to rest in a creek bed. The tractor and tanker semitrailer were destroyed, and the driver received moderate injuries.

The driver stated to the Safety Board that he attempted to shift gears without using the clutch. This procedure allowed the engine rpm to slow, and when he released the throttle pressure, the engine retarder stalled the engine. The driver further stated that his motor carrier had instructed him to use this procedure when shifting gears. The Safety Board contacted the General Manager of McDonald Farms/Liquid Waste Services, Inc., of Longmont, Colorado, and found that this shifting procedure was required of all employees.

The Jacobs Manufacturing Company's *Jacobs Engine Brake Owner's Manual* explicitly prohibits this procedure stating, "Under no circumstances should the Jake Brake be used for gear shifting."

In 1982 and 1983, the National Highway Traffic Safety Administration (NHTSA) sponsored research that was performed by the Transportation Research Institute of the University of Michigan.<sup>5</sup> This research explored the influences of retarder torque on directional control on slippery pavement. In summary, the findings of this study indicate that drivers of retarder-equipped vehicles should be informed that they may avoid potential control problems by turning off their retarders when operating empty or lightly loaded vehicles on roads that are either icy or slippery when wet. Moreover, the experimental portion of this research was performed by a test driver who had experience in heavy truck braking experiments on slippery surfaces. In the experiments, this driver could not recover from the rapid jackknives that occurred on a slippery surface in an empty vehicle during turning maneuvers when decelerating with the engine retarder.

The research showed that a single-axle tractor, equipped with an engine retarder and pulling an empty trailer, developed a retarding force equal to approximately 20 psi brake application. A three-axle tractor, equipped with an engine retarder and pulling an empty trailer, developed a retarding force equal to approximately 10 psi brake application.

While the Safety Board recognizes the safety and economic benefits that can result from the proper application and use of retarders, the Board has two areas of concern regarding these accidents. First, the circumstances of these accidents indicated that the drivers were not provided with a manufacturer's operating manual by their employers. The motor carriers have not established operating procedures consistent with the warnings from Jacobs about possible loss of directional control on slippery pavement if the retarder is not used properly. In some

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<sup>4</sup>Highway Field Report--1976 Kenworth Ran Off Road and Overturned, near Boulder, Colorado, May 5, 1986, (NTSB-DEN-86-H-TR12).

<sup>5</sup>Retarders for Heavy Vehicles: Phase III Experimentation and Analysis; Performance, Brake Savings, and Vehicle Stability (DOT HS 806 672).

instances, as in the Boulder, Colorado, accident, the motor carrier has established operating procedures that are in direct conflict with the explicit instructions in the *Jacobs Engine Brake Owner's Manual*.

Second, the Safety Board is concerned that the owner's manuals of the other leading manufacturers of engine brakes do not include information relating to single- versus twin-drive axle operational characteristics with regard to directional stability on wet surfaces with an empty trailer.

Although the *Jacobs Engine Brake Owner's Manual* does provide an effective warning on discontinuing the use of the retarder when fishtailing occurs in a loaded vehicle, it does not make a more pronounced warning about using the retarder on a slippery surface in an empty truck. It also does not explain how a single-drive axle tractor could be more at risk with these instabilities. The owner's manual of the Cummins Engine Company, Inc., C-Brake and the owner's manual of the Mack Truck, Inc., Dynatard engine brake also do not make such warnings.

However, the Jacobs Manufacturing Company indicated that it had obtained permission from the NHTSA to reprint its booklet entitled *A Professional Truck Driver's Guide on the Use of Retarders*.<sup>6</sup> In this booklet, truck drivers are warned to turn the retarder off when operating empty on wet pavement or when bobtailing.

Additionally, the Jacobs Manufacturing Company and the Cummins Engine Company, Inc., manufacturer of the C-Brake, an engine brake with similar retarding power, provide a warning placard on the use of the engine retarder with each unit they sell.

The Safety Board believes that in an empty single-drive axle tractor on a slippery road, the jackknife can occur quickly, and operational techniques described in the current engine brake manufacturer's owner's manual on a slippery surface are inadequate. The manuals instruct a driver to discontinue use only after he has experienced a loss of traction or fishtailing motion. The Safety Board believes that adherence to these instructions could result in a jackknife accident.

To prevent these types of accidents, the Safety Board believes it is imperative that drivers have adequate warnings to remind them not to use the engine retarder when operating an empty vehicle on a slippery surface, and not to use the engine retarder as a means of shifting gears.

Therefore, the National Transportation Safety Board recommends that the Federal Highway Administration:

Include in the commercial driver's license testing procedures questions regarding the proper operation of engine retarder systems. (Class II, Priority Action) (H-89-45)

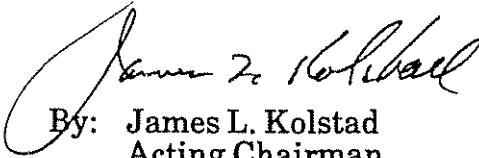
Also, as a result of these investigations, the Safety Board issued Safety Recommendations:

H-89-38 to the National Highway Traffic Safety Administration;  
H-89-39 to the Professional Truck Drivers Institute of America, Inc.;

<sup>6</sup>DOT HS 806 675, January 1985.

H-89-40 and -41 to the International Brotherhood of Teamsters;  
H-89-42 and -43 to the American Trucking Associations, Inc.; and  
H-89-44 to the engine retarder manufacturers.

KOLSTAD, Acting Chairman, BURNETT, LAUBER, NALL, and  
DICKINSON, Members, concurred in this recommendation.

  
By: James L. Kolstad  
Acting Chairman