Analysis of Fire Occurrence in Automotive Crashes Using NASS CDS Data (1995 – 2004)

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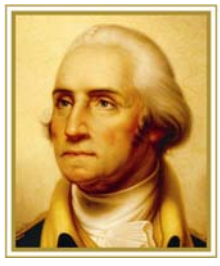

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ABSTRACT

This work is a continuation of a 2005 GW University study that investigated the occurrence of fire in automotive crashes on US roads. The earlier study analyzed data from NASS/CDS from 1994 through 2002 The present study uses NASS/CDS 1994-2004 and examines additional characteristics of crashes with fire involvement. A review of all fire related crashes, as well as specific analyses of rollover fires, fatal fires, underhood fires and fires with entrapment were performed. Tables of data present information on fire origin, tank location, body type, leak location, vehicle MAIS, entrapment, trip location, number of quarter turns and final rest position. Each variable is examined with respect to crash mode and fire occurrence. Some tables are also developed to investigate the relationship between selected variables. All weighted and unweighted tables of data are presented in the appendices.

INTRODUCTION

This work updates a study prepared in January 2005, which reviews the occurrence of fire in automotive crashes on US roads [Bahouth 2005]. That work concentrated on three main areas with concern to fire occurrences which were; development of an automated crash query tool, analysis of historical data, and performance of a literature review. This work will specifically address the analysis of historical data.

In the work by Bahouth, data from the NASS CDS database from years 1994 through 2002 was analyzed to determine what the characteristics were of recorded cases in which the occurrence of fire was prevalent. Data from the same source concerning the years 1994 through 2004 is analyzed in this paper.

The analysis presented here is divided into three main sections; development of the database, analysis of all fire cases, and investigation of subsections of data which have been shown to have a high prevalence of fire occurrence. Each subsection is further divided according to the specific crash characteristics investigated.

METHODOLOGY

The following sections will discuss the methods used in developing the data set, analyzing the main data set and finally analyzing subsets of the data which were indicated as requiring further investigation in the first analysis.

DATABASE DEVELOPMENT

The first phase of this work was to develop a database of NASS CDS cases which occurred on US roads during the years 1994 - 2004. This was performed using data sets provided by NHTSA on their website [NHTSA 2006]. This data was then compiled using SAS statistical software to compile a complete database of all cases.

Once the database of cases was developed, some further pre-processing of the data was necessary to develop a workable format. This analysis is based upon vehicle level data, however, some of the variables necessary had to be derived from an occupant level. For example, to determine if an entrapment had occurred in a vehicle, all occupant records for a given vehicle had to be examined and a new variable created which indicates if any occupant had been entrapped. As a result, the initial database was developed at the person level, and vehicle level variables generated based on this information. To process the data at a vehicle level, only those records of the driver were used, thus resulting in an analysis of all vehicles which had at least a driver in them included in the analysis.

The result of the above process is a vehicle level data set of vehicles involved in automotive crashes recorded in the NASS CDS database between the years of 1994 and 2004 which had at least a single occupant. Development of specific derived variables used in the analysis is discussed below.

DERIVED VARIABLES

This work is a continuation of that performed earlier by Bahouth, as such, some summary variables were previously defined which would be useful in analyzing the data. Variables such as Crash Direction, Vehicle

Body Type and Final Rest Position are not directly provided in the NASS CDS database. Below is a discussion of each of the derived variables used in the analysis.

Vehicle Body Type

In following the earlier analysis by Bahouth, a general variable of Body Type was developed by which to classify the types of vehicles involved in fires. The NASS CDS database does provide a variable for vehicle body type, however this was found to be too specific for the analysis at hand; instead a more general classification into the categories of Passenger Car, Pickup, SUV and Van was derived as shown below. A more detailed discussion of the effects of this generalization may be found later in this work.

Passenger Car - Passenger cars were determined to be any vehicle with the following listed as the original Vehicle Body Type:

- CONVERTIBLE
- 2DR SEDAN/HT/CPE
- 3DR/2DR HATCHBAK
- 4-DR SEDAN/HDTOP
- 5DR/4DR HATCHBAK
- STATION WAGON
- HATCHBACK DR UNK
- OTHER AUTOMOBILE
- UNK AUTO TYPE
- LARGE LIMOUSINE
- 3-DOOR COUPE

Pickup - Pickups were determined to be any vehicle with the following listed as the original Vehicle Body Type:

- AUTO BASE PICKUP
- LARGE UTILITY
- COMPACT PICKUP
- LARGE PICKUP
- PICKUP/CAMPER
- CONVERT PICKUP
- UNK PICKUP TRUCK
- CAB CHASSIS
- TRUCK BASE PANEL
- LT TRK MOTORHOME
- OTH LIGHT TRUCK
- UNK LIGHT TRUCK

SUV - SUVs were determined to be any vehicle with the following listed as the original Vehicle Body Type:

- COMPACT UTILITY
- UTILITY STAWAGON
- UTILITY UNK BODY

Van - Vans were determined to be any vehicle with the following listed as the original Vehicle Body Type:

- MINIVAN
- LARGE VAN
- STEP VAN <10K LB
- VAN BASE MTRHOME
- VAN BASED SCHBUS
- VAN BASED OTHBUS
- OTHER VAN TYPE
- UNKNOWN VAN TYPE

Crash Mode

One of the most significant variables in the analysis of fire occurrence is crash direction (mode); namely whether a crash is frontal, near side, far side, rear or rollover. Crash direction however is not a variable provided in the database but it is a combination of principal direction of force (PDOF), general area of damage (GAD1), Occupant Seating location (SEATPOS), and rollover (ROLLOVER). The following criteria were used to establish crash direction.

Frontal - Frontal crashes were determined to be any crash where the PDOF was 1, 11, or 12 o'clock or was at either 10 or 2 o'clock with the highest deformation location coded as front (F).

Side - Side crashes were determined to be any crash where the PDOF was 3 or 4 o'clock or was at 2 o'clock with the highest deformation location not coded as front (F) or a where the PDOF was 12 or 1 o'clock or was at 11 o'clock with the highest deformation location not coded as front (F).

Rear - Rear crashes were determined to be any crash where the PDOF was 5, 6 or 7 o'clock.

Rollover - Rollover crashes were determined to be any crash where a rollover was indicated by the variable ROLLOVER. It is important to note that crashes with any involvement of rollover were included as a rollover crash; hence multiple impacts with any other planar impact occurring first would also be included as a rollover crash. A classification of rollover indicates that a rollover event was involved in the crash at some point.

Other - All Crashes not meeting the criteria of the other aforementioned crash directions was labeled as 'Other.'

Number of Quarter-turns

Data from groups of four quarter-turns were aggregated and the results were reported as the number of complete revolutions.

Final Rest Position

A variable for final rest position was developed based on the coded number of quarter-turns. For this variable, the following final positions were established:

Side - A final rest position of side was determined to be when 1, 3, 5 or any odd numbers of quarter-turns occurred.

Roof - A final rest position of roof was determined when the number of quarter-turns were equal to 2, 6, 10 or any even number not divisible by 4.

Wheels - A final rest position of on wheels was determined to be when 4 quarter-turns, or any multiple of this number of quarter-turns occurred.

End-over-end - The determination of end over end is not necessarily a final rest position but was used to indicate those cases where an end-over-end roll was coded as having occurred. In these cases, no number of quarter-turns was provided. The final rest position was determined by reviewing the scene diagram and other information in the case documentation.

Unknown - A rollover case was listed as unknown when the variable for rollover was coded as '99' indicating unknown in the data set. Note that planar crashes were not included in this data set.

Explanation of other variables

As is the case with many databases, errors and variations in coding by individual investigators are to be expected. One common variation which was found was the coding of 'unknown' in different variables used in the analysis. Some investigators would code a case as 'unknown' while other would use '99' which is the equivalent code. As the analysis is discussed, an explanation of instances where such variable codes are grouped will be provided.

ANALYSIS OF ALL FIRE CASES

This first section of the analysis examines all of the fire cases which were retrieved from NASS CDS. In following the general outline of the Bahouth work, the tables discussed below will be presented. A brief discussion of the purpose of each table is also provided.

SUMMARY OF ALL FIRE OCCURRENCES

The table shows the summary of the complete data set after initial preprocessing as already discussed. In total over the 11 year period from 1994-2004, 631 fire cases were recorded in NASS CDS, representing 79,354 actual cases. The cases were approximately evenly distributed between minor and major fire occurrences (46% / 53%, unweighted).

CRASH MODE

This table shows the distribution of all fires cases using the 'Crash Direction' variable, explained earlier, to classify the mode of the crash. This table is used to indicate if a specific crash direction is more likely to involve a fire. There were a large number of vehicles for which crash direction could not be determined. This may be an artifact of taking every crash involved vehicle and / or not implementing an alternative means of determining crash direction when no PDOF is supplied in the data. It is also important to note that in CDS cases, many times the secondary vehicle is not inspected in time to properly code or not inspected at all which would also result in unknown data.

ORIGIN

This table shows the distribution of all fires cases using the fire origin to classify each crash. This table is used to indicate if a specific area of the vehicle is likely to be the source for a fire. In this analysis, 'other' and 'unknown' locations are not grouped in this analysis because a classification of 'other' implies that an origin was found.

TANK LOCATION

This table shows the distribution of all fires cases using the location of the tank to classify each crash. This table is used to indicate if a specific tank location is likely to be the source for a fire.

BODY TYPE

This table shows the distribution of all fires cases using the 'Body Type' variable, explained earlier, to classify the vehicle involved in each crash. This table is used to indicate if a specific vehicle body type is more likely to be involved in a fire. The assumptions described earlier regarding these classifications may have a significant effect upon the results indicated in this table. The current classification groupings were developed based upon the work by Bahouth however an analysis of several alternate groupings may be necessary to ensure that this analysis is correct (for example including 'LARGE UTILITY' in the SUV category instead of in the Pickup category).

FUEL LEAKAGE LOCATION

This table shows the distribution of all fires cases using the location of the leakage / or no leakage to classify each crash. This table is used to indicate both whether leakage is occurring in fire cases and if it is, what is the source.

VEHICLE MAIS

This table shows the distribution of all fires cases using the maximum AIS of the vehicle to classify each crash (VAIS). The VAIS of the vehicle is the maximum AIS score recorded from ANY occupant in the vehicle which was involved in the crash. This table is used to indicate if fire cases are contributing to more serious injuries. A breakdown is also provided according to minor or major fire classification to determine if a given level of fire occurrence is contributing more serious injuries.

Vehicle MAIS 2+ and MAIS 3+

A further breakdown according to VAIS 2+ and 3+ is also provided. VAIS 2+ differentiates between injuries coded as more or less than moderate in severity (AIS 2). Similarly, VAIS 3+ differentiates between injuries coded as more or less than serious in severity (AIS 3); this is the typical level at which crash data are analyzed.

ENTRAPMENT

This table shows the distribution of all fires cases using the occurrence of occupant entrapment to classify each crash. As mentioned earlier, the variable of entrapment indicates that at least one occupant of a vehicle was entrapped in some form.

This table is used to indicate if entrapment is occurring in the cases being studied. Further, a breakdown by major and minor fires is provided to examine if entrapment is more likely to occur in conjunction with a specific type of fire.

ANALYSIS OF ROLLOVER FIRE CASES

According to data published by NHTSA [NHTSA,2], rollovers accounted for only 3% of all crashes on US roads according to 2002 data. Examining the occurrence of fire in that same year, rollover accounted for 16% of fires using unweighted data. This disparity in contribution to all crashes and fire occurrence indicates that while frontal crashes happen often and as a result have more fires, it is more likely that a fire will occur given that a rollover has happened. A further discussion of the significance of rollover crashes may be found in the results section of this work. For now, suffice to say that a more detailed analysis of this crash mode was undertaken. This analysis was broken into two subsections; a rollover general analysis and a rollover specific analysis.

ROLLOVER GENERAL ANALYSIS

The first part of the rollover analysis was to perform something similar to that which was done for all fire cases. Rollover fire cases are analyzed by similar variables; summary of all occurrences, fire origin, tank location, vehicle body type, leak location, and MAIS.

Also, to provide a reference for comparison, each of the variables listed is also analyzed for the frontal crash mode alone. Given that the frontal crash mode is the most prevalent in all crashes as well as in fires; its distribution is assumed to be a stable baseline for comparison with the rollover crash mode. (Results from all crash modes may be found in the appendix of this report)

It should be noted that in all cases presented (unless otherwise noted), unweighted data is used to establish distributions given that at this level of detail the number of cases can be quite small and weighting factors can have a significant effect upon results.

The second part of the rollover analysis was to perform an analysis of those variables which would be specific to rollover cases. The following variables were analyzed in this section:

Trip Location

The location of force which initiated the rollover was used to classify rollover fire cases. This was performed to determine if a specific tripping mechanism was causing more fires than others.

Number of Quarter Turns

The number of quarter turns recorded was used to classify rollover fire cases. This was performed to determine if higher severity rollovers (more quarter turns) were causing more fires than others.

Final Rest Position

This table shows the distribution of rollover fires cases using the ‘Final Rest Position’ variable, explained earlier, to classify each crash. This table is used to indicate if a specific rest position is more likely to involve a fire.

ANALYSIS OF ROLLOVER ENGINE COMPARTMENT FIRE CASES

The first two analyses just described arrived at a particular finding which will be discussed later. That finding was that rollover involved crashes had the highest risk of fire occurrence. Also in both all fires and in rollover fires specifically, the engine compartment was the most likely location of fire origin; as a result of these facts, an analysis of the same form as that for rollovers in general was performed specifically targeting rollover crashes with engine compartment fires.

MISCELLANEOUS ANALYSES

In addition to the analyses undertaken in this work and just described, several smaller analyses were performed to understand the relationship between various factors. These smaller analyses include an evaluation of fires with entrapment, fatal fires, and finally an examination of the relationship between different variables (such as VAIS vs. Entrapment and Fire Origin vs. Crash Mode).

RESULTS

The results of each of the individual analyses described above will be presented in a similar fashion to that of the methodology section. The analysis of all fire cases is used to determine what the general characteristics are of cases with a high prevalence of fire involvement. The

specific analysis of rollover is a direct result of the investigation of all fires. The rollover specific analysis is conducted to provide some insight as to why fires may be occurring more often in rollover crashes. Finally the miscellaneous analyses provided are used to examine some of the relationships between the variables examine in the first two analyses.

ANALYSIS OF ALL FIRE CASES

The first analysis presented here is of all cases of fire occurrence recorded in NASS CDS between the years of 1994 and 2004. The tables to follow are unweighted data. Similar tables of weighted data are presented in the Appendix.

SUMMARY OF ALL FIRE OCCURRENCES

Distribution of All Fire Cases (NASS/CDS 1994/2004)				
Count	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Total Cases Recorded	290	335	6	71,101
Average Annual Cases	26	30	1	6,464

Table 1.1

Table 1.1 shows a summary of all fire cases which were recorded by NASS CDS as having occurred on US roads between 1994 and 2004. Fire occurrence is divided almost equally between minor and major fires (46% and 53% respectively). The average annual case counts and general distribution found are similar to that presented in Bahouth, 2005. In the 1994-2004 NASS there were an average of 57 annual fire crashes representing 7,214 crashes when weighted.

CRASH MODE

Distribution of All Fire Cases By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	172	170	2	32,001
Side	31	32	1	9,227
Rear	10	33	0	3,452
Rollover	68	70	2	7,846
Other	9	30	1	18,575

Table 1.2

Table 1.2 shows the distribution of fire cases by 'crash direction'. Using unweighted data, it was found that frontal crashes were the most prevalent type of crash with fire occurrence, comprising 55% of all fire cases. However this is not surprising given that frontal crashes are the most typical crash type recorded. What is more interesting is that crashes involving rollover contributed to 22% (unweighted) of fire cases while this mode is much less prevalent in terms of all crashes.

$$\frac{\text{(\# rollover fires) /(\# rollover fires+ non fires)}}{\text{(\# frontal fires)/ (\# frontal fires + frontal non fires)}}$$

Equation 1

When comparing the risk of fire occurrence between rollover and frontal crashes, it was found that rollover type crashes are roughly 1.6 times as likely to involve a fire based on unweighted data.

It was also observed that across almost all directions, the distribution of minor and major fires was approximately 50/50 with the exception of rear impacts which appear to show a prevalence of resulting in a major fire (77% of rear fires are major fires.).

FIRE ORIGIN

Distribution of All Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	7	27	6
Vehicle Exterior	7	8	0
Exhaust System	3	1	0
Fuel Tank	8	81	0
Engine Compartment	245	198	0
Cargo / Trunk Area	4	1	0
Instrument Panel	7	6	0
Passenger Area	2	4	0
Other Location	7	9	0

Table 1.3

Table 1.3 shows the distribution of fire cases by fire origin. It was found that the most frequent origin of fires is the engine compartment (70% of all fires unweighted). To put this in perspective, the next most frequent origin of fires was the fuel tank (14% unweighted).

It should be noted that many origins other than the engine compartment and fuel tank have few recorded case from which to draw any conclusions as to a prevalence to start a minor or major fire. However, it was noted that engine compartment fires were approximately evenly distributed between minor and major fires while fuel tank originated fires had a tendency to start major fires (91% unweighted, of all fires starting in the fuel tank were major fires).

