

Fire Occurrence in Side Crashes Based on NASS/CDS

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ABSTRACT

The basis for this analysis was NASS/CDS 1997 to 2006. In the NASS database there were 60 cases with major fires in side impact crashes, 37 of which were in passenger vehicles less than 10 years old. These newer vehicles were examined in this study.

Cases in NASS were examined to identify crash characteristics associated with major fires in side crashes. The database contained 22 cases with fatalities, eleven of which were coded as fire related. Three of these were associated with fires that did not originate from the crashed vehicle.

The fuel tank was coded as the fire origin for 41% of the major fires in vehicles with side damage and for 7 out of the 8 vehicles with fire related fatalities. The most frequent crash characteristic was an impact with a narrow object that produced severe side damage. Lower extent of damage was evident in two fatal cases that involved a rollover following the side impact.

INTRODUCTION

The research reported in this paper is an extension of the projects reported in earlier papers [Digges 2007 and 2008; Kildare 2006]. These earlier papers attempted to examine the characteristics of rollover and frontal crashes in which fires occurred. This paper examines the crash factors that are associated with fires that occur after side crashes.

This paper uses the (NASS/CDS) National Automotive Sampling System/Crashworthiness Data System data to examine the crash factors that are associated with crash induced motor vehicle fires. NASS/CDS is a sample of tow away crashes that occur on US roads each year. The sample is stratified by the severity of the crash. The sample rate for minor crashes is much lower than for severe crashes. In order to expand the stratified sample to the entire population it represents, an inflation factor is assigned to each case in the NASS/CDS sample. When the data is processed using the actual number of cases investigated, the data is referred to as "unweighted" or "raw." When the data is processed using the total of the inflation factors, the results should represent the total population of vehicles and the data is referred to as "weighted."

NASS/CDS classifies fires as either Major or Minor. These fire severities are defined as the following:

A Minor Fire is used to describe the following situations:

- Engine compartment only fire
- Trunk compartment only fire
- Partial passenger compartment only fire
- Undercarriage only fire
- Tire(s) only fire

A Major Fire is defined as those situations where the vehicle experienced a greater fire involvement and is used in the following situations:

- Total passenger compartment fire (fire limited to the passenger compartment)
- Combined engine and passenger compartment fire
- Combined trunk and passenger compartment fire
- Combined undercarriage and passenger compartment
- Combined tire(s) and passenger compartment

This paper deals only with major fires.

SUMMARY OF EARLIER ANALYSIS

A previous paper analyzed a national database of fatal crashes (FARS) to determine trends in vehicle fires with fatalities [Digges 2008]. The paper reported a general decrease in the fire rate over the past 20 years.

The Fatality Analysis Reporting System (FARS) is a database maintained by the US Department of Transportation. It contains records of all fatal crashes that occur on public roads in the United States. The FARS database has been used to document the variations in fatal injuries annually since 1975.

The FARS database documents all fatalities that occurred as a result of the crash including those where a fire resulted. The FARS coding designates the fatalities in which a fire occurred in the vehicle, regardless of whether or not the fire caused the fatality. FARS also codes the “most harmful event” (MHE). If the fire event has been coded as the most harmful event, burn or inhalation injuries are the most likely cause of the fatality. In many crashes, it may be difficult to discern the cause of the fatality (biomechanical trauma vs. fire trauma). This distinction was not investigated in this paper and the coding was taken directly from FARS.

Table 1 shows the distribution of fatalities in FARS years 2000 to 2005 where fire was the most harmful event. The distribution is broken down by the most severe crash direction and rollover is also identified if it occurred during the sequence of crash events. Side crashes are identified by the right and left damage areas. About 16% of the crashes with fire as most harmful event involved side crashes. Twenty nine percent of these crashes also involved rollovers.

The entrapment rate for FARS crashes with side damage and fire as the most harmful event was 21% for right side damage and 25% for left side. The overall entrapment rate was 23% [Digges 2008].

Table 1. Distribution of Average Annual Fatalities when Fire was Most Harmful Event by Crash Type and Damage Location – FARS 2000 to 2005

Damage Location	No Rollover	Rollover	Total
Non-Collision	2.1%	3.3%	5.4%
Front	45.8%	14.5%	60.3%
Right	5.8%	2.5%	8.3%
Rear	9.4%	2.0%	11.4%
Left	5.6%	2.1%	7.8%
Top	0.4%	1.4%	1.9%
Undercarriage	1.0%	0.6%	1.6%
Unknown	1.7%	1.7%	3.4%
Total	71.8%	28.2%	100.0%

Earlier studies of FARS have found that the rate of crash induced fires increases with vehicle age [Fell 2007]. The analysis by Fell indicates that fire rates in FARS crashes increases when vehicles age past about ten years. To reduce the influence of vehicle age, this paper analyzes cases of major fires in vehicles that were less than 10 years old and had side damage. The NASS years 1997 to 2006 were used. Consequently, the oldest vehicles in the side crash study would be 1988 models that crashed in the NASS year 1997.

NASS ANALYSIS OF SIDE CRASHES

A query of NASS/CDS 1997 to 2006 for major fires in side crashes (CDC damage R or L) produced 27 left side and 33 right side cases. Of these 60 cases 37 involved vehicles less than 10 years old.

In NASS, injury severity is coded using the AIS scale. This scale ranges from 1 to 6, with 1 representing a minor injury and 6 representing an injury so severe as to be fatal. Death can occur as a result of injuries with AIS scores lower than 6. However, the survival rate becomes much higher as the AIS number decreases.

Twenty-two of these cases involved fatalities. Eleven of the vehicles had fatalities coded as AIS 6 attributed to burns and without crash injuries more severe than AIS 4. Seven of the vehicles had fatalities that were attributed only to crash forces. Four cases with fatalities involved severe crash injuries with burns that may have contributed to the fatality.

Upon examining the 11 vehicles with fatalities attributed to burns, it was found that three cases involved crashes with fuel trucks or trailers. In these cases, the fire did not originate from the crashed vehicle. These three cases were eliminated from the analysis. The final population analyzed consisted of 34 vehicles, 19 of which contained fatalities and in 8 of the vehicles there were fatalities with the most severe injury coded as AIS 6 burns.