U.S. Department of
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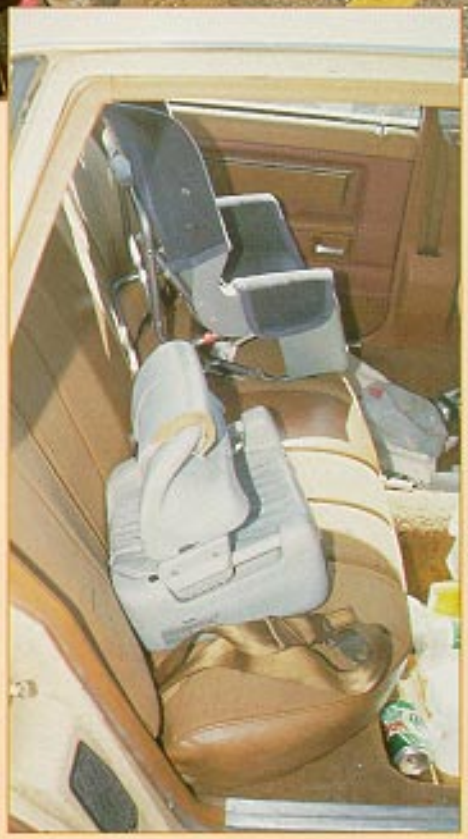
**National Highway
Traffic Safety
Administration**



National Accident Sampling System Crashworthiness Data System 1991-1993

U.S. Department of Transportation
National Highway Traffic
Safety Administration

National Accident Sampling System
Crashworthiness Data System
1991 -1993

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Executive Summary

During the period 1991 through 1993, an estimated 10.6 million vehicles each year were involved in police-reported traffic crashes. Approximately 95 percent of these were automobiles, pickup trucks, vans, and sport/utility vehicles, collectively referred to as *passenger vehicles*. Pickup trucks, vans, and utility vehicles are collectively referred to as *light trucks*. Most of these vehicles were not seriously damaged: less than 29 percent of them were towed from the crash scene due to damage sustained. Approximately 46,000 were involved in fatal crashes each year.

This report focuses attention on occupants of those passenger vehicles that were towed from the crash scene. NHTSA's National Accident Sampling System (NASS)/ Crashworthiness Data System (CDS) collects detailed information on towed passenger vehicle crashes, employing trained, professional accident investigation teams. The in-depth data collection, scientific protocols, and professionalism of those involved make the NASS/CDS database a valuable resource to many in the traffic safety community.

NASS data are used by government, industry, and the private sector to conduct research, identify injury patterns and mechanisms, provide a basis for regulatory decisionmaking, and provide a means of evaluating the association between occupant injury and various crash-related characteristics.

Some highlights of the report include:

- Passenger cars comprise the largest segment (about 76 percent) of the passenger vehicles found in the NASS/CDS, and hence, in police-reported towaway crashes. In the report, cars are treated separately from the remaining vehicles, which have been grouped together as light trucks.

- Occupancy patterns for towed crash-involved cars and light trucks were very similar: about two-thirds of the time, the only occupant of a towed crash-involved car or light truck was the driver. A front-seat passenger was present in the car or light truck about 22.5 percent of the time, with passengers in the second and further seats about 12.5 percent of the time.

- One of the health-care consequences of motor vehicle crashes is the burden on emergency services. About 242,000 occupants of passenger vehicles were hospitalized each year as a result of police-reported traffic crashes. Another 989,000 occupants were transported to a medical facility and released, and 235,000 occupants were treated at the scene of the crash.

- Contact with the steering assembly accounted for about 11 percent of the minor injuries but about 16 percent of the severe (AIS 3+) injuries. A similar pattern was observed for contact with the interior side surface, comprising 7 percent of the minor injuries and about 15 percent of severe and greater injuries.

- The percentage of injuries resulting from contact with the instrument panel decreased as injury severity increased; the same was true for contact with the windshield.

