

Log H-568



National Transportation Safety Board

Washington, D. C. 20594

Safety Recommendation

Date: October 23, 1992

In Reply Refer To: H-92-98 through -101

To the attached mailing
list

Throughout its 25-year history, the Safety Board has conducted in-depth investigations of hundreds of highway accidents involving commercial vehicles over 10,000 pounds. Prior to the fall of 1991, Safety Board investigators cited a wheel failure as the causal factor in only one fatal case.

Beginning in fall 1991, the Safety Board investigated a spate of five truck-wheel runoff accidents in which a total of seven people died. In the 3-week period alone between October 14 and November 4, 1991, three fatal heavy truck-wheel separation accidents occurred, including an accident in which the front left wheel broke off of a two-axle cargo van truck and careened into the path of an oncoming schoolbus carrying 46 fourth-graders and their chaperones. The 365-pound wheel slammed through the bus windshield, killing two children and a chaperone.

The seemingly high incidence of similar fatal accidents aroused public and Congressional concerns about the potential magnitude of the wheel separation problem. The Safety Board therefore initiated a 6-month special investigation in November 1991 in order to determine the magnitude of the wheel separation problem, the types and causes of failures, and the adequacy of current truck wheel inspection and maintenance guidance and procedures.¹

¹For detailed information, read Special Investigation Report--"Medium/Heavy Truck Wheel Separations" (NTSB/SIR-92/04)

Because the Safety Board had investigated only six fatal accidents that had resulted from wheel separations, we recognized that we did not have a sufficient database with which to perform a comprehensive analysis. To compile the data needed for this special investigation, the Safety Board researched numerous sources and worked with several transportation agencies, including the Federal Highway Administration's Office of Motor Carriers (OMC) and the National Highway Traffic Safety Administration (NHTSA). Study group members also surveyed the six States that maintain separate accident data on wheel defects and interviewed truck carriers, manufacturers, engineers, and mechanics.

The Safety Board found that no one data source was sufficient by itself to enable us to determine the leading causes of wheel separations. However, we believe that the databases examined showed similar patterns and, in combination, enabled us to identify the most probable causes of wheel separation. The Safety Board believes that the most common causes of truck-wheel separations are the loss or breakage of wheel fasteners and wheel bearing failure. Both result mainly from improper maintenance.

Wheel failures involving broken studs, lugs, or loose nuts most frequently result from the improper tightening of the nuts or failure to retighten the nuts after the initial seating of the fasteners. The Safety Board identified undertightening as the causal factor in its 1991 investigations of fatal accidents near Warrior, Alabama, and Marion, North Carolina. The OMC violation data and maintenance records provided by one of the nation's largest carriers support the Safety Board's findings that undertightening of fasteners results in most wheel separations. The carrier's maintenance records showed that 65 percent of the wheel separations that the company's fleet experienced resulted from undertightening and 20 percent resulted from overtightening. In addition, the OMC's MCSAP data shows that in commercial vehicle inspections conducted by the States, 40 percent of all wheel violations issued were for loose or missing nuts or studs. Stud hole elongation, which results when fasteners are loose during wheel use, was the third leading violation.

The Safety Board also interviewed representatives from several wheel manufacturers who stated that when company metallurgists had analyzed failed studs, they determined the failures had been caused by fatigue that most likely resulted from the improper tightening of wheel nuts by various service facilities.

During the course of this special investigation, the Safety Board found that wheel failures resulting from seized bearings also stemmed primarily from improper maintenance. In trucks requiring grease, the Board determined that bearing seizure usually resulted from lack of lubrication. In several cases, overloading a vehicle and installing the axle nut using either too much or too little torque resulted in bearing failure. The Safety Board identified bearing failure as the causal factor in both the Miami, Florida, and Greensboro, North Carolina, fatal accident investigations.

Wheel bearing manufacturers indicated to the Safety Board that improper adjustment is the most frequent cause of bearing failure/wheel separation. The industry uses different types of wheel bearing adjustment components, and adjustment procedures also differ. Use of the correct procedure for the components involved is essential.

Manufacturers and carriers indicated to the Safety Board that fewer wheel separations result from bearing failures now that most bearings on large truck wheels are lubricated with oil instead of grease; the oil is visible and also leaks. Still, most single-unit trucks (similar to those investigated by the Safety Board) are built with grease bearings on the front wheel. While seal material and grease have been

improved, such vehicles still require periodic maintenance and monitoring. During routine maintenance inspections, determining whether a greased bearing is dry is difficult without disassembling the hub. Carriers indicated that if an oil seal leaks, a visible spray pattern is usually easy to detect and corrections are made. In addition, for oil-lubrication bearings, checking oil levels in the hub's viewing glass is easier. However, some engineers warned that the tendency to place covers on wheels eliminates the opportunity to frequently check oil level, as well as the nut torque and rust streaks, and should therefore be discouraged.