TANK LOCATION

Distribution of All Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	5	20	3	15,829
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	74	85	1	11,154
Behind Rear Axle, Left Side	1	2	0	540
Behind Rear Axle, Right Side	3	2	0	472
Forward of Rear Axle, Centered	154	132	2	28,557
Forward of Rear Axle, Left Side	39	67	0	10,695
Forward of Rear Axle, Right Side	12	18	0	2,895
Over Center of Rear Wheels	2	5	0	751
Other	0	4	0	208

Table 1.4

Table 1.4 shows the distribution of fire cases by the location of the fuel tank. It was found that the most frequent tank location in fire crashes is centered, forward of the rear axle (46% of all fires unweighted). To put this in perspective, the next most frequent tank location was the centered, behind rear axle (25% unweighted).

It should be noted that many tank locations other than the most prevalent have few recorded case from which to draw any conclusions as to a prevalence to be involved in a minor or major fire. However, it was noted that the fire type for the three most frequent tank locations were approximately evenly distributed between minor and major fires.

The influence of weighting factors may be readily identified in this section of the analysis. As noted above, the centered, behind rear axle tank location was a prevalent location, however the distribution of minor / major fires actually switches between unweighted and weighted data (46% / 53% unweighted, 66% / 34% weighted). This example shows the effect of weighting factors, especially when applied to small populations of reported cases, as such when disparities are noted they will not be used to draw conclusions.

BODY TYPE

Distribution of All Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	214	213	5	49,210
Pickup	28	70	0	10,465
SUV	24	29	1	6,480
Van	24	23	0	4,941
Other	0	0	0	5

Table 1.5

Table 1.5 shows the distribution of fire cases by the vehicle body type; using the classifications described earlier in the methodology. It was found that the most frequent body type in fire crashes is passenger vehicles (68% of all fires unweighted). In Bahouth (1), this analysis was performed using a normalized count of crashes by comparing the number of vehicles involved in fire with the number of registered vehicles for a given body type; this step was not undertaken in this work.

While most vehicles types showed no prevalence for minor vs. major fire occurrence, it was noted that in fire cases with Pickups, major fires occurred 71% (unweighted) of the time when a fire occurred at all. The rate of fire was fairly uniform across all vehicle types.

FUEL LEAKAGE LOCATION

Distribution of All Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	20	84	3
No Fuel Leakage	256	157	3
Tank	5	40	0
Filler Neck	4	21	0
Cap	1	2	0
Line/Pump/Filter	3	13	0
Other	1	18	0

Table 1.6

Table 1.6 shows the distribution of fire cases by the fuel leakage location or if no leak was involved. It was found that the most frequent occurrence in fire crashes was for no leakage to be noted (66% of all fires unweighted). The tank and filler neck locations were the two next most frequent sources of leakage location (7% and 4% of all fires, unweighted, excluding unknown leakage location).

In general, when no leakage was recorded, fires were mostly minor (62% unweighted). However when leakage was noted, the prevalence for a major fire ranged from 67% to 89% (unweighted) depending on the location. The final conclusion from these finding is that when fuel leakage occurs (in 17% of all fires), a major fire is more likely to occur.

VEHICLE MAIS

Distribution of All Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	3	3	0	817
0	29	20	0	15,612
1	64	64	0	28,563
2	45	35	1	9,036
3	54	47	2	6,688
4	27	24	2	2,447
5	24	33	0	2,219
6	16	86	0	857
Injured, Unk Sev	28	23	1	4,862

Table 1.7

Table 1.7 shows the distribution of fire cases by the maximum AIS score recorded for any occupant in the vehicle (known as the vehicle MAIS or VAIS). There was no significantly prevalent level of injury associated with the occurrence of fires. All levels of injury were found to occur at roughly the same frequency, ranging from 8% to 20% unweighted). Similarly, other than fatalities, all injury levels appeared to be evenly distributed between minor and major fires. VAIS 6 injuries were found to be more prevalent in major fires (84% unweighted of all VAIS 6 in fires occurred in major fires).

<u>VEHICLE MAIS 2+ and MAIS 3+</u>

Using the data provided in table 1.7, a further investigation of the distribution of injuries when grouped into VAIS 2+ or 3+ categories was also performed. (VAIS 3+ indicating that one category included VAIS 0,1 and 2 level injuries while the other included VAIS 3,4,5 and 6 level injuries). It was found that VAIS 2+ injuries occurred in 63% of fires while VAIS 3+ injuries accounted for 50%.

Also, no prevalence was shown in either of these categories; with only a slight bias (60% unweighted) of MAIS 3+ injuries to occur in major fires.

ENTRAPMENT

Distribution of All Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	65	83	3	5,163
Not Entrapped	213	231	3	61,268
Unknown	12	21	0	4,670

Table 1.8

Table 1.8 shows the distribution of fire cases by the occurrence of entrapment. The most prevalent situation was that no entrapment occurred in conjunction with a fire (71% of all fires cases, unweighted). However, noting that entrapment of some form was occurring in approximately 24% of all fire cases while it is not as prevalent in crashes overall (7% of all crashes reported involved entrapment), may indicate that entrapment is more prevalent in cases involving fire.

It was also found that in all fire cases (with or without entrapment) prevalence for minor or major fires was not indicated.

ANALYSIS OF ROLLOVER FIRE CASES

The analysis presented here is of rollover cases of fire occurrence specifically. As noted earlier, a general analysis, similar to that conducted in the last section of this work, and a rollover specific analysis are presented here.

Results for the frontal crash mode are referenced to serve as a baseline for comparison with the trends observed in rollover. For conciseness, only rollover unweighted results are presented here. Rollover weighted and other crash mode results may be found in the appendix.

SUMMARY OF ROLLOVER FIRE OCCURRENCES

Distribution of Fire Cases By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	172	170	2	32,001
Side	31	32	1	9,227
Rear	10	33	0	3,452
Rollover	68	70	2	7,846
Other	9	30	1	18,575

Table 2.1

Table 2.1 shows a summary of all cases, by crash mode, which were recorded by NASS CDS as having occurred on US roads between 1994 and 2004. Fire occurrence is divided almost equally between minor and major fires in both the frontal and rollover crash mode.

FIRE ORIGIN

Distribution of Rollover Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	3	6	2
Vehicle Exterior	0	0	0
Exhaust System	1	0	0
Fuel Tank	3	23	0
Engine Compartment	53	38	0
Cargo / Trunk Area	1	0	0
Instrument Panel	2	3	0
Passenger Area	2	0	0
Other Location	3	0	0

Table 2.2

Table 2.2 shows the distribution of fire cases by fire origin. As observed earlier with all fire cases, the most frequent origin of fires in rollover is the engine compartment (65% unweighted). Also, note that the distribution of fire origin in rollover has a second relatively high occurrence rate for the fuel tank (19% unweighted). This second highest frequency of the fuel tank is not a trend found in frontal crashes by comparison. However, in side impact crashes there is this second peak for the fuel tank and in rear crashes the fuel tank is actually the most prevalent. The prevalence of fuel tank origin fires in rear impact crashes is logical since this is the crash mode which would most likely damage the tank directly. The similarity between side impact and rollover crashes having the fuel tank as the second most prevalent origin of fire indicates that similar damage patterns may be resulting from these two crash modes. An investigation of fuel tank fires in both side and rollover crashes may show this connection more clearly.

Rollover weighted data as well as other crash mode data may be found in the appendices.

TANK LOCATION

Distribution of Rollover Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	2	2	1	1,200
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	16	18	0	1,555
Behind Rear Axle, Left Side	1	0	0	72
Behind Rear Axle, Right Side	1	1	0	57
Forward of Rear Axle, Centered	30	27	1	2,447
Forward of Rear Axle, Left Side	15	18	0	1,975
Forward of Rear Axle, Right Side	3	1	0	450
Over Center of Rear Wheels	0	2	0	55
Other	0	1	0	35

Table 2.3

Table 2.3 shows the distribution of rollover fire cases by the location of the fuel tank. A similar distribution both to frontal crashes and to all crashes in general was found when examining rollover fire cases. The centered, forward of rear axle location was again the most prevalent location in fire occurrence. Similar to all fire cases, the forward of rear axle left side and behind rear axle centered were the next most frequent tank locations in fire cases.

Rollover weighted data as well as other crash mode data may be found in the appendices.

BODY TYPE

Distribution of Rollover Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	37	37	1	3,506
Pickup	13	17	0	1,960
SUV	10	12	1	1,809
Van	8	4	0	571
Other	0	0	0	0

Table 2.4

Table 2.4 shows the distribution of fire cases by the vehicle body type; using the classifications described earlier in the methodology. It was found that the most frequent body type in rollover fire crashes is passenger vehicles (54% unweighted). What is interesting to note is that Pickup, SUV and Van vehicle types have increased in prevalence, accounting together for approximately 46% (unweighted) of rollover fire cases, while they accounted for only 28% (unweighted) of all frontal crash fire cases.

Rollover weighted data as well as other crash mode data may be found in the appendices.

FUEL LEAKAGE LOCATION

Distribution of Rollover Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	8	19	1
No Fuel Leakage	53	31	1
Tank	2	5	0
Filler Neck	2	8	0
Cap	1	2	0
Line/Pump/Filter	1	3	0
Other	1	2	0

Table 2.5

Table 2.5 shows the distribution of rollover fire cases by the fuel leakage location or if no leak was involved. It was found that similar to the distribution in all fire cases, the most frequent occurrence in rollover fire crashes was for no leakage to be noted (61% unweighted). The tank and filler neck locations were also the two next most frequent sources of leakage location (5% and 7% of all fires, unweighted). However, their prevalence has increased with respect to all fire cases. In side impact crashes, leakage from the fuel tank is slightly more prevalent (17% of side impact fires have fuel tank leakage), and in rear impacts tank leakage is the most prevalent occurrence (28% unweighted).

It should be noted that the increase in occurrence of fuel leakage (from any location) in rollover fires as compared to its occurrence in frontal crash fires may be indicative of leakage being a problem associated with rollover type crashes. There is a noticeable increase in fuel leakage in all other crash modes from the frontal crash mode (frontal, 8% of fires had fuel leakage; side, 31%; rear, 49% and rollover, 19%)

Rollover weighted data as well as other crash mode data may be found in the appendices.

VEHICLE MAIS

Distribution of Rollover Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	2	1	0	47
0	3	2	0	573
1	9	14	0	2,880
2	13	9	1	1,432
3	13	13	1	1,146
4	9	6	0	596
5	8	8	0	542
6	4	11	0	194
Injured, Unk Sev	7	6	0	436

Table 2.6

Table 2.6 shows the distribution rollover fire cases by the maximum AIS score recorded for any occupant in the vehicle, or vehicle MAIS. Similar to the earlier analysis, there was no significantly prevalent level of injury associated with the occurrence of fires in rollover crashes. All levels of injury were found to occur at roughly the same frequency, ranging from 11% to 19% unweighted).

Rollover weighted data as well as other crash mode data may be found in the appendices.

MAIS 2+ and MAIS 3+

Using the data provided in table 2.6, a further investigation of the distribution of injuries when grouped into MAIS 2+ or 3+ categories was also performed. Results from these analyses showed similar results to that obtained for all fire cases. Suffice to say, no significant trend was found related either to injury level or fire severity.

ENTRAPMENT

Distribution of Rollover Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	20	14	1	1,057
Not Entrapped	45	51	1	6,397
Unknown	3	5	0	392

Table 2.7

Table 2.7 shows the distribution of rollover fire cases by the occurrence of entrapment. The most prevalent situation was that no entrapment occurred in conjunction with a rollover fire (69% of all fires cases, unweighted). Essentially, the same distribution was found as in the analysis of all fire cases.

It was also found that in rollover cases (with or without entrapment) prevalence for minor or major fires was not indicated.

Rollover weighted data as well as other crash mode data may be found in the appendices.

TRIP LOCATION

Distribution of Rollover Fire Cases By Trip Location (NASS/CDS 1994/2004)				
Trip Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	2	7	2	829
Wheels / Tires	25	30	0	4,048
Side Plane	7	3	0	808
End Plane	10	12	0	715
Undercarriage	14	13	0	643
Other Loc On Veh	0	0	0	5
Non-Contact Force	6	3	0	605
End-Over-End	4	2	0	193

Table 2.8

Table 2.8 shows the distribution of rollover fire cases by the location of the tripping mechanism. The most prevalent situation was when tripping was caused at the wheels / tires (39% of rollover fire cases, unweighted). The trip mechanism locations associated with the highest risk of fire occurrence were the undercarriage and end-plane locations, i.e. more frequently in these situations a subsequent rollover results in a fire.

NUMBER OF QUARTER TURNS

Distribution of Rollover Fire Cases By Number of Quarter Turns (NASS/CDS 1994/2004)				
Number of Quarter Turns	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Details Unknown	2	7	2	817
1	23	8	0	1,332
2	19	17	0	2,091
3	1	1	0	460
4	7	19	0	1,595
5	0	2	0	235
6	3	5	0	606
7	1	1	0	82
8	3	3	0	305
9	0	3	0	37
10	1	2	0	83
11	0	0	0	5
12	3	1	0	70
13	0	0	0	3
14	0	0	0	16
15	0	0	0	3
16	1	0	0	11
> 16	0	0	0	10
End-Over-End	4	1	0	85

Table 2.9

Table 2.9 shows the distribution of rollover fire cases by the number of quarter turns involved in the rollover. The most prevalent situation was when the vehicle completed at most one full roll (70% of rollover fire cases, unweighted).

FINAL REST POSITION

Distribution of Rollover Fire Cases By Final Rest Position (NASS/CDS 1994/2004)				
Position	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
> 16 Quarter Turns	0	0	0	10
End-Over-End	4	1	0	85
Roof	23	24	0	2,796
Side	25	15	0	2,157
Unknown	2	7	2	817
Wheels	14	23	0	1,981

Table 2.10

Table 2.10 shows the distribution of rollover fire cases by the final rest position of the vehicle after rollover. The most prevalent final rest position was on the roof of the vehicle (34% of rollover fire cases, unweighted). However it should be noted that the final positions of 'on wheels' and 'on side' were still contributing in major proportion to rollover fires (26% and 29% unweighted, respectively).

From a further review of the data, it appears that when the vehicle comes to rest either on its roof or wheels, the fire will likely be major (62% and 51% unweighted, of these situations respectively results in major fires) while if the vehicle comes to rest on its side the tendency is for the fire to be minor (63% unweighted).

ANALYSIS OF ROLLOVER / ENGINE COMPARTMENT FIRE CASES

The analysis presented here is of rollover cases with fires originating in the engine compartment. As noted earlier, a general analysis, similar to that conducted in the last section of this work, and a rollover specific analysis are presented here.

Results for the frontal crash mode are referenced to serve as a baseline for comparison with the trends observed in rollover. For conciseness, only rollover unweighted results are presented here. Rollover weighted and other crash mode results may be found in the appendix.

SUMMARY OF ROLLOVER ENGINE COMPARTMENT FIRE OCCURRENCES

Distribution of Engine Compartment Fire Cases By Crash Mode (NASS/CDS 1994/2004)		
Crash Mode	By Fire Type	
	Minor Fire	Major Fire
Frontal	157	134
Side	25	11
Rear	2	5
Rollover	53	38
Others	8	10

Table 3.1

Table 3.1 shows a summary of all frontal and rollover crash mode fire cases, with the engine compartment as the fire origin, which were recorded by NASS CDS as having occurred on US roads between 1994 and 2004. Fire occurrence is divided almost equally between minor and major fires in both the frontal and rollover crash mode.

TANK LOCATION

Distribution of Rollover / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	2	1
No Fuel Tank	0	0
Behind Rear Axle, Centered	12	10
Behind Rear Axle, Left Side	1	0
Behind Rear Axle, Right Side	1	0
Forward of Rear Axle, Centered	22	14
Forward of Rear Axle, Left Side	14	11
Forward of Rear Axle, Right Side	1	1
Over Center of Rear Wheels	0	1
Other	0	0

Table 3.2

Table 3.2 shows the distribution of rollover / engine compartment fire cases by the location of the fuel tank. A similar distribution both to frontal crashes and to all crashes in general was found when examining rollover fire cases. The centered, forward of rear axle location was again the most prevalent location in fire occurrence. Similar to all fire cases, the forward of rear axle left side and behind rear axle centered were the next most frequent tank locations in fire cases.

BODY TYPE

Distribution of Rollover / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	28	18
Pickup	10	10
SUV	8	7
Van	7	3
Other	0	0

Table 3.3

Table 2.4 shows the distribution of fire cases by the vehicle body type; using the classifications described earlier in the methodology. Similar to all fire cases and specifically frontal fire cases, it was found that the most frequent body type in rollover fire crashes is passenger vehicles (51% unweighted). What is interesting to note is that Pickup, SUV and Van vehicle types have increased in prevalence, accounting together for approximately 49% (unweighted) of rollover engine compartment fire cases, while they accounted for only 27% (unweighted) of frontal engine compartment fire cases.

Rollover weighted data as well as other crash mode data may be found in the appendices.

FUEL LEAKAGE LOCATION

Distribution of Rollover / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	8	10
No Fuel Leakage	41	22
Tank	1	0
Filler Neck	1	0
Cap	0	2
Line/Pump/Filter	1	2
Other	1	2

Table 3.4

Table 3.4 shows the distribution of rollover engine compartment fire cases by the fuel leakage location or if no leak was involved. It was found that similar to the distribution in the all fires case, the most frequent occurrence in rollover fire crashes was for no leakage to be noted (69% unweighted).This is an increase with respect to all fires and in comparison to all rollover fires which had a 61% occurrence of no fuel leakage.

