

Fire in Large Truck Crashes: Comparing Results from the Large Truck Crash Causation Study with FARS and NASS/GES Data

Rose M. Ray, Bruce E. Ketcham, Su-Wei Huang and Colleen Kelly
Exponent-Failure Analysis Associates

Copyright © 2008 SAE International

ABSTRACT

Fires originating in large trucks can be significant in terms of both the potential for personal injury or death and the potential for substantial economic loss of the vehicle and its cargo. This analysis examines the large trucks involved in fire incidents and the causes of the fires by examining the National Automotive Sampling System (NASS/GES), the Large Truck Crash Causation Study (LTCCS), and the Fatality Analysis Reporting System (FARS).

In this report we compare the rate of post-collision fire observed in these databases, analyze the reasons for differences in and describe the circumstances of large truck fires as reported in the LTCCS.

INTRODUCTION

Fires originating in large trucks can be significant in terms of both the potential for personal injury or death and the potential for substantial economic loss of the vehicle and its cargo. Large truck fires also present the risk of damage to the highway infrastructure and the resultant costs incurred due to significant traffic disruptions and/or in rebuilding the infrastructure. This analysis examines large trucks involved in fire incidents and the causes of the fires by examining three databases, which represent an increasing level of crash severity. Fire statistics for light trucks and passenger cars are reported as a comparison to large truck fire statistics.

The National Automotive Sampling System/General Estimates System (NASS/GES) [1] is a nationally representative sample of all police reported traffic crashes. It contains crashes of all levels of severity sufficient to warrant a police report. Property damage only, minor injury and fatal crashes are included. The

data is collected from police reports and includes large trucks as well as passenger vehicles (GES). The occurrence of vehicle fire is reported for large trucks in NASS/ GES if the fire is reported in the state police report. The rate of vehicle fire per crash involved vehicle, reported in NASS/GES is 0.49% for large trucks and 0.11% for passenger vehicles.

The Large Truck Crash Causation Study (LTCCS) [2, 3, 4, 5] was conducted for the Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA) at 24 data collection sites in 17 States from 2001 through 2003. It is a nationally representative sample of crashes with trucks with a Gross Vehicle Weight Rating (GVWR) greater than 10,000 pounds, which resulted in at least one injury or fatality. Data were collected on up to 1,000 elements in each crash. The data became available to the public in 2006.

Onsite investigations, interviews with witnesses and telephone interviews with motor carriers and surrogate drivers were used to collect the data. The Large Truck Crash Causation Study is based on a data collection project jointly conducted by the FMCSA and NHTSA. The mandate for the study was the Motor Carrier Safety Improvement Act that was passed by the U.S. Congress in 1999. The Act's goal was to determine the causes and contributing factors to commercial motor vehicle crashes and identify effective countermeasures.

Although the LTCCS contains some descriptive data similar to the primary national databases such as the Fatality Analysis Reporting System (FARS) and the General Estimates Systems (GES), it includes additional data on pre-crash factors such as driver fatigue and distraction, vehicle condition, weather, and roadway conditions. It provides substantially more data than other databases and the event is described in more detail. It

is the large truck analogue to the NASS Crashworthiness Data System (NASS/CDS).

During the nearly three-year study period from 2001 through 2003, data was collected on 970 crashes involving almost 2,300 vehicles, of which more than 1,100 were large trucks. Each crash involved at least one large truck with a gross vehicle weight rating of over 10,000 pounds which resulted in at least one serious injury or fatality; the injury or fatality involved either a large truck occupant, an occupant of another vehicle in the crash or a pedestrian or cyclist.

Onsite investigations were performed by a two-person team consisting of a researcher from NHTSA's National Automotive Sampling System (NASS) and a State truck inspector. The team collected a comprehensive description of the physical events, along with driver and vehicle information in each crash through crash scene investigations, interviews, and vehicle inspection. Data on approximately 1,000 variables were collected on each crash. Crash data were coded and then reviewed by FMCSA and NHTSA personnel and independent national truck crash experts.

The LTCCS file contains a lengthy narrative of each crash as well as the crash analyst's description of the critical events for each vehicle involved in the crash. This information provides insight into the cause and origin of fire in large truck crashes. A summary of the design of the LTCCS study and a description of its uses may be found in Hedlund (2006).

The estimated risk of fire in the LTCCS is 3.1% for large trucks and 2.0% for other vehicles involved in a crash with the large truck.

The Fatality Analysis Reporting System (FARS) [6] is a census of US traffic crashes on public roadways in which at least one death attributable to the crash occurred within 30 days of the crash. The data has been collected since 1975. Data from police accident reports and coroner's reports is collected by FARS analysts into a uniform format. The rate of fire per vehicle in a fatal crash is 6% in all large trucks and 3% for passenger vehicles.

These three databases represent an increasing level of crash severity in that NASS/GES is a nationally representative sample of all police reported crashes, the LTCCS is a nationally representative sample of large

truck crashes with injury, and FARS is a census of fatal traffic crashes.

METHODOLOGY

In each of the databases, NASS/GES, LTCCS and FARS, large trucks, passenger cars and light trucks were identified using the body type code for the database. Vehicles with unknown body type were excluded from further analysis. Large trucks include both medium and heavy trucks and are defined as vehicles with GVWR greater than 10,000 pounds.

Rates of vehicle fire were calculated for each vehicle type. Their rates were further subdivided according to whether the crash involved a single vehicle or multiple vehicles, whether there was a rollover and by direction of impact for non-rollover vehicles.

