



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 27, 2001

In reply refer to: H-01-01

Mr. Robert Shelton
Executive Director
National Highway Traffic Safety Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

In this letter, the National Transportation Safety Board recommends that action be taken to address a safety issue concerning the use of automatic brake adjusters in air-braked commercial vehicles, particularly the use of Haldex Brake Products Corporation (Haldex) automatic brake adjusters with failed control arms. The control arm design is essentially unique to Haldex. The Safety Board identified the issue during its investigation of a fatal accident involving a motorcoach. Safety Board investigators analyzed the dynamics of the accident through computer simulations. Although brake performance was not determined to be a causal factor in the accident, the performance of the automatic brake adjuster could have implications for other highway accidents. As a result, the Safety Board has issued five safety recommendations, one of which is addressed to the National Highway Traffic Safety Administration. Information supporting the recommendations is discussed below.

On December 24, 1998, about 10:35 a.m., eastern standard time, a 1992 Van Hool N.V. coach bus, operated by Bruins Transportation of Brooklyn, New York, was southbound on the Garden State Parkway near Old Bridge, New Jersey. The bus, which was carrying 22 passengers, was on a regular route from New York City to casinos in Atlantic City, New Jersey. According to police, the road was wet, and the temperature was close to freezing. When the busdriver tried to move to the left lane, he later said, he lost control. The bus rotated counterclockwise, departed the left side of the roadway, and overturned into an earthen ravine. Eight passengers were killed; the driver and 14 passengers were seriously injured.

The bus had automatic brake adjusters, also known as automatic slack adjusters. Slack adjusters, which link the air brake chamber to the service brake, adjust brakes as necessary to compensate for wear in the brake lining. Manual slack adjusters must be adjusted periodically by hand; automatic slack adjusters adjust automatically while the vehicle is in operation.

Figure 1 illustrates the automatic slack adjuster, which was manufactured by Haldex, on the accident bus. Figure 2 illustrates the relationship of a slack adjuster to the rest of the foundation brake system.¹

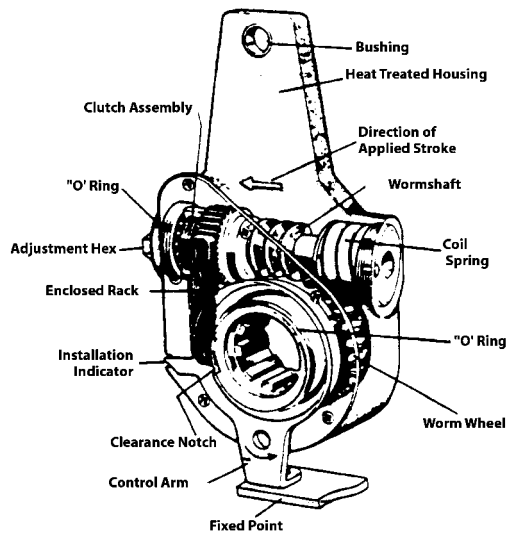


Figure 1. Automatic slack adjuster.

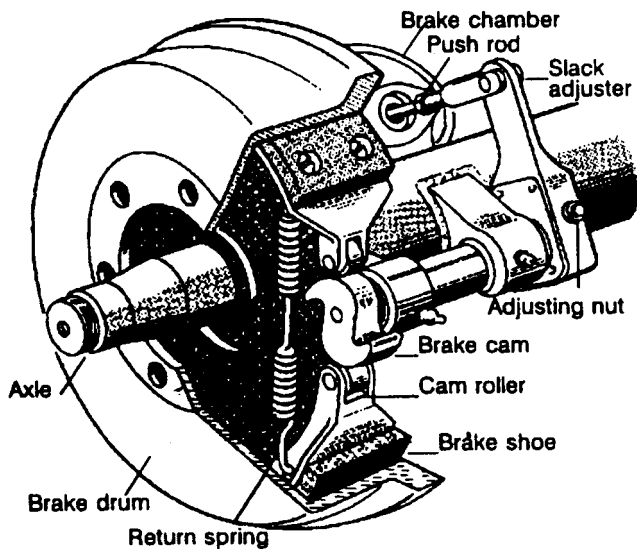


Figure 2. Foundation brake system.

¹ Air pressure from the brake chamber exerts force on the push rod. The push rod, through the slack adjuster, uses the force to rotate the brake cam shaft. The brake cam forces the shoes away from one another, pressing them against the inside of the brake drum.

Even though the accident vehicle had automatic slack adjusters, the postaccident inspection revealed a significant difference between the adjustment of the right- and left-side brakes on the drive axle. The right-side brake was grossly out of adjustment. The right brake shoes had only minimal contact with the drum. (An out-of-adjustment brake increases stopping distance and can cause a bus to rotate if the bus is suddenly braked.) The left-side brake was properly adjusted. Such a disparity was particularly surprising in this case because the brakes of the vehicle had been maintained and inspected less than a month before the accident.

Further examination of the right-side slack adjustment hardware revealed that the control arm had fractured. The pieces of the control arm were still in contact with each other, constraining the motion of the arm. Although investigators could not determine when the fracture had occurred, the wear pattern suggested that the fracture had been present for some time.

When an automatic slack adjuster has a fractured control arm, the adjuster no longer works automatically; it, like a manual slack adjuster, then requires periodic adjustment by hand. However, the adjustment of the right-rear brake on the accident bus had degraded much more rapidly than would be expected with a manual slack adjuster.