Rollover weighted data as well as other crash mode data may be found in the appendices.

VEHICLE MAIS

Distribution of Rollover / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	2	1
0	2	1
1	6	9
2	10	6
3	9	7
4	8	2
5	6	6
6	4	2
Injured, Unk Sev	6	4

Table 3.5

Table 3.5 shows the distribution of rollover engine compartment fire cases by the maximum AIS score recorded for any occupant in the vehicle, or vehicle MAIS. Similar to the earlier analysis, there was no significantly prevalent level of injury associated with the occurrence of fires in rollover crashes. All levels of injury were found to occur at roughly the same frequency, ranging from 7% to 18% unweighted).

Rollover weighted data as well as other crash mode data may be found in the appendices.

MAIS 2+ and MAIS 3+

Using the data provided in table 3.5, a further investigation of the distribution of injuries when grouped into MAIS 2+ or 3+ categories was also performed. Results from these analyses showed similar results to that obtained for all fire cases. Suffice to say, no significant trend was found related either to injury level or fire severity.

ENTRAPMENT

Distribution of Rollover / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	16	7
Not Entrapped	35	30
Unknown	2	1

Table 3.6

Table 3.6 shows the distribution of rollover engine compartment fire cases by the occurrence of entrapment. The most prevalent situation was that no entrapment occurred in conjunction with a rollover fire (71%, unweighted). Essentially, the same distribution was found as in the analysis of all fire cases.

Rollover weighted data as well as other crash mode data may be found in the appendices.

TRIP LOCATION

Distribution of Rollover / Engine Compartment Fire Cases By Trip Location (NASS/CDS 1994/2004)		
Trip Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	1	2
Wheels / Tires	20	18
Side Plane	5	3
End Plane	8	4
Undercarriage	12	8
Other Loc On Veh	0	0
Non-Contact Force	5	2
End-Over-End	2	1

Table 3.7

Table 3.7 shows the distribution of rollover engine compartment fire cases by the location of the tripping mechanism. The most prevalent situation was when tripping was caused at the wheels / tires (42% of rollover fire cases, unweighted).

NUMBER OF QUARTER TURNS

Distribution of Rollover / Engine Compartment Fire Cases By Number of Quarter Turns (NASS/CDS 1994/2004)		
Number of Quarter Turns	By Fire Type	
	Minor Fire	Major Fire
Details Unknown	1	2
1	18	3
2	16	9
3	1	0
4	6	13
5	0	1
6	2	4
7	1	1
8	3	2
9	0	1
10	0	1
11	0	0
12	2	1
13	0	0
14	0	0
15	0	0
16	1	0
> 16	0	0
End-Over-End	2	0

Table 3.8

Table 3.8 shows the distribution of rollover engine compartment fire cases by the number of quarter turns involved in the rollover. The most prevalent situation was when the vehicle completed at most one full roll (74% of rollover fire cases, unweighted).

FINAL REST POSITION

Distribution of Rollover / Engine Compartment Fire Cases By Final Rest Position (NASS/CDS 1994/2004)		
Position	By Fire Type	
	Minor Fire	Major Fire
> 16 Quarter Turns	0	0
End-Over-End	2	0
Roof	18	14
Side	20	6
Unknown	1	2
Wheels	12	16

Table 3.9

Table 3.9 shows the distribution of rollover engine compartment fire cases by the final rest position of the vehicle after rollover. The most prevalent final rest position was on the roof of the vehicle (35% of rollover fire cases, unweighted). However it should be noted that the final positions of ‘on wheels’ and ‘on side’ were still contributing in major proportion to rollover fires (31% and 29% unweighted, respectively).

MISCELLEANEOUS ANALYSES

In addition to the major analyses described above, two other special analyses were undertaken as a separate group, analyzing the relationship between certain variables of interest. The first special analysis was of fire cases in which fatalities occurred. The second analysis concentrated on fire cases in which entrapment occurred. Finally, the other analyses are the relationship between MAIS (VAIS) and Entrapment and the relationship between Fire Origin and Crash Mode.

FATALITIES IN FIRE

This section of the work describes an analysis examining those cases of fire where a fatality was recorded. Specifically, the analysis examines the crash mode and fire origin with relation to fire occurrence. A third section examines the cause of the fatal injury.

Summary of Fire Cases Involving Fatalities

Distribution of Vehicle Fires with Fatality (NASS/CDS 1994/2004)				
Count	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Total Cases Recorded	59	127	1	4,454
Average Annual Cases	5	12	0	405

Table 4.1

In all, there were 4,641 vehicles in crashes in which a fatality was recorded as occurring. Of these 187 were associated with a vehicle involving fire. The data shows that fatalities in conjunction with fire typically occurred in major fires (67.9% unweighted).

Crash Mode

Distribution of Vehicle Fires with Fatality By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	26	60	1	1,550
Side	8	15	0	987
Rear	1	13	0	97
Rollover	22	21	0	1,246
Other	2	18	0	574

Table 4.2

Table 4.2 shows the distribution of fatalities in cases of fire by crash mode. Again as noted in the last section, across all modes, except rollover, fatalities show a prevalence to occur with major fires. It was found that the rear crash mode has the highest ratio of fatalities occurring in fires vs. those not occurring in fires. The frontal and rollover crash modes made up the largest percentages of all fatalities (35% and 27% respectively). These modes were also the largest contributors to the number of fatalities in fire involved crashes (47% and 23% respectively).

Fire Origin

Distribution of Vehicle Fires with Fatality By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	2	13	1
Vehicle Exterior	0	2	0
Exhaust System	1	0	0
Fuel Tank	2	42	0
Engine Compartment	51	64	0
Cargo / Trunk Area	1	0	0
Instrument Panel	2	0	0
Passenger Area	0	2	0
Other Location	0	4	0

Table 4.3

Table 4.3 shows the distribution of fatalities in cases of fire by fire origin. The engine compartment was again the most frequently occurring origin of fires, just as observed in earlier analyses. Another observation for table 4.3 is that fires originating at the fuel tank are also contributing to a large portion of the fatalities occurring in fire cases. This coincides with the earlier observations that fires originating in the fuel tank tend to be major fires and fatalities are associated with major fires.

Cause of Fatality

Distribution of Vehicle Fires with Fatality By Cause of Injury (NASS/CDS 1994/2004)		
Cause	By Fire Type	
	Minor Fire	Major Fire
Fire	2	67
Crash	54	44
Either	0	11
Unknown	3	5

Table 4.4

Table 4.4 shows the distribution of fatalities in cases of fire by the cause of the fatality. The cause was determined by a case by case review of each of the 187 cases of fatality in a fire involved crashes. When the fatality had fire listed as the cause in some manner, then the fatality was determined to be caused by ‘fire’. If the injuries were more related to crash forces (acceleration, contact, intrusion) then the fatality was deemed to be caused by the ‘crash.’ It is important to note that this analysis was done after a cursory review and is subject to the opinion of the analyst, others may draw different conclusions. The conclusions of ‘either’ or ‘unknown’ were used to indicate cases where the occupant had suffered such a mix of injuries or injuries were not listed clearly enough to indicate the direct cause.

Table 4.4 shows that more fatalities in fire cases were associated with the forces in the crash than with fire. When the fire was minor, more often the fatality was associated with the crash whereas in the major fire cases, the fatality was only slightly more likely to have been caused by the fire.

ROLLOVER AND ENTRAPMENT IN FIRE

This section of the work specifically examines the occurrence of entrapment in rollover fire crashes. From table 2.7 we can see that there were 35 rollover fire cases involving entrapment, 20 of which were minor fires while the other 14 were major fires (1 of unknown extent). In this analysis, similar to the analysis of fatalities, each case was reviewed and examined to determine if the major injury (vehicle MAIS or VAIS) was caused by crash related factors or due to the fire itself. The distribution of VAIS and fire origin was also examined.

It should be noted that at this level of specificity the population is quite small and as such no definitive conclusions are drawn from these results, rather they are presented simply for review.

Cause of Injury

Distribution of Rollover / Entrapment Fire Cases By Cause of Injury (NASS/CDS 1994/2004)		
Cause	By Fire Type	
	Minor Fire	Major Fire
Fire	1	4
Crash	18	7

Table 5.1

In table 5.1 we can see that in these 30 cases in which the extent of the fire and cause of injury were distinguishable, most of the significant injuries were caused by the crash itself in some manner and not by the fire.

Vehicle MAIS

Distribution of Rollover / Entrapment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	0	0
1	2	2
2	3	2
3	7	2
4	4	1
5	2	2
6	2	3
Injured, Unk Sev	0	2

Table 5.2

Table 5.2 shows the distribution of VAIS in relation to the type of fire involvement. While the number of cases was quite small, a trend towards higher level injuries can be noticed, roughly 70% of injuries are AIS 3+ in both minor and major rollover fires with entrapment.

Fire Origin

Distribution of Rollover / Entrapment Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	2	2	1
Vehicle Exterior	0	0	0
Exhaust System	0	0	0
Fuel Tank	0	5	0
Engine Compartment	16	7	0
Cargo / Trunk Area	1	0	0
Instrument Panel	1	0	0
Passenger Area	0	0	0
Other Location	0	0	0

Table 5.3

Table 5.3 show the distribution of rollover fire cases with entrapment according to the origin of the fire. As shown in earlier analyses, the engine compartment is again the most common location of fire origin.

VEHICLE MAIS DISTRIBUTIONS

This analysis is designed to examine how the distribution of injuries varies from one population to the next. Particularly, we are interested in the distribution of three populations, all vehicles in crashes without fire, all vehicles in crashes with fire and all vehicles in crashes with fire and entrapment. Table 6.1 below shows these distributions

Vehicle MAIS Comparison / All vs. Fire vs. Fire and Entrapment (NASS CDS 1994-2004)			
Vehicle MAIS	Population		
	All Vehicle	Fire Vehicles	Fire Vehicles with Entrapment
Not Collected	0	0	0
Unk If Injured	817	6	2
Not Injured	15612	49	1
Minor Injury	28563	128	12
Moderate Injury	9036	81	17
Serious Injury	6688	103	29
Severe Injury	2447	53	16
Critical Injury	2219	57	16
Maximum Injury	857	102	48
Injured, Unk Sev	4862	52	10

Table 6.1

What was found using this data was a shift in the distribution of injuries towards more severe injuries as we move across populations. Specifically in AIS 3+ injuries, the contribution of these level injuries to the overall population increased from 19% (unweighted, excluding unknowns) in ‘no fire’ cases up to 55% and 78% in the ‘fire’ and ‘fire and entrapment’ cases.

DAMAGE EXTENT DISTRIBUTIONS

This analysis is designed to examine how the distribution of extend of damage to vehicles (CDC EXTENT) varies from one population to the next. Particularly, we are interested in the distribution of three populations, all vehicles in crashes without fire, all vehicles in crashes with fire and all vehicles in crashes with fire and entrapment. Table 7.1 below shows these distributions

Deformation Extent Comparison / All vs. Fire vs. Fire and Entrapment (NASS CDS 1994-2004)			
Extent of Damage	Population		
	All Vehicle	Fire Vehicles	Fire Vehicles with Entrapment
No CDC	15099	0	0
Unknown	6652	801	19
1	11096	42	0
2	16193	119	7
3	12192	139	19
4	4674	85	27
5	1957	59	28
6	1579	50	24
7	569	34	16
8	310	6	4
9	780	17	7

Table 7.1

What was found using this data was a shift in the distribution of deformation extent towards more severe as we move across populations. Specifically when considering deformation extents coded as 4 or more (4+), the contribution of these level damages to the overall population increased from 20% (unweighted, excluding unknowns) in the 'no fire' cases up to 46% and 80% in the 'fire' and 'fire and entrapment' cases.

CRASH MODE VS. ORIGIN

Table 8.1 shows the distribution of fire origin by crash direction for all crashes coded as having involved a fire.

Distribution of Fire Origin vs. Crash Mode (NASS/CDS 1994-2004)					
Fire Origin	Crash Mode				
	Frontal	Side	Rear	Rollover	Other
Unknown Origin	12	4	4	11	9
Veicle Exterior	10	1	4	0	0
Exhaust System	3	0	0	1	0
Fuel Tank	10	17	25	26	11
Engine Compartment	291	36	7	91	18
Cargo / Trunk Area	2	1	1	1	0
Instrument Panel	5	2	1	5	0
Passenger Area	3	1	0	2	0
Other Location	8	2	1	3	2

Table 8.1

The distribution shown above indicates that across almost all crash modes, with the exception of rear, the engine compartment is the most likely location of a fire's origin given that a fire has occurred (48% to 85% unweighted). In the case of the rear crash mode, the fuel tank is the most likely origin of fire.

DISCUSSION

The results in the previous sections show how the analysis of fire occurrence was undertaken. Given that this work consists of multiple layers of data being investigated, the conclusions drawn from each analysis individually will be handled in the separate sections found below. The overarching conclusions of this study as a whole may be found in the final section of this work.

DATABASE DEVELOPMENT

As stated earlier in this work, the basis of this study was the development of a vehicle level data set which included a single file for each vehicle recorded as involved in a crash. The methodology for this development was already discussed however, there were several issues worth discussing here.

Inclusion

In this study, all vehicles which were coded in NASS CDS between the years of 1994 and 2004 were included. This implies that if multiple vehicles were involved in an accident, each was included. A modification of this study may be made to account for only the primary vehicle in each case, thus reducing the number of vehicles with missing or unknown data.

Derived Variables

One step in the database development process which could be a source of contention was the derivation of some variables. A discussion of each of these variables and possible modifications to the study may be found below.

Fire Occurrence - In this study, the variable 'FIRE' was used from the CDS database to determine if a fire occurred. During the early stages of this work, it was found that many vehicles were listed without any form of coding for a fire. Currently, there may be other means of determining if a fire occurred in a vehicle involved in a crash using alternate variables and an appropriately designed logic however this was not done for this study. In our case, it was assumed that if the 'FIRE' variable was not coded then most likely, that vehicle was not involved in a fire.

Crash Mode - Similar to the earlier finding with regards to the variable 'FIRE,' in the derived variable of Crash Mode it was found that a number of vehicles could not be classified. This may be an artifact of the inclusion criteria as discussed just above. If many of the included vehicles were not the primary vehicle of the case, it is possible that these vehicles did not get classified as to an area of damage or principal direction of force without which a crash mode cannot be established. Hopefully, a separate review of un-coded cases may indicate a means of either excluding or properly classifying them.

It should also be noted that the assignment of rollover included those cases where rollover occurred at any point in the collision sequence. Thus, multiple impacts in which a rollover was secondary to an initial impact would still be coded as a rollover. A secondary study of rollover crashes independently with regards to multiple impacts may clarify this distribution.

Vehicle Body Type - While most vehicles were able to be classified into one of the four body type groupings discussed earlier, it should still be noted that the classification was done in such a manner as to closely mimic the work performed by Bahouth. It may be necessary to later review the data using specified groupings established by NASS. Another influence upon this grouping is the inclusion criteria. A separate study could be made which only includes what NASS considers as light passenger vehicles or other such group.

ANALYSIS OF ALL FIRE CASES

The analysis of all fire cases within CDS was used as a base to determine under what conditions fire was likely to occur. The following sections discuss each set of results individually

Crash Mode

It was found that the frontal and rollover crash modes were the two most frequent modes in which fires occurred. Using the ratio of the number of fires for a given mode to the total number of crash involved vehicles per mode, it was determined that 1.75% of rollover involved crashes resulted in a fire; this is 1.65 times the rate in frontal collisions and is almost one and a half times the next highest rate of fire which was for rear at 1.23%.

Origin

The engine compartment was found to be the most frequent origin of fire; 70% of all fires started there. The fuel tank was the second most common origin at 14%. It was also noted that while engine compartment originating fires tended to be spread equally between major and minor fires, when the origin of a fire was the fuel tank, the fires tended to be major 91% of the time.

Tank Location

Similar to the results of the Bahouth study, it was found that, in order, the most frequent locations for a fuel tank when a fire occurred were; forward of rear axle centered, behind rear axle centered and forward of rear axle left side. All other locations had occurrences of 5% or less. Of the three most frequent tank locations it was found that the location of behind the rear axle centered had the highest risk of fire involvement (1.41% of crashes with a tank in this location results in a fire).

Body Type

The results of the body type analysis are fairly unremarkable. While passenger cars make up the bulk of fire occurrences (68%) this is not surprising given that passenger cars in general make up the bulk of the current vehicle fleet on the road. It was also found that the risk of fire is relatively level across all body types ranging from 0.83% to 0.94% occurrence rates (chance of fire / crash of a given body type).

Fuel Leakage Location

The analysis of fuel leakage location indicates that in most fires, no leakage is recoded as having occurred (66%). The only other item of note from this analysis was that when leakage was coded as having occurred (from any source) it was often associated with a major fire occurrence; this ranged from 67% of fires when the leak was at the fuel cap to 89% of fires when the leakage was at the tank.