- Approximately 54,000 injuries to occupants resulted from contacting an airbag. More than 94 percent were minor injuries, and less than 3 percent were severe injuries.
- Less than 6 percent of the towed cars in crashes rolled over, compared with 14 percent of the towed light trucks.
- About 8 percent of car occupants in rollover crashes were ejected; the remaining crash types exhibited ejection rates in the range of 1 to 2 percent.
- The restraint use rate for all occupants of passenger vehicles was about 66 percent; for occupants under 16 years of age—that is, children—the restraint use rate was 68 percent.
- The instrument panel was the cause of almost 14 percent of all injuries to children and 20 percent of the severe (AIS 3+) injuries to children.

1. Introduction

Background

The National Accident Sampling System (NASS) is the mechanism through which the National Highway Traffic Safety Administration (NHTSA) collects nationally representative data on motor vehicle traffic crashes, to aid in the development, implementation, and evaluation of motor vehicle and highway safety countermeasures. The NASS was originally designed and implemented in 1979 to support highway and motor vehicle safety programs. The NASS program was reevaluated in the mid-1980s. The evaluation team concluded that the program should be redesigned to focus on enhanced in-depth analyses of passenger vehicle crash protection performance. This reevaluation resulted in changes that were implemented by NHTSA's National Center for Statistics and Analysis (NCSA) in January 1988.

To enhance its applicability in addressing crashworthiness issues, the NASS was divided into two parts: (1) the General Estimates System (GES), which collects data on an annual sample of approximately 50,000 police-reported traffic crashes; and (2) the Crashworthiness Data System (CDS), which collects additional detailed information on an annual sample of approximately 5,000 police-reported traffic crashes involving passenger vehicles towed from the crash scene due to damage resulting from the crash. In this report, the term *passenger vehicles* is used to refer to all cars, pickup trucks, vans, and sport/utility vehicles with a gross vehicle weight rating (GVWR) of 10,000 pounds or less. The term *light trucks* is used to refer to pickup trucks, vans, and sport/utility vehicles.

Unlike the CDS, the GES does not investigate crashes. Its only source of information is the police accident report. It does provide the data needed for assessments of the state of and trends in motor vehicle and traffic safety. An annual report is published each year that describes the data availability from the NASS/GES and the Fatality Accident Reporting System (FARS). The FARS is a census of all fatal crashes that occur in the United States and Puerto Rico.

Objective

The objective of this report is to illustrate the availability, resolution, and applicability of crash, vehicle, occupant, and casualty attributes for the characterization of vehicle crash protection performance on U.S. roads during the years 1991 through 1993, based on the NASS/CDS records for those years.

Vehicles Under Consideration

This report addresses primarily towed passenger cars. In addition, selected data are presented for light trucks (pickup trucks, vans, and sport/utility vehicles, all under 10,000 pounds GVWR. Sport/utility vehicles include jeeps, truck-based station wagons, utility vehicles, and other van- or truck-based motor vehicles under 10,000 pounds GVWR that are not cars, pickups, or vans. Motorcycles, bicycles, horse-drawn carriages, etc., are not included.

CDS Estimates

Unless otherwise noted, all the CDS statistics presented in this report are estimates—not exact counts—generated from a sample of crashes that occurred in the 3-year period from 1991 through 1993. Descriptions of the CDS sample design and the procedure used to obtain the data shown in the tables are contained in Appendix B. Since the CDS is a probability sample, the sampling error of every CDS statistic can be estimated. Approximate sampling errors for the weighted average counts over the 1991-1993 period are provided in Appendix G.

