Final Report:

A FURTHER ANALYSIS OF FIRE OCCURRENCE AND ROLLOVER RATES IN THE FATALITY ANALYSIS REPORTING SYSTEM (FARS)

Study Conducted for:
The Motor Vehicle Fire Research Institute

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Table of Contents

List of Tables

List of Figures

BACKGROUND

The Fatality Analysis Reporting System (FARS) is one of the most important and frequently used data systems on traffic crash related deaths in the world. Initiated in 1975 by the National Highway Traffic Safety Administration (NHTSA), the FARS contains important information pertaining to fatal motor vehicle crashes that occur in the United States (US). FARS adheres to strict definitions of a fatal crash (e.g. death from the crash must occur within 30 days of the crash to be included in FARS; the crash must involve a motor vehicle in transport on a public roadway; etc.) and rules regarding coding of data. Therefore, FARS does not include information on certain fatal motor vehicle crashes that do not fit FARS definitions and rules. Based upon death certificate and other data sources, it has been estimated that motor vehicle related fatalities that occur on private property, result in a death more than 30 days after the crash, involve a death without a crash occurring (e.g. suffocation, fire) etc. (i.e. do not fit the FARS definition), may account for 1,000 to 2,000 more deaths annually than appear in FARS (National Safety Council, 1990, NHTSA 1996).

Up to 100 or more data elements are collected for each crash (depending upon the number of vehicles involved and the data availability), including information about the crash location and crash scene, key data on each of the vehicles involved in the fatal crash, and vital information on all the drivers, passengers and pedestrians/bicyclists involved in the crash. FARS has been used to identify vehicle safety issues, highway safety problems, examine trends, evaluate countermeasures, and provide key statistics on fatal crashes occurring in the Nation.

FARS data sources include police accident reports, driver licensing records, vehicle registration files, coroner's and medical examiner's reports, emergency medical services (EMS) log sheets, death certificates, hospital reports, and roadway inventories, as examples. FARS Analysts in each State gather data sources and code the information in an electronic FARS file. Some data elements are readily available to these FARS Analysts------other data are difficult to obtain.

Recently, NHTSA released reports generated by Integrated Project Teams (IPTs) on high priority initiatives to address: Safety Belt Use, Impaired Driving, Rollover Mitigation and Vehicle Compatibility (NHTSA 2003). An IPT report was also developed to address Data Improvement which includes FARS data (NHTSA 2004).

Every data element in FARS is important for analysis purposes and it is imperative that data are as complete and as accurate as possible for these analyses to be useful. This is especially true for the following key data elements which are used very frequently in safety investigations and analyses: (1) fire occurrence, (2) rollover occurrence and (3) both fire and rollover occurrence.

For example, FARS data are used to determine the incidence of vehicle fires in fatal crashes and whether the fire caused the death of any occupant. The relative frequency of fires by year/make/model of the vehicle where the fire occurred is used to determine if there is a potential safety problem. It is important for FARS Analysts to use every source of information available to assess whether a fire occurred and then to provide accurate information on the vehicle involved and the injuries sustained. For several reasons, there is good evidence that fire occurrence is underreported in FARS.

It is equally important to determine if a rollover occurred in the crash and to accurately record the vehicle identifying information and the injuries to occupants, including whether they were ejected or not from the vehicle. Vehicle rollovers cause an inordinate number of fatal injuries, so it is important to obtain accurate information concerning their occurrence. There is also some evidence from NASS/CDS data that fires occur at a higher rate in rollover crashes than in other crash modes (Digges, 2005). Consequently it is important that FARS accurately report rollovers and fires in rollovers

In most States, if a fire occurred in close proximity to the crash or if it caused the death of a victim, it should appear in the police report somewhere. However, in a review of NHTSA's Crash Forms Catalog in 2007, it was determined that only 9 States had a specific "box" with a fire notation for routine coding in their PAR (AR, KS, KY, MT, NC, OR, SD, TN, and WV). A full 36 States had the choice of "fire" for the most harmful event while 13 States had "fire" as a choice for their truck/bus fatal supplemental form. Five States made no mention of fire at all in the PAR (CA, DC, MD, VA and WY).

While quality control measures in FARS are state-of-the-art, human resources are limited and it is very difficult for Federal monitors to uncover all the reasons for incomplete or inaccurate data in these areas. There is an urgent need for a special quality control effort to improve reporting rates in these critical areas of FARS.

PREVIOUS RESEARCH

In a prior study (Fell, Tippetts and Bahouth, 2007, SAE), the 10 States with the lowest fire occurrence and rollover rates for 2000-2002 were examined further to investigate whether underreporting of fires and rollovers in those States may have been a factor in the low rate. NHTSA officials contacted the FARS Analysts in these low rate States to discuss potential issues that may result in inaccurate data or underreported occurrences, and the reasons for them. Classifications included issues such as:

- Data source problems (e.g. not able to obtain death certificate to verify a fire death)
- Legal barriers in obtaining the desired data (e.g. such as not having access to certain data due to pending litigation)
- Administrative problems or policy issues (privilege, confidentiality, etc.)

- Communication problems/issues (not contacting the right person)
- FARS definitions and data entry rules (e.g. interpretations from the FARS Coding Manual)
- Other

NHTSA officials also queried the FARS Analysts from the low rate States about the availability and use of such key records as:

- Death certificates
- Vehicle Identification Number (VIN)
- Vehicle Registration Files (especially for out-of-state vehicles)

Other issues were also discussed with the FARS Analysts from the low rate States:

- Definition of a motor vehicle crash death within 30 days of the crash
- Possible underreporting of vehicle fires, especially in rear-end collisions (and crashes involving police vehicles)
- Crashes involving stationary vehicles off the roadway, especially where the fire and the death occurs in the parked vehicle
- Various sources of information for vehicle fires or rollovers

NHTSA provided written responses to questions about fires and rollovers from FARS Analysts in the 14 States with very low rates. Below is a summary of the responses on key questions:

Fires

- ***Data Sources:*** Of the 10 States with very low reported fire rates, 4 States only used the police accident report (PAR) as their source of coding. Two States used the PAR and the death certificate (DC) for verification. Two States used the PAR and the emergency medical services (EMS) report as verification. One State used the PAR and the medical examiners (ME) report and the final State used the PAR, the DC and the ME reports as verification. Ideally, States should use some other source in addition to the PAR for fire occurrence coding.
- ***Death Certificates:*** Only 3 of the 10 States receive and use the death certificate for coding fire occurrence. Ideally, most States should have access to death certificates and should use them for fire occurrence coding.
- ***Barriers and Issues:*** No States reported any legal issues or barriers concerning reporting fire occurrence. One State of the 10 reported an administrative barrier (lack of cooperation from another state agency) while 2 States reported communication issues. Five States reported other reasons for not capturing a fire occurrence when one occurred (not reported in the PAR).

- ***FARS Definition Issues or Rules:*** None of the 10 States reported any FARS definition issues or rules that would affect their coding of a fire occurrence.
- ***News Services:*** Only one State reported that there was a news service available in the State where news articles about fires might be reported.

Rollovers

- ***Data Sources:*** Of the 10 States with very low reported rollover rates, 5 States only used the police accident report (PAR) as their source of coding. One State used the PAR and the death certificate (DC) for verification. One State used the PAR and the medical examiners (ME) report and one State used the PAR, the DC and the ME reports as verification. Two States used the PAR and one other source (supplemental report from police, news article) for verification. Ideally, States should use some other source in addition to the PAR for coding rollover occurrence.
- ***Death Certificates:*** Only 2 of the 10 States receive and use the death certificate for coding rollover occurrence. Ideally, most States should have access to death certificates and should use them for rollover occurrence coding.
- ***Barriers and Issues:*** One State reported a legal issue (cases involving police vehicles delayed) concerning reporting rollover occurrence. One State of the 10 reported an administrative barrier (lack of details from local police agencies) while no States reported communication issues. One State reported one other reason for not capturing a rollover occurrence when one occurred (not reported in the PAR in one of four sequences of events).
- ***FARS Definition Issues or Rules:*** None of the 10 States reported any FARS definition issues or rules that would affect their coding of a rollover occurrence.

General Coding Issues

- ***Availability of Various Data Sources***: Of the 14 States with either low fire or low rollover rates, many did not have access to key data sources:

  Death Certificates: Only 8 of the 14 States reported routine access to death certificates.
  Medical Examiner/Coroner Reports: Only 5 States had routine access.
  Vehicle Registration Files: All 14 States had access.
  Vehicle Identification Number: 13 States had access.
  Driver Records: 13 States had access.
  Highway Inventories: 12 States had access.
  Other Data Sources: Only 2 States reported the use of other data sources (police supplemental reports; news clips)

- ***Other Barriers and Issues***: Only one State of the 14 reported that the 30 day definition of a fatality in FARS may be an issue in coding fire or rollover

occurrence. Two States reported the involvement of police vehicles as a delay issue due to pending litigation. Two States reported the parked or stationary vehicle off the roadway as a possible issue in the coding. Finally, two States reported the lack of a distinct box in the PAR for fire or rollover occurrence as an issue in determining fire or rollover occurrence.

In summary, it appears that many FARS Analysts in these 14 States with low fire and rollover rates do not have routine access nor routinely use other data sources (other than the PAR) in coding fire or rollover occurrences. This lack of information could lead to an under reporting of both fires and rollovers. There is no reason to believe that the missing information would lead to over reporting in the states with higher fire and rollover rates. Consequently, national averages based on data that is under reported can be considered as underestimates.

Every effort should be made to obtain access to key data as an aid to reporting these important data elements in FARS. Death certificates, medical examiners or coroners reports, emergency medical service reports and even news clippings of the fatal crash would all help in the FARS coding.

Given this as a background, further analyses of the fire and rollover occurrences in FARS for the six year period from 2000-2005 were conducted.

METHODS

Fire Occurrence and Rollover Occurrence reporting rates were generated for the combined years 2000-2005 on a State-by-State basis compared to the average rates for the group.. The rates in the Tables 1 through 18 to follow were calculated using the number of fire occurrences and rollover occurrences in FARS per total number of vehicles in fatal crashes for that State during that combined 6-year period (2000-2005). Although FARS contains a census of fatal crashes, vehicles where no fatality occurred yet are involved in the crash are included, as well. It should be noted that fires per fatal crash reported in these tables includes any vehicle coded in the FARS even if no fatality occurred in that vehicle. While the number of fire related fatalities is also of interest, the results can be skewed due to multiple occupants per vehicle where some vehicle types are more likely to be operated with more than just a driver. For this reason, the vehicles in FARS rather than the fatalities are examined.

Appendix Table A1 lists each state, fatality count and fatality rates for the 2000-2007 crash years. Within Table A1, fire rates and rollover rates are calculated in two ways. The first, labeled as 'Death in Vehicle' rates includes only vehicles where one or more person died in both the numerator and denominator of the rate calculation. The second rate, labeled as 'All FARS' vehicle rate includes any vehicle coded in FARS even if no fatality occurred in that vehicle. As expected, the rate of fire and the rate of rollover are

higher when only vehicles where one or more fatality occurred in that vehicle compared with rates using all vehicles in FARS. Table A1 also includes Annual Vehicle Miles Travelled (VMT) in millions of miles as estimated by FHWA in 2003. This data is presented by state and offers insight into varied exposure for drivers by state and could explain differences in fatal crash involvement. The most recent year of VMT data available was 2003 as shown in the table. Appendix Table A2 shows the number of fires, fire rate per FARS crash and fires as most harmful event by state.

RESULTS

Factors that Could Influence Fire Rates

It is clear from Figure 1 below that the reporting of fire occurrence in FARS is widely variable in the States. The rate per number of vehicles in fatal crashes for 2000-2005 ranges from 0.42% in Utah to 5.95% in Minnesota with the group average at 2.88%.

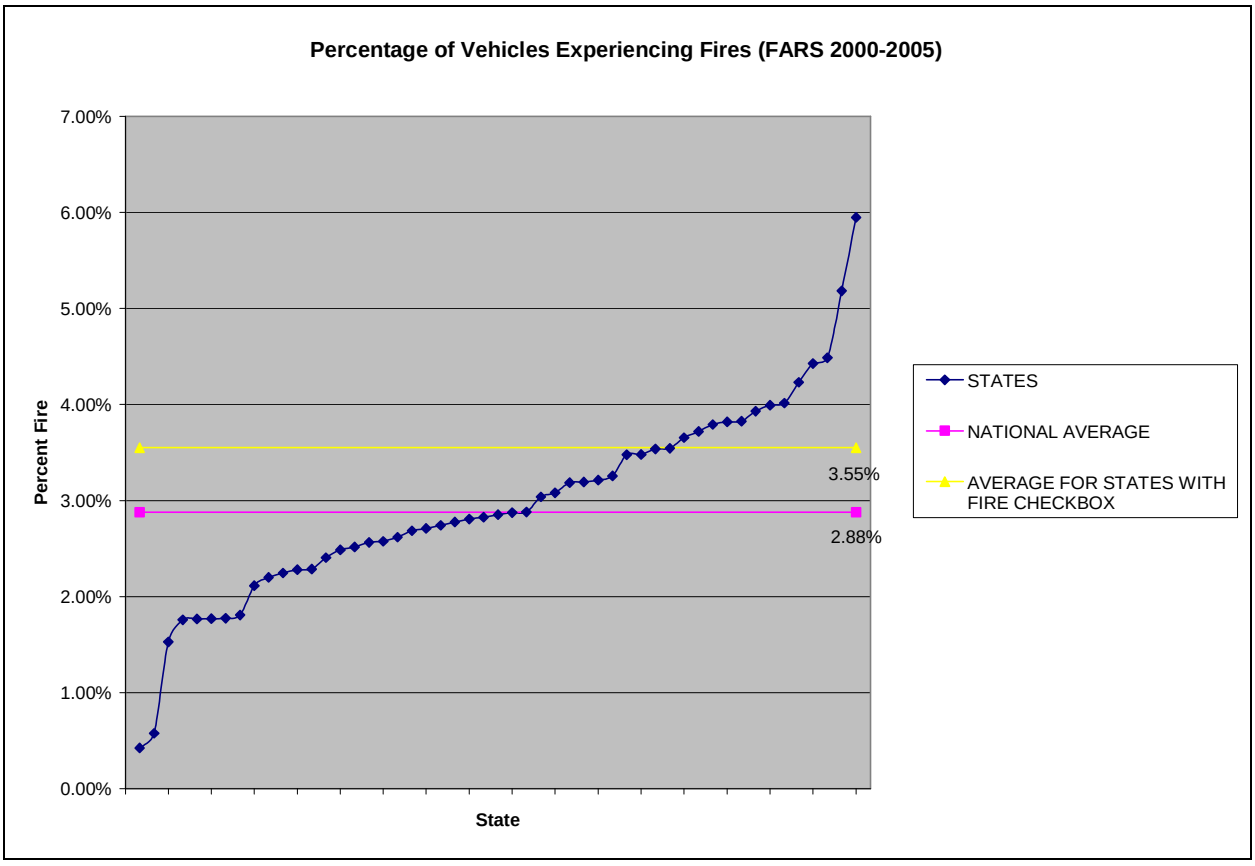

Figure 1. Fire Occurrence Rates by State in FARS (2000-2005)

The 10 States with the lowest rates of fire occurrence per vehicles involved in fatal crashes are shown in Table 1. The group average fire rate for rural crashes was 3.37% compared to 2.33% for urban crashes. Consequently, states with higher percentages of

urban fatal crashes would be expected to have lower fire rates. To provide information on whether the low rates are because of the urban/rural mix of the State, the lowest rates of fire occurrence by State by rural area are shown in Table 2 and by urban area in Table 3. Six of the 10 lowest rate States appear in both the rural (Table 2) and urban (Table 3) lowest rate States. None of these 10 States have a box to check if a fire occurs. Two of these states, VA and WY have no mention of fire on the PAR. This suggests that coding and data source issues exist in those two States, and that under reporting is present in at least four and possibly all of the others. Appendix Table A2 identifies those states where no check box exists on the PAR indicating Fire as the most harmful event.