Vehicle Maximum AIS (VAIS)

The analysis of VAIS showed that injuries of all levels were fairly well distributed across all injury levels. However it was noted that when fire occurred, the risk of and AIS 2 or greater injury was often higher than that for non-fire involved vehicles (risk is the ratio of number of AIS injuries of a given level to the total number of injuries recorded for either fire or non-fire vehicles). A marked difference appears at the AIS 4 through 6 levels. For AIS 4 and 5 injuries, when a fire occurred the risk of such an injury was 2.47 and 2.93 times that of a non-fire involved vehicle. In the AIS 6 level, the risk of injury when fire occurred was 13.59 times that of non-fire involved vehicles. It should be noted that many confounding factors could play a role in this result including; delta-v, deformation extent, etc.

Entrapment

Entrapment was found to occur quite infrequently in both fire and non-fire involved crashes (24% of fire crashes had entrapment and only 7% of non-fire crashes had entrapment). When examining the risk of entrapment it was found that when a fire occurred, entrapment was 3 times as likely to have also occurred.

ANALYSIS OF ROLLOVER FIRE CASES

As mentioned in the last section the rollover crash mode was found to have a high risk of fire occurrence. This section of the analysis examined similar attributes and some new attributes of fire occurrences as directly related to the rollover crash mode. A comparison with frontal crashes was also presented for comparison; frontal were used as a baseline because they are the most frequent type of crash recorded. Similar to the last section, each individual characteristic evaluation will be discussed in the following sections separately.

Origin

The engine compartment was found to be the most frequent origin of fire; 65% of all rollover fires started there. The fuel tank was the second most common origin at 19%. It was also noted that while engine compartment originating fires tended to be spread equally between major and minor fires, when the origin of a fire was the fuel tank, the fires tended to be major 88% of the time.

Tank Location

Similar to the results of the analysis of all fires, it was found that the most frequent locations for a fuel tank when a fire occurred were; forward of rear axle centered, behind rear axle centered and forward of rear axle left side. All other locations had occurrences of 5% or less.

Body Type

The results of the body type analysis, as before, show little insight as to a prevalence of one body type over another for involvement in a fire. Passenger vehicles are the most frequent type of vehicle involved in a rollover fire.

Fuel Leakage Location

As found in the analysis of all fire cases, the occurrence of “no fuel leakage” was by far the most common (61% unweighted). However, this is a smaller percentage than observed in the all fire cases study. This may indicate that leakage plays more of a part in rollover crash fires than in planar crash fires. In comparison with frontal crashes, rollover fires have a much higher percentage of leakage occurrences. In a rollover fire, leakage is associated with approximately 19% of occurrences, while in frontal fires leakage is found to occur only 8% of the time.

Vehicle Maximum AIS (VAIS)

The distribution of VAIS injuries with respect to rollover fires and non-fires indicates that when a fire occurs, the risk of more severe injuries increases. In rollover fires, AIS 3+ injuries account for 59% of all coded injuries (0-6) while in rollovers without fire, they accounted for only 34%. For comparison, in frontal crashes with fires, AIS 3+ injuries accounted for only 50% of all coded injuries while in frontal crashes without fire, AIS 3+ injuries accounted for only 18%. These results indicate that not only are rollover and fires more harmful events with respect to injury levels, but when these are coupled together they can increase the likelihood of sustaining a sever injury.

Entrapment

The occurrence of entrapment was found to be only slightly greater in rollover fires than in all fires or frontal fires. Also, similar to the all fire crashes analysis, it was found that the risk of entrapment occurring increased with the occurrence of fire. According to the results, entrapment is 2.2 times more likely to result when a fire occurs in a rollover than when it does not.

Trip Location

The evaluation of the distribution of location of initial tripping force indicated that the wheels or tires were the most frequent. 39% of rollover fires had a roll initiated by a force at the wheels or tires. In terms of the risk of fire however, it was found that undercarriage initiated rollovers had the highest risk of fire, (19% of rollover fires). The two locations with the next highest risk of fires were the end-over-end and end plane, both of which together made up 20% of the population of rollover fires.

Number of Quarter Turns

The number of quarter turns experienced in a rollover was the next variable which was examined. It was found that in both rollovers with fire and those without fire, 1 to 4 quarter turns make up roughly 70% of the population (68% of fires, 70% of non fires). Of this group, the situation of 1 quarter turn has the highest risk of fire occurrence. When a higher number of quarter turns is noted, the risk of fire is increased, however, these situations make up a relatively small portion of the overall population. Also, it is reasonable to assume that as the number of quarter turns increases, the survivability of the crash itself decreases dramatically and because this work attempts to identify risks associated with fire specifically and not the severity of the crash and effort to deal with the small populations of higher numbers of quarter turns is not attempted.

Final Rest Position

The analysis of the final rest position was used to determine if a specific position at the end of a rollover crash showed an increased prevalence for fire occurrence. It was found that the final position of the vehicle being on its roof was the most common in both fire and non-fire rollover crashes. In terms of the risk of fire, end-over-end type rolls which did not have a final rest position listed had the highest risk of fire occurrence however they only accounted for 4% of the population. Of the other final positions contributing more significantly to the overall population, the position of on ‘side’ had the

highest risk of fire. The positions of 'on wheels' and 'on roof' had the second and third highest risks of this group.

ANALYSIS OF ROLLOVER ENGINE COMPARTMENT FIRE CASES

In the first analysis of all fire cases, we came to the conclusion the rollovers presented a high risk of fire occurrence. In both the analysis of all fires and the analysis of rollover fires alone it was shown that the engine compartment was the most likely origin of a fire. Given this understanding we continued the work to analyze specifically those cases of rollover crashes with fires starting in the engine compartment. The following sections discuss the results presented earlier.

Tank Location

As noted in earlier results, the three tank locations of the highest frequency in rollover fires are forward of rear axle centered, forward of rear axle left side and behind rear axle centered. None of these locations show prevalence for major or minor fire occurrence.

Body Type

The body type portion of the rollover engine compartment analysis indicates that at this level, larger vehicles are contributing much more to the total population then observed previously. In the fontal engine compartment fire cases, passenger cars make up 73% of the population, in rollover, passenger cars only account for 51%. The contribution of the larger vehicles in rollover is divided fairly evenly amongst pickups, SUVs and vans.

Fuel Leakage Location

The distribution of fuel leakage occurrence shows that in 69% of the rollover engine compartment fires, no fuel leakage was indicated. This is a higher percentage than both the all fire cases results and the rollover fire results. This may indicate that while fuel leakage may be more prevalent in rollover cases, in the situation of a rollover engine compartment fire, fuel leakage may not be the most significant factor. This also shows that fuel leakage is most likely contributing to fires originating elsewhere in rollover crashes.

Populations at this level of detail are quite small, however it can be noted that when no fuel leakage occurs, the tendency is for the fire to be minor (65% unweighted).

Vehicle Maximum AIS (VAIS)

VAIS injuries of all levels appear to be evenly distributed in rollover engine compartment fires. Rollover engine compartment fires shows a prevalence for causing injuries of the AIS 1-3 level, and show a lower percentage of AIS 6 level injuries than frontal crashes with engine compartment fires.

Entrapment

The distribution of occurrence of entrapment is roughly the same as that observed in all fire cases and in rollover fire cases. Entrapment is shown to occur in approximately 25% of rollovers with engine compartment fires. There is no indication for a prevalence of entrapment to occur with a minor or major fire for this population.

Trip Location

Similar to the findings of the rollover fire analysis, the trip location of 'wheel / tires' appears to be the most common in the population of rollovers with engine compartment fires. Again, the end plane and undercarriage are the two next most frequent location of trip initiation.

Number of Quarter Turns

The analysis of the number of quarter turns undergone shows that the bulk of rollovers undergo 1-4 quarter turns (1 or less complete rolls). 74% of the population is in this grouping. The small number of vehicles in this population does not lend itself to description of a tendency for major or minor fires.

Final Rest Position

The final rest position of the 'roof' is again the most common position found for this population. 'On wheels' and 'on side' positions are the next two most frequent positions in this population.

ANALYSIS OF FATAL FIRE CASES

The analysis of fatalities in fires was undertaken to identify under which conditions of fire cases they were occurring. The summary data indicated that vehicle with fatalities in fire accounted for only 4.2% of all vehicle with fatalities observed. 68% of the vehicles with fatalities in fire cases occurred in cases with major fires. The subsequent three analyses attempt to further define the fire situations under which fatalities are occurring.

Crash Mode

The analysis of crash mode and fatality occurrence indicated that most fatalities in fire involved crashes occur in frontal and rollover type crashes. These modes are also the most frequent modes for fatalities without fires.

Fire Origin

The distribution of fatalities in fire cases with respect to the origin of the fire indicates that, as in the other investigations, the engine compartment is the most

frequent source. 61% of fatal fires originate in the engine compartment. The other interesting item to note is that the fuel tank was the second most common origin, making up 24% of fatal fires. In either situation, where the origin was the tank or the engine compartment, fires associated with fatalities were predominately major.

Cause of Fatality

A case by case review of fatal fire cases was undertaken to determine if fire was the predominate cause of the fatality in these cases. It was found that of the 186 vehicles with fatalities associated with fire, 69 of the vehicles with a fatality (37%) were directly linked to the injuries caused by the fire itself. It was also found that 127 of the fatalities were associated with major fire. The two findings indicate that, while the number of fatalities associated with fire is small, they are predominately occurring in major fires.

ROLLOVER AND ENTRAPMENT IN FIRE

Entrapment has been found to more prevalent in the rollover crash mode. 14% of rollover crashes involved entrapment as compared to the rate of 7% of all crashes or 7% of frontal crashes. However, when examining only fire cases, entrapment was found to occur at approximately the same rate as for all fire cases or for frontal fire case; 22% of rollover fires involved entrapment. While these numbers do not indicate a major link between fire and entrapment or rollover, a separate analysis was undertaken. The basis for examining fire and entrapment is that should a fire occur, even minor, the situation of entrapment could lead to more severe injuries if an occupant could not exit a burning vehicle.

Cause of Injury

Each rollover fire case which included entrapment was reviewed. The cause of the most significant injury (highest AIS) was determined to be caused either directly by the fire or by forces due to the crash itself. It was found that the majority of injuries in these cases were due to the crash and not the fire. This may indicate that when entrapment occurs, crash forces are significant such that any subsequent fire related injuries are minor by comparison.

Vehicle MAIS

The distribution of injuries according to the Vehicle MAIS was used to determine if rollover entrapment fires were leading to more severe injuries. As showing in table 5.2 earlier, 72% of injuries in rollover fires with entrapment are AIS 3+ in severity. By comparison, only 50% of injuries in all fire case or in rollover fire cases were AIS 3+. A further comparison of these populations may be found later in this work.

Fire Origin

As with the earlier analyses of fire origin, the engine compartment is the most common location. It should also be mentioned that a majority of the fires starting in the engine compartment in these cases were minor fires, although this conclusion is based on only 35 cases.

VEHICLE MAIS DISTRIBUTIONS

While many of the earlier analyses included an examination of the vehicle MAIS, the table presented in this section was meant to summarize how the distribution is affected by the occurrences of fire and fire with entrapment. What was observed in this analysis was that the contribution of AIS 3+ injuries to the overall population increased from 19% in all non-fire crashes, to 55% in fire crashes and finally up to 78% in fire crashes with entrapment. A similar trend is also observed in AIS 2+ injuries which increase from 32% in non-fires to 69% in fires and finally to 91% in fires with rollover. What these findings indicate is that fire alone increases the likelihood of sustaining an AIS 3+ level injury, and when fire and entrapment both occur the risk of AIS 2+ injuries is increased even more.

DAMAGE EXTENT DISTRIBUTIONS

The analysis of the extent of damage in the three populations (no fire, fire and fire with entrapment) is meant to examine how the severity of a crash is related to each outcome. What has been observed is that as we move from crashes without fire to crashes with fire a higher level of damage is occurring. As we then moved into cases where fire and entrapment are occurring, even greater damage is found to occur more often. While this result is logical in that as damage (severity increases) we would expect an increase in the likelihood of fire and entrapment, the percentages may indicate a level at which fires in general and fires and entrapment together are occurring. If the percentages are examined grouping higher level damages together (ie. Looking at the percentages of the 4+, 5+ . . .7+ levels to each population) we can see a trend appear. If we use the 75% mark as an example (i.e the level at which roughly 75% of a population is included), when no fire occurs, 75% of the population has a damage extent of 2+, in fires this is approximately 3+ and finally in fires with entrapment this is approximately 5+. What this trend indicates is that vehicles are more likely to catch fire after a certain level of damage, and more specifically at an approximate level of damage, fire and entrapment are likely to occur. Given that the concurrence of fire and entrapment could possibly lead to the situation of an occupant being trapped in a burning vehicle, this may indicate a need to either address the causes of fire at this level of damage or to examine the structure of the door to allow an occupant to exit a vehicle given that a fire is likely to occur.

CRASH MODE VS. ORIGIN

Table 8.1 indicated that engine compartment fires were the most common location for a fire to begin in a crash,

regardless of the crash mode, save a collision from the rear.

CONCLUSIONS

The above analysis seeks to provide an overview of the occurrence of fire in NASS/CDS database. Due to the limited number of fires, this paper presents both weighted and unweighted data. It should be noted that unweighted data can not be extrapolated to predict the frequency of events on US highways. However, it is useful for examining trends and observing the presence or absence of factors that contribute to harmful events. Using the NASS CDS data from 1994-2004 several observations follow:

ALL FIRES

1. Fires occur in approximately 1% of NASS unweighted crashes (0.2% when using weighted data).

2. Crashes involving a rollover event have been shown to have a higher risk of having a fire occur. The risk of fire in a rollover involved crash is 1.4 times that of a rear, 1.6 times that of a frontal and 2.5 times that of a side impact, based on unweighted data.

3. Rear impact fires tend to be major fires (77%) while most other crash directions have a 50/50 distribution for major and minor fire types.

4. When a fire occurs in most crash directions, the origin is the engine compartment. 70% of all fires originated in the engine compartment. This observation holds for both weighted and unweighted data.

5. In rear collisions the most likely origin is the fuel tank. When the fuel tank was the origin of a fire, about 90% of them were major fires. This observation holds for both weighted and unweighted data.

6. Fuel leakage is often not a contributing factor in vehicle fires. 66% of all fires, unweighted, had no leakage recorded. When leakage was recoded from any source, fires tended to be major. 87% of fires with leakage were major in comparison to only 38% of fires without leakage being major.

7. Of Vehicle MAIS injuries recorded, fire involved vehicles in crashes tend to have a higher percentage of VAIS 3+ injuries than non-fire involved vehicles. 55% (unweighted) of VAIS injuries in fire involved vehicles are VAIS 3+ while in non fire vehicles VAIS 3+ injuries only makeup 19% of the population.

8. Entrapment of occupants, while infrequent in most crashes, occurs more often in crashes involving fire. Only 7% of non-fire crashes involve entrapment while 23% of crashes with fire involve entrapment.

ROLLOVER FIRES

1. Rollover crashes have been shown to have the highest rate of fire occurrence per number of vehicles involved in this crash mode (1.75% of rollover crashes involved fire).

2. In rollover fires, the most common origin of the fire is the engine compartment (65% unweighted). The fuel tank is the second most common origin in rollover fires (19% unweighted). Similarly, side impact fires also have the fuel tank as the second most common location (27% unweighted). As noted earlier, rear impact fires have the fuel tank as the most common location of fire origin with the engine compartment as the second most frequent.

3. In all crash directions, passenger vehicles make up the largest percentage of vehicles involved. This is also true in cases of fire. In the frontal, side and rear directions, passenger cars make up approximately 75% (unweighted) of the population, while in the rollover mode passenger cars make up only 54% (unweighted) of fires. This indicates that when considering fires in rollover, vans, pickups and suv's make up a larger portion of the vehicles which are igniting after a crash.

4. In rollover fires the no leakage situation was the most common (61%, unweighted). When leakage did occur, the tank and filler neck were the next most common leakage locations. Leakage was more common in side and rear impacts, and in both of these, the tank was the most common source of fuel leakage.

5. As noted earlier, in fires, the percentage of VAIS 3+ injuries increases when compared to no fire cases. In rollover fires, the percentage of VAIS 3+ injuries is 59% (unweighted) as compared to rollovers without fire at 34% (unweighted). Of all crash directions, only side impacts with fire have a higher percentage of VAIS 3+ injuries (65%, unweighted). In all directions the percentage of VAIS 3+ injuries increases when a fire occurs.

6. Across all crash directions, the rate of entrapment was found to increase with the occurrence of fire. Rear crashes had the highest increase in entrapment with the occurrence of fire (5% without fire, 33% with fire). The side impact mode had the highest percentage of entrapment in fire cases at 34% (unweighted). Entrapment in rollover cases increased from 14% to 27% when fire occurred.

7. In rollover crashes both with and without fire, the wheels / tires are the most common location for a

rollover to be initiated. The undercarriage location was the trip initiation location with the highest percentage of fire occurrences.

8. Most rollover crashes involve at most 1 full roll (1 to 4 quarter turns). Roughly 70% of rollovers, with or without fire experienced at most 1 full turn.

9. In rollovers with fire and without fire the roof was the most common final rest position, however both the on side and on wheels positions contributed significantly as well. The data also indicated that when the vehicle comes to rest on its roof or wheels, if a fire occurs it tend to be a major fire while when the vehicles comes to rest on its side, the fire tends to be minor.

ROLLOVER ENGINE COMPARTMENT FIRES

1. Rollover crashes with engine compartment fires were examined because rollover crashes were found to be at the highest risk of having a fire occur and the engine compartment was found to be the most common origin of fires in all crashes as well as in rollovers.