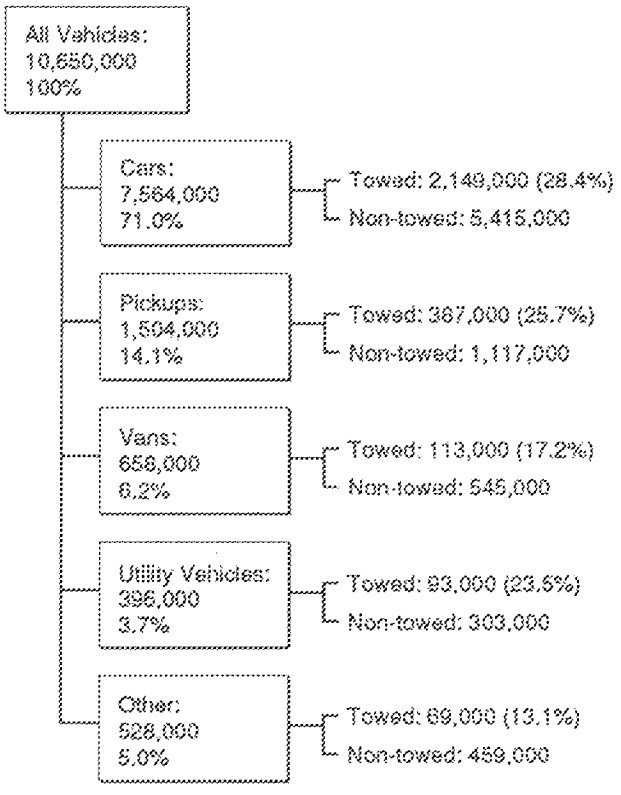
2. Perspective

A perspective on crash-involved vehicles is illustrated in Figure 1, which shows annual incidence averaged over the years 1991-1993.

The number of all vehicle body types involved in police-reported crashes each year in the United States is about 10,650,000; about 95.0 percent of these are passenger cars and light trucks. Each of these body types is subdivided into (a) towed vehicles, involved in the most severe crashes, and (b) non-towed.

The towed vehicles shown in Figure 1 are investigated in the NASS/CDS, because of interest in the crashworthiness of vehicles involved in the more severe crashes. These are the subject of the following analyses and illustrations, with emphasis on cars. During the period 1991-1993, the average number of registered passenger vehicles per year, as reported by R.L. Polk & Co., was 175,733,785, of which 121,576,470 (69.2 percent) were passenger cars and 54,157,315 (30.8 percent) were light trucks.

Figure 1
Crash-Involved Vehicles in the United States, Average per Year, 1991-1993



Note: While all vehicles are addressed by NASS/GES, only towed passenger vehicles are addressed by NASS/CDS.
Source: NASS/CDS and NASS/GES, 1991-1993.

3. Vehicle Crash Data

Car Size

About 2,149,000 cars are towed away from the scene of traffic crashes every year. Table 1 shows the distribution of these cars by weight class. Passenger cars made up about 76 percent of all NASS/CDS towed vehicles; the remaining 24 percent were light trucks (see Table 5).

Table 1
Crash-Involved Towed Cars by Weight Class, 1991-1993

Weight Class	Total Sample	Total Crash-Involved		Annual Weighted Average	
		Percent	Count	Percent	Count
Small (<2,500 lbs)	5,090	33.6	2,044,168	33.3	715,301
Mid-Size (2,500-3,000 lbs)	5,262	33.5	2,041,535	33.1	712,370
Large (>3,000 lbs)	5,095	31.4	1,915,084	32.0	687,906
Unknown Size	301	1.5	91,185	1.6	33,448
Total	**15,748**	**100.0**	**6,091,972**	**100.0**	**2,148,025**

Examples of Weight Class:
Small—Ford Tempo, Mercury Tracer, Saturn, Nissan Sentra, Honda Civic
Mid-size—Plymouth Sundance, Ford Probe, Honda Prelude, Toyota Celica
Large—Ford Taurus, Dodge Dynasty, BMW 3 series, Pontiac Grand Prix

Car Crash Modes and Areas of Damage

Table 2 and Figure 2 show the distribution of towed cars among the primary crash modes and areas of damage. Frontal damage in nonrollover car crashes is the most frequent crash type, accounting for about 53 percent of all towed car crashes. Side damage and all other nonrollover crash types account for 29 percent and 12 percent, respectively. Rollover car crashes account for the remaining 6 percent.