Rates of Fire Occurrence, by State, 10 Lowest			
	State	Fires 2000-2005	Rate per Vehicles Inv.
1.	Utah	10	0.42%
2.	Mississippi	39	0.58%
3.	Florida	414	1.53%
4.	Virginia	134	1.76%
5.	South Carolina	147	1.77%
6.	Michigan	195	1.77%
7.	Dist of Columbia	8	1.77%
8.	Idaho	37	1.81%
9.	Colorado	118	2.11%
10.	New Hampshire	26	2.20%
	National	10096	2.88%

Table 1. Lowest Rates of Fire Occurrence in FARS

Rates of Rural Fire Occurrence, by State, 10 Lowest			
	State	Fires 2000-2005	Rate per Vehicles Inv.
1.	Dist of Columbia	0	0.00%
2.	Mississippi	34	0.57%
3.	Utah	10	0.57%
4.	Hawaii	6	1.39%
5.	Idaho	28	1.72%
6.	South Carolina	138	1.89%
7.	Florida	233	1.95%
8.	Michigan	113	1.97%
9.	Virginia	98	2.17%
10.	New Hampshire	20	2.36%
	National	6647	3.37%

Table 2. Lowest Rates of Fire Occurrence in FARS in Rural Areas of the State

Rates of Urban Fire Occurrence, by State, 10 Lowest			
	State	Fires 2000-2005	Rate per Vehicles Inv.
1.	Utah	0	0.00%
2.	Mississippi	4	0.52%
3.	Nebraska	3	0.60%
4.	South Carolina	9	0.88%
5.	Wyoming	2	1.07%
6.	Florida	170	1.16%
7.	Virginia	36	1.18%
8.	New Mexico	13	1.29%
9.	Michigan	76	1.49%
10.	Alabama	50	1.74%
	National	3315	2.23%

Table 3. Lowest Rates of Fire Occurrence in FARS in Urban Areas of the State

The 10 States with the highest fire occurrence rates in FARS are shown in Tables 4, 5 and 6. Table 4 shows the top 10 highest rate States overall with Tables 5 and 6 showing those top 10 rates for rural and urban areas of the State, respectively. Six of the nine states with a fire box on the PAR show up in Table 4 and/or Table 6 as high fire rate States. The average fire rate for these six States is 3.76. For all nine States with a fire check box, the average is 3.55. This result suggests that if properly reported in FARS, the National average for the fire rate might be around 3.55 rather than 2.88 as shown in Figure 1.

Rates of Fire Occurrence, by State, 10 Highest			
	State	Fires 2000-2005	Rate per Vehicles Inv.
1.	Montana	67	3.82%
2.	Wisconsin	251	3.83%
3.	Illinois	462	3.93%
4.	Tennessee	405	3.99%
5.	North Dakota	31	4.02%
6.	Missouri	403	4.23%
7.	Kansas	169	4.43%
8.	Oklahoma	260	4.49%
9.	Arkansas	265	5.18%
10.	Minnesota	299	5.95%
	National	10096	2.88%

Table 4. States with the Highest Fire Occurrence Rates in FARS (in ascending order)

Rates of Rural Fire Occurrence, by State, 10 Highest			
	State	Fires 2000-2005	Rate per Vehicles Inv.
1.	Tennessee	228	4.38%
2.	Wisconsin	211	4.45%
3.	Arizona	178	4.57%
4.	Missouri	298	4.59%
5.	Oklahoma	194	4.86%
6.	Illinois	242	5.23%
7.	Kansas	152	5.26%
8.	Rhode Island	7	5.74%
9.	Arkansas	226	5.80%
10.	Minnesota	224	6.39%
	National	6647	3.37%

Table 5. States with the Highest Fire Occurrence Rates in their Rural Areas

Rates of Urban Fire Occurrence, by State, 10 Highest			
	State	Fires 2000-2005	Rate per Vehicles Inv.
1.	Illinois	220	3.09%
2.	Arkansas	39	3.21%
3.	Connecticut	63	3.21%
4.	Oregon	31	3.27%
5.	Missouri	105	3.47%
6.	Tennessee	129	3.56%
7.	Oklahoma	66	3.67%
8.	North Dakota	4	3.74%
9.	West Virginia	24	4.26%
10.	Minnesota	75	4.92%
	National	3315	2.23%

Table 6. States with the Highest Fire Occurrence Rates in their Urban Areas

Minnesota has the highest fire occurrence rates in the Nation in both their rural and urban areas. In fact, six of the 10 highest rate States appear in both the rural table (Table 5) and the urban table (Table 6).

Appendix Tables A3 through A3 examine the FARS data for different ages of vehicles – less than 5 years, less than ten years and ten years and older. The Tables show vehicle counts in FARS and fatality counts by crash direction, fire involvement and fire as most harmful event. The MHE is defined as the most severe injury-producing event for the vehicle. When a vehicle is involved in multiple harmful events, the event which produced the most severe injury or property damage is used. Any crash where one or more quarter turns occurred, regardless of the most harmful event is classified as a

rollover crash for this portion of the analysis. In general, analysis of this data showed that most passenger vehicles ten years and older have higher fire rates than newer vehicles. The results are presented later in this report.

Appendix Table A9 lists fire related fatality counts and rates by state and percentage of fatalities in vehicles older than 10 years for 2000-2005 crashes. The fire rates shown do not support the hypothesis that states with a higher fire rate also have a higher percentage of older vehicles in service.

Factors that Could Influence Rollover Rates

Similar analyses were performed on FARS data for rollover occurrence. The results are shown nationally in Figure 2. The rates vary from under 10% to 45%. The average for the group was 18.84%. Since the principal focus of this study was fire occurrence, the cause for the large difference in rollover rates was not studied in detail. However, the data showed that the rollover rate for FARS vehicles is much greater for rural areas compared to urban areas. Consequently, the breakout of rural vs. urban is presented for the ten states with the highest and lowers rollover rates.

The States with the 10 lowest and the 10 highest rates appear in Tables 7-12. Table 7 shows the rollover rates for the ten States with the lowest rollover rates. Tables 8 and 9 show the ten states with the lowest rollover rates in rural and urban areas, respectively. Tables 10, 11 and 12 show similar data for the ten states with the highest rollover rates.

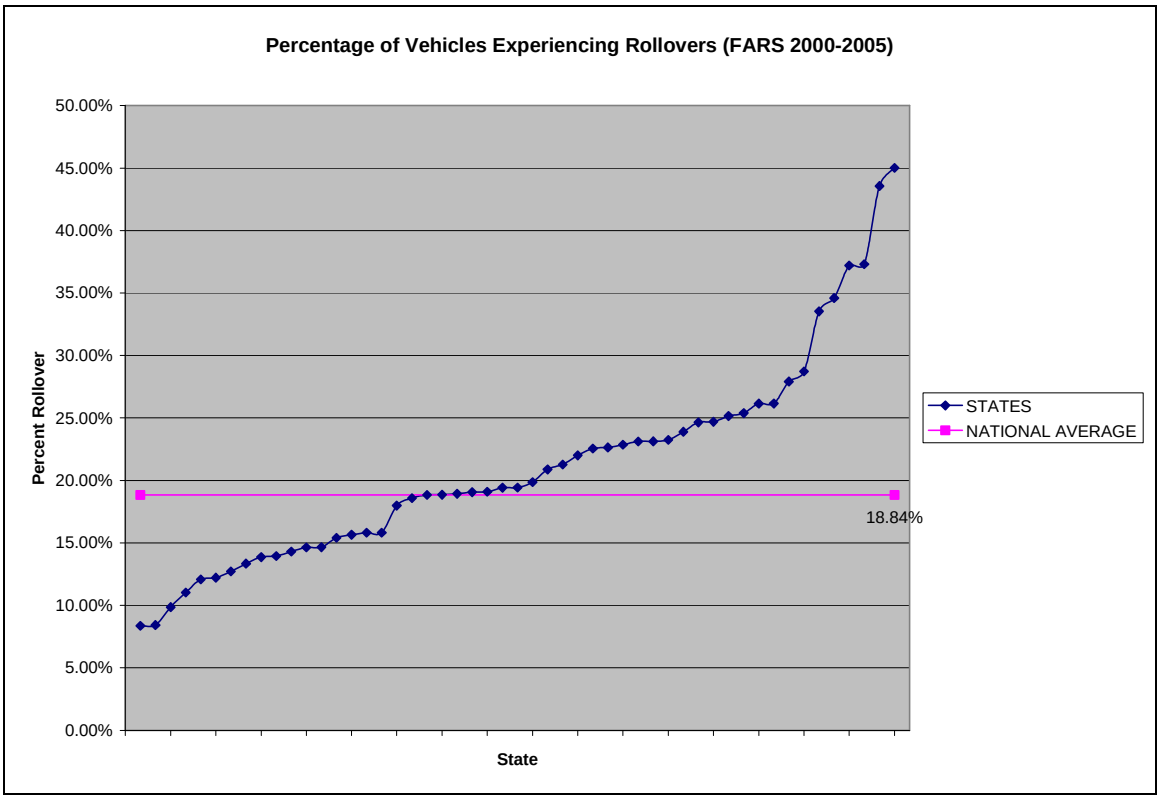

Figure 2. Percentage of Vehicles Experiencing Rollovers in FARS (2000-2005)

Rates of Rollover Occurrence, by State, 10 Lowest			
	State	Rollovers 2000-2005	Rate per Vehicles Inv.
1.	New Jersey	534	8.37%
2.	Dist of Columbia	38	8.43%
3.	Maryland	549	9.85%
4.	New York	1336	11.03%
5.	Mississippi	818	12.08%
6.	Michigan	1347	12.22%
7.	Hawaii	136	12.72%
8.	Massachusetts	493	13.34%
9.	Florida	3754	13.86%
10.	Indiana	1068	13.94%
	National	66102	18.84%

Table 7. States with Lowest Rollover Occurrence Rates in FARS (ascending order)

Rates of Rural Rollover Occurrence, by State, 10 Lowest			
	State	Rollovers 2000-2005	Rate per Vehicles Inv.
1.	New Jersey	140	10.61%
2.	Maryland	275	12.07%
3.	Mississippi	753	12.62%
4.	Massachusetts	93	15.10%
5.	Indiana	820	15.44%
6.	Michigan	898	15.69%
7.	New York	897	16.12%
8.	Connecticut	93	16.37%
9.	New Hampshire	147	17.38%
10.	Pennsylvania	1354	18.13%
	National	48604	24.66%

Table 8. States with Lowest Rollover Occurrence Rates in their Rural Areas

Rates of Urban Rollover Occurrence, by State, 10 Lowest			
	State	Rollovers 2000-2005	Rate per Vehicles Inv.
1.	New York	438	6.71%
2.	Oregon	68	7.17%
3.	Hawaii	48	7.75%
4.	Mississippi	60	7.76%
5.	New Jersey	394	7.79%
6.	Dist of Columbia	36	8.11%
7.	Maryland	263	8.34%
8.	Michigan	428	8.39%
9.	Delaware	44	8.59%
10.	Illinois	631	8.87%
	National	16713	11.26%

Table 9. States with Lowest Rollover Occurrence Rates in Urban Areas

Five States appeared as the 10 lowest rollover rate States in both rural areas (Table 8) of their State and urban areas (Table 9). Once again, this could indicate some data source issues in these States.

Rates of Rollover Occurrence, by State, 10 Highest			
	State	Rollovers 2000-2005	Rate per Vehicles Inv.
1.	Missouri	2491	26.15%
2.	Nebraska	589	26.15%
3.	Colorado	1559	27.91%
4.	Utah	679	28.72%
5.	South Dakota	451	33.53%
6.	New Mexico	1182	34.60%
7.	Idaho	761	37.19%
8.	North Dakota	288	37.31%
9.	Montana	764	43.56%
10.	Wyoming	537	45.01%
	National	66102	18.84%

Table 10. States with the Highest Rollover Occurrence Rates in FARS (ascending order)

Rates of Rural Rollover Occurrence, by State, 10 Highest			
	State	Rollovers 2000-2005	Rate per Vehicles Inv.
1.	Utah	594	34.02%
2.	South Dakota	430	36.20%
3.	Colorado	1189	39.70%
4.	Arizona	1582	40.63%
5.	North Dakota	276	41.50%
6.	New Mexico	1010	42.05%
7.	Idaho	690	42.31%
8.	Montana	738	46.18%
9.	Nevada	512	47.10%
10.	Wyoming	510	50.70%
	National	48604	24.66%

Table 11. States with Highest Rollover Rates in their Rural Areas

Rates of Urban Rollover Occurrence, by State, 10 Highest			
	State	Rollovers 2000-2005	Rate per Vehicles Inv.
1.	Wyoming	27	14.44%
2.	Rhode Island	85	14.68%
3.	Alabama	432	15.02%
4.	Arkansas	198	16.28%
5.	Montana	26	16.67%
6.	New Mexico	169	16.73%
7.	Idaho	71	17.11%
8.	Vermont	14	17.28%
9.	Missouri	524	17.32%
10.	Alaska	48	17.78%
	National	16713	11.26%

Table 12. States with Highest Rollover Rates in their Urban Areas

Three States, NM, ND and WY, had higher than average rollover rates in both their rural areas (Table 11) and their urban areas (Table 12). These States have low population densities where higher speed roadways may be more prevalent and vehicles with lower resistance to rollover could also be more common.

Figure 3 shows the national rates of rollover crashes that also experienced fires. That rate varies from under .20% in a couple of States to almost 1.60% in some States.