2. The forward of rear axle, centered tank location is the most common tank location in all crash directions. Vehicle counts at this level of detail were too small to draw any significant conlusion as to prevalence for major or minor fires.

3. Passenger vehicles make up the largest percentage of vehicles in all crash directions with engine compartment fires. In rollovers with engine compartment fires, the passenger cars are still the greatest percentage however vans, pickups and suvs make up a larger contribution to this population than to engine compartment fires in any other given direction.

4. The “no fuel leakage” situation was the most common in rollover engine compartment fires. This is a similar finding to that of all fires and rollover fires in general.

5. Rear crashes with engine compartment fires were found to have the highest percentage of VAIS 3+ level injuries (57% unweighted). Rollover engine compartment fires had the third highest percentage at 48%. (note that crash counts at this level of detail are extremely small, i.e. there were only 91 rollover engine compartment fires cases over the 11 years examined.)

6. As already noted, entrapment was found to occur more frequently when fire occurred. The same rate of entrapment for all fires was found when engine compartment fires were examined. Specifically, in rollover engine compartment fires, the percentage of crashes with entrapment was 25%, this was second only to side impact engine compartment fires which had a 36% occurrence of entrapment.

7. The wheels / tires were the most common trip location in rollover engine compartment fires.

8. As in the earlier results, most vehicles in rollover engine compartment fires underwent at most one full roll.

9. The on roof final rest position is again the most common position however, the distribution is essentially equally split between the side, roof and on wheels positions.

FATALITIES IN FIRE

1. Fatal fire cases were found to be recorded more often as major fires.

2. Frontal and rollover crashes makeup up the largest portions of the population of fatal fire cases. Rear collisions have the highest risk of suffering a fatality if a fire occurs.

3. The engine compartment and fuel tank are the most frequent fire origins in fatal fire cases.

4. When a fire was classified as minor, more often the fatality was caused by crash forces. When a fire was major, more often the cause of the fatality was the fire itself.

ROLLOVER AND ENTRAPMENT IN FIRE

1. Cases of vehicle rollover’s with fire and entrapment are very rare (35 recorded cases, representing 1,627 over 11 years of the study)

2. Regardless of the type of fire (major / minor) the crash was most often deemed to be the cause of the most severe injury in the vehicle.

3. 72% of the vehicles with rollover and entrapment in a fire had a VAIS of 3+.

4. Similar to earlier findings, the engine compartment is the most common ignition source for a fire.

OTHER ANALYSES

1. It was found that the percentage of VAIS 3+ injuries increased with the occurrence of fire in a crash. This was further increased when examining vehicles with fire and entrapment.

2. As the extent of damage to a vehicle increase, the likelihood of fire increases, after a certain level the likelihood of fire and entrapment also increases noticeably.

3. As noted in earlier findings, the engine compartment is the most common location for the origin of a fire. The exception to this is rear collisions, in this case, the most common origin is the fuel tank.

The conclusions listed above were developed based upon the data and methods outlined earlier in this work. As noted throughout this paper, there are several instances in which a different choice in definition of variables may affect the outcome and possibly the conclusion listed above. An investigation of these possibilities was not undertaken for this paper but should be considered when referencing this work. Complete tables of all data, in both weighted and unweighted format, have been provided in the appendix.

REFERENCES

1. Bahouth, J; Kuznetsov, A; "Automotive and Fire Safety Research;" Jan, 2005

2. NHTSA,'Safecar.gov-Rollover'; http://www.nhtsa.dot.gov/cars/testing/ncap/Rollover/Index.htm (NHTSA 2006)

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APPENDIX

A. ALL FIRE CASES, UNWEIGHTED

Distribution of All Fire Cases (NASS/CDS 1994/2004)				
Count	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Total Cases Recorded	290	335	6	71,101
Average Annual Cases	26	30	1	6,464

Table A 1 : Summary Distribution

Distribution of All Fire Cases By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	172	170	2	32,001
Side	31	32	1	9,227
Rear	10	33	0	3,452
Rollover	68	70	2	7,846
Other	9	30	1	18,575

Table A 2 : Crash Direction

Distribution of All Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	7	27	6
Vehicle Exterior	7	8	0
Exhaust System	3	1	0
Fuel Tank	8	81	0
Engine Compartment	245	198	0
Cargo / Trunk Area	4	1	0
Instrument Panel	7	6	0
Passenger Area	2	4	0
Other Location	7	9	0

Table A 3 : Fire Origin

Distribution of All Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	5	20	3	15,829
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	74	85	1	11,154
Behind Rear Axle, Left Side	1	2	0	540
Behind Rear Axle, Right Side	3	2	0	472
Forward of Rear Axle, Centered	154	132	2	28,557
Forward of Rear Axle, Left Side	39	67	0	10,695
Forward of Rear Axle, Right Side	12	18	0	2,895
Over Center of Rear Wheels	2	5	0	751
Other	0	4	0	208

Table A 4 : Tank Location

Distribution of All Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	214	213	5	49,210
Pickup	28	70	0	10,465
SUV	24	29	1	6,480
Van	24	23	0	4,941
Other	0	0	0	5

Table A 5 : Body Type

Distribution of All Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	20	84	3
No Fuel Leakage	256	157	3
Tank	5	40	0
Filler Neck	4	21	0
Cap	1	2	0
Line/Pump/Filter	3	13	0
Other	1	18	0

Table A 6 : Leak Location

Distribution of All Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	3	3	0	817
0	29	20	0	15,612
1	64	64	0	28,563
2	45	35	1	9,036
3	54	47	2	6,688
4	27	24	2	2,447
5	24	33	0	2,219
6	16	86	0	857
Injured, Unk Sev	28	23	1	4,862

Table A 7 : Vehicle MAIS (VAIS)

Distribution of All Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	93	84	0	44,175
VAIS 2-6	166	225	5	21,247
Injured, Unk Sev	28	23	1	4,862
Not Collected	0	0	0	0
Unk If Injured	3	3	0	817

Table A 8 : VAIS 2+

Distribution of All Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	138	119	1	53,211
VAIS 3-6	121	190	4	12,211
Injured, Unk Sev	28	23	1	4,862
Not Collected	0	0	0	0
Unk If Injured	3	3	0	817

Table A 9 : VAIS 3+

Distribution of All Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	65	83	3	5,163
Not Entrapped	213	231	3	61,268
Unknown	12	21	0	4,670

Table A 10 : Entrapment

APPENDIX

B. ALL FIRE CASES, WEIGHTED

Distribution of All Fire Cases (NASS/CDS 1994/2004)				
Count	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Total Cases Recorded	40,994	38,173	187	35,955,359
Average Annual Cases	3,727	3,470	17	3,268,669

Table B 1 : Summary Distribution

Distribution of All Fire Cases By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	22,615	17,197	69	15,100,000
Side	2,616	2,149	74	4,327,218
Rear	890	2,929	0	2,186,244
Rollover	10,420	11,004	5	2,865,133
Other	4,454	4,893	39	11,480,000

Table B 2 : Crash Direction

Distribution of All Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	329	2,121	187
Vehicle Exterior	413	405	0
Exhaust System	209	6	0
Fuel Tank	484	9,843	0
Engine Compartment	35,205	23,172	0
Cargo / Trunk Area	955	943	0
Instrument Panel	3,148	336	0
Passenger Area	65	80	0
Other Location	186	1,266	0

Table B 3 : Fire Origin

Distribution of All Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	642	744	68	9,022,452
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	12,001	6,120	41	5,431,591
Behind Rear Axle, Left Side	18	202	0	271,988
Behind Rear Axle, Right Side	209	491	0	232,218
Forward of Rear Axle, Centered	22,686	17,180	78	14,240,000
Forward of Rear Axle, Left Side	3,965	9,648	0	4,793,069
Forward of Rear Axle, Right Side	1,375	3,470	0	1,560,296
Over Center of Rear Wheels	99	96	0	319,899
Other	0	222	0	87,181

Table B 4 : Tank Location

Distribution of All Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	24,056	22,956	186	25,730,000
Pickup	9,451	8,551	0	4,888,946
SUV	1,912	4,445	1	3,032,235
Van	5,575	2,221	0	2,299,799
Other	0	0	0	527

Table B 5 : Body Type

Distribution of All Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	1,513	7,127	68
No Fuel Leakage	38,630	19,901	120
Tank	336	2,176	0
Filler Neck	171	6,457	0
Cap	37	83	0
Line/Pump/Filter	241	534	0
Other	65	1,894	0

Table B 6 : Leak Location

Distribution of All Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	16	492	0	574,219
0	12,484	7,274	0	16,380,000
1	16,151	11,456	0	13,880,000
2	3,646	3,269	1	1,890,688
3	2,827	3,996	78	725,981
4	1,694	1,553	69	206,716
5	1,003	2,225	0	129,462
6	895	5,535	0	35,711
Injured, Unk Sev	2,279	2,373	39	2,140,725

Table B 7 : Vehicle MAIS (VAIS)

Distribution of All Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	28,634	18,730	0	30,250,000
VAIS 2-6	10,065	16,577	148	2,988,558
Injured, Unk Sev	2,279	2,373	39	2,140,725
Not Collected	0	0	0	0
Unk If Injured	16	492	0	574,219

Table B 8 : VAIS 2+

Distribution of All Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	32,280	21,999	1	32,140,000
VAIS 3-6	6,419	13,308	147	1,097,870
0	2,279	2,373	39	2,140,725
Not Collected	0	0	0	0
Unk If Injured	16	492	0	574,219

Table B 9 : VAIS 3+

Distribution of All Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	2,665	6,148	120	839,566
Not Entrapped	37,538	30,118	68	33,290,000
Unknown	791	1,907	0	1,824,109

Table B 10 : Entrapment

APPENDIX

C. ROLLOVER FIRE CASES, UNWEIGHTED

Distribution of Fire Cases By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	172	170	2	32,001
Side	31	32	1	9,227
Rear	10	33	0	3,452
Rollover	68	70	2	7,846
Other	9	30	1	18,575

Table C 1 : Summary Distribution

Distribution of Rollover Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	3	6	2
Vehicle Exterior	0	0	0
Exhaust System	1	0	0
Fuel Tank	3	23	0
Engine Compartment	53	38	0
Cargo / Trunk Area	1	0	0
Instrument Panel	2	3	0
Passenger Area	2	0	0
Other Location	3	0	0

Table C 2 : Fire Origin

Distribution of Rollover Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	2	2	1	1,200
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	16	18	0	1,555
Behind Rear Axle, Left Side	1	0	0	72
Behind Rear Axle, Right Side	1	1	0	57
Forward of Rear Axle, Centered	30	27	1	2,447
Forward of Rear Axle, Left Side	15	18	0	1,975
Forward of Rear Axle, Right Side	3	1	0	450
Over Center of Rear Wheels	0	2	0	55
Other	0	1	0	35

Table C 3 : Tank Location

Distribution of Rollover Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	37	37	1	3,506
Pickup	13	17	0	1,960
SUV	10	12	1	1,809
Van	8	4	0	571
Other	0	0	0	0

Table C 4 : Body Type

Distribution of Rollover Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	8	19	1
No Fuel Leakage	53	31	1
Tank	2	5	0
Filler Neck	2	8	0
Cap	1	2	0
Line/Pump/Filter	1	3	0
Other	1	2	0

Table C 5 : Leak Location

Distribution of Rollover Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	2	1	0	47
0	3	2	0	573
1	9	14	0	2,880
2	13	9	1	1,432
3	13	13	1	1,146
4	9	6	0	596
5	8	8	0	542
6	4	11	0	194
Injured, Unk Sev	7	6	0	436

Table C 6 : Vehicle MAIS (VAIS)

Distribution of Rollover Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	12	16	0	3,453
VAIS 2-6	47	47	2	3,910
Injured, Unk Sev	7	6	0	436
Not Collected	0	0	0	0
Unk If Injured	2	1	0	47

Table C 7 : VAIS 2+

Distribution of Rollover Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	25	25	1	4,885
VAIS 2-6	34	38	1	2,478
Injured, Unk Sev	7	6	0	436
Not Collected	0	0	0	0
Unk If Injured	2	1	0	47

Table C 8 : VAIS 3+

Distribution of Rollover Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	20	14	1	1,057
Not Entrapped	45	51	1	6,397
Unknown	3	5	0	392

Table C 9 : Entrapment

Distribution of Rollover Fire Cases By Trip Location (NASS/CDS 1994/2004)				
Trip Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	2	7	2	829
Wheels / Tires	25	30	0	4,048
Side Plane	7	3	0	808
End Plane	10	12	0	715
Undercarriage	14	13	0	643
Other Loc On Veh	0	0	0	5
Non-Contact Force	6	3	0	605
End-Over-End	4	2	0	193

Table C 10 : Trip Location

APPENDIX

C. ROLLOVER FIRE CASES, UNWEIGHTED (CONTINUED)

Distribution of Rollover Fire Cases By Number of Quarter Turns (NASS/CDS 1994/2004)				
Number of Quarter Turns	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Details Unknown	2	7	2	817
1	23	8	0	1,332
2	19	17	0	2,091
3	1	1	0	460
4	7	19	0	1,595
5	0	2	0	235
6	3	5	0	606
7	1	1	0	82
8	3	3	0	305
9	0	3	0	37
10	1	2	0	83
11	0	0	0	5
12	3	1	0	70
13	0	0	0	3
14	0	0	0	16
15	0	0	0	3
16	1	0	0	11
> 16	0	0	0	10
End-Over-End	4	1	0	85

Table C 11 : Number of Quarter Turns

Distribution of Rollover Fire Cases By Final Rest Position (NASS/CDS 1994/2004)				
Position	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
> 16 Quarter Turns	0	0	0	10
End-Over-End	4	1	0	85
Roof	23	24	0	2,796
Side	25	15	0	2,157
Unknown	2	7	2	817
Wheels	14	23	0	1,981

Table C 12 : Final Rest Position

APPENDIX

D. ROLLOVER FIRE CASES, WEIGHTED

Distribution of Fire Cases By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	22,615	17,197	69	15,100,000
Side	2,616	2,149	74	4,327,218
Rear	890	2,929	0	2,186,244
Rollover	10,420	11,004	5	2,865,133
Other	4,454	4,893	39	11,480,000

Table D 1 : Summary Distribution

Distribution of Rollover Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	108	587	5
Vehicle Exterior	0	0	0
Exhaust System	142	0	0
Fuel Tank	184	5,017	0
Engine Compartment	6,776	5,209	0
Cargo / Trunk Area	132	0	0
Instrument Panel	2,930	192	0
Passenger Area	65	0	0
Other Location	82	0	0

Table D2 : Fire Origin

Distribution of Rollover Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	65	170	1	467,632
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	4,390	798	0	627,199
Behind Rear Axle, Left Side	18	0	0	18,406
Behind Rear Axle, Right Side	40	183	0	15,918
Forward of Rear Axle, Centered	4,574	5,520	5	898,404
Forward of Rear Axle, Left Side	1,076	2,190	0	655,553
Forward of Rear Axle, Right Side	257	2,075	0	153,204
Over Center of Rear Wheels	0	68	0	16,403
Other	0	0	0	12,413

Table D3 : Tank Location

Distribution of Rollover Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	4,635	6,191	5	1,249,974
Pickup	1,463	3,708	0	710,663
SUV	466	914	1	744,657
Van	3,857	191	0	159,839
Other	0	0	0	0

Table D4 : Body Type

Distribution of Rollover Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	728	1,037	1
No Fuel Leakage	9,349	5,043	5
Tank	102	428	0
Filler Neck	106	4,106	0
Cap	37	83	0
Line/Pump/Filter	33	95	0
Other	65	213	0

Table D5 : Leak Location

Distribution of Rollover Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	0	0	0	47,241
0	5,837	3,459	0	839,188
1	1,393	3,573	0	1,308,950
2	686	845	1	290,137
3	444	744	5	135,766
4	337	464	0	52,954
5	498	190	0	33,265
6	597	1,283	0	7,914
Injured, Unk Sev	629	448	0	149,717

Table D6 : Vehicle MAIS (VAIS)

Distribution of Rollover Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	7,230	7,032	0	2,148,138
VAIS 2-6	2,561	3,525	5	520,036
Injured, Unk Sev	629	448	0	149,717
Not Collected	0	0	0	0
Unk If Injured	0	0	0	47,241

Table D7 : VAIS 2+

Distribution of Rollover Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	7,915	7,876	1	2,438,275
VAIS 2-6	1,876	2,680	5	229,899
Injured, Unk Sev	629	448	0	149,717
Not Collected	0	0	0	0
Unk If Injured	0	0	0	47,241

Table D8 : VAIS 3+

Distribution of Rollover Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	899	723	5	237,226
Not Entrapped	9,345	10,024	1	2,467,713
Unknown	175	257	0	160,193

Table D9 : Entrapment

Distribution of Rollover Fire Cases By Trip Location (NASS/CDS 1994/2004)				
Trip Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	130	592	5	237,316
Wheels / Tires	2,273	5,988	0	1,662,341
Side Plane	549	59	0	193,521
End Plane	426	901	0	174,392
Undercarriage	3,722	3,167	0	183,388
Other Loc On Veh	0	0	0	83
Non-Contact Force	3,032	126	0	359,705
End-Over-End	288	172	0	54,386