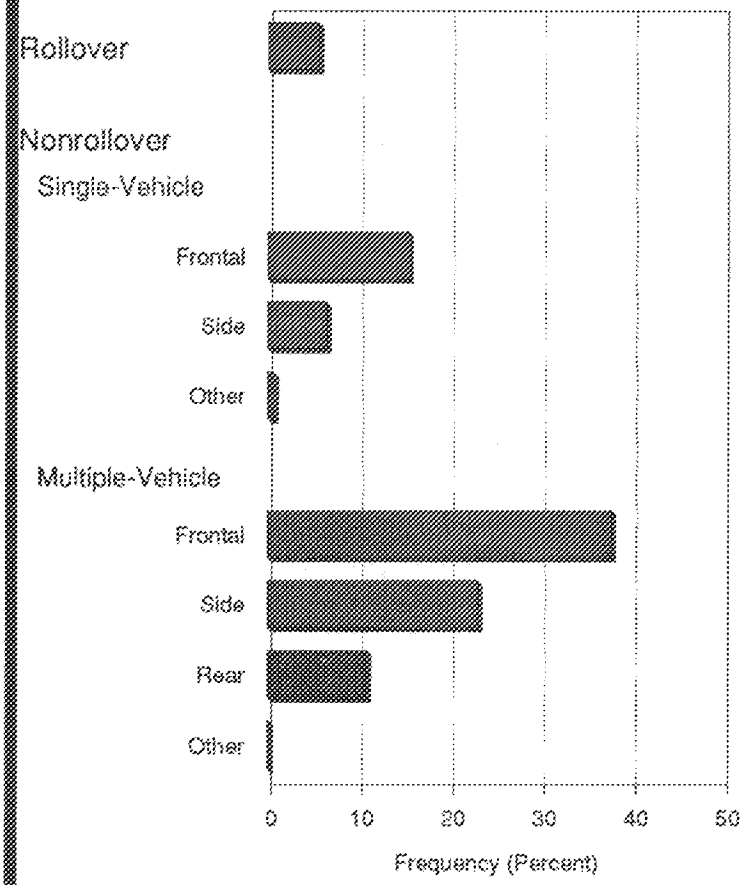
These crash frequencies do not reflect the distribution of harmful outcomes to the car occupants. Certain crash types are associated with higher proportions of injury. For example, although rollover occurs in about 6 percent of towed car crashes, it is responsible for about 17 percent of the harm-weighted injuries to car occupants in towed crashes. On the other hand, car crashes with rear damage account for about 12 percent of the cases but are responsible for about 5 percent of the harm-weighted injuries to occupants (see Table 21).

Table 2
Distribution of Towed Car Crash Modes and Areas of Damage, 1991-1993

Crash Mode and Area of Damage	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Rollover					
1-3 Quarter Turns	660	3.4	208,877	3.3	70,338
4+ Quarter Turns	462	2.1	125,043	2.2	46,336
End Over End	48	0.2	10,450	0.2	3,963
Total Rollover	*1,170*	*5.7*	*344,370*	*5.6*	*120,637*
Nonrollover					
Single-Vehicle					
Frontal Damage	2,270	14.8	899,370	15.4	330,485
Side Damage	687	5.4	328,898	6.5	140,555
Rear, Top, or Under Damage	127	0.8	48,225	0.7	15,876
Total Single-Vehicle	3,084	21.0	1,276,493	22.7	486,916
Multiple-Vehicle					
Frontal Damage	6,454	38.4	2,341,979	37.7	810,542
Side Damage	3,804	24.4	1,484,838	23.1	495,697
Rear Damage	1,224	10.5	641,346	10.9	233,369
Top or Under Damage	12	0.0	2,946	0.1	1,864
Total Multiple-Vehicle	11,494	73.4	4,471,109	71.7	1,541,471
Total Nonrollover	*14,578*	*94.3*	*5,747,602*	*94.4*	*2,028,386*
Total Towed Car Crashes	**15,748**	**100.0**	**6,091,972**	**100.0**	**2,149,025**

Note: Damage Area "Unknown" has been imputed into the known damage areas.