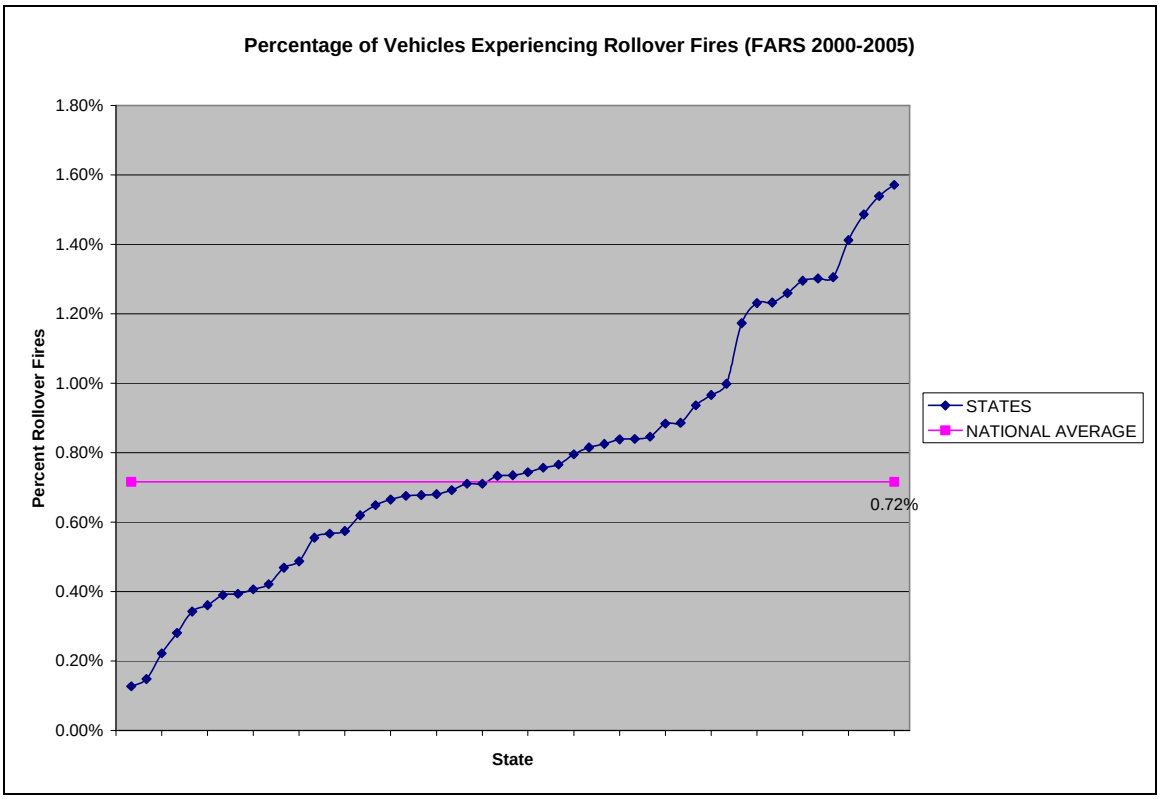

Figure 3. Percent of Vehicles in Rollover Crashes with a Fire Occurrence

Tables for rates of rollover crashes that also resulted in fires were also constructed. Tables 13-18 show the States with the 10 lowest rates (Table 13), the 10 States with the lowest rural rates (Table 14), the 10 States with the lowest urban rates (Table 15), followed by the 10 States with the highest rates (Table 16), the 10 States with the highest rural rates (Table 17) and the 10 States with the highest urban rates (Table 18).

There were 4 States with the 10 lowest rates in both their rural areas and urban areas, but the numbers are very small here. There was only one State that had high rates of rollover crashes with a fire for both their rural and urban areas (MO).

Rates of Rollover Fire Occurrence, by State, 10 Lowest			
	State	Rollover Fires 2000-2005	Rate per Vehicles Inv.
1.	Utah	3	0.13%
2.	Mississippi	10	0.15%
3.	Dist of Columbia	1	0.22%
4.	Hawaii	3	0.28%
5.	Delaware	4	0.34%
6.	New Jersey	23	0.36%
7.	Michigan	43	0.39%
8.	Virginia	30	0.39%
9.	Florida	110	0.41%
10.	New York	51	0.42%
	National	2513	0.72%

Table 13. States with Lowest Rates of Rollover Crashes with a Fire

Rates of Rural Rollover Fire Occurrence, by State, 10 Lowest			
	State	Rollover Fires 2000-2005	Rate per Vehicles Inv.
1.	Dist of Columbia	0	0.00%
2.	Hawaii	0	0.00%
3.	Mississippi	8	0.13%
4.	Utah	3	0.17%
5.	Connecticut	1	0.18%
6.	Virginia	21	0.46%
7.	Delaware	3	0.48%
8.	Maryland	11	0.48%
9.	Massachusetts	3	0.49%
10.	Michigan	28	0.49%
	National	1800	0.91%

Table 14. States with Lowest Rates of Rollover Crashes with Fires in their Rural Areas

Rates of Urban Rollover Fire Occurrence, by State, 10 Lowest			
	State	Rollover Fires 2000-2005	Rate per Vehicles Inv.
1.	Utah	0	0.00%
2.	Wyoming	0	0.00%
3.	Alaska	0	0.00%
4.	Mississippi	1	0.13%
5.	West Virginia	1	0.18%
6.	Delaware	1	0.20%
7.	South Carolina	2	0.20%
8.	New Mexico	2	0.20%
9.	Nebraska	1	0.20%
10.	Dist of Columbia	1	0.23%
	National	681	0.46%

Table 15. States with Lowest Rates of Rollover Crashes with Fires in their Urban Areas

Rates of Rollover Fire Occurrence, by State, 10 Highest			
	State	Rollover Fires 2000-2005	Rate per Vehicles Inv.
1.	Kansas	47	1.23%
2.	Vermont	8	1.23%
3.	Oklahoma	73	1.26%
4.	North Dakota	10	1.30%
5.	Missouri	124	1.30%
6.	Maine	20	1.31%
7.	South Dakota	19	1.41%
8.	Arkansas	76	1.49%
9.	Montana	27	1.54%
10.	Minnesota	79	1.57%
	National	2513	0.72%

Table 16. States with Highest Rates of Rollover Crashes with Fires

Rates of Rural Rollover Fire Occurrence, by State, 10 Highest			
	State	Rollover Fires 2000-2005	Rate per Vehicles Inv.
1.	Illinois	62	1.34%
2.	Missouri	87	1.34%
3.	Oklahoma	55	1.38%
4.	Kansas	43	1.49%
5.	South Dakota	18	1.52%
6.	Tennessee	82	1.58%
7.	Montana	26	1.63%
8.	Arkansas	67	1.72%
9.	Nevada	19	1.75%
10.	Minnesota	67	1.91%
	National	1800	0.91%

Table 17. States with Highest Rates of Rollover Fires in their Rural Areas

Rates of Urban Rollover Fire Occurrence, by State, 10 Highest			
	State	Rollover Fires 2000-2005	Rate per Vehicles Inv.
1.	Minnesota	12	0.79%
2.	Indiana	16	0.82%
3.	Connecticut	17	0.87%
4.	Oklahoma	18	1.00%
5.	Rhode Island	6	1.04%
6.	Idaho	5	1.20%
7.	Missouri	37	1.22%
8.	Vermont	1	1.23%
9.	Maine	2	1.71%
10.	North Dakota	2	1.87%
	National	681	0.46%

Table 18. States with Highest Rates of Rollover Fires in their Urban Areas

Factors that Could Influence Extrication

Figure 4 shows the high variability in extrication required for drivers (entrapment) by state. While the national average is 12% of fatal crashes result in driver entrapment, values range from 0.05% to 32% by state. This variability could result from varied definitions of entrapment, varied requirements by state for reporting this data or errors in reporting. As described in the 2007 FARS Coding and Validation Manual, extrication refers to the use of equipment or other force to remove persons from the vehicles requiring more than just lifting or carrying person out of wreckage. If the police officer uses the word "extricated" to indicate occupant removal, then this is sufficient information for FARS investigators to indicate extrication required even if no mention of equipment is made.

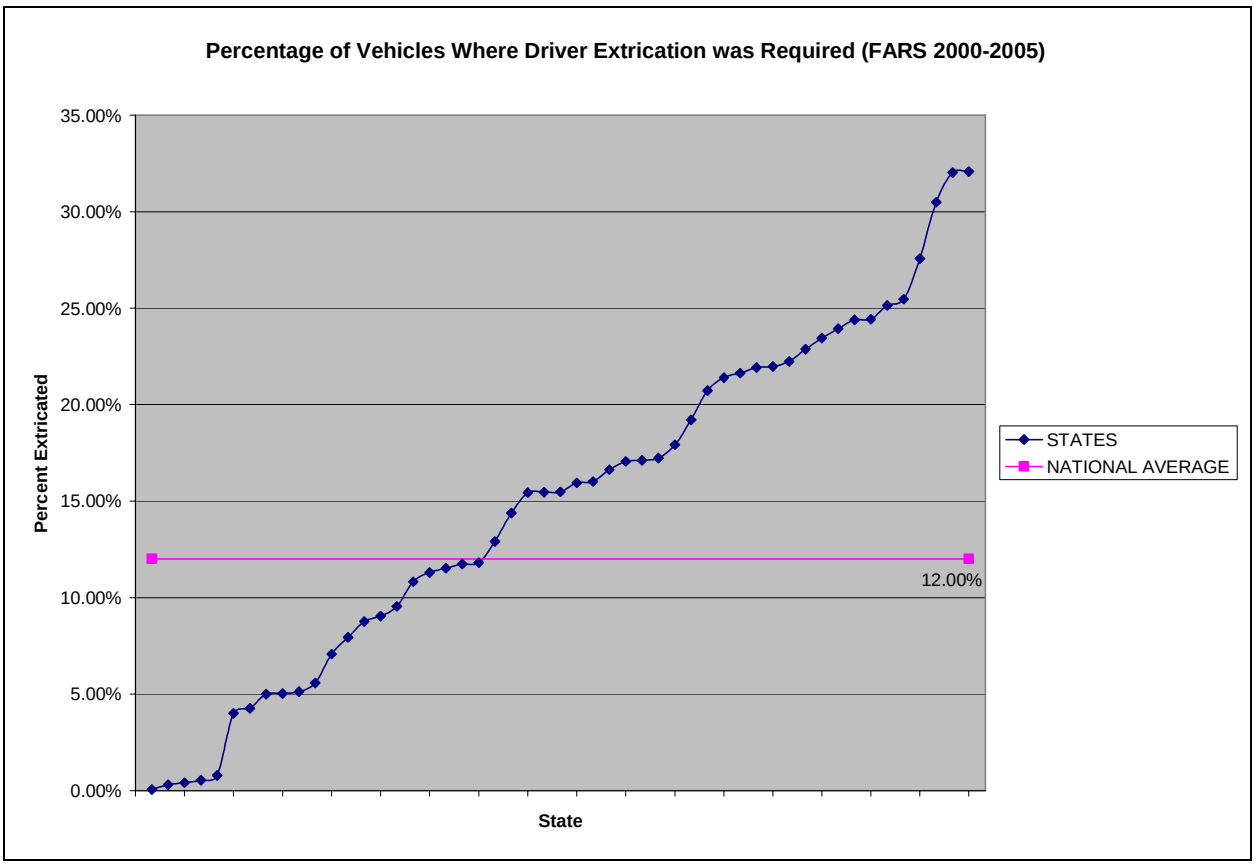

Figure 4. Percent of Vehicles In All FARS Crashes Where Driver Extrication Was Required

Appendix Table A10 shows the annual entrapment fatalities in FARS Tables 10 and 11 show the entrapments with fire involvement and fire as MHE. Table A13 lists the count of entrapments by State for the 2000-2007 crash years. Obviously, many of the larger States show the high numbers, but not always. When analyzed by state, some indications of coding issues with this variable become evident. For example, Virginia only indicated that 7 vehicles experienced entrapments from 2000-2007 FARS while 4,562 vehicles did not, a rate of less than .09%. West Virginia, on the other hand, indicated that 999 vehicles experienced entrapment while 1,067 vehicles did not-------a rate of 34%. Clearly, the coding of entrapment needs to be thoroughly reviewed in FARS for quality and data sources before valid data analyses can be conducted.

ANALYSIS OF FARS TRENDS- FIRES AND ROLLOVERS

The first section of this report and earlier analyses examined the extent to which fires and rollover information could be improperly coded or missed by FARS analysts (Fell 2006). For this reason, fire rates were calculated including any vehicle coded in the FARS system regardless of the presence of fatal occupants and the number who died. Additional FARS analyses were performed to provide a historical perspective on fatalities during fire and rollovers crashes on a national level. For reference, the Appendix contains the data by year and the tables to follow present findings in 3 year intervals. Results below are summarized in two ways including 1) occupant fatality counts and 2) number of vehicles involved and coded in the FARS regardless of the number of fatalities within the vehicle. While the number of fatalities that result from a set of crashes is of most interest, results can be skewed due to multiple occupants per vehicle where some vehicle types are more likely to be operated with more than just a driver. For this reason, a second table containing the number of vehicles involved and coded in FARS is also presented for each case below.

All						
Crash Year	Frontal	Side	Rear	Rollover	Other	Total
1978-1980	44,304	23,638	2,472	16,351	4,413	91,178
1981-1983	39,511	20,757	2,475	12,239	6,872	81,854
1984-1986	40,200	22,807	2,877	11,061	4,908	81,853
1987-1989	44,432	25,447	3,427	12,385	4,385	90,076
1990-1992	42,113	24,221	2,891	9,654	3,867	82,746
1993-1995	42,846	24,338	3,085	9,042	3,542	82,853
1996-1998	44,193	25,569	3,502	9,520	3,585	86,369
1999-2001	42,841	25,352	3,917	10,549	3,636	86,295
2002-2004	42,957	25,758	3,861	10,202	3,377	86,155
2005-2007	41,143	23,197	3,549	9,895	4,035	81,819
Fire Involved						
1978-1980	1,682	664	327	454	179	3,306
1981-1983	1,714	571	281	327	282	3,175
1984-1986	1,747	655	278	275	207	3,162
1987-1989	2,019	691	303	264	227	3,504
1990-1992	2,101	655	220	176	147	3,299
1993-1995	2,116	646	221	142	157	3,282
1996-1998	2,113	609	224	161	147	3,254
1999-2001	2,233	617	288	206	152	3,496
2002-2004	2,171	641	240	195	156	3,403
2005-2007	2,206	615	243	218	180	3,462
Fire Coded as Most Harmful Event						
1978-1980	470	190	113	148	67	988
1981-1983	667	196	163	145	99	1,270
1984-1986	599	174	110	102	78	1,063
1987-1989	672	197	124	90	112	1,195
1990-1992	616	165	115	48	68	1,012
1993-1995	547	160	107	45	76	935
1996-1998	497	142	82	26	63	810
1999-2001	475	112	110	27	47	771
2002-2004	652	177	100	51	57	1,037
2005-2007	813	211	127	67	82	1,300

Table 19. Fatality Counts in All Passenger Vehicles by Crash Mode (FARS 1978-2007, 'Other' category includes unknown, undercarriage, top damage and non-collision including immersion, fall or thrown from vehicle, non-collision fire/explosion, gas inhalation events)

Crash mode was defined using the principal impact point which is the damage area on the vehicle that produced the most severe instance of injury or property damage. Using this definition, it is possible that a rollover crash where one or more quarter turns occurs about the vehicle lateral or longitudinal axis may be classified as a planar event (i.e. a frontal, side, rear crash) if other more severe impacts occur as determined by the FARS investigator. Later in this report, an alternate approach is used to calculate fire rates where rollover crashes are defined as an event where one or more vehicle quarter turns occurs regardless of the principle impact point or most harmful event coded. The 'Other' category includes unknown, undercarriage, non-collision (i.e. immersion, fall or

thrown from vehicle, non-collision fire/explosion, gas inhalation, etc.) and top damage related events.
As defined in the 2008 FARS Analytical Reference Guide, Most Harmful Event applies to the vehicle. Since the most harmful event describes a vehicle, not a person, one cannot assume that the most harmful event for a vehicle was the cause of any death or injury for any specific individual within the vehicle.

Table 19 is broken into three sections. The first (labeled All) lists the number of vehicles where one or more fatalities occurred in each 3 year segment. The second section lists the vehicle count where a fire occurred as a result of the crash when a fatality occurred in that vehicle. The third section shows the vehicle count where the fire was coded as the most harmful event by the FARS investigator and a fatality occurred in the vehicle.