Table D10 : Trip Location

APPENDIX

D. ROLLOVER FIRE CASES, WEIGHTED (CONTINUED)

Distribution of Rollover Fire Cases By Number of Quarter Turns (NASS/CDS 1994/2004)				
Number of Quarter Turns	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Details Unknown	130	592	5	234,703
1	4,465	496	0	529,467
2	3,761	1,525	0	996,838
3	68	45	0	158,776
4	893	5,038	0	571,016
5	0	156	0	73,478
6	199	2,203	0	165,817
7	150	50	0	14,452
8	101	387	0	71,119
9	0	212	0	7,782
10	37	134	0	18,649
11	0	0	0	697
12	273	78	0	6,449
13	0	0	0	186
14	0	0	0	1,942
15	0	0	0	71
16	54	0	0	646
> 16	0	0	0	984
End-Over-End	288	86	0	12,062

Table D11 : Number of Quarter Turns

Distribution of Rollover Fire Cases By Final Rest Position (NASS/CDS 1994/2004)				
Position	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
> 16 Quarter Turns	0	0	0	984
End-Over-End	288	86	0	12,062
Roof	3,997	3,863	0	1,183,245
Side	4,683	960	0	784,908
Unknown	130	592	5	234,703
Wheels	1,322	5,503	0	649,230

Table D12 : Final Rest Position

APPENDIX

E. FRONTAL FIRE CASES, UNWEIGHTED

Distribution of Frontal Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	2	8	2
Vehicle Exterior	4	6	0
Exhaust System	2	1	0
Fuel Tank	0	10	0
Engine Compartment	157	134	0
Cargo / Trunk Area	1	1	0
Instrument Panel	3	2	0
Passenger Area	0	3	0
Other Location	3	5	0

Table E 1 : Fire Origin

Distribution of Frontal Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	1	9	1	328
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	45	36	1	6,364
Behind Rear Axle, Left Side	0	1	0	305
Behind Rear Axle, Right Side	1	1	0	266
Forward of Rear Axle, Centered	94	76	0	16,563
Forward of Rear Axle, Left Side	20	32	0	5,979
Forward of Rear Axle, Right Side	9	13	0	1,634
Over Center of Rear Wheels	2	1	0	445
Other	0	1	0	117

Table E 2 : Tank Location

Distribution of Frontal Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	134	111	2	22,592
Pickup	14	33	0	4,728
SUV	13	13	0	2,445
Van	11	13	0	2,235
Other	0	0	0	1

Table E 3 : Body Type

Distribution of Frontal Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	6	36	1
No Fuel Leakage	164	110	1
Tank	0	11	0
Filler Neck	0	4	0
Cap	0	0	0
Line/Pump/Filter	2	6	0
Other	0	3	0

Table E 4 : Leak Location

Distribution of Frontal Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	1	2	0	346
0	21	9	0	6,266
1	43	35	0	13,881
2	25	22	0	4,530
3	34	24	0	3,348
4	15	14	2	912
5	9	17	0	764
6	8	36	0	315
Injured, Unk Sev	16	11	0	1,639

Table E 5 : Vehicle MAIS (VAIS)

Distribution of Frontal Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	64	44	0	20,147
VAIS 2-6	91	113	2	9,869
Injured, Unk Sev	16	11	0	1,639
Not Collected	0	0	0	0
Unk If Injured	1	2	0	346

Table E 6 : VAIS 2+

Distribution of Frontal Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	89	66	0	24,677
VAIS 3-6	66	91	2	5,339
Injured, Unk Sev	16	11	0	1,639
Not Collected	0	0	0	0
Unk If Injured	1	2	0	346

Table E 7 : VAIS 3+

Distribution of Frontal Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	30	42	1	2,198
Not Entrapped	135	117	1	29,421
Unknown	7	11	0	382

Table E 8 : Entrapment

APPENDIX

F. FRONTAL FIRE CASES, WEIGHTED

Distribution of Frontal Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	153	587	69
Vehicle Exterior	227	239	0
Exhaust System	66	6	0
Fuel Tank	0	236	0
Engine Compartment	21,909	14,905	0
Cargo / Trunk Area	20	943	0
Instrument Panel	147	97	0
Passenger Area	0	67	0
Other Location	93	117	0

Table F 9 : Fire Origin

Distribution of Frontal Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	20	149	28	93,573
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	6,812	2,158	41	3,018,680
Behind Rear Axle, Left Side	0	41	0	157,249
Behind Rear Axle, Right Side	0	308	0	151,253
Forward of Rear Axle, Centered	12,393	8,367	0	7,919,863
Forward of Rear Axle, Left Side	2,172	5,004	0	2,620,492
Forward of Rear Axle, Right Side	1,118	1,125	0	923,335
Over Center of Rear Wheels	99	5	0	167,494
Other	0	40	0	47,591

Table F 10 : Tank Location

Distribution of Frontal Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	12,218	9,972	69	11,170,000
Pickup	7,971	2,866	0	1,976,449
SUV	1,406	2,583	0	1,056,956
Van	1,020	1,777	0	900,980
Other	0	0	0	72

Table F 11 : Body Type

Distribution of Frontal Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	151	3,474	28
No Fuel Leakage	22,257	11,634	41
Tank	0	550	0
Filler Neck	0	188	0
Cap	0	0	0
Line/Pump/Filter	208	203	0
Other	0	1,148	0

Table F 12 : Leak Location

Distribution of Frontal Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	16	492	0	192,692
0	2,450	2,742	0	6,319,745
1	12,655	4,362	0	6,565,785
2	2,465	2,162	0	956,324
3	2,223	2,104	0	364,388
4	1,266	947	69	76,935
5	260	978	0	46,359
6	257	1,754	0	15,454
Injured, Unk Sev	1,022	1,656	0	561,850

Table F 13 : Vehicle MAIS (VAIS)

Distribution of Frontal Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	15,105	7,104	0	12,890,000
VAIS 2-6	6,472	7,946	69	1,459,460
Injured, Unk Sev	1,022	1,656	0	561,850
Not Collected	0	0	0	0
Unk If Injured	16	492	0	192,692

Table F 14 : VAIS 2+

Distribution of Frontal Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	17,571	9,266	0	13,840,000
VAIS 3-6	4,006	5,783	69	503,136
Injured, Unk Sev	1,022	1,656	0	561,850
Not Collected	0	0	0	0
Unk If Injured	16	492	0	192,692

Table F 15 : VAIS 3+

Distribution of Frontal Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	1,134	3,007	41	290,584
Not Entrapped	20,898	13,085	28	14,770,000
Unknown	584	1,105	0	35,409

Table F 16 : Entrapment

APPENDIX

G. SIDE FIRE CASES, UNWEIGHTED

Distribution of Side Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	1	2	1
Vehicle Exterior	1	0	0
Exhaust System	0	0	0
Fuel Tank	2	15	0
Engine Compartment	25	11	0
Cargo / Trunk Area	1	0	0
Instrument Panel	1	1	0
Passenger Area	0	1	0
Other Location	0	2	0

Table G 17 : Fire Origin

Distribution of Side Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	0	2	0	112
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	7	7	0	1,750
Behind Rear Axle, Left Side	0	1	0	91
Behind Rear Axle, Right Side	0	0	0	82
Forward of Rear Axle, Centered	21	9	1	5,354
Forward of Rear Axle, Left Side	3	9	0	1,278
Forward of Rear Axle, Right Side	0	2	0	402
Over Center of Rear Wheels	0	1	0	131
Other	0	1	0	27

Table G 18 : Tank Location

Distribution of Side Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	28	21	1	7,402
Pickup	1	11	0	761
SUV	1	0	0	527
Van	1	0	0	537
Other	0	0	0	0

Table G 19 : Body Type

Distribution of Side Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	3	6	0
No Fuel Leakage	26	8	1
Tank	2	9	0
Filler Neck	0	3	0
Cap	0	0	0
Line/Pump/Filter	0	1	0
Other	0	5	0

Table G 20 : Leak Location

Distribution of Side Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	0	0	0	71
0	0	3	0	1,537
1	8	5	0	3,520
2	5	0	0	1,246
3	5	5	1	1,046
4	3	3	0	579
5	4	4	0	571
6	2	12	0	208
Injured, Unk Sev	4	0	0	449

Table G 21 : Vehicle MAIS (VAIS)

Distribution of Side Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	8	8	0	5,057
VAIS 2-6	19	24	1	3,650
Injured, Unk Sev	4	0	0	449
Not Collected	0	0	0	0
Unk If Injured	0	0	0	71

Table G 22 : VAIS 2+

Distribution of Side Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	13	8	0	6,303
VAIS 3-6	14	24	1	2,404
Injured, Unk Sev	4	0	0	449
Not Collected	0	0	0	0
Unk If Injured	0	0	0	71

Table G 23 : VAIS 3+

Distribution of Side Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	11	9	1	1,263
Not Entrapped	19	21	0	7,788
Unknown	1	2	0	176

Table G 24 : Entrapment

APPENDIX

H. SIDE FIRE CASES, WEIGHTED

Distribution of Side Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	45	12	74
Vehicle Exterior	17	0	0
Exhaust System	0	0	0
Fuel Tank	185	879	0
Engine Compartment	1,522	1,147	0
Cargo / Trunk Area	802	0	0
Instrument Panel	45	48	0
Passenger Area	0	13	0
Other Location	0	50	0

Table H 25 : Fire Origin

Distribution of Side Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	0	93	0	34,054
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	648	480	0	872,753
Behind Rear Axle, Left Side	0	161	0	47,609
Behind Rear Axle, Right Side	0	0	0	32,959
Forward of Rear Axle, Centered	1,902	694	74	2,445,716
Forward of Rear Axle, Left Side	66	511	0	618,394
Forward of Rear Axle, Right Side	0	140	0	193,816
Over Center of Rear Wheels	0	23	0	70,794
Other	0	48	0	11,122

Table H 26 : Tank Location

Distribution of Side Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	2,548	1,532	74	3,437,927
Pickup	17	617	0	331,795
SUV	40	0	0	270,479
Van	11	0	0	287,016
Other	0	0	0	0

Table H 27 : Body Type

Distribution of Side Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	78	403	0
No Fuel Leakage	2,353	806	74
Tank	185	613	0
Filler Neck	0	163	0
Cap	0	0	0
Line/Pump/Filter	0	6	0
Other	0	158	0

Table H 28 : Leak Location

Distribution of Side Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	0	0	0	50,238
0	0	629	0	1,660,023
1	1,867	524	0	1,955,130
2	326	0	0	254,914
3	83	158	74	110,868
4	91	98	0	43,299
5	137	157	0	28,598
6	17	583	0	6,115
Injured, Unk Sev	95	0	0	218,033

Table H 29 : Vehicle MAIS (VAIS)

Distribution of Side Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	1,867	1,153	0	3,615,153
VAIS 2-6	654	996	74	443,794
Injured, Unk Sev	95	0	0	218,033
Not Collected	0	0	0	0
Unk If Injured	0	0	0	50,238

Table H 30 : VAIS 2+

Distribution of Side Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	2,193	1,153	0	3,870,068
VAIS 3-6	328	996	74	188,880
Injured, Unk Sev	95	0	0	218,033
Not Collected	0	0	0	0
Unk If Injured	0	0	0	50,238

Table H 31 : VAIS 3+

Distribution of Side Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	420	347	74	181,289
Not Entrapped	2,187	1,732	0	4,124,386
Unknown	9	71	0	21,544

Table H 32 : Entrapment

APPENDIX

I. REAR FIRE CASES, UNWEIGHTED

Distribution of Rear Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	1	3	0
Vehicle Exterior	2	2	0
Exhaust System	0	0	0
Fuel Tank	2	23	0
Engine Compartment	2	5	0
Cargo / Trunk Area	1	0	0
Instrument Panel	1	0	0
Passenger Area	0	0	0
Other Location	1	0	0

Table I 33 : Fire Origin

Distribution of Rear Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	2	1	0	55
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	3	18	0	625
Behind Rear Axle, Left Side	0	0	0	24
Behind Rear Axle, Right Side	1	0	0	25
Forward of Rear Axle, Centered	4	11	0	1,962
Forward of Rear Axle, Left Side	0	1	0	520
Forward of Rear Axle, Right Side	0	2	0	168
Over Center of Rear Wheels	0	0	0	57
Other	0	0	0	16

Table I 34 : Tank Location

Distribution of Rear Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	8	24	0	2,664
Pickup	0	1	0	347
SUV	0	4	0	226
Van	2	4	0	215
Other	0	0	0	0

Table I 35 : Body Type

Distribution of Rear Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	2	12	0
No Fuel Leakage	6	2	0
Tank	1	11	0
Filler Neck	1	4	0
Cap	0	0	0
Line/Pump/Filter	0	0	0
Other	0	4	0

Table I 36 : Leak Location

Distribution of Rear Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	0	0	0	28
0	1	3	0	872
1	2	5	0	1,903
2	2	3	0	214
3	2	3	0	104
4	0	0	0	47
5	1	3	0	50
6	1	11	0	18
Injured, Unk Sev	1	5	0	216

Table I 37 : Vehicle MAIS (VAIS)

Distribution of Rear Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	3	8	0	2,775
VAIS 2-6	6	20	0	433
Injured, Unk Sev	1	5	0	216
Not Collected	0	0	0	0
Unk If Injured	0	0	0	28

Table I 38 : VAIS 2+

Distribution of Rear Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	5	11	0	2,989
VAIS 3-6	4	17	0	219
Injured, Unk Sev	1	5	0	216
Not Collected	0	0	0	0
Unk If Injured	0	0	0	28

Table I 39 : VAIS 3+

Distribution of Rear Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	2	11	0	163
Not Entrapped	7	20	0	3,265
Unknown	1	2	0	24

Table I 40 : Entrapment

APPENDIX

J. REAR FIRE CASES, WEIGHTED

Distribution of Rear Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	24	100	0
Vehicle Exterior	169	166	0
Exhaust System	0	0	0
Fuel Tank	107	2,369	0
Engine Compartment	553	295	0
Cargo / Trunk Area	0	0	0
Instrument Panel	26	0	0
Passenger Area	0	0	0
Other Location	11	0	0

Table J 41 : Fire Origin

Distribution of Rear Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	557	21	0	28,921
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	77	2,266	0	365,443
Behind Rear Axle, Left Side	0	0	0	15,954
Behind Rear Axle, Right Side	169	0	0	8,889
Forward of Rear Axle, Centered	87	512	0	1,339,803
Forward of Rear Axle, Left Side	0	0	0	295,750
Forward of Rear Axle, Right Side	0	130	0	98,465
Over Center of Rear Wheels	0	0	0	28,839
Other	0	0	0	4,181

Table J 42 : Tank Location

Distribution of Rear Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	853	1,673	0	1,773,906
Pickup	0	110	0	170,106
SUV	0	948	0	99,093
Van	37	199	0	143,139
Other	0	0	0	0

Table J 43 : Body Type

Distribution of Rear Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	557	1,312	0
No Fuel Leakage	226	73	0
Tank	50	366	0
Filler Neck	57	974	0
Cap	0	0	0
Line/Pump/Filter	0	0	0
Other	0	206	0

Table J 44 : Leak Location

Distribution of Rear Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	0	0	0	12,857
0	0	57	0	921,949
1	37	1,082	0	1,049,572
2	169	158	0	64,233
3	77	179	0	8,247
4	0	0	0	4,226
5	50	883	0	3,138
6	24	436	0	597
Injured, Unk Sev	533	135	0	121,424

Table J 45 : Vehicle MAIS (VAIS)

Distribution of Rear Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	37	1,139	0	1,971,522
VAIS 2-6	319	1,656	0	80,441
Injured, Unk Sev	533	135	0	121,424
Not Collected	0	0	0	0
Unk If Injured	0	0	0	12,857

Table J 46 : VAIS 2+

Distribution of Rear Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	206	1,297	0	2,035,755
VAIS 3-6	151	1,497	0	16,208
Injured, Unk Sev	533	135	0	121,424
Not Collected	0	0	0	0
Unk If Injured	0	0	0	12,857

Table J 47 : VAIS 3+

Distribution of Rear Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	26	1,282	0	43,376
Not Entrapped	840	1,644	0	2,141,111
Unknown	24	4	0	1,758

Table J 48 : Entrapment

APPENDIX

K. OTHER FIRE CASES, UNWEIGHTED

Distribution of Other Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	0	8	1
Vehicle Exterior	0	0	0
Exhaust System	0	0	0
Fuel Tank	1	10	0
Engine Compartment	8	10	0
Cargo / Trunk Area	0	0	0
Instrument Panel	0	0	0
Passenger Area	0	0	0
Other Location	0	2	0

Table K 49 : Fire Origin

Distribution of Other Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	0	6	1	14,134
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	3	6	0	860
Behind Rear Axle, Left Side	0	0	0	48
Behind Rear Axle, Right Side	0	0	0	42
Forward of Rear Axle, Centered	5	9	0	2,231
Forward of Rear Axle, Left Side	1	7	0	943
Forward of Rear Axle, Right Side	0	0	0	241
Over Center of Rear Wheels	0	1	0	63
Other	0	1	0	13

Table K 50 : Tank Location

Distribution of Other Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	7	20	1	13,046
Pickup	0	8	0	2,669
SUV	0	0	0	1,473
Van	2	2	0	1,383
Other	0	0	0	4

Table K 51 : Body Type

Distribution of Other Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	1	11	1
No Fuel Leakage	7	6	0
Tank	0	4	0
Filler Neck	1	2	0
Cap	0	0	0
Line/Pump/Filter	0	3	0
Other	0	4	0