For databases restricted to injury (LTCCS) or fatal (FARS) crashes, fire rates were calculated for all vehicles in the database and for vehicles with an occupant injury (LTCCS) or fatality (FARS).

For databases collected through a cluster sampling method (GES and LTCCS), the SAS procedure SURVEYMEANS was used to calculate 95% confidence intervals for the fire rates. The Normal approximation to the Binomial was used to calculate the 95% confidence intervals for the FARS fire rates.

In addition to these basic statistical analyses, every crash narrative in the LTCCS was reviewed to verify that a large truck was involved in a fire and to characterize the types of fires observed. Corrections to the coding of large truck fires in LTCCS were made as necessary based upon review of the narrative.

RESULTS

NASS/GES – Data from the period 2000-2005 were used to calculate the rates of vehicle fire for large trucks, passenger cars and light trucks.

All crashes – The risk of fire is low for all types of vehicles. However, it is statistically significantly higher for large trucks than for passenger cars or light trucks ($p < 0.02$) (Figure 1.)

Risk of Fire in Police Reported Crashes All Crash Types

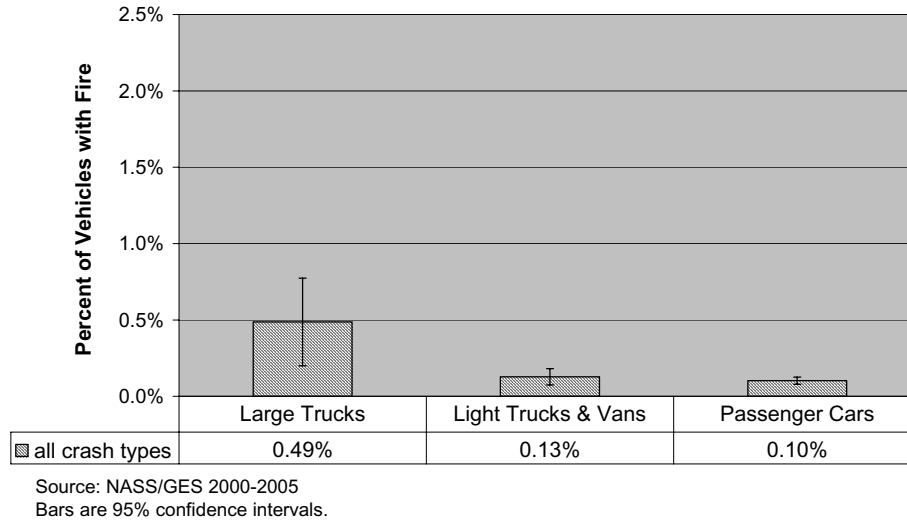


Figure 1: Risk of fire in crashes of all severities (NASS/GES).

Single Vehicle/Multiple Vehicle crashes – The risk of fire is substantially higher in single vehicle crashes than in multiple vehicle crashes. This is true for passenger cars and light trucks as well as for large trucks ($p < 0.03$). In multiple vehicle crashes, the risk of fire is statistically significantly higher for large trucks than for passenger

cars or light trucks ($P < 0.002$). This is not the case in single vehicle crashes; here the differences in fire rates between large trucks and passenger vehicles are within sampling variation ($P = .08$ for large trucks vs. passenger cars and $P = .15$ for large trucks vs. light trucks) See Figure 2.

Risk of Fire in Police Reported Crashes by Single vs Multiple Vehicle Crashes

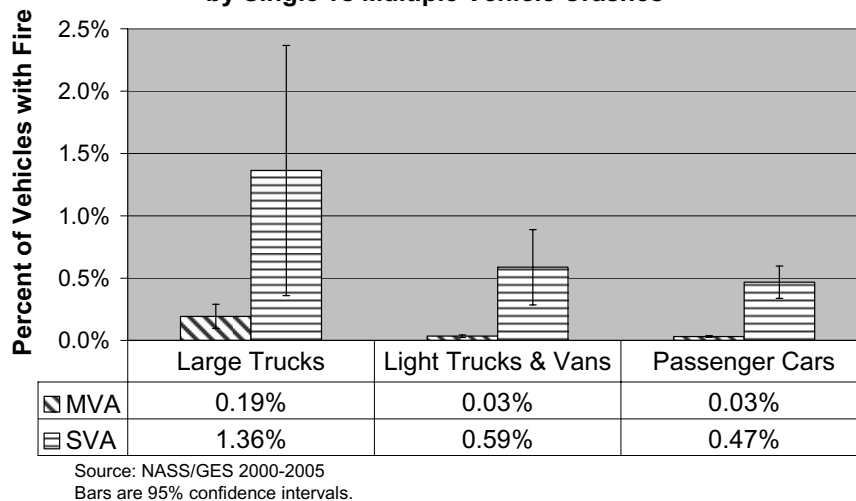


Figure 2: Vehicle fire rates in single and multiple vehicle crashes of all severities (NASS/GES)

Rollover & Direction of Impact – The risk of fire is statistically significantly higher in rollover crashes than in frontal, side or rear impacts. This is true for large trucks as well as for passenger vehicles ($p < 0.0001$). The risk of

fire is statistically significantly higher for large trucks than for passenger vehicles in frontal and rollover crashes ($p < 0.02$), but not in right, left or rear crashes ($P > .18$).