All						
Crash Year	Frontal	Side	Rear	Rollover	Other	
1978-1980	94,720	32,067	6,627	16,771	6,539	156,724
1981-1983	83,288	27,751	6,452	12,411	11,360	141,262
1984-1986	85,510	30,488	7,279	11,181	8,426	142,884
1987-1989	93,666	33,352	7,755	12,534	7,160	154,467
1990-1992	86,690	31,042	6,728	9,717	6,116	140,293
1993-1995	88,568	30,465	6,993	9,101	5,591	140,718
1996-1998	91,272	31,785	7,749	9,580	5,677	146,063
1999-2001	88,380	31,544	8,386	10,653	5,740	144,703
2002-2004	88,864	32,619	8,537	10,334	5,393	145,747
2005-2007	83,559	30,244	8,460	10,053	6,330	138,646
Fire Involved						
1978-1980	2,067	737	380	470	188	3,842
1981-1983	2,074	631	343	331	310	3,689
1984-1986	2,086	725	353	280	229	3,673
1987-1989	2,469	760	380	267	249	4,125
1990-1992	2,477	719	283	178	156	3,813
1993-1995	2,516	697	261	143	172	3,789
1996-1998	2,486	652	282	161	156	3,737
1999-2001	2,675	652	345	209	165	4,046
2002-2004	2,624	678	289	198	183	3,972
2005-2007	2,595	658	277	222	197	3,949
Fire Coded as Most Harmful Event						
1978-1980	507	195	121	150	68	1,041
1981-1983	702	210	175	147	103	1,337
1984-1986	632	181	123	103	80	1,119
1987-1989	709	203	133	91	120	1,256
1990-1992	650	171	132	48	71	1,072
1993-1995	582	166	117	46	82	993
1996-1998	524	150	92	26	64	856
1999-2001	496	115	119	27	54	811
2002-2004	715	181	114	52	60	1,122
2005-2007	889	222	140	68	88	1,407

Table 20. Passenger Vehicle Counts by Crash Mode (FARS 1978-2007)

Similarly, Table 20 shows the number of *vehicles* involved in fatal crashes by primary impact type. This includes any vehicle coded in the FARS with one or more fatalities and each vehicle is counted only once regardless of the number of fatalities that occurred in that vehicle. When compared, Table 19 and Table 20 show similar trends over time with respect to crash mode.

All						
Crash Year	Frontal	Side	Rear	Rollover	Other	Total
1978-1980	8,135	3,444	370	1,749	713	14,411
1981-1983	5,781	2,963	267	976	1,684	11,671
1984-1986	5,778	3,187	303	653	1,183	11,104
1987-1989	7,276	3,886	475	865	688	13,190
1990-1992	7,098	3,940	375	675	462	12,550
1993-1995	7,936	4,364	475	710	557	14,042
1996-1998	9,640	5,298	592	909	597	17,036
1999-2001	11,086	6,711	803	1,182	720	20,502
2002-2004	11,649	7,395	869	1,348	668	21,929
2005-2007	10,728	6,736	745	1,345	753	20,307
Fire Involved						
1978-1980	548	222	126	117	55	1,068
1981-1983	421	151	62	65	98	797
1984-1986	359	161	66	34	70	690
1987-1989	480	134	85	42	64	805
1990-1992	473	149	56	18	26	722
1993-1995	520	143	67	17	36	783
1996-1998	638	150	81	18	37	924
1999-2001	807	205	115	50	46	1,223
2002-2004	793	229	114	38	57	1,231
2005-2007	816	193	101	48	48	1,206
Fire Coded as Most Harmful Event						
1978-1980	150	88	57	42	19	356
1981-1983	141	51	47	40	28	307
1984-1986	92	26	26	20	10	174
1987-1989	138	37	22	18	24	239
1990-1992	109	40	35	7	9	200
1993-1995	131	37	43	6	17	234
1996-1998	118	32	24	7	14	195
1999-2001	177	41	52	15	18	303
2002-2004	237	72	48	10	10	377
2005-2007	288	64	49	17	22	440

Table 21. Entrapment- Fatality counts where one or more occupants was entrapped by Crash Mode (FARS 1978-2007, passenger vehicles only)

Table 21 shows the count of vehicles where one or more occupants were entrapped following a crash. This includes those requiring extrication and those pinned in the vehicle. As defined in the 2007 FARS Coding and Validation Manual, extrication refers to the use of equipment or other force to remove persons from the vehicles; i.e., more than just lifting or carrying person out of wreckage. Occupants who were pinned or

wedged in the vehicle are also coded and included in the "Entrapment" category in Table 21. It is possible that a pinned occupant may have been removed with force, but FARS does not make it clear whether equipment was used or not. Both extricated and pinned occupants would benefit from increased time before fire penetration occurs and are therefore grouped together within the "Entrapment" category

A comparison of data in Tables 19 and 21 indicates that fatal occupant entrapment was coded for 34% of the fatalities where fire was the MHE for 2005-2007 data years. The highest rates of entrapment were in frontal and rear crash modes. In terms of survivability, increased fire penetration times might prevent some of these fatalities as the time required for rescue to identify a crash, travel to the crash scene and extricate severely injured occupants could be quite lengthy in some cases. Appendix Tables A10-A12 list the number of entrapped fatal crash victims by year, crash mode and the occurrence of a vehicle fire. Appendix Tables A11 and A12 separate fatality counts for crashes where fire occurred and fire was coded as the most harmful event.

All						
Crash Year	Frontal	Side	Rear	Rollover	Other	Total
1978-1980	7,724	2,655	253	1,419	476	12,527
1981-1983	5,540	2,344	205	794	1,481	10,364
1984-1986	5,598	2,507	230	543	1,012	9,890
1987-1989	7,152	3,054	363	706	517	11,792
1990-1992	7,170	3,090	283	569	376	11,488
1993-1995	8,160	3,461	344	600	406	12,971
1996-1998	9,769	4,122	445	792	441	15,569
1999-2001	11,382	5,379	646	1,018	543	18,968
2002-2004	12,130	5,994	694	1,168	522	20,508
2005-2007	11,371	5,516	618	1,203	624	19,332
Fire Involved						
1978-1980	429	154	61	83	31	758
1981-1983	353	111	40	43	69	616
1984-1986	285	114	38	29	49	515
1987-1989	393	98	58	29	38	616
1990-1992	389	108	34	15	21	567
1993-1995	429	105	34	14	23	605
1996-1998	535	106	44	16	21	722
1999-2001	663	142	73	37	31	946
2002-2004	650	176	73	31	41	971
2005-2007	692	153	72	33	34	984
Fire Coded as Most Harmful Event						
1978-1980	109	55	25	29	14	232
1981-1983	104	38	28	23	15	208
1984-1986	76	19	16	17	7	135
1987-1989	98	23	17	13	8	159
1990-1992	83	31	19	5	10	148
1993-1995	104	25	19	4	9	161
1996-1998	85	23	13	6	5	132
1999-2001	129	30	30	10	13	212
2002-2004	175	52	30	9	6	272
2005-2007	232	51	36	11	14	344

Table 22. Entrapment-Vehicle counts where the driver was entrapped by Crash Mode (FARS 1978-2007, Passenger vehicles only)

Table 22 shows the vehicle level count of entrapment per 3 year interval where entrapment occurred in fatal crashes.

Vehicle Type and Age

Fatal crash data from FARS 2000-2007 were analyzed to identify differences in fire rate by vehicle body type. Fatal crash rates were calculated by dividing the number of vehicles where a fire occurred and one or more occupants died by the total number of vehicles involved in crashes where one or more occupants died. Seven primary vehicle body type categories were analyzed as shown in Table 23 below. Overall, the large truck and bus category showed the highest rate of fire occurrence (22.43 fires per 100

fatal crashes). It was noted earlier that PAR's in 9 States have a box to designate fires. An additional 13 have a supplemental form for trucks that includes a fire designation. Table 23 shows that the frequency of large truck crash occurrence (fire and non-fire involved) is substantially smaller when compared with passenger vehicles. Among passenger vehicles, Pickups have the highest fire rate during fatal crashes (5.04) followed by SUVs (4.60), Passenger Cars (3.94) and Minivans (3.52). Table 23 indicates that SUV's, Pickups, Big Vans and Large Trucks/Buses have higher than average fire rates while Passenger cars, Minivans and Motorcycles involved in fatal crashes have lower than average fire rates when compared to the total vehicle population.

Vehicle Type	Fatal Crashes with Fires (2000-2007)	Fatal Crashes without Fires (2000-2007)	Rate Per 100 Veh. Inv.
All Passenger Vehicles	9,001	212,847	4.23
All Vehicles	10,897	256,202	4.25
Large Trucks & Buses	1,094	4,878	22.43
Big Van	195	3,328	5.86
Pickup	2,134	42,357	5.04
SUV	1,361	29,587	4.60
Passenger Car	5,164	131,193	3.94
Minivan	342	9,710	3.52
Other	109	4,953	2.20
Motorcycles	498	30,196	1.65

Table 23. Frequency of fire occurrence by vehicle type (FARS 2000-2007)

Table 24 shows the fatality frequency by body type where fire was coded as the most harmful event. As described earlier, the MHE is not necessarily the cause of death however it is the event which caused the most vehicle related damage and in most cases we could infer a strong relationship with occupant fatality.

Vehicle Type	Fatal Crashes with Fire as MHE (2000-2007)	Fatal Crashes without MHE Fires (2000-2007)	Rate Per 100 Veh. Inv.
All Passenger Vehicles	2,824	219,024	1.29
All Vehicles	3,491	263,608	1.32
Large Trucks & Buses	512	5,460	9.38
Big Van	73	3,450	2.12
Pickup	703	43,788	1.61
SUV	444	30,504	1.46
Passenger Car	1,580	134,777	1.17
Minivan	97	9,955	0.97
Other	38	5,024	0.76
Motorcycles	44	30,650	0.14

Table 24. Frequency of fire as most harmful event (MHE) occurrence by vehicle type (FARS 2000-2007)

In an effort to understand the impact of vehicle age on fire occurrence during fatal crashes, vehicles were classified according to their age at the time of the crash. Overall, Table 25 indicates that the rate of fire occurrence for vehicles over the age of 10 years is 7.5% higher compared to those less than 5 years old. It should be noted that the fire rate increase with age for Pickups (15%) and SUVs (38%) is larger than the corresponding increase for passenger cars (4%). The cause of this difference is unclear.

Appendix Tables A3-A8 contain a breakdown by year of fatalities and vehicles involved by vehicle age and crash mode.

Vehicle Type	Fires in Vehicles Lt. 5 Yrs	Rate Per 100 Veh. Inv.	Fires in Vehicles Lt. 10 Yrs	Rate Per 100 Veh. Inv.	Fires in Vehicles Gt. 10 Yrs.	Rate Per 100 Veh. Inv.
All Passenger Vehicles	3,066	4.13	5,230	4.04	3,771	4.52
All Vehicles	4,168	4.15	6,704	4.13	4,193	4.46
Large Trucks & Buses	665	27.45	908	25.72	186	13.80
Big Van	64	5.87	107	6.00	88	5.70
Pickup	765	4.81	1,205	4.71	929	5.53
SUV	554	4.17	919	4.19	442	5.76
Passenger Car	1,645	3.94	2,896	3.82	2,268	4.09
Minivan	102	3.10	210	3.35	132	3.83
Other	62	1.66	73	1.77	36	4.29
Motorcycles	311	1.64	386	1.66	112	1.61

Table 25. Frequency of fire by vehicle type and vehicle age (FARS 2000-2007)

Fire involved crashes where one or more fatalities occurred in the vehicle were further subdivided by crash mode for each vehicle type. Table 26 lists the fire frequency (count) and fire rate for the FARS 2000-2007 fatality data. Crashes are coded as Rollovers when the rollover is the most severe crash event. Fire rate is calculated as the

number of fatal involved vehicles where a fire occurred per 100 vehicles with one or more fatal occupants. These rates are calculated for each cell of the resulting vehicle type versus crash mode table. As shown in Table 19 and Table 20, fires most frequently occur following a frontal crash, however, when fire rate is considered (see Table 26) in vehicles with one or more deaths, rear crashes show much higher values.

Vehicle Type Fire Frequency *Fire Rate*	Frontal	Side	Rear	Rollover	Other	All Modes Combined
Passenger Vehicles	5,745	1,624	667	538	427	
	5.18	*2.49*	*6.72*	*2.03*	*4.49*	*4.06*
All Vehicles	7,102	1,841	722	654	578	
	5.13	*2.57*	*6.24*	*2.27*	*3.48*	*4.08*
Motorcycles	387	50	10	.	51	
	1.96	*1.16*	*1.04*	*0.00*	*0.98*	*1.65*
Passenger Cars	3,231	994	462	230	247	
	5.00	*2.14*	*7.50*	*2.46*	*5.38*	*3.94*
Pickups	1,440	379	89	131	95	
	6.38	*4.42*	*6.35*	*1.78*	*3.88*	*5.04*
SUVs	843	200	97	154	67	
	6.67	*3.37*	*8.06*	*1.89*	*3.99*	4.60
Minivans	231	51	19	23	18	
	4.44	*2.00*	*3.87*	*2.11*	*4.86*	*3.52*
Big Vans	138	23	13	9	12	
	7.19	*3.89*	*8.39*	*1.84*	*6.90*	*5.86*
Other	60	11	9	9	20	
	2.97	*1.59*	*2.60*	*1.25*	*1.71*	2.20
Large Trucks & Buses	772	133	23	98	68	
	28.18	*20.62*	*16.79*	*10.07*	*17.75*	*22.43*

Table 26. Fire rates by vehicle type and crash mode where one or more fatalities occurred in that vehicle (FARS 2000-2007)

It should be noted that, due to the large amount of crush space in the rear of vehicles and inherent protection for occupants provided by the vehicle seat, rear impact crashes resulting in death tend to be very high energy events with significant vehicle damage and a higher risk of fire. In the absence of other impact events, rollover crashes where the rollover was coded as the most harmful event (MHE) results in fire less often than other crash modes (2.03% for passenger vehicles and 2.27% for all vehicles. However, as noted in the earlier sections, there is considerable evidence of under reporting of both rollover crashes and crashes with fires in FARS.

Table 27 shows crash counts and fire rates by crash mode for any vehicle included in FARS. This data differs significantly from that shown in Table 26 where only vehicles where one or more deaths occurred in the vehicles were included in the analysis. Overall, the rate of fire occurrence in all passenger vehicles in FARS is 2.79 per 100 crashes. Considering vehicles where one or more fatalities occurred in that vehicle, the fire rate for passenger vehicles was 4.06 per 100 (see Table 26). Presumably, those vehicles where one or more fatalities occurred were more heavily damaged and therefore fires resulted more often due to engine compartment, electrical component or fuel system damage.

Vehicle Type Fire Frequency *Fire Rate*	Frontal	Side	Rear	Rollover	Other	All Modes Combined
Passenger Vehicles	6,842	1,724	784	552	473	
	3.04	*2.09*	*3.55*	*2.06*	*3.17*	*2.79*
All Vehicles	9,128	2,075	960	675	678	
	3.23	*2.16*	*3.06*	*2.31*	*2.65*	*2.91*
Motorcycles	403	52	13	.	55	
	8.05	*4.08*	*81.25*		*96.57*	*1.61*
Passenger Cars	3,702	1,032	519	234	266	
	3.07	*1.83*	*4.12*	*2.41*	*3.39*	*2.78*
Pickups	1,798	421	111	137	107	
	3.14	*3.12*	*2.40*	*1.80*	*2.83*	*2.97*
SUVs	1,066	216	125	157	79	
	3.08	*2.41*	*3.58*	*1.86*	*3.05*	*2.83*
Minivans	276	55	29	24	21	
	2.16	*1.45*	*2.13*	*2.11*	*2.87*	*2.04*
Big Vans	164	26	23	10	16	
	2.47	*2.16*	*3.60*	*1.95*	*4.10*	*2.55*
Other	86	11	13	10	20	
	1.60	*0.96*	*1.26*	*1.36*	*0.75*	*1.28*
Large Trucks & Buses	1,633	262	127	103	114	
	6.61	*4.13*	*1.97*	*9.05*	*5.64*	*5.51*

Table 27. Fire rates by vehicle type and crash mode for all FARS vehicles (FARS 2000-2007)

Table 28 and Table 29 below explore rollover crashes further to identify their impact on fire rate. Comparing Table 27 and Table 29 , the overall fire rate for passenger vehicles when rollovers occur increases from 2.79 to 3.36 per 100 vehicles in FARS. This is a 20% overall increase fire risk during rollovers compared to all crashes. It should be noted that the observation that fire rates increase when rollovers occur is supported by

earlier findings of the research team (Fell 2006) and other research studies (Tessmer 1994, Digges 2005).