Wheel separations due to bearing problems do not generally appear to involve the design or manufacture of the bearings. Since the 1970's, only two manufacturers' campaigns have involved more than 100 vehicles with bearing problems, and both of these occurred in the late 1970s. Lubricants, such as synthetic grease, are improving, and oil lubrication of bearings has apparently helped reduce the incidence of dry bearings. Some large carriers are re-evaluating greased bearings as advances are made in these areas. It is evident that improvements to reduce the incidence of failures must come in the maintenance and operation area.

The Safety Board found that numerous sources identified the failure to follow proper maintenance practices as the primary cause of improper tightening of wheel fasteners and bearing failure. The OMC surveyed 16 carriers who performed their own wheel maintenance and found that 9 admitted to not following manufacturers' procedures.

To determine what guidance was available to installers and maintenance personnel, the Safety Board looked at the manuals of several truck, wheel, and bearing manufacturers. Included in our review was the National Wheel & Rim Association's manual,² which contains safety information, operating procedures, and wheel and rim maintenance information for 12 of the nation's leading wheel manufacturers. The manuals all identified deficiencies and practices that could affect fasteners and bearings. However, the maintenance manuals were not uniform in content and presentation.

The Safety Board also determined from examining the manuals and from conducting interviews with manufacturers and motor carriers that the recommended inspection frequency for fasteners and bearings varied greatly among them. The Board found that industry has not adopted standard guidelines for replacing broken wheel studs. Few manufacturers call for bearings to be checked other than when the wheel is pulled. Wheels will be pulled less frequently in the future because most carriers are specifying outboard-mounted brake drums, which do not require that the wheel be pulled to change the brakes.

Because wheel bearing failures apparently are the second major cause of truck wheel separations, an industry-wide practice for properly maintaining bearings is needed. The Maintenance Council of the ATA sponsored a Wheel End Assemblies Task Force, which developed a "Recommended Practice" for the installation of wheels and wheel bearings and for axle nut adjustment. This practice covers assembly of the bearings on the spindle and tightening of the wheel nuts(s) to

²"Wheel & Rim Manual," National Wheel & Rim Association, Form W-770, 1992 Issue, September 1991. The manual contains recommended procedures for Accuride, Alcoa, Budd, Dayton Walther, Erie, Firestone, Goodyear/Motor Wheel, Gunite, Kelysey-Hayes, Redco, and Webb.

obtain the proper bearing end play. It calls for bearing adjustment of smaller tolerances that should help reduce some problems associated with overly loose axle nuts. However, the Recommended Practice, which was distributed to ATA's membership for final approval by September 1992, does not address intervals for checking bearings or lubrication. The Safety Board believes that ATA should also develop guidelines on bearing inspection intervals.

In summary, the Safety Board believes that to reduce wheel separations due to improper tightening and bearing failure, the wheel and truck manufacturers need to develop a comprehensive service manual that addresses all of the above areas and the manual should be disseminated to all involved in heavy-truck maintenance. The manual needs to address those maintenance procedures that are often not observed by mechanics, as well as uniform procedures on matters where conflict currently exists. Once this manual is available, the industry should launch an intensive training effort through manufacturers, carriers, media, truck stops, and repair facilities to highlight the need to follow recommended practices for mounting wheels.

During the course of this special investigation, several wheel manufacturers provided the Safety Board with torque specification labels which they now provide with their products. The labels show such information as tightening sequence, proper installation procedures, recommended inspection frequency, and warnings about the impact of incorrect torque. During the technical review of this special investigation report that was conducted with government and industry representatives, the Truck Trailers Manufacturers Association informed the Safety Board that all their manufacturers were placing specification labels on trailers. Most of the participants at the technical review contended that labels were beneficial because mechanics may not always refer to manuals. The Safety Board agrees that labels provide a good quick reference to or reminder of the torque required, the sequence for tightening nuts, and the need to periodically retighten fasteners. The Safety Board believes that all manufacturers should consider providing labels to place on trucks near the wheels.

Therefore, the National Transportation Safety Board recommends that the American Trucking Associations, in cooperation with the National Wheel & Rim Association, the Motor Vehicle Manufacturers Association of the United States, Truck Trailer Manufacturers Association, and the Society of Automotive Engineers:

Develop and disseminate model guidelines for the inspection and maintenance of all types of medium/heavy truck wheels. (Class II, Priority Action) (H-92-98)

Develop uniform recommended practices that specify how often truck wheel bearings should be examined. (Class II, Priority Action) (H-92-99)


Promote an educational program on proper wheel tightening procedures through carriers, manufacturers, and government. (Class II, Priority Action) (H-92-100)

Encourage manufacturers to provide a label on trucks that indicates the recommended torque for wheel fasteners, proper tightening sequence, and recommended frequency for retorquing fasteners. (Class II, Priority Action) (H-92-101)

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "... to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations H-92-98 through -101 in your reply

Also the Safety Board issued Safety Recommendations H-92-102 to the Federal Highway Administration and H-92-103 to the Department of Transportation.

VOGT, Chairman, COUGHLIN, Vice Chairman, and LAUBER, HART, HAMMERSCHMIDT, Members, concurred in these recommendations.


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