Table K 52 : Leak Location

Distribution of Other Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	0	0	0	325
0	4	3	0	6,364
1	2	5	0	6,379
2	0	1	0	1,614
3	0	2	0	1,044
4	0	1	0	313
5	2	1	0	292
6	1	16	0	122
Injured, Unk Sev	0	1	1	2,122

Table K 53 : Vehicle MAIS (VAIS)

Distribution of Other Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	6	8	0	12,743
VAIS 2-6	3	21	0	3,385
Injured, Unk Sev	0	1	1	2,122
Not Collected	0	0	0	0
Unk If Injured	0	0	0	325

Table K 54 : VAIS 2+

Distribution of Other Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	6	9	0	14,357
VAIS 3-6	3	20	0	1,771
Injured, Unk Sev	0	1	1	2,122
Not Collected	0	0	0	0
Unk If Injured	0	0	0	325

Table K 55 : VAIS 3+

Distribution of Other Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	2	7	0	482
Not Entrapped	7	22	1	14,397
Unknown	0	1	0	3,696

Table K 56 : Entrapment

APPENDIX

L. OTHER FIRE CASES, WEIGHTED

Distribution of Other Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	0	835	39
Vehicle Exterior	0	0	0
Exhaust System	0	0	0
Fuel Tank	8	1,342	0
Engine Compartment	4,446	1,617	0
Cargo / Trunk Area	0	0	0
Instrument Panel	0	0	0
Passenger Area	0	0	0
Other Location	0	1,099	0

Table L 57 : Fire Origin

Distribution of Other Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)				
Tank Location	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Unknown	0	310	39	8,398,271
No Fuel Tank	0	0	0	0
Behind Rear Axle, Centered	74	418	0	547,516
Behind Rear Axle, Left Side	0	0	0	32,770
Behind Rear Axle, Right Side	0	0	0	23,200
Forward of Rear Axle, Centered	3,729	2,087	0	1,632,878
Forward of Rear Axle, Left Side	651	1,943	0	602,880
Forward of Rear Axle, Right Side	0	0	0	191,475
Over Center of Rear Wheels	0	0	0	36,368
Other	0	135	0	11,874

Table L 58 : Tank Location

Distribution of Other Fire Cases By Body Type (NASS/CDS 1994/2004)				
Body Type	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Passenger Car	3,803	3,589	39	8,106,971
Pickup	0	1,250	0	1,699,932
SUV	0	0	0	861,049
Van	651	54	0	808,826
Other	0	0	0	455

Table L 59 : Body Type

Distribution of Other Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)			
Leak Location	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown	0	902	39
No Fuel Leakage	4,446	2,347	0
Tank	0	219	0
Filler Neck	8	1,026	0
Cap	0	0	0
Line/Pump/Filter	0	231	0
Other	0	169	0

Table L 60 : Leak Location

Distribution of Other Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)				
Maximum Vehicle AIS	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Not Collected	0	0	0	0
Unk If Injured	0	0	0	271,191
0	4,197	387	0	6,634,758
1	198	1,915	0	2,996,757
2	0	104	0	325,080
3	0	811	0	106,711
4	0	43	0	29,302
5	58	18	0	18,103
6	0	1,479	0	5,632
Injured, Unk Sev	0	135	39	1,089,701

Table L 61 : Vehicle MAIS (VAIS)

Distribution of Other Fire Cases By Vehicle VAIS 2+ (NASS/CDS 1994/2004)				
VAIS 2+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-1	4,395	2,303	0	9,631,515
VAIS 2-6	58	2,456	0	484,827
Injured, Unk Sev	0	135	39	1,089,701
Not Collected	0	0	0	0
Unk If Injured	0	0	0	271,191

Table L 62 : VAIS 2+

Distribution of Other Fire Cases By Vehicle VAIS 3+ (NASS/CDS 1994/2004)				
VAIS 3+	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
VAIS 0-2	4,395	2,407	0	9,956,595
VAIS 3-6	58	2,352	0	159,747
Injured, Unk Sev	0	135	39	1,089,701
Not Collected	0	0	0	0
Unk If Injured	0	0	0	271,191

Table L 63 : VAIS 3+

Distribution of Other Fire Cases By Entrapment (NASS/CDS 1994/2004)				
Entrapment	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Entrapped	186	789	0	87,091
Not Entrapped	4,268	3,633	39	9,784,937
Unknown	0	471	0	1,605,205

Table L 64 : Entrapment

APPENDIX

M. ROLLOVER, ENGINE COMPARTMENT FIRE CASES, UNWEIGHTED

Distribution of Engine Compartment Fire Cases By Crash Mode (NASS/CDS 1994/2004)		
Crash Mode	By Fire Type	
	Minor Fire	Major Fire
Frontal	157	134
Side	25	11
Rear	2	5
Rollover	53	38
Others	8	10

Table M 1 : Summary Distribution

Distribution of Rollover / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	2	1
No Fuel Tank	0	0
Behind Rear Axle, Centered	12	10
Behind Rear Axle, Left Side	1	0
Behind Rear Axle, Right Side	1	0
Forward of Rear Axle, Centered	22	14
Forward of Rear Axle, Left Side	14	11
Forward of Rear Axle, Right Side	1	1
Over Center of Rear Wheels	0	1
Other	0	0

Table M 2 : Tank Location

Distribution of Rollover / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	28	18
Pickup	10	10
SUV	8	7
Van	7	3
Other	0	0

Table M 3 : Body Type

Distribution of Rollover / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	8	10
No Fuel Leakage	41	22
Tank	1	0
Filler Neck	1	0
Cap	0	2
Line/Pump/Filter	1	2
Other	1	2

Table M 4 : Leak Location

Distribution of Rollover / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	2	1
0	2	1
1	6	9
2	10	6
3	9	7
4	8	2
5	6	6
6	4	2
Injured, Unk Sev	6	4

Table M 5 : Vehicle MAIS (VAIS)

Distribution of Rollover / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	8	10
VAIS 2-6	37	23
Injured, Unk Sev	6	4
Not Collected	0	0
Unknown if Injured	2	1

Table M 6 : VAIS 2+

Distribution of Rollover / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	18	16
VAIS 3-6	27	17
Injured, Unk Sev	6	4
Not Collected	0	0
Unknown if Injured	2	1

Table M 7 : VAIS 3+

Distribution of Rollover / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	16	7
Not Entrapped	35	30
Unknown	2	1

Table M 8 : Entrapment

Distribution of Rollover / Engine Compartment Fire Cases By Trip Location (NASS/CDS 1994/2004)		
Trip Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	1	2
Wheels / Tires	20	18
Side Plane	5	3
End Plane	8	4
Undercarriage	12	8
Other Loc On Veh	0	0
Non-Contact Force	5	2
End-Over-End	2	1

Table M 9 : Trip Location

Distribution of Rollover / Engine Compartment Fire Cases By Number of Quarter Turns (NASS/CDS 1994/2004)		
Number of Quarter Turns	By Fire Type	
	Minor Fire	Major Fire
Details Unknown	1	2
1	18	3
2	16	9
3	1	0
4	6	13
5	0	1
6	2	4
7	1	1
8	3	2
9	0	1
10	0	1
11	0	0
12	2	1
13	0	0
14	0	0
15	0	0
16	1	0
> 16	0	0
End-Over-End	2	0

Table M 10 : Number of Quarter Turns

Distribution of Rollover / Engine Compartment Fire Cases By Final Rest Position (NASS/CDS 1994/2004)		
Position	By Fire Type	
	Minor Fire	Major Fire
> 16 Quarter Turns	0	0
End-Over-End	2	0
Roof	18	14
Side	20	6
Unknown	1	2
Wheels	12	16

Table M 11 : Final Rest Position

APPENDIX

N. ROLLOVER, ENGINE COMPARTMENT FIRE CASES, WEIGHTED

Distribution of Engine Compartment Fire Cases By Crash Mode (NASS/CDS 1994/2004)		
Crash Mode	By Fire Type	
	Minor Fire	Major Fire
Frontal	21,909	14,905
Side	1,522	1,147
Rear	553	295
Rollover	6,776	5,209
Others	4,446	1,617

Table N 12 : Summary Distribution

Distribution of Rollover / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	65	125
No Fuel Tank	0	0
Behind Rear Axle, Centered	4,155	486
Behind Rear Axle, Left Side	18	0
Behind Rear Axle, Right Side	40	0
Forward of Rear Axle, Centered	1,353	1,307
Forward of Rear Axle, Left Side	1,076	1,166
Forward of Rear Axle, Right Side	69	2,075
Over Center of Rear Wheels	0	50
Other	0	0

Table N 13 : Tank Location

Distribution of Rollover / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	28	18
Pickup	10	10
SUV	8	7
Van	7	3
Other	0	0

Table N 14 : Body Type

Distribution of Rollover / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	728	634
No Fuel Leakage	5,889	4,197
Tank	0	0
Filler Neck	61	0
Cap	0	83
Line/Pump/Filter	33	82
Other	65	213

Table N 15 : Leak Location

Distribution of Rollover / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	2,948	0
1	1,311	3,180
2	413	771
3	281	496
4	324	103
5	310	166
6	597	120
Injured, Unk Sev	591	372

Table N 16 : Vehicle MAIS (VAIS)

Distribution of Rollover / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	4,259	3,180
VAIS 2-6	1,926	1,656
Injured, Unk Sev	591	372
Not Collected	0	0
Unknown if Injured	0	0

Table N 17 : VAIS 2+

Distribution of Rollover / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	4,672	3,951
VAIS 3-6	1,513	885
Injured, Unk Sev	591	372
Not Collected	0	0
Unknown if Injured	0	0

Table N 18 : VAIS 3+

Distribution of Rollover / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	675	336
Not Entrapped	5,983	4,787
Unknown	119	86

Table N 19 : Entrapment

Distribution of Rollover / Engine Compartment Fire Cases By Trip Location (NASS/CDS 1994/2004)		
Trip Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	84	467
Wheels / Tires	1,977	1,671
Side Plane	465	59
End Plane	344	217
Undercarriage	820	2,631
Other Loc On Veh	0	0
Non-Contact Force	3,032	78
End-Over-End	55	86

Table N 20 : Trip Location

Distribution of Rollover / Engine Compartment Fire Cases By Number of Quarter Turns (NASS/CDS 1994/2004)		
Number of Quarter Turns	By Fire Type	
	Minor Fire	Major Fire
Details Unknown	84	467
1	4,313	111
2	807	624
3	68	0
4	855	1,270
5	0	11
6	158	2,194
7	150	50
8	101	313
9	0	57
10	0	34
11	0	0
12	131	78
13	0	0
14	0	0
15	0	0
16	54	0
> 16	0	0
End-Over-End	55	0

Table N 21 : Number of Quarter Turns

Distribution of Rollover / Engine Compartment Fire Cases By Final Rest Position (NASS/CDS 1994/2004)		
Position	By Fire Type	
	Minor Fire	Major Fire
> 16 Quarter Turns	0	0
End-Over-End	55	0
Roof	965	2,852
Side	4,531	229
Unknown	84	467
Wheels	1,141	1,661

Table N 22 : Final Rest Position

APPENDIX

O. FRONTAL, ENGINE COMPARTMENT FIRE CASES, UNWEIGHTED

Distribution of Frontal / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	0	2
No Fuel Tank	0	0
Behind Rear Axle, Centered	45	30
Behind Rear Axle, Left Side	0	1
Behind Rear Axle, Right Side	1	1
Forward of Rear Axle, Centered	84	61
Forward of Rear Axle, Left Side	17	26
Forward of Rear Axle, Right Side	8	12
Over Center of Rear Wheels	2	1
Other	0	0

Table O 1 : Tank Location

Distribution of Frontal / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	122	89
Pickup	13	23
SUV	11	12
Van	11	10
Other	0	0

Table O 2 : Body Type

Distribution of Frontal / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	5	25
No Fuel Leakage	150	96
Tank	0	3
Filler Neck	0	2
Cap	0	0
Line/Pump/Filter	2	6
Other	0	2

Table O 3 : Leak Location

Distribution of Frontal / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	1	1
0	19	5
1	43	29
2	21	19
3	29	20
4	13	10
5	8	13
6	8	30
Injured, Unk Sev	15	7

Table O 4 : Vehicle MAIS (VAIS)

Distribution of Frontal / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	62	34
VAIS 2-6	79	92
Injured, Unk Sev	15	7
Not Collected	0	0
Unknown if Injured	1	1

Table O 5 : VAIS 2+

Distribution of Frontal / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	83	53
VAIS 3-6	58	73
Injured, Unk Sev	15	7
Not Collected	0	0
Unknown if Injured	1	1

Table O 6 : VAIS 3+

Distribution of Frontal / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	27	34
Not Entrapped	123	90
Unknown	7	10

Table O 7 : Entrapment

APPENDIX

P. FRONTAL, ENGINE COMPARTMENT FIRE CASES, WEIGHTED

Distribution of Frontal / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	0	21
No Fuel Tank	0	0
Behind Rear Axle, Centered	6,812	1,640
Behind Rear Axle, Left Side	0	41
Behind Rear Axle, Right Side	0	308
Forward of Rear Axle, Centered	11,921	7,075
Forward of Rear Axle, Left Side	1,995	4,747
Forward of Rear Axle, Right Side	1,081	1,069
Over Center of Rear Wheels	99	5
Other	0	0

Table P 2 : Tank Location

Distribution of Frontal / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	11,602	8,159
Pickup	7,950	2,493
SUV	1,337	2,571
Van	1,020	1,681
Other	0	0

Table P 2 : Body Type

Distribution of Frontal / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	131	2,857
No Fuel Leakage	21,571	11,172
Tank	0	349
Filler Neck	0	119
Cap	0	0
Line/Pump/Filter	208	203
Other	0	205

Table P 3 : Leak Location

Distribution of Frontal / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	16	492
0	2,418	2,649
1	12,655	3,826
2	2,322	2,149
3	1,925	1,962
4	1,122	791
5	194	793
6	257	1,617
Injured, Unk Sev	1,001	625

Table P 4 : Vehicle MAIS (VAIS)

Distribution of Frontal / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	15,073	6,475
VAIS 2-6	5,819	7,313
Injured, Unk Sev	1,001	625
Not Collected	0	0
Unknown if Injured	16	492

Table P 5 : VAIS 2+

Distribution of Frontal / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	17,395	8,623
VAIS 3-6	3,497	5,164
Injured, Unk Sev	1,001	625
Not Collected	0	0
Unknown if Injured	16	492

Table P 6 : VAIS 3+

Distribution of Frontal / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	949	2,643
Not Entrapped	20,377	11,179
Unknown	584	1,082

Table P 7 : Entrapment

APPENDIX

Q. SIDE, ENGINE COMPARTMENT FIRE CASES, UNWEIGHTED

Distribution of Side / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	0	1
No Fuel Tank	0	0
Behind Rear Axle, Centered	5	5
Behind Rear Axle, Left Side	0	0
Behind Rear Axle, Right Side	0	0
Forward of Rear Axle, Centered	18	1
Forward of Rear Axle, Left Side	2	3
Forward of Rear Axle, Right Side	0	1
Over Center of Rear Wheels	0	0
Other	0	0

Table Q 3 : Tank Location

Distribution of Side / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	24	6
Pickup	0	5
SUV	1	0
Van	0	0
Other	0	0

Table Q 2 : Body Type

Distribution of Side / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	2	2
No Fuel Leakage	23	6
Tank	0	0
Filler Neck	0	0
Cap	0	0
Line/Pump/Filter	0	1
Other	0	2

Table Q 3 : Leak Location

Distribution of Side / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	0	1
1	6	3
2	5	0
3	3	3
4	2	1
5	4	1
6	2	2
Injured, Unk Sev	3	0

Table Q 4 : Vehicle MAIS (VAIS)

Distribution of Side / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	6	4
VAIS 2-6	16	7
Injured, Unk Sev	3	0
Not Collected	0	0
Unknown if Injured	0	0

Table Q 5 : VAIS 2+

Distribution of Side / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	11	4
VAIS 3-6	11	7
Injured, Unk Sev	3	0
Not Collected	0	0
Unknown if Injured	0	0

Table Q 6 : VAIS 3+

Distribution of Side / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	8	5
Not Entrapped	16	6
Unknown	1	0

Table Q 7 : Entrapment

APPENDIX

R. SIDE, ENGINE COMPARTMENT FIRE CASES, WEIGHTED

Distribution of Side / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	0	51
No Fuel Tank	0	0
Behind Rear Axle, Centered	463	438
Behind Rear Axle, Left Side	0	0
Behind Rear Axle, Right Side	0	0
Forward of Rear Axle, Centered	1,010	495
Forward of Rear Axle, Left Side	49	104
Forward of Rear Axle, Right Side	0	60
Over Center of Rear Wheels	0	0
Other	0	0

Table R 4 : Tank Location

Distribution of Side / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	1,481	956
Pickup	0	191
SUV	40	0
Van	0	0
Other	0	0

Table R 2 : Body Type

Distribution of Side / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	33	313
No Fuel Leakage	1,489	758
Tank	0	0
Filler Neck	0	0
Cap	0	0
Line/Pump/Filter	0	6
Other	0	70

Table R 3 : Leak Location

Distribution of Side / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	0	495
1	891	322
2	326	0
3	55	110
4	46	51
5	137	27
6	17	142
Injured, Unk Sev	50	0

Table R 4 : Vehicle MAIS (VAIS)

Distribution of Side / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	891	816
VAIS 2-6	581	331
Injured, Unk Sev	50	0
Not Collected	0	0
Unknown if Injured	0	0