Vehicle Type Fire Frequency *Fire Rate*	Frontal	Side	Rear	Rollover	Other	All Modes Combined
Passenger Vehicles	1,259	412	113	538	168	
	4.66	*3.29*	*3.71*	*2.03*	*3.35*	*3.36*
All Vehicles	1,557	491	132	654	208	
	5.31	*3.66*	*3.96*	*2.27*	*3.86*	*3.79*
Motorcycles	0	0	0	0	0	
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Passenger Cars	607	195	52	230	79	
	4.92	*3.39*	*4.19*	*2.46*	*3.58*	*3.63*
Pickups	353	110	27	131	51	
	5.06	*3.65*	*3.57*	*1.78*	*3.96*	*3.35*
SUVs	242	80	29	154	32	
	4.52	*2.95*	*3.88*	*1.89*	*2.74*	2.88
Minivans	57	27	5	23	6	
	5.38	*4.21*	*2.65*	*2.11*	*3.28*	*4.09*
Big Vans	39	10	3	9	3	
	8.04	*4.33*	*3.75*	*1.84*	*4.84*	*1.76*
Other	9	5	3	9	2	
	1.71	*2.82*	*2.63*	*1.25*	*1.69*	2.10
Large Trucks & Buses	250	64	13	98	35	
	24.58	*16.54*	*17.11*	*10.07*	*21.47*	*3.83*

Table 28. Fire rates where rollover occurred by vehicle type and principle crash mode where one or more fatalities occurred in that vehicle (FARS 2000-2007)

Vehicle Type Fire Frequency *Fire Rate*	Frontal	Side	Rear	Rollover	Other	All Modes Combined
Passenger Vehicles	1,400	431	125	552	174	
	4.52	*3.22*	*3.66*	*2.06*	*3.35*	*3.36*
All Vehicles	1,806	529	148	675	220	
	5.16	*3.58*	*3.84*	*2.31*	*3.89*	*3.81*
Motorcycles	0	0	0	0	0	
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Passenger Cars	637	195	56	234	81	
	4.63	*3.17*	*4.00*	*2.41*	*3.45*	*3.61*
Pickups	411	125	29	137	53	
	4.54	*3.62*	*3.21*	*1.80*	*3.80*	*3.37*
SUVs	288	84	34	157	34	
	4.19	*2.74*	*3.78*	*1.86*	*2.71*	*2.91*
Minivans	64	27	6	24	6	
	4.98	*3.79*	*2.80*	*2.11*	*3.05*	*3.58*
Big Vans	44	10	4	10	3	
	5.71	*3.47*	*4.26*	*1.95*	*4.29*	*4.09*
Other	11	5	3	10	3	
	1.86	*2.45*	*2.14*	*1.36*	*2.38*	*1.78*
Large Trucks & Buses	351	83	16	103	39	
	13.01	*9.10*	*7.84*	*9.05*	*14.39*	*11.33*

Table 29. Fire rates where rollover occurred by vehicle type and principle crash mode for all FARS vehicles (FARS 2000-2007)

Appendix Tables A15 and A16 list the number of fatalities and fatal crash involved vehicles respectively by year where a rollover took place.

All						
Crash Year	Frontal	Side	Rear	Pure Rollover	Other	Total
1978-1980	4,995	3,473	394	16,351	1,012	26,225
1981-1983	6,739	2,942	590	12,239	1,459	23,969
1984-1986	7,568	3,373	730	11,061	1,122	23,854
1987-1989	8,551	3,758	877	12,385	1,488	27,059
1990-1992	8,945	3,830	865	9,654	1,666	24,960
1993-1995	8,955	4,006	895	9,042	1,601	24,499
1996-1998	9,312	4,443	1,032	9,520	1,820	26,127
1999-2001	9,556	4,348	1,165	10,549	1,809	27,427
2002-2004	10,514	4,929	1,190	10,238	1,774	28,645
2005-2007	10,596	4,990	1,150	9,895	2,188	28,819
Fire Involved						
1978-1980	267	164	33	454	41	959
1981-1983	387	110	36	327	50	910
1984-1986	373	131	38	275	44	861
1987-1989	432	126	48	264	69	939
1990-1992	486	124	32	176	47	865
1993-1995	461	121	31	142	61	816
1996-1998	443	131	38	161	47	820
1999-2001	479	141	39	206	67	932
2002-2004	499	165	43	195	61	963
2005-2007	494	158	46	218	65	981
Fire Coded as Most Harmful Event						
1978-1980	73	50	11	148	10	292
1981-1983	149	39	19	145	17	369
1984-1986	141	48	13	102	14	318
1987-1989	153	46	18	90	39	346
1990-1992	151	38	14	48	17	268
1993-1995	141	32	14	45	27	259
1996-1998	107	37	13	26	12	195
1999-2001	100	26	9	27	14	176
2002-2004	134	45	17	51	14	261
2005-2007	184	55	19	67	16	341

Table 30. Rollover Crashes (as MHE), Fatality Counts for Passenger Vehicles by Crash Mode

All						
Crash Year	Frontal	Side	Rear	Pure Rollover	Other	Total
1978-1980	5,621	3,741	473	16,771	1,035	27,641
1981-1983	7,523	3,149	656	12,411	1,542	25,281
1984-1986	8,426	3,618	816	11,181	1,170	25,211
1987-1989	9,647	4,038	976	12,534	1,535	28,730
1990-1992	10,121	4,085	948	9,717	1,707	26,578
1993-1995	10,235	4,265	993	9,101	1,657	26,251
1996-1998	10,727	4,743	1,151	9,580	1,868	28,069
1999-2001	10,956	4,599	1,309	10,653	1,883	29,400
2002-2004	12,179	5,258	1,337	10,334	1,816	30,924
2005-2007	12,127	5,353	1,282	10,053	2,263	31,078
Fire Involved						
1978-1980	298	174	35	470	41	1,018
1981-1983	422	117	38	331	53	961
1984-1986	402	137	39	280	48	906
1987-1989	463	137	52	267	72	991
1990-1992	525	133	34	178	48	918
1993-1995	503	129	32	143	64	871
1996-1998	494	138	43	161	49	885
1999-2001	529	146	44	209	70	998
2002-2004	567	170	51	198	62	1,048
2005-2007	535	167	48	222	67	1,039
Fire Coded as Most Harmful Event						
1978-1980	75	50	11	150	10	296
1981-1983	152	41	20	147	17	377
1984-1986	145	48	13	103	14	323
1987-1989	158	46	18	91	40	353
1990-1992	154	40	14	48	17	273
1993-1995	143	32	15	46	27	263
1996-1998	109	37	13	26	12	197
1999-2001	103	26	9	27	15	180
2002-2004	137	46	17	52	14	266
2005-2007	187	58	20	68	16	349

Table 31. Rollover Crashes (as MHE), Vehicle Counts for Passenger Vehicles by Crash Mode

Damage Severity

When damage severity is considered, it is clear that the majority of fires occur when vehicles sustain severe/disabling damage (see Table 32, Table 33 & Table 34). Within FARS, damage severity is coded based on tow status and police officer report. If the police report indicates that the vehicle was 'totaled' and the vehicle was towed away, this is considered 'Disabling' damage." If the report indicates that the vehicle was 'totaled,' but the vehicle was driven away, this is 'Functional.'

All						
Crash Year	Frontal	Side	Rear	Rollover	Other	Total
1978-1980	260	121	32	88	60	561
1981-1983	331	143	39	123	78	714
1984-1986	259	128	37	101	64	589
1987-1989	267	128	52	105	83	635
1990-1992	286	109	46	89	83	613
1993-1995	266	89	34	70	59	518
1996-1998	261	102	28	55	58	504
1999-2001	224	86	35	57	67	469
2002-2004	242	92	46	48	48	476
2005-2007	228	61	34	38	33	394
Fire Involved						
1978-1980	6	1	.	1	2	10
1981-1983	6	6	1	4	.	17
1984-1986	5	1	.	2	1	9
1987-1989	1	5	.	3	1	10
1990-1992	9	-	1	1	3	14
1993-1995	4	1	.	.	1	6
1996-1998	6	-	.	.	.	6
1999-2001	7	1	2	.	.	10
2002-2004	4	1	.	.	.	5
2005-2007	5	1	.	.	1	7
Fire Coded as Most Harmful Event						
1978-1980	2	-	.	.	1	3
1981-1983	5	3	.	3	.	11
1984-1986	.	-	.	1	.	1
1987-1989	1	2	.	1	.	4
1990-1992	4	-	.	.	2	6
1993-1995	1	-	.	.	.	1
1996-1998	3	-	.	.	.	3
1999-2001	1	-	1	.	.	2
2002-2004	1	-	.	.	.	1
2005-2007	5	-	.	.	1	6

Table 32. Crashes with Minor Damage, Fatality Counts for Passenger Vehicles by Crash Mode

All						
Crash Year	Frontal	Side	Rear	Rollover	Other	Total
1978-1980	2,092	1,318	151	944	156	4,661
1981-1983	2,206	1,302	164	989	208	4,869
1984-1986	2,102	1,286	194	1,089	164	4,835
1987-1989	2,395	1,456	237	1,190	233	5,511
1990-1992	2,976	1,593	260	891	261	5,981
1993-1995	2,973	1,517	283	786	250	5,809
1996-1998	3,127	1,756	259	849	316	6,307
1999-2001	2,592	1,472	275	734	272	5,345
2002-2004	2,461	1,482	284	635	196	5,058
2005-2007	2,191	1,202	224	549	209	4,375
Fire Involved						
1978-1980	32	14	7	8	2	63
1981-1983	52	21	14	16	1	104
1984-1986	47	22	14	18	.	101
1987-1989	67	27	13	13	9	129
1990-1992	114	27	11	12	7	171
1993-1995	103	29	9	6	3	150
1996-1998	75	23	6	6	11	121
1999-2001	51	16	6	6	6	85
2002-2004	53	9	6	4	1	73
2005-2007	36	15	4	7	1	63
Fire Coded as Most Harmful Event						
1978-1980	12	7	4	3	.	26
1981-1983	27	8	13	9	.	57
1984-1986	20	4	6	3	.	33
1987-1989	31	15	5	6	9	66
1990-1992	46	9	6	5	4	70
1993-1995	31	3	5	2	1	42
1996-1998	14	9	4	.	3	30
1999-2001	14	4	4	.	1	23
2002-2004	25	5	3	1	.	34
2005-2007	14	6	1	.	1	22

Table 33. Crashes with Moderate/Functional Damage, Fatality Counts for Passenger Vehicles by Crash Mode

All						
Crash Year	Frontal	Side	Rear	Rollover	Other	Total
1978-1980	41,725	22,028	2,264	15,226	3,065	84,308
1981-1983	36,746	19,204	2,250	11,019	5,629	74,848
1984-1986	37,544	21,236	2,621	9,773	3,819	74,993
1987-1989	40,739	23,377	3,058	10,834	3,223	81,231
1990-1992	38,131	22,179	2,517	8,489	2,819	74,135
1993-1995	39,444	22,610	2,735	8,092	2,550	75,431
1996-1998	40,621	23,593	3,175	8,530	2,631	78,550
1999-2001	39,820	23,681	3,578	9,669	2,711	79,459
2002-2004	40,440	24,255	3,537	9,494	2,602	80,328
2005-2007	38,585	21,872	3,281	9,266	3,327	76,331
Fire Involved						
1978-1980	1,642	645	319	442	170	3,218
1981-1983	1,652	543	266	302	279	3,042
1984-1986	1,689	630	263	255	203	3,040
1987-1989	1,896	641	286	242	208	3,273
1990-1992	1,931	611	204	161	137	3,044
1993-1995	2,006	615	212	133	150	3,116
1996-1998	2,027	583	216	154	132	3,112
1999-2001	2,167	600	279	199	144	3,389
2002-2004	2,126	629	234	191	152	3,332
2005-2007	2,159	597	239	210	175	3,380
Fire Coded as Most Harmful Event						
1978-1980	456	183	109	143	62	953
1981-1983	634	185	150	130	99	1,198
1984-1986	579	170	103	98	77	1,027
1987-1989	640	180	119	83	99	1,121
1990-1992	566	156	108	42	62	934
1993-1995	515	157	102	43	74	891
1996-1998	479	133	78	25	57	772
1999-2001	458	108	105	27	45	743
2002-2004	636	173	99	50	56	1,014
2005-2007	791	204	126	66	80	1,267

Table 34. Crashes with Severe/Disabling Damage, Fatality Counts for Passenger Vehicles by Crash Mode

CONCLUSIONS

In summary, this study presents descriptive statistics documenting the rate that states report fatal fire involved and rollover involved crashes per fatal crash occurrence. Based on interview findings, it appears that many FARS Analysts in the 14 States with low fire and rollover rates do not have routine access nor routinely use other data sources (other than the PAR) in coding fire or rollover occurrences. These states include Utah, Mississippi, Florida, Michigan, South Carolina, Dist of Columbia, Idaho, Virginia, New York, Nebraska, New Jersey, Colorado, Alabama and Nevada. Since these states include both predominantly rural and urban classes, it is unlikely that level of urbanization, which does affect fire and rollover crash rates, introduces any significant bias in reporting rates.

Five states made no mention of fire on their PAR. Only 9 states had a specific box for routine coding in their PAR. The fire rate for these 9 states ranged from 2.45 in North Carolina to 3.42 in Alaska. The average fire rate for these states was 3.55. This compared to an average of 2.88 for the entire group of 50 States and DC. Lack of data on the PAR requires additional resources to identify FARS cases with fires.

Figures 1 through 4 show the very large variations FARS rate data by State for fires, rollovers, rollovers with fires and extractions. These variations lead to questions regarding the validity of the data in predicting actual magnitude of these events.

Every effort should be made to obtain access to key data as an aid to reporting these important data elements in FARS. Death certificates, medical examiners or coroners reports, emergency medical service reports and even news clippings of the fatal crash would all help in the FARS coding. This study investigates a few critical data elements coded within FARS that many analysts use for safety evaluations including the occurrence of fire, rollover and occupant entrapment. Additional training should be conducted to alert FARS analysts and NHTSA staff of these deficiencies and to implement best practices to see that the information is adequately recognized and coded in the future. Further, follow- up analyses like the one presented in this report should be conducted regularly to insure that FARS analysts make changes and continue to maintain high standards for data collection.

REFERENCES

Digges, K., Stephenson, R, and Bedewi, P., "Research Programs in Crash-Induced Fire Safety", SAE 2005-01-1425, April 2005.

Digges, K., Stephenson, R., "A Research Program to Study Impact Related Fire Safety", Enhanced Safety of Vehicles, Paper 05-0448, June 2005.

FHWA, Office of Highway Policy Information, State & Urbanized Area Statistics, 2003.

Fell, J. C., Tippetts, A. S., Bahouth, G. T. "Analysis Of Fire Occurrence And Rollover Rates In The Fatality Analysis Reporting System (Fars)", Report to the Motor Vehicle Fire Research Institute, March 2006.