Safety Board investigators conducted follow-up testing at the Haldex corporate facility in Grain Valley, Missouri, to determine how a Haldex automatic slack adjuster performs when its control arm has failed. The investigators tested the right- and left-side slack adjusters from the accident bus. In addition, they tested a small sample of new and used Haldex slack adjusters.

The test fixture was configured to be similar to the axle on the accident bus and on other air-braked commercial vehicles. The control arm was detached and the slack adjusters were cycled, as they would be in normal service, with varying air application pressures. The investigators monitored the clearance between the brake lining and brake drum to gauge the level of brake adjustment. They also monitored push-rod stroke, a measure of brake adjustment, and performed numerous repetitive brake applications.

The investigators found that when the control arm is detached from an automatic slack adjuster:

1. Push-rod stroke increases with repetitive brake applications.
2. The rate of stroke increase is greatest when the application air pressures are higher, the application and release times are faster, the control arm is constrained in motion (as on the accident bus), and the internal spring force in the automatic slack adjuster has deteriorated.

These test results are of concern since frequent brake applications and the high air-pressure rapid cycling with antilock brake systems are common real-world conditions. Similarly, a fractured control arm could constrain motion at the fracture plane of the control arm. Additionally, the internal spring force on the Haldex adjuster could be modified in field service or could deteriorate over time due to fatigue. These conditions, in the event of a control arm failure, could lead to a loss of brake performance at the affected wheel.

The Haldex automatic slack adjuster has been used for over 10 years on a variety of commercial vehicles with air brakes. Through industry contacts, Safety Board staff understands that fractured control arms are often replaced as maintenance items. The Safety Board has not identified instances of such fractures in previous investigations, and how often control arms have failed or contributed to accidents is not known. In many situations, the failure of a control arm is not readily apparent. However, the Safety Board uncovered this problem in this investigation, duplicated the discrepancy during testing of the accident bus, and observed similar problems with other Haldex automatic slack adjusters that it tested.

Therefore, the Safety Board is concerned about brake deadadjustment, which is an acceleration of the rate at which a brake system goes out of adjustment, that can affect Haldex slack adjuster assemblies when the control arm is broken or disconnected. Consequently, the Board believes that Haldex should determine how to prevent brake deadadjustment caused by a fractured or disconnected control arm, distribute service advisories notifying users of this danger, and take appropriate measures to prevent brake deadadjustment.

In 1992, the Safety Board issued a study² that evaluated the effectiveness of air brake systems on large commercial trucks and buses. The data highlighted several problems. The most significant problem was the difficulty of keeping the air brakes of commercial vehicles properly adjusted. About 46 percent of the 1,520 large trucks inspected jointly by the Safety Board and the States were removed from service because their brakes were poorly adjusted.

As a result of the study, the Safety Board issued Safety Recommendation H-92-51 to the U.S. Department of Transportation. The recommendation asked the agency to expedite adopting a requirement that newly manufactured commercial vehicles with air brakes have automatic slack adjusters. The National Highway Traffic Safety Administration issued a final rule requiring the installation of such adjusters; as a result, on October 19, 1992, the Board classified Safety Recommendation H-92-51 "Closed—Acceptable Action." Although the Safety Board recognizes that automatic slack adjusters for commercial vehicles are a significant safety improvement, this accident demonstrates that the adjusters may not be fail-safe. Therefore, the Safety Board believes that the National Highway Traffic Safety Administration should monitor the progress of Haldex in correcting the brake deadadjustment caused by a fractured or disconnected control arm and ensure that Haldex takes appropriate corrective action.

Since rapid brake deadadjustment can occur when the control arm is fractured or disconnected, the Safety Board is concerned that the commercial vehicle industry and safety inspectors need to be alerted to this safety problem. This bus had received recent inspections; however, the failed control arm was not noticed. Because of the location of automatic slack adjusters, especially on motorcoaches, inspectors have difficulty observing the control arm. Therefore, the Board believes that the American Trucking Associations, Inc., through its Maintenance Council; the American Bus Association; and the United Motorcoach Association should urge their member companies, and the Federal Motor Carrier Safety Administration should advise all vehicle inspection personnel, to inspect all vehicles with automatic slack adjusters for fractured or disconnected control arms and inform them of the circumstances of this

² See National Transportation Safety Board, *Heavy Vehicle Airbrake Performance, April 29, 1992*, Highway Safety Study NTSB/SS-92/01 (Washington, DC: NTSB, 1992).

accident; the Commercial Vehicle Safety Alliance should also provide this advice and information to all State and local inspectors of commercial vehicles.³

As a result of its investigation, the National Transportation Safety Board makes the following safety recommendation to the National Highway Traffic Safety Administration:

Monitor the progress of Haldex Brake Products Corporation in correcting the brake deadadjustment caused by a fractured or disconnected control arm and ensure that Haldex takes appropriate corrective action. (H-01-01)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration; the Haldex Brake Products Corporation; the Maintenance Council of the American Trucking Associations, Inc.; the American Bus Association; the United Motorcoach Association; and the Commercial Vehicle Safety Alliance.

Please refer to Safety Recommendation H-01-01 in your reply. If you need additional information, you may call (202) 314-6170.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Carol J. Carmody
Acting Chairman

³ Enclosed is a copy of relevant sections from the group chairman's factual report of this accident.