Table R 5 : VAIS 2+

Distribution of Side / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	1,217	816
VAIS 3-6	255	331
Injured, Unk Sev	50	0
Not Collected	0	0
Unknown if Injured	0	0

Table R 6 : VAIS 3+

Distribution of Side / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	183	190
Not Entrapped	1,329	958
Unknown	9	0

Table R 7 : Entrapment

APPENDIX

S. REAR, ENGINE COMPARTMENT FIRE CASES, UNWEIGHTED

Distribution of Rear / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	1	0
No Fuel Tank	0	0
Behind Rear Axle, Centered	1	2
Behind Rear Axle, Left Side	0	0
Behind Rear Axle, Right Side	0	0
Forward of Rear Axle, Centered	0	3
Forward of Rear Axle, Left Side	0	0
Forward of Rear Axle, Right Side	0	0
Over Center of Rear Wheels	0	0
Other	0	0

Table S 5 : Tank Location

Distribution of Rear / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	2	4
Pickup	0	0
SUV	0	1
Van	0	0
Other	0	0

Table S 2 : Body Type

Distribution of Rear / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	1	2
No Fuel Leakage	1	2
Tank	0	1
Filler Neck	0	0
Cap	0	0
Line/Pump/Filter	0	0
Other	0	0

Table S 3 : Leak Location

Distribution of Rear / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	0	0
1	0	2
2	0	0
3	1	1
4	0	0
5	0	0
6	0	2
Injured, Unk Sev	1	0

Table S 4 : Vehicle MAIS (VAIS)

Distribution of Rear / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	0	2
VAIS 2-6	1	3
Injured, Unk Sev	1	0
Not Collected	0	0
Unknown if Injured	0	0

Table S 5 : VAIS 2+

Distribution of Rear / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	0	2
VAIS 3-6	1	3
Injured, Unk Sev	1	0
Not Collected	0	0
Unknown if Injured	0	0

Table S 6 : VAIS 3+

Distribution of Rear / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	0	1
Not Entrapped	2	4
Unknown	0	0

Table S 7 : Entrapment

APPENDIX

T. REAR, ENGINE COMPARTMENT FIRE CASES, WEIGHTED

Distribution of Rear / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	533	0
No Fuel Tank	0	0
Behind Rear Axle, Centered	20	232
Behind Rear Axle, Left Side	0	0
Behind Rear Axle, Right Side	0	0
Forward of Rear Axle, Centered	0	63
Forward of Rear Axle, Left Side	0	0
Forward of Rear Axle, Right Side	0	0
Over Center of Rear Wheels	0	0
Other	0	0

Table T 6 : Tank Location

Distribution of Rear / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	553	222
Pickup	0	0
SUV	0	73
Van	0	0
Other	0	0

Table T 2 : Body Type

Distribution of Rear / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	533	63
No Fuel Leakage	20	73
Tank	0	159
Filler Neck	0	0
Cap	0	0
Line/Pump/Filter	0	0
Other	0	0

Table T 3 : Leak Location

Distribution of Rear / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	0	0
1	0	73
2	0	0
3	20	159
4	0	0
5	0	0
6	0	63
Injured, Unk Sev	533	0

Table T 4 : Vehicle MAIS (VAIS)

Distribution of Rear / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	0	73
VAIS 2-6	20	222
Injured, Unk Sev	533	0
Not Collected	0	0
Unknown if Injured	0	0

Table T 5 : VAIS 2+

Distribution of Rear / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	0	73
VAIS 3-6	20	222
Injured, Unk Sev	533	0
Not Collected	0	0
Unknown if Injured	0	0

Table T 6 : VAIS 3+

Distribution of Rear / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	0	43
Not Entrapped	553	252
Unknown	0	0

Table T 7 : Entrapment

APPENDIX

U. OTHER, ENGINE COMPARTMENT FIRE CASES, UNWEIGHTED

Distribution of Other / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	0	0
No Fuel Tank	0	0
Behind Rear Axle, Centered	2	3
Behind Rear Axle, Left Side	0	0
Behind Rear Axle, Right Side	0	0
Forward of Rear Axle, Centered	5	2
Forward of Rear Axle, Left Side	1	5
Forward of Rear Axle, Right Side	0	0
Over Center of Rear Wheels	0	0
Other	0	0

Table U 7 : Tank Location

Distribution of Other / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	6	6
Pickup	0	3
SUV	0	0
Van	2	1
Other	0	0

Table U 2 : Body Type

Distribution of Other / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	1	2
No Fuel Leakage	7	5
Tank	0	0
Filler Neck	0	0
Cap	0	0
Line/Pump/Filter	0	2
Other	0	1

Table U 3 : Leak Location

Distribution of Other / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	4	1
1	2	2
2	0	1
3	0	1
4	0	0
5	1	1
6	1	4
Injured, Unk Sev	0	0

Table U 4 : Vehicle MAIS (VAIS)

Distribution of Other / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	6	3
VAIS 2-6	2	7
Injured, Unk Sev	0	0
Not Collected	0	0
Unknown if Injured	0	0

Table U 5 : VAIS 2+

Distribution of Other / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	6	4
VAIS 3-6	2	6
Injured, Unk Sev	0	0
Not Collected	0	0
Unknown if Injured	0	0

Table U 6 : VAIS 3+

Distribution of Other / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	2	1
Not Entrapped	6	9
Unknown	0	0

Table U 7 : Entrapment

APPENDIX

V. OTHER, ENGINE COMPARTMENT FIRE CASES, WEIGHTED

Distribution of Other / Engine Compartment Fire Cases By Fuel Tank Location (NASS/CDS 1994/2004)		
Tank Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	0	0
No Fuel Tank	0	0
Behind Rear Axle, Centered	66	87
Behind Rear Axle, Left Side	0	0
Behind Rear Axle, Right Side	0	0
Forward of Rear Axle, Centered	3,729	104
Forward of Rear Axle, Left Side	651	1,426
Forward of Rear Axle, Right Side	0	0
Over Center of Rear Wheels	0	0
Other	0	0

Table V 8 : Tank Location

Distribution of Other / Engine Compartment Fire Cases By Body Type (NASS/CDS 1994/2004)		
Body Type	By Fire Type	
	Minor Fire	Major Fire
Passenger Car	3,795	984
Pickup	0	578
SUV	0	0
Van	0	54
Other	651	0

Table V 2 : Body Type

Distribution of Other / Engine Compartment Fire Cases By Fuel Leak Location (NASS/CDS 1994/2004)		
Leak Location	By Fire Type	
	Minor Fire	Major Fire
Unknown	0	54
No Fuel Leakage	4,446	1,268
Tank	0	0
Filler Neck	0	0
Cap	0	0
Line/Pump/Filter	0	191
Other	0	104

Table V 3 : Leak Location

Distribution of Other / Engine Compartment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	4,197	387
1	198	37
2	0	104
3	0	811
4	0	0
5	50	18
6	0	259
Injured, Unk Sev	0	0

Table V 4 : Vehicle MAIS (VAIS)

Distribution of Other / Engine Compartment Fire Cases By Vehicle MAIS 2+ (NASS/CDS 1994/2004)		
VAIS 2+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-1	4,395	424
VAIS 2-6	50	1,193
Injured, Unk Sev	0	0
Not Collected	0	0
Unknown if Injured	0	0

Table V 5 : VAIS 2+

Distribution of Other / Engine Compartment Fire Cases By Vehicle MAIS 3+ (NASS/CDS 1994/2004)		
VAIS 3+	By Fire Type	
	Minor Fire	Major Fire
VAIS 0-2	4,395	528
VAIS 3-6	50	1,089
Injured, Unk Sev	0	0
Not Collected	0	0
Unknown if Injured	0	0

Table V 6 : VAIS 3+

Distribution of Other / Engine Compartment Fire Cases By Entrapment (NASS/CDS 1994/2004)		
Entrapment	By Fire Type	
	Minor Fire	Major Fire
Entrapped	186	173
Not Entrapped	4,260	1,444
Unknown	0	0

Table V 7 : Entrapment

APPENDIX

W. FATAL FIRES (UNWEIGHTED AND WEIGHTED)

Distribution of Vehicle Fires with Fatality (NASS/CDS 1994/2004)				
Count	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Total Cases Recorded	59	127	1	4,454
Average Annual Cases	5	12	0	405

Table W 1 : Vehicle Fatality Distribution (unweighted)

Distribution of Vehicle Fires with Fatality By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	26	60	1	1,550
Side	8	15	0	987
Rear	1	13	0	97
Rollover	22	21	0	1,246
Other	2	18	0	574

Table W 2: Crash Mode (unweighted)

Distribution of Vehicle Fires with Fatality By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	2	13	1
Vehicle Exterior	0	2	0
Exhaust System	1	0	0
Fuel Tank	2	42	0
Engine Compartment	51	64	0
Cargo / Trunk Area	1	0	0
Instrument Panel	2	0	0
Passenger Area	0	2	0
Other Location	0	4	0

Table W 3 : Fire Origin (unweighted)

Distribution of Vehicle Fires with Fatality By Cause of Injury (NASS/CDS 1994/2004)		
Cause	By Fire Type	
	Minor Fire	Major Fire
Fire	2	67
Crash	54	44
Either	0	11
Unknown	3	5

Table W 4 : Cause of Fatality (unweighted)

Distribution of Vehicle Fires with Fatality (NASS/CDS 1994/2004)				
Count	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Total Cases Recorded	3,474	7,448	41	252,965
Average Annual Cases	316	677	4	22,997

Table W 5 : Vehicle Fatality Distribution (weighted)

Distribution of Vehicle Fires with Fatality By Crash Mode (NASS/CDS 1994/2004)				
Crash Mode	By Fire Type			
	Minor Fire	Major Fire	Unk. Extent	No Fire
Frontal	1,610	3,008	41	87,276
Side	252	685	0	48,843
Rear	24	481	0	5,550
Rollover	1,580	1,644	0	79,391
Other	8	1,632	0	31,905

Table W 6: Crash Mode (weighted)

Distribution of Vehicle Fires with Fatality By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	36	1,331	41
Vehicle Exterior	0	200	0
Exhaust System	142	0	0
Fuel Tank	46	2,517	0
Engine Compartment	3,144	3,229	0
Cargo / Trunk Area	20	0	0
Instrument Panel	86	0	0
Passenger Area	0	61	0
Other Location	0	110	0

Table W 7 : Fire Origin (weighted)

Distribution of Vehicle Fires with Fatality By Cause of Injury (NASS/CDS 1994/2004)		
Cause	By Fire Type	
	Minor Fire	Major Fire
Fire	476	4,477
Crash	2,891	2,329
Either	0	446
Unknown	108	196

Table W 8 : Cause of Fatality (unweighted)

APPENDIX

X. ROLLOVER ENTRAPMENT FIRES (UNWEIGHTED AND WEIGHTED)

Distribution of Rollover / Entrapment Fire Cases (NASS/CDS 1994/2004)			
Count	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Total Cases Recorded	20	14	1
Average Annual Cases	2	1	0

Table X 1 : Vehicle Distribution (unweighted)

Distribution of Rollover / Entrapment Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	2	2	1
Vehicle Exterior	0	0	0
Exhaust System	0	0	0
Fuel Tank	0	5	0
Engine Compartment	16	7	0
Cargo / Trunk Area	1	0	0
Instrument Panel	1	0	0
Passenger Area	0	0	0
Other Location	0	0	0

Table X 2: Fire Origin (unweighted)

Distribution of Rollover / Entrapment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	0	0
1	2	2
2	3	2
3	7	2
4	4	1
5	2	2
6	2	3
Injured, Unk Sev	0	2

Table X 3 : VAIS (unweighted)

Distribution of Rollover / Entrapment Fire Cases By Cause of Injury (NASS/CDS 1994/2004)		
Cause	By Fire Type	
	Minor Fire	Major Fire
Fire	1	4
Crash	18	7

Table X 4 : Cause of Fatality (unweighted)

Distribution of Rollover / Entrapment Fire Cases (NASS/CDS 1994/2004)			
Count	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Total Cases Recorded	899	723	5
Average Annual Cases	82	66	0

Table X 5 : Vehicle Distribution (weighted)

Distribution of Rollover / Entrapment Fire Cases By Fire Origin (NASS/CDS 1994/2004)			
Fire Origin	By Fire Type		
	Minor Fire	Major Fire	Unk. Extent
Unknown Origin	51	248	5
Vehicle Exterior	0	0	0
Exhaust System	0	0	0
Fuel Tank	0	139	0
Engine Compartment	675	336	0
Cargo / Trunk Area	132	0	0
Instrument Panel	41	0	0
Passenger Area	0	0	0
Other Location	0	0	0

Table X 6: Fire Origin (weighted)

Distribution of Rollover / Entrapment Fire Cases By Vehicle MAIS (NASS/CDS 1994/2004)		
Maximum Vehicle AIS	By Fire Type	
	Minor Fire	Major Fire
Not Collected	0	0
Unk If Injured	0	0
0	0	0
1	186	13
2	171	93
3	243	123
4	149	193
5	49	74
6	101	162
Injured, Unk Sev	0	65

Table X 7 : VAIS (weighted)

Distribution of Rollover / Entrapment Fire Cases By Cause of Injury (NASS/CDS 1994/2004)		
Cause	By Fire Type	
	Minor Fire	Major Fire
Fire	41	202
Crash	825	491

Table X 8 : Cause of Fatality (unweighted)

APPENDIX

Y. VAIS, DAMAGE EXTENT AND CRASH MODE VS. ORIGIN DISTRIBUTIONS (UNWEIGHTED AND WEIGHTED)

Vehicle MAIS Comparison / All vs. Fire vs. Fire and Entrapment (NASS CDS 1994-2004)			
Vehicle MAIS	Population		
	All Vehicle	Fire Vehicles	Fire Vehicles with Entrapment
Not Collected	0	0	0
Unk If Injured	817	6	2
Not Injured	15612	49	1
Minor Injury	28563	128	12
Moderate Injury	9036	81	17
Serious Injury	6688	103	29
Severe Injury	2447	53	16
Critical Injury	2219	57	16
Maximum Injury	857	102	48
Injured, Unk Sev	4862	52	10

Table Y 1 : Vehicle MAIS Distributions (unweighted)

Deformation Extent Comparison / All vs. Fire vs. Fire and Entrapment (NASS CDS 1994-2004)			
Extent of Damage	Population		
	All Vehicle	Fire Vehicles	Fire Vehicles with Entrapment
No CDC	15099	0	0
Unknown	6652	801	19
1	11096	42	0
2	16193	119	7
3	12192	139	19
4	4674	85	27
5	1957	59	28
6	1579	50	24
7	569	34	16
8	310	6	4
9	780	17	7

Table Y 2: Damage Extent Distributions (unweighted)

Distribution of Fire Origin vs. Crash Mode (NASS/CDS 1994-2004)					
Fire Origin	Crash Mode				
	Frontal	Side	Rear	Rollover	Other
Unknown Origin	12	4	4	11	9
Veicle Exterior	10	1	4	0	0
Exhaust System	3	0	0	1	0
Fuel Tank	10	17	25	26	11
Engine Compartment	291	36	7	91	18
Cargo / Trunk Area	2	1	1	1	0
Instrument Panel	5	2	1	5	0
Passenger Area	3	1	0	2	0
Other Location	8	2	1	3	2

Table Y 3 : CRASH MODE vs. ORIGIN (unweighted)

Vehicle MAIS Comparison / All vs. Fire vs. Fire and Entrapment (NASS CDS 1994-2004)			
Vehicle MAIS	Population		
	All Vehicle	Fire Vehicles	Fire Vehicles with Entrapment
Not Collected	0	0	0
Unk If Collected	574219	508	508
Not Injured	16375663	19758	12
Minor Injury	13876195	27607	1012
Moderate Injury	1890688	6915	885
Serious Injury	725981	6901	1086
Severe Injury	206716	3316	752
Critical Injury	129462	3228	1409
Maximum Injury	35711	6430	2944
Injured, Unk Sev	2140725	4691	323

Table Y 4 : Vehicle MAIS Distributions (weighted)

Deformation Extent Comparison / All vs. Fire vs. Fire and Entrapment (NASS CDS 1994-2004)			
Extent of Damage	Population		
	All Vehicle	Fire Vehicles	Fire Vehicles with Entrapment
No CDC	8786578	0	0
Unknown	4352823	13674	999
1	7892122	4789	0
2	8048001	23616	339
3	4218213	14007	1188
4	1138919	5799	1566
5	478213	4750	2222
6	487330	3859	1650
7	173631	7266	590
8	95858	353	214
9	283673	1240	164

Table Y 5: Damage Extent Distributions (weighted)

Distribution of Fire Origin vs. Crash Mode (NASS/CDS 1994-2004)					
Fire Origin	Crash Mode				
	Frontal	Side	Rear	Rollover	Other
Unknown Origin	809	131	124	700	873
Veicle Exterior	466	17	334	0	0
Exhaust System	72	0	0	142	0
Fuel Tank	236	1064	2477	5201	1350
Engine Compartment	36814	2669	847	11985	6062
Cargo / Trunk Area	963	802	0	132	0
Instrument Panel	244	93	26	3122	0
Passenger Area	67	13	0	65	0
Other Location	210	50	11	82	1099

Table Y 6 : CRASH MODE vs. ORIGIN (weighted)