Fell, J. C., Tippets A. S., Bahouth, G. T. "An Analysis of Vehicle Fire Rates in Fatal Crashes: Is there an Indication of Underreporting," Society of Automotive Engineers World Congress, Paper Number 2007–01–0876, April 2007.

National Safety Council, Injury Facts, 1990 Edition.

National Highway Traffic Safety Administration, "Traffic Safety Fact 1995s: A Compilation of Motor Vehicle Crash Data from the Fatal Accident Reporting System and the General Estimates System" September 1996.

NHTSA Rollover Integrated Project Team, "Initiatives to Address the Mitigation of Vehicle Rollover", June 2003, Docket No. NHTSA-2003-14622-1.

NHTSA Compatibility Integrated Project Team, "Initiatives to Address Vehicle Compatibility", June 2003, Docket No. NHTSA–2003–14623.

NHTSA Impaired Driving Integrated Project Team, "Initiatives to Address Impaired Driving", December 2003, Docket No. NHTSA-2003-14621-1.

NHTSA Data Integrated Project Team, "Initiatives to Address Improving Traffic Safety Data", May 2004, Docket No. NHTSA-2004-17339.

Tessmer, J "An analysis of Fires in Passenger Cars, Light Trucks and Vans," U.S. Department of Transportation, National Highway Transportation Safety Administration (NHTSA) Report No. HS 808 208; December 1994.

Appendix A- Fatality Data by State and Crash Types

State	Number of Vehicles where 1+ Deaths Occurred	Number of FARS Vehicles	Total VMT (2003 FHWA)	Fire Rate (death in vehicle)	Fire Rate (all FARS Vehicles)	Roll Rate (death in vehicle)	Roll Rate (all FARS Vehicles)	Entrap Rate (death in vehicle)	Entrap Rate (all FARS Vehicles)
Alabama	5,356	8,582	56,534	3.68	2.76	66.62	77.37	6.58	3.48
Alaska	441	734	4,613	4.99	3.54	64.40	77.11	41.82	30.70
Arizona	4,909	8,905	49,768	4.46	3.25	59.60	75.72	34.03	18.38
Arkansas	3,281	5,118	29,167	6.40	5.12	63.67	74.64	8.65	5.80
California	17,317	33,263	306,649	4.44	2.87	67.49	80.88	10.79	5.52
Colorado	3,278	5,585	41,771	2.72	2.11	56.59	72.09	14.08	9.32
Connecticut	1,497	2,552	30,756	4.07	3.02	77.42	85.46	43.93	27.92
Delaware	618	1,161	8,240	4.37	2.84	76.38	85.62	40.52	25.36
Dist of Columbia	210	451	3,498	3.33	1.77	84.76	91.57	26.21	12.90
Florida	13,822	27,036	152,136	2.55	1.53	76.03	86.12	0.66	0.63
Georgia	7,844	13,867	105,010	4.87	3.48	71.20	82.00	39.18	24.99
Hawaii	536	1,069	8,543	3.17	2.15	77.61	87.28	24.20	13.16
Idaho	1,384	2,046	13,534	1.88	1.81	48.84	62.81	42.56	30.77
Illinois	6,508	11,730	102,866	5.53	3.91	74.46	84.30	19.73	13.26
Indiana	4,462	7,658	70,862	3.88	2.74	78.22	86.05	40.65	27.60
Iowa	2,172	3,547	29,433	4.05	2.62	70.81	81.42	34.38	25.35
Kansas	2,402	3,821	28,130	5.62	4.42	63.78	75.29	33.89	24.05
Kentucky	4,622	7,398	46,803	4.46	3.26	71.29	80.56	39.97	26.96
Louisiana	4,401	7,596	40,849	5.34	3.69	70.35	80.94	20.70	17.00
Maine	958	1,531	14,190	3.13	2.81	69.73	78.71	15.45	10.13
Maryland	2,894	5,567	50,174	3.87	2.41	83.07	90.14	14.32	6.45
Massachusetts	2,090	3,693	52,796	3.64	2.52	78.85	86.65	33.47	21.23
Michigan	5,893	11,019	97,792	2.80	1.76	79.67	87.78	35.69	21.95
Minnesota	3,020	5,026	52,601	7.85	5.95	65.76	77.44	19.83	13.57
Mississippi	4,502	6,773	35,536	0.87	0.65	82.12	87.92	1.33	2.71
Missouri	5,869	9,519	67,083	5.16	4.23	61.75	73.83	8.13	5.57
Montana	1,250	1,753	9,882	4.64	3.82	42.48	56.42	26.42	22.08
Nebraska	1,388	2,252	18,081	2.88	2.49	61.17	73.85	28.39	20.03
Nevada	1,627	2,987	17,639	4.12	2.71	58.02	74.86	28.59	17.44
New Hampshire	735	1,182	12,021	2.99	2.20	75.78	84.26	29.74	24.02
New Jersey	3,151	6,340	67,446	3.87	2.24	85.72	91.99	9.58	5.49

New Mexico	2,108	3,416	22,760	3.27	2.58	46.82	65.40	8.86	5.60
New York	6,163	12,099	129,057	3.81	2.29	80.92	88.98	32.50	18.70
North Carolina	7,472	12,920	89,504	3.60	2.66	70.64	81.08	25.26	15.53
North Dakota	533	773	7,217	5.07	4.01	49.91	62.74	14.50	11.62
Ohio	6,789	11,506	105,898	3.58	2.56	76.36	84.18	39.54	26.02
Oklahoma	3,558	5,784	43,355	5.99	4.50	64.42	75.26	26.78	17.66
Oregon	2,186	3,722	35,010	4.76	3.55	69.67	80.15	52.87	36.09
Pennsylvania	7,571	13,093	102,337	4.24	3.22	76.99	85.33	53.45	35.37
Rhode Island	423	700	8,359	4.49	2.86	76.12	84.57	39.72	24.60
South Carolina	5,137	8,324	45,538	2.49	1.75	70.94	81.13	0.92	0.53
South Dakota	913	1,345	8,432	5.04	3.79	53.23	66.47	19.35	14.18
Tennessee	6,403	10,201	65,732	5.33	4.00	67.97	77.85	35.48	25.14
Texas	17,241	30,461	220,064	4.20	2.88	68.88	80.57	0.64	0.45
Utah	1,463	2,364	22,597	0.62	0.42	55.09	71.28	41.22	28.29
Vermont	415	649	6,811	4.34	3.08	67.95	76.89	39.75	30.74
Virginia	4,569	7,628	74,801	2.10	1.74	70.72	81.16	0.15	0.11
Washington	2,943	5,008	53,330	4.66	3.45	68.13	79.09	29.36	19.26
West Virginia	2,067	3,223	19,242	4.69	3.72	66.13	76.73	48.35	32.83
Wisconsin	4,057	6,557	57,266	4.78	3.83	66.18	76.86	30.73	23.18
Wyoming	844	1,192	8,090	2.96	3.19	39.81	54.95	14.05	10.75
Total	**201,292**	**350,726**	**2,749,803**	**4.05**	**2.88**	**70.17**	**81.14**	**21.44**	**13.80**

Table A1. Fatality, fire, rollover and entrapment rates by state (FARS 2000-2005, VMT Data Source: FHWA, OHPI, State & Urbanized Area Statistics, 2003)

State	Fire as Most Harmful Event	Fire	Total	Rate per Vehicles Inv.
Alabama	124	237	8,582	2.76%
Alaska	7	26	734	3.54%
Arizona	55	289	8,905	3.25%
Arkansas	120	262	5,118	5.12%
California*	212	956	33,263	2.87%
Colorado*	10	118	5,585	2.11%
Connecticut	18	77	2,552	3.02%
Delaware*	6	33	1,161	2.84%
Dist of Columbia*	2	8	451	1.77%
Florida	175	414	27,036	1.53%
Georgia	85	483	13,867	3.48%
Hawaii	2	23	1,069	2.15%
Idaho	12	37	2,046	1.81%
Illinois	75	459	11,730	3.91%
Indiana	60	210	7,658	2.74%
Iowa	7	93	3,547	2.62%
Kansas*	46	169	3,821	4.42%
Kentucky	32	241	7,398	3.26%
Louisiana	124	280	7,596	3.69%
Maine	17	43	1,531	2.81%
Maryland*	57	134	5,567	2.41%
Massachusetts	18	93	3,693	2.52%
Michigan	36	194	11,019	1.76%
Minnesota	21	299	5,026	5.95%
Mississippi		44	6,773	0.65%
Missouri	82	403	9,519	4.23%
Montana*	17	67	1,753	3.82%
Nebraska	11	56	2,252	2.49%
Nevada	7	81	2,987	2.71%
New Hampshire	5	26	1,182	2.20%
New Jersey	45	142	6,340	2.24%
New Mexico	5	88	3,416	2.58%
New York	188	277	12,099	2.29%
North Carolina*	104	344	12,920	2.66%
North Dakota	13	31	773	4.01%
Ohio	96	295	11,506	2.56%
Oklahoma*	25	260	5,784	4.50%
Oregon	52	132	3,722	3.55%
Pennsylvania*	137	421	13,093	3.22%
Rhode Island*	1	20	700	2.86%
South Carolina	100	146	8,324	1.75%
South Dakota*	11	51	1,345	3.79%
Tennessee	115	408	10,201	4.00%
Texas	283	877	30,461	2.88%
Utah		10	2,364	0.42%

Vermont	11	20	649	3.08%
Virginia	31	133	7,628	1.74%
Washington	48	173	5,008	3.45%
West Virginia	19	120	3,223	3.72%
Wisconsin	43	251	6,557	3.83%
Wyoming	7	38	1,192	3.19%

Table A2. Fire Counts, Most Harmful Event Fire Counts and FARS crash counts (2000-2005 FARS vehicle Counts, '*' denotes states where no specific check box for fire as most harmful event exists on the PAR)

All					
Crash Year	Frontal	Side	Rear	Rollover	Other
1978-1980	19,151	10,147	1,051	7,428	1,816
1981-1983	16,531	8,614	1,012	5,149	2,709
1984-1986	15,434	8,802	1,099	4,161	1,769
1987-1989	18,669	10,656	1,445	5,319	1,626
1990-1992	15,706	9,008	1,075	3,847	1,373
1993-1995	13,155	7,789	959	3,220	1,091
1996-1998	12,688	8,162	1,191	3,599	1,198
1999-2001	11,622	7,788	1,225	4,048	1,236
2002-2004	11,739	7,636	1,138	3,646	1,169
2005-2007	10,568	6,058	967	2,766	1,205
Fire Involved					
1978-1980	796	301	135	194	69
1981-1983	642	192	107	96	113
1984-1986	567	234	72	67	73
1987-1989	794	273	94	77	80
1990-1992	714	192	55	37	38
1993-1995	549	163	50	34	46
1996-1998	576	181	49	59	44
1999-2001	560	211	75	70	47
2002-2004	598	197	68	60	45
2005-2007	593	171	57	54	53
Fire Coded as Most Harmful Event					
1978-1980	218	82	46	53	21
1981-1983	241	66	59	41	33
1984-1986	180	54	28	22	27
1987-1989	250	75	36	25	36
1990-1992	212	58	25	6	15
1993-1995	137	37	27	12	24
1996-1998	128	35	18	8	23
1999-2001	114	38	28	7	11
2002-2004	180	57	28	16	17
2005-2007	220	54	32	12	20

Table A3. Fatality Counts in Passenger Vehicles Less Than 5 Years Old by Crash Mode

All					
Crash Year	Frontal	Side	Rear	Rollover	Other
1978-1980	42,131	14,052	2,977	7,595	2,749
1981-1983	33,925	11,461	2,532	5,220	4,637
1984-1986	31,647	11,702	2,674	4,202	3,161
1987-1989	39,742	14,143	3,256	5,387	2,939
1990-1992	33,760	11,789	2,593	3,885	2,387
1993-1995	30,517	10,087	2,419	3,243	2,001
1996-1998	31,445	10,682	2,875	3,622	2,113
1999-2001	29,455	10,326	3,087	4,105	2,210
2002-2004	29,497	10,439	3,035	3,697	2,091
2005-2007	25,894	8,751	2,914	2,825	2,145
Fire Involved					
1978-1980	981	338	157	200	73
1981-1983	761	216	132	99	128
1984-1986	672	255	96	67	78
1987-1989	962	302	125	77	89
1990-1992	824	211	74	39	40
1993-1995	688	172	60	34	54
1996-1998	717	201	70	59	47
1999-2001	732	224	102	72	53
2002-2004	781	212	85	61	62
2005-2007	723	183	71	55	59
Fire Coded as Most Harmful Event					
1978-1980	235	86	52	53	21
1981-1983	254	73	64	43	36
1984-1986	191	55	31	22	27
1987-1989	269	78	41	25	42
1990-1992	223	61	29	6	17
1993-1995	152	37	29	12	28
1996-1998	144	39	24	8	23
1999-2001	124	39	33	7	15
2002-2004	207	60	31	17	21
2005-2007	251	58	35	12	23

Table A4. FARS Vehicle Counts- Passenger Vehicles Less Than 5 Years Old by Crash Mode

All					
Crash Year	Frontal	Side	Rear	Rollover	Other
1978-1980	34,834	18,683	1,936	12,985	3,415
1981-1983	29,400	15,527	1,834	9,232	5,112
1984-1986	29,115	16,596	2,097	7,833	3,424
1987-1989	31,867	18,470	2,447	8,694	2,878
1990-1992	29,312	17,048	1,989	6,630	2,494
1993-1995	29,012	16,903	2,109	6,307	2,263
1996-1998	27,720	16,783	2,297	6,335	2,298
1999-2001	25,288	16,157	2,475	7,046	2,325
2002-2004	25,120	16,340	2,430	7,038	2,236
2005-2007	23,302	13,959	2,136	6,382	2,572
Fire Involved					
1978-1980	1,385	542	260	347	133
1981-1983	1,246	385	211	205	216
1984-1986	1,154	433	183	158	143
1987-1989	1,361	443	189	154	151
1990-1992	1,407	416	121	90	91
1993-1995	1,328	379	117	80	97
1996-1998	1,262	352	105	89	89
1999-2001	1,238	377	156	125	93
2002-2004	1,242	401	130	116	95
2005-2007	1,289	349	136	131	120
Fire Coded as Most Harmful Event					
1978-1980	381	148	88	104	45
1981-1983	461	129	118	91	75
1984-1986	379	105	72	58	56
1987-1989	443	118	71	47	66
1990-1992	403	106	59	18	38
1993-1995	331	92	58	26	51
1996-1998	283	74	35	12	38
1999-2001	252	64	59	16	26
2002-2004	387	111	54	30	36
2005-2007	471	117	72	32	51

Table A5. Fatality Counts in Passenger Vehicles Less Than 10 Years Old by Crash Mode

All					
Crash Year	Frontal	Side	Rear	Rollover	Other
1978-1980	76,383	25,631	5,344	13,312	5,160
1981-1983	63,032	20,963	4,813	9,363	8,680
1984-1986	61,699	22,285	5,259	7,923	6,038
1987-1989	65,898	24,178	5,474	8,806	4,883
1990-1992	60,824	21,855	4,650	6,680	4,138
1993-1995	61,974	21,296	4,870	6,350	3,764
1996-1998	61,007	21,255	5,274	6,379	3,808
1999-2001	57,273	20,593	5,624	7,123	3,875
2002-2004	57,532	21,185	5,796	7,115	3,763
2005-2007	52,926	18,989	5,680	6,506	4,241
Fire Involved					
1978-1980	1,711	601	302	358	141
1981-1983	1,514	429	257	208	239
1984-1986	1,391	478	228	162	156
1987-1989	1,645	490	235	156	163
1990-1992	1,624	455	156	92	95
1993-1995	1,605	407	140	81	109
1996-1998	1,516	383	142	89	96
1999-2001	1,547	398	195	127	103
2002-2004	1,547	425	158	117	114
2005-2007	1,564	378	162	134	135
Fire Coded as Most Harmful Event					
1978-1980	413	152	95	105	46
1981-1983	490	138	125	93	79
1984-1986	404	111	79	59	58
1987-1989	470	122	79	47	72
1990-1992	426	111	70	18	40
1993-1995	356	96	64	27	57
1996-1998	303	79	41	12	38
1999-2001	269	65	66	16	32
2002-2004	424	113	59	31	39
2005-2007	528	125	82	32	57

Table A6. FARS Vehicle Counts- Passenger Vehicles Less Than 10 Years Old by Crash Mode

All					
Crash Year	Frontal	Side	Rear	Rollover	Other
1978-1980	9,470	4,955	536	3,366	998
1981-1983	10,111	5,230	641	3,007	1,760
1984-1986	11,085	6,211	780	3,228	1,484
1987-1989	12,565	6,977	980	3,691	1,507
1990-1992	12,801	7,173	902	3,024	1,373
1993-1995	13,834	7,435	976	2,735	1,279
1996-1998	16,473	8,786	1,205	3,185	1,287
1999-2001	17,553	9,195	1,442	3,503	1,311
2002-2004	18,178	9,595	1,466	3,200	1,128
2005-2007	17,841	9,238	1,413	3,513	1,463
Fire Involved					
1978-1980	297	122	67	107	46
1981-1983	468	186	70	122	66
1984-1986	593	222	95	117	64
1987-1989	658	248	114	110	76
1990-1992	694	239	99	86	56
1993-1995	788	267	104	62	60
1996-1998	851	257	119	72	58
1999-2001	995	240	132	81	59
2002-2004	947	241	110	79	61
2005-2007	917	266	107	87	60
Fire Coded as Most Harmful Event					
1978-1980	89	42	25	44	22
1981-1983	206	67	45	54	24
1984-1986	220	69	38	44	22
1987-1989	229	79	53	43	46
1990-1992	213	59	56	30	30
1993-1995	216	68	49	19	25
1996-1998	214	68	47	14	25
1999-2001	223	48	51	11	21
2002-2004	276	67	48	21	21
2005-2007	342	94	55	35	31

Table A7. Fatality Counts- Passenger Vehicles 10 Yrs. Old and Older by Crash Mode

All					
Crash Year	Frontal	Side	Rear	Rollover	Other
1978-1980	18,337	6,436	1,283	3,459	1,379
1981-1983	20,256	6,788	1,639	3,048	2,680
1984-1986	23,811	8,203	2,020	3,258	2,388
1987-1989	27,768	9,174	2,281	3,728	2,277
1990-1992	25,866	9,187	2,078	3,037	1,978
1993-1995	26,594	9,169	2,123	2,751	1,827
1996-1998	30,265	10,530	2,475	3,201	1,869
1999-2001	31,107	10,951	2,762	3,530	1,865
2002-2004	31,332	11,434	2,741	3,219	1,630
2005-2007	30,633	11,255	2,780	3,547	2,089
Fire Involved					
1978-1980	356	136	78	112	47
1981-1983	560	202	86	123	71
1984-1986	695	247	125	118	73
1987-1989	824	270	145	111	86
1990-1992	853	264	127	86	61
1993-1995	911	290	121	62	63
1996-1998	970	269	140	72	60
1999-2001	1,128	254	150	82	62
2002-2004	1,077	253	131	81	69
2005-2007	1,031	280	115	88	62
Fire Coded as Most Harmful Event					
1978-1980	94	43	26	45	22
1981-1983	212	72	50	54	24
1984-1986	228	70	44	44	22
1987-1989	239	81	54	44	48
1990-1992	224	60	62	30	31
1993-1995	226	70	53	19	25
1996-1998	221	71	51	14	26
1999-2001	227	50	53	11	22
2002-2004	291	68	55	21	21
2005-2007	361	97	58	36	31

Table A8. FARS Vehicle Counts- Passenger Vehicles 10 Yrs. Old and Older

State	Count- Fire Crashes (2000-2007)	% All Fatals- Vehicles 10 Yrs Old+	% Fire Involved Fatals- All Vehicles
Oregon	134	54%	5.4%
Washington	166	54%	5.0%
Idaho	36	50%	2.3%
Alaska	23	47%	5.3%
Tennessee	381	46%	5.2%
Kentucky	248	45%	4.7%
North Dakota	33	45%	5.2%
Hawaii	23	44%	4.2%
California	858	44%	4.4%
Nebraska	40	44%	2.5%
North Carolina	293	44%	3.4%
Montana	72	43%	4.9%
South Dakota	48	43%	4.9%
Ohio	283	43%	3.8%
Virginia	126	42%	2.3%
Alabama	252	42%	3.9%
Kansas	142	42%	5.2%
West Virginia	107	41%	4.6%
South Carolina	150	41%	2.6%
Iowa	92	41%	3.8%
Wisconsin	238	41%	5.4%
Indiana	204	41%	4.1%
Minnesota	257	41%	7.7%
Missouri	329	41%	4.9%
Pennsylvania	358	40%	4.3%
Mississippi	48	40%	0.9%
Georgia	430	39%	4.7%
Colorado	90	39%	2.6%
Maine	38	39%	3.5%
Connecticut	74	38%	4.8%
Dist of Columbia	8	38%	4.1%
Arkansas	202	38%	5.5%
Oklahoma	246	38%	6.0%
Michigan	189	37%	2.9%
Utah	7	36%	0.4%
Arizona	244	36%	4.7%

Table A9. Percent of All Vehicle Fires by Age of Vehicle by State

State	Count- Fire Crashes (2000-2007)	% All Fatals- Vehicles 10 Yrs Old+	% Fire Involved Fatals- All Vehicles
Nevada	74	36%	4.0%
New York	250	36%	3.8%
Maryland	116	35%	3.6%
Rhode Island	22	35%	5.1%
Delaware	38	35%	5.3%
Illinois	408	35%	5.7%
Vermont	20	35%	4.4%
Massachusetts	85	35%	3.7%
New Jersey	132	35%	4.2%
Florida	417	34%	2.9%
Wyoming	22	34%	2.3%
New Mexico	61	34%	2.7%
Louisiana	263	34%	5.1%
Texas	785	33%	4.1%
New Hampshire	27	32%	3.6%

Table A8 continued. Percent of All Vehicle Fires by Age of Vehicle by State

Crash Year	Mode					
	Frontal	Nearside	Farside	Rear	Rollover	Other
1978	2,657	768	381	159	620	215
1979	2,901	789	393	122	598	273
1980	2,357	717	369	77	521	222
1981	2,147	696	324	109	401	195
1982	1,963	656	332	77	354	720
1983	1,666	637	311	79	217	758
1984	1,817	626	338	87	246	688
1985	1,981	757	388	104	198	202
1986	1,971	744	329	112	208	293
1987	2,336	841	362	179	317	295
1988	2,474	907	395	163	312	215
1989	2,446	943	433	132	236	176
1990	2,490	924	357	131	196	156
1991	2,223	841	407	115	252	146
1992	2,371	966	440	129	223	160
1993	2,422	918	424	141	213	154
1994	2,778	1,040	456	179	268	211
1995	2,725	1,089	433	154	228	192
1996	3,008	1,130	477	178	264	181
1997	3,296	1,328	504	186	280	202
1998	3,325	1,347	507	223	363	213
1999	3,636	1,528	557	257	360	280
2000	3,720	1,696	656	272	403	230
2001	3,720	1,616	655	273	419	209
2002	3,931	1,775	673	308	456	226
2003	3,916	1,709	710	319	433	197
2004	3,736	1,836	669	240	448	251
2005	3,580	1,576	605	230	459	226
2006	3,626	1,668	682	250	444	258
2007	3,510	1,543	658	265	440	268

Table A10. Entrapment Fatalities by Year and Crash Mode- Passenger Vehicle Occupant Count (FARS 1978-2007).

Crash Year	Mode					
	Frontal	Nearside	Farside	Rear	Rollover	Other
1978	161	36	22	51	52	25
1979	200	44	42	49	36	21
1980	161	42	33	20	28	9
1981	171	31	21	30	27	17
1982	145	27	18	12	22	36
1983	105	31	23	18	15	45
1984	123	28	25	21	15	25
1985	112	27	20	20	8	21
1986	123	33	28	25	11	24
1987	165	26	19	35	14	24
1988	170	23	21	26	21	19
1989	140	21	24	23	7	21
1990	144	31	14	25	3	10
1991	155	24	24	13	4	3
1992	171	33	23	18	9	13
1993	159	17	13	13	6	13
1994	167	31	28	25	2	10
1995	191	28	25	28	9	13
1996	182	25	13	14	2	12
1997	221	33	21	27	6	20
1998	233	35	23	35	9	5
1999	226	36	27	31	15	23
2000	294	47	23	40	14	10
2001	284	40	32	44	21	12
2002	285	39	29	34	15	23
2003	266	47	28	42	11	17
2004	236	55	30	38	12	16
2005	272	33	20	28	8	23
2006	276	37	29	37	20	8
2007	264	42	32	36	20	17

Table A11. Entrapment Fire Involved, Fatalities by Year and Crash Mode- Passenger Vehicle Occupant Count (FARS 1978-2007).

Crash Year	Mode					
	Frontal	Nearside	Farside	Rear	Rollover	Other
1979	80	25	25	38	21	13
1980	70	16	22	14	21	6
1981	54	9	9	19	17	11
1982	60	6	9	10	16	10
1983	27	10	8	16	6	7
1984	36	4	6	9	11	3
1985	36	6	2	8	4	3
1986	20	4	4	9	5	4
1987	63	9	8	7	5	3
1988	48	3	7	6	13	9
1989	27	4	6	9	.	12
1990	26	6	7	18	.	2
1991	45	7	4	8	1	3
1992	38	8	8	9	4	4
1993	46	1	4	8	1	5
1994	42	11	10	10	.	6
1995	42	4	7	24	5	6
1996	36	3	2	4	1	3
1997	49	9	7	10	3	11
1998	33	5	6	10	2	.
1999	52	9	7	11	5	7
2000	52	10	5	23	5	4
2001	71	7	3	18	5	7
2002	81	11	6	11	2	2
2003	76	15	7	15	4	4
2004	79	21	12	22	4	4
2005	96	6	6	14	3	11
2006	93	12	12	19	7	4
2007	96	17	11	16	7	7

Table A12. Entrapment Fire as MHE, Fatalities by Year and Crash Mode- Passenger Vehicle Occupant Count (FARS 1978-2007).

Crash Year	Vehicle Age		
	less than 5 yrs	5-9 yrs	10+ yrs
Alabama	83	124	143
Alaska	73	58	112
Arizona	710	647	710
Arkansas	95	129	114
California	633	536	884
Colorado	172	194	197
Connecticut	233	291	311
Delaware	112	117	117
Dist of Columbia	23	21	23
Florida	58	66	76
Georgia	1,190	1,393	1,548
Hawaii	70	39	63
Idaho	176	213	347
Illinois	530	622	626
Indiana	630	814	971
Iowa	238	372	462
Kansas	280	339	430
Kentucky	549	797	1,073
Louisiana	504	503	522
Maine	47	59	79
Maryland	134	129	135
Massachusetts	280	320	321
Michigan	805	928	1,026
Minnesota	194	232	312
Mississippi	56	76	68
Missouri	176	235	211
Montana	129	121	190
Nebraska	135	178	223
Nevada	237	178	236
New Hampshire	112	124	122
New Jersey	124	127	125
New Mexico	65	71	66
New York	774	881	907
North Carolina	592	733	1,075
North Dakota	19	24	52
Ohio	835	1,170	1,511
Oklahoma	367	408	437
Oregon	397	422	786
Pennsylvania	1,446	1,638	2,153
Rhode Island	62	64	75
South Carolina	14	12	25
South Dakota	44	78	86
Tennessee	712	960	1,375
Texas	35	58	58
Utah	231	220	270
Vermont	63	90	75
Virginia	1	3	5
Washington	217	298	565
West Virginia	328	422	502
Wisconsin	395	508	628
Wyoming	39	51	45

Table A13. Entrapment by US State, Fatalities by Year and Crash Mode- Occupant Count (FARS 2000-2007).

	Mode				
Crash Year	Frontal	Nearside	Rear	Rollover	Other
1978	1,549	1,418	132	5,671	384
1979	1,721	1,307	156	6,050	402
1980	2,354	1,215	181	6,148	323
1981	2,504	1,210	246	5,225	581
1982	2,413	1,017	213	4,157	484
1983	2,481	1,116	225	3,879	523
1984	2,669	1,226	237	3,846	505
1985	2,577	1,184	261	3,894	342
1986	3,150	1,357	312	4,261	379
1987	2,974	1,349	337	4,670	450
1988	3,125	1,405	335	4,729	516
1989	3,221	1,479	313	4,000	648
1990	3,410	1,588	291	3,603	704
1991	3,236	1,449	330	3,634	596
1992	3,119	1,362	336	3,271	531
1993	3,033	1,454	304	3,296	466
1994	3,250	1,447	355	3,285	630
1995	3,585	1,658	350	3,254	665
1996	3,437	1,718	372	3,443	642
1997	3,430	1,594	381	3,424	683
1998	3,356	1,714	420	3,589	676
1999	3,338	1,654	397	3,991	751
2000	3,366	1,584	446	3,939	609
2001	3,686	1,664	445	3,729	615
2002	3,821	1,729	467	3,961	667
2003	3,699	1,864	432	3,771	599
2004	3,877	1,903	424	3,605	712
2005	3,927	1,856	456	3,833	727
2006	3,799	1,896	432	3,699	849
2007	3,791	1,796	380	3,373	839

Table A14. Passenger Vehicle Rollover Fatalities by Year and Crash Mode- Occupant Count (FARS 1978-2007).

	Mode				
Crash Year	Frontal	Nearside	Rear	Rollover	Other
1978	85	79	10	185	16
1979	120	71	24	204	20
1980	139	64	16	176	16
1981	179	53	18	168	20
1982	148	42	29	131	12
1983	140	41	10	92	27
1984	163	69	19	83	16
1985	130	48	15	94	16
1986	212	55	19	137	14
1987	160	49	26	117	35
1988	181	66	21	131	21
1989	184	49	14	79	29
1990	188	62	14	72	24
1991	189	49	17	81	16
1992	199	54	9	66	12
1993	181	46	9	56	25
1994	184	61	14	62	24
1995	210	56	26	49	27
1996	192	67	19	46	13
1997	171	47	16	64	25
1998	180	62	15	75	23
1999	201	53	18	83	29
2000	188	57	21	84	28
2001	187	71	17	87	26
2002	189	63	19	85	28
2003	208	83	21	81	20
2004	183	69	16	63	20
2005	206	75	19	75	29
2006	182	71	16	109	22
2007	204	53	23	78	34

Table A15. Rollover Fire Involved, Passenger Vehicle Fatalities by Year and Crash Mode-Occupant Count (FARS 1978-2007)

	Mode				
Crash Year	Frontal	Nearside	Rear	Rollover	Other
1979	38	37	18	86	5
1980	60	28	7	102	7
1981	79	19	13	89	9
1982	59	25	13	56	2
1983	53	11	3	37	10
1984	60	27	6	36	3
1985	55	19	4	28	5
1986	79	18	5	58	6
1987	54	21	9	53	17
1988	73	29	8	47	16
1989	66	19	9	18	16
1990	55	23	7	26	12
1991	56	18	9	23	6
1992	73	15	5	18	1
1993	57	9	4	18	17
1994	55	24	10	23	6
1995	75	15	15	16	13
1996	53	14	9	6	4
1997	51	19	7	10	10
1998	34	21	5	11	5
1999	37	19	8	11	8
2000	51	7	5	16	6
2001	44	10	1	19	4
2002	44	17	4	18	9
2003	51	24	11	15	4
2004	53	20	8	25	5
2005	84	23	14	20	9
2006	58	19	2	33	2
2007	78	27	8	29	8

Table A16. Rollover Fire as MHE, Passenger Vehicle Fatalities by Year and Crash Mode-Occupant Count (FARS 1978-2007).

APPENDIX B– FARS FIRE DATA 1979 to 2007 BY DAMAGE AREA

Table B1. Passenger Vehicle Fatal Occupant Counts- Fire Occurrence for All Damage Areas (FARS 1978-2007).

Crash Year	All Fatals	All Fires	MHE Fires
1979	33,442	1,575	640
1980	33,504	1,457	717
1981	32,243	1,512	659
1982	28,370	1,338	566
1983	27,956	1,225	457
1984	28,829	1,287	437
1985	28,685	1,216	360
1986	30,694	1,567	572
1987	31,735	1,455	539
1988	32,523	1,591	575
1989	32,203	1,411	463
1990	31,270	1,423	466
1991	29,358	1,418	466
1992	28,177	1,308	391
1993	28,744	1,333	404
1994	29,518	1,383	388
1995	30,563	1,428	440
1996	31,142	1,296	386
1997	31,111	1,337	381
1998	30,484	1,415	284
1999	30,694	1,433	296
2000	30,716	1,509	366
2001	30,589	1,454	356
2002	31,118	1,480	407
2003	30,882	1,389	427
2004	30,523	1,343	493
2005	30,074	1,475	583
2006	29,214	1,472	527
2007	27,694	1,378	534

Note: MHE indicates the Most Harmful Event for the crashed vehicle as coded in the FARS file. One can not assume that the most harmful event for a vehicle was the cause of any death or injury for any specific individual within the vehicle.

Table B2. Passenger Vehicle Fatal Occupant Counts- Fire Occurrence for Rollover Crashes (FARS 1978-2007).

Crash Year	All Fatals	No Roll	Rollovers	All Fires	Fire & Rollover	MHE All Fires	MHE Rollover with Fires
1979	35,017	25,351	9,666	1,575	442	640	187
1980	34,961	24,721	10,240	1,457	412	717	205
1981	33,755	23,955	9,800	1,512	439	659	210
1982	29,708	21,410	8,298	1,338	363	566	155
1983	29,181	20,962	8,219	1,225	311	457	114
1984	30,116	21,619	8,497	1,287	351	437	133
1985	29,901	21,617	8,284	1,216	305	360	113
1986	32,261	22,787	9,474	1,567	440	572	167
1987	33,190	23,389	9,801	1,455	387	539	154
1988	34,114	23,976	10,138	1,591	423	575	173
1989	33,614	23,925	9,689	1,411	356	463	129
1990	32,693	23,074	9,619	1,423	362	466	125
1991	30,776	21,518	9,258	1,418	357	466	112
1992	29,485	20,849	8,636	1,308	341	391	113
1993	30,077	21,516	8,561	1,333	318	404	105
1994	30,901	21,920	8,981	1,383	345	388	118
1995	31,991	22,454	9,537	1,428	368	440	134
1996	32,438	22,814	9,624	1,296	338	386	87
1997	32,448	22,921	9,527	1,337	324	381	97
1998	31,899	22,126	9,773	1,415	358	284	77
1999	32,127	21,987	10,140	1,433	384	296	83
2000	32,225	22,266	9,959	1,509	379	366	85
2001	32,043	21,886	10,157	1,454	391	356	79
2002	32,598	21,932	10,666	1,480	384	407	92
2003	32,271	21,829	10,442	1,389	414	427	105
2004	31,866	21,276	10,590	1,343	357	493	113
2005	31,549	20,679	10,870	1,475	406	583	155
2006	30,686	19,944	10,742	1,472	404	527	112
2007	29,072	18,832	10,240	1,378	394	534	151

Table B3. Passenger Vehicle Fatal Occupant Counts- Fire Occurrence for Planar Only, Frontal Crashes (FARS 1978-2007).

Crash Year	All Fatals	No Frontals	Frontals	All Fires	Fire & Frontals	MHE All Fires	MHE Frontals with Fires
1979	35,017	19,770	15,247	1,575	679	640	242
1980	34,961	19,972	14,989	1,457	644	717	307
1981	33,755	20,066	13,689	1,512	608	659	235
1982	29,708	17,636	12,072	1,338	575	566	247
1983	29,181	17,702	11,479	1,225	517	457	184
1984	30,116	18,454	11,662	1,287	523	437	193
1985	29,901	17,494	12,407	1,216	572	360	157
1986	32,261	19,564	12,697	1,567	656	572	239
1987	33,190	20,034	13,156	1,455	617	539	246
1988	34,114	20,606	13,508	1,591	701	575	225
1989	33,614	20,080	13,534	1,411	662	463	197
1990	32,693	19,601	13,092	1,423	678	466	194
1991	30,776	18,617	12,159	1,418	658	466	207
1992	29,485	17,646	11,839	1,308	635	391	178
1993	30,077	17,632	12,445	1,333	675	404	173
1994	30,901	18,390	12,511	1,383	664	388	144
1995	31,991	19,223	12,768	1,428	691	440	169
1996	32,438	19,420	13,018	1,296	634	386	186
1997	32,448	19,329	13,119	1,337	665	381	165
1998	31,899	19,239	12,660	1,415	726	284	140
1999	32,127	19,923	12,204	1,433	675	296	138
2000	32,225	19,768	12,457	1,509	791	366	180
2001	32,043	19,730	12,313	1,454	712	356	163
2002	32,598	20,289	12,309	1,480	760	407	221
2003	32,271	20,057	12,214	1,389	650	427	217
2004	31,866	20,061	11,805	1,343	662	493	241
2005	31,549	19,950	11,599	1,475	723	583	275
2006	30,686	19,350	11,336	1,472	724	527	274
2007	29,072	18,285	10,787	1,378	651	534	244

Table B4. Passenger Vehicle Fatal Occupant Counts- Fire Occurrence for Planar Only, Rear Crashes (FARS 1978-2007).

Crash Year	All Fatals	No Rears	Rears	All Fires	Fire & Rears	MHE All Fires	MHE Rears with Fires
1979	35,017	34,225	792	1,575	156	640	75
1980	34,961	34,193	768	1,457	126	717	71
1981	33,755	32,926	829	1,512	142	659	82
1982	29,708	29,041	667	1,338	89	566	62
1983	29,181	28,480	701	1,225	93	457	57
1984	30,116	29,416	700	1,287	105	437	38
1985	29,901	29,052	849	1,216	93	360	29
1986	32,261	31,331	930	1,567	142	572	66
1987	33,190	32,166	1,024	1,455	140	539	55
1988	34,114	33,066	1,048	1,591	136	575	59
1989	33,614	32,714	900	1,411	96	463	47
1990	32,693	31,836	857	1,423	100	466	65
1991	30,776	30,017	759	1,418	97	466	55
1992	29,485	28,728	757	1,308	82	391	46
1993	30,077	29,240	837	1,333	84	404	44
1994	30,901	30,013	888	1,383	118	388	49
1995	31,991	31,145	846	1,428	77	440	50
1996	32,438	31,492	946	1,296	81	386	39
1997	32,448	31,479	969	1,337	91	381	36
1998	31,899	30,923	976	1,415	96	284	21
1999	32,127	31,119	1,008	1,433	102	296	28
2000	32,225	31,185	1,040	1,509	91	366	45
2001	32,043	30,937	1,106	1,454	128	356	59
2002	32,598	31,512	1,086	1,480	83	407	35
2003	32,271	31,200	1,071	1,389	105	427	40
2004	31,866	30,904	962	1,343	89	493	47
2005	31,549	30,591	958	1,475	108	583	61
2006	30,686	29,776	910	1,472	90	527	44
2007	29,072	28,146	926	1,378	81	534	44

Table B5. Passenger Vehicle Fatal Occupant Counts- Fire Occurrence for Planar Only, Right Damage Crashes (FARS 1978-2007).

Crash Year	All Fatals	Non-Right Damage	Right Damage	All Fires	Fire & Right Damage	MHE All Fires	MHE Right Damage with Fires
1979	35,017	31,072	3,945	1,575	120	640	55
1980	34,961	31,104	3,857	1,457	117	717	58
1981	33,755	30,016	3,739	1,512	131	659	49
1982	29,708	26,212	3,496	1,338	125	566	47
1983	29,181	25,766	3,415	1,225	109	457	26
1984	30,116	26,303	3,813	1,287	128	437	28
1985	29,901	26,044	3,857	1,216	114	360	26
1986	32,261	28,299	3,962	1,567	144	572	42
1987	33,190	29,255	3,935	1,455	132	539	33
1988	34,114	29,873	4,241	1,591	151	575	48
1989	33,614	29,371	4,243	1,411	133	463	29
1990	32,693	28,653	4,040	1,423	136	466	33
1991	30,776	27,000	3,776	1,418	128	466	30
1992	29,485	25,786	3,699	1,308	117	391	18
1993	30,077	26,418	3,659	1,333	96	404	30
1994	30,901	27,130	3,771	1,383	120	388	27
1995	31,991	28,126	3,865	1,428	148	440	39
1996	32,438	28,468	3,970	1,296	100	386	21
1997	32,448	28,528	3,920	1,337	113	381	30
1998	31,899	28,230	3,669	1,415	99	284	16
1999	32,127	28,493	3,634	1,433	108	296	13
2000	32,225	28,423	3,802	1,509	114	366	23
2001	32,043	28,369	3,674	1,454	95	356	17
2002	32,598	28,974	3,624	1,480	113	407	28
2003	32,271	28,520	3,751	1,389	92	427	25
2004	31,866	28,176	3,690	1,343	117	493	50
2005	31,549	28,102	3,447	1,475	96	583	36
2006	30,686	27,479	3,207	1,472	101	527	29
2007	29,072	26,032	3,040	1,378	106	534	42

Table B6. Passenger Vehicle Fatal Occupant Counts- Fire Occurrence for Planar Only, Left Damage Crashes (FARS 1978-2007).

Crash Year	All Fatals	Non-Left Damage	Left Damage	All Fires	Fire & Left Damage	MHE All Fires	MHE Left Damage with Fires
1979	35,017	31,014	4,003	1,575	107	640	42
1980	34,961	31,123	3,838	1,457	109	717	44
1981	33,755	30,210	3,545	1,512	84	659	42
1982	29,708	26,470	3,238	1,338	67	566	19
1983	29,181	25,906	3,275	1,225	104	457	43
1984	30,116	26,582	3,534	1,287	97	437	24
1985	29,901	26,389	3,512	1,216	91	360	19
1986	32,261	28,424	3,837	1,567	105	572	22
1987	33,190	29,219	3,971	1,455	103	539	27
1988	34,114	29,950	4,164	1,591	115	575	31
1989	33,614	29,330	4,284	1,411	112	463	37
1990	32,693	28,514	4,179	1,423	100	466	25
1991	30,776	26,801	3,975	1,418	134	466	36
1992	29,485	25,701	3,784	1,308	92	391	21
1993	30,077	26,298	3,779	1,333	105	404	27
1994	30,901	26,885	4,016	1,383	97	388	29
1995	31,991	27,687	4,304	1,428	105	440	23
1996	32,438	28,231	4,207	1,296	102	386	33
1997	32,448	28,204	4,244	1,337	104	381	24
1998	31,899	27,735	4,164	1,415	95	284	17
1999	32,127	27,704	4,423	1,433	133	296	26
2000	32,225	27,959	4,266	1,509	90	366	17
2001	32,043	27,900	4,143	1,454	96	356	22
2002	32,598	28,307	4,291	1,480	90	407	15
2003	32,271	28,002	4,269	1,389	96	427	25
2004	31,866	27,628	4,238	1,343	89	493	24
2005	31,549	27,600	3,949	1,475	88	583	26
2006	30,686	26,928	3,758	1,472	103	527	35
2007	29,072	25,631	3,441	1,378	109	534	35

Table B7. Passenger Vehicle Fatal Occupant Counts- Fire Crashes with No Rollover by Principle Impact Point (FARS 1978-2007).

Crash Year	Non-Collision	Front	Right	Rear	Left	Top	Undercarriage	Unknown
1979	15	677	120	156	107	22	7	27
1980	12	642	117	126	109	9	3	25
1981	27	608	131	142	84	11	7	63
1982	15	575	125	89	67	16	10	59
1983	10	517	109	93	104	15	15	51
1984	17	523	128	105	97	12	6	48
1985	8	572	114	93	91	17	3	13
1986	30	656	144	142	105	20	7	23
1987	27	617	132	140	103	12	5	32
1988	14	701	151	136	115	12	18	21
1989	5	662	133	96	112	15	1	31
1990	4	678	136	100	100	12	5	26
1991	9	658	128	97	134	8	6	21
1992	6	635	117	82	92	.	6	29
1993	14	675	96	84	105	6	4	31
1994	9	664	120	118	97	5	13	12
1995	6	691	148	77	105	4	9	20
1996	6	634	100	81	102	10	3	22
1997	17	665	113	91	104	6	7	10
1998	4	726	99	96	95	11	7	19
1999	1	675	108	102	133	8	3	19
2000	9	791	114	91	90	5	10	20
2001	8	712	95	128	96	5	5	14
2002	7	760	113	83	90	7	6	30
2003	7	650	92	105	96	2	6	17
2004	3	662	117	89	89	10	3	13
2005	2	723	96	108	88	15	2	35
2006	6	724	101	90	103	15	8	21
2007	2	651	106	81	109	12	6	17

Table B8. Passenger Vehicle Fatal Occupant Counts- Rollover Fire Crashes by Principle Impact Point (FARS 1978-2007).

Crash Year	Non-Collision	Front	Right	Rear	Left	Top	Undercarriage	Unknown
1979	41	120	30	24	42	165	3	17
1980	70	139	29	16	35	107	5	11
1981	84	179	20	18	33	85	8	12
1982	61	148	24	29	18	70	4	9
1983	50	140	19	10	22	42	4	24
1984	48	164	32	19	37	35	3	13
1985	57	130	29	15	19	39	10	6
1986	78	214	28	19	27	60	8	6
1987	72	160	38	26	11	45	14	21
1988	78	183	35	21	31	54	9	12
1989	53	185	29	14	20	26	9	20
1990	55	188	27	14	35	19	10	14
1991	49	194	37	17	12	32	4	12
1992	41	200	17	9	37	25	8	4
1993	38	181	16	9	30	19	14	11
1994	37	184	40	14	21	25	6	18
1995	35	210	27	26	29	14	8	19
1996	30	192	49	19	18	17	4	9
1997	39	171	29	16	18	26	9	16
1998	47	181	34	16	28	29	9	14
1999	44	201	30	18	23	39	5	24
2000	55	188	22	21	35	29	8	21
2001	64	189	34	17	37	23	7	20
2002	69	189	32	19	31	16	10	18
2003	61	209	42	21	41	20	4	16
2004	40	185	39	16	30	26	4	17
2005	32	207	37	19	38	44	9	20
2006	60	185	47	16	24	50	5	17
2007	26	206	27	23	26	52	6	28