Figure 2
Distribution of Towed Car Crash Modes and Areas of Damage, 1991-1993



Note: The "Other" category for single-vehicle crashes includes rear, top, and under damage. For multiple-vehicle crashes, "Other" includes top and under damage.
Source: NASS/CDS, 1991-1993.

Car Crash Severity

Crash severity (delta-v in miles per hour) for cars varies generally in the range from 1 to 50 mph. Table 3 shows the distribution of towed cars by severity and area of damage. No crash severity, in terms of delta-v, can be defined for rollover crashes. Figure 3 illustrates the primary aspects of this distribution.

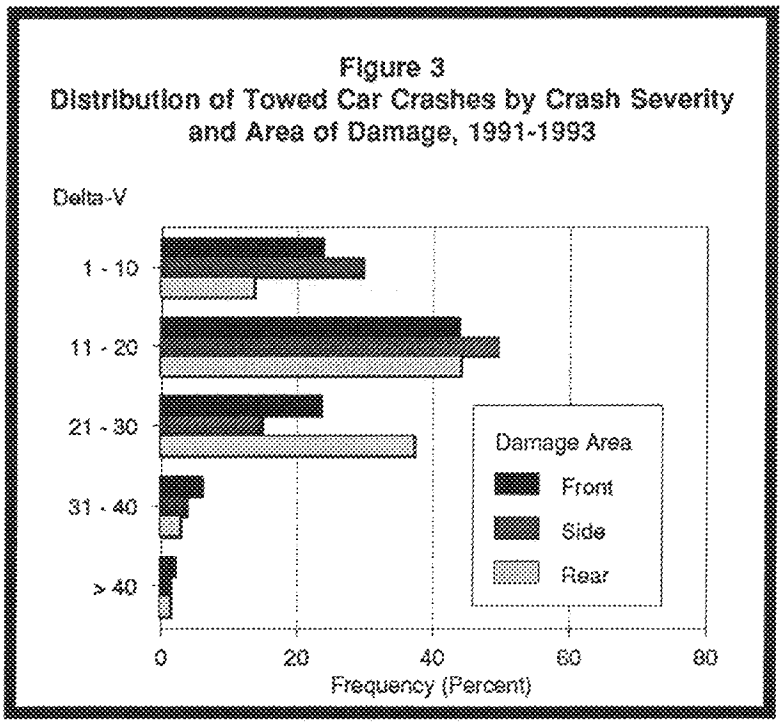
Crash frequency rises sharply to a peak located between 11 and 20 mph, as shown in Figure 3. This frequency drops sharply following the peak; cumulative frequency beyond 40 mph is about 2 percent. The same general pattern holds for all areas of damage in nonrollover crashes: front, side, and rear.

Great caution is recommended in the use and interpretation of crash severity data, for two reasons: (a) the large number of unknowns; and (b) the sharp reduction in the number of available cases as crash severity increases. For "Unknown" area of damage in Table 3, crash severity was calculated using the missing vehicle reconstruction algorithm (see Appendix E, "CRASHPC and OLDMISSPC Summary"). Area of damage "other" includes top and undercarriage, which are outside the scope of the reconstruction algorithm.

Table 3
Distribution of Towed Cars by Crash Severity (delta-v) and Area of Damage: Weighted Average per Year, 1991-1993

Area of Damage	Crash Frequency by Crash Severity*						
	1-10 mph	11-20 mph	21-30 mph	31-40 mph	>40 mph	Unknown	Total
Front	109,695	201,330	108,748	28,461	10,621	382,544	841,401
	23.9%	43.9%	23.7%	6.2%	2.3%	45.5%	39.2%
Side	51,440	85,671	25,929	6,979	2,757	264,802	437,578
	29.8%	49.6%	15.0%	4.0%	1.6%	60.5%	20.3%
Rear	16,773	53,692	45,462	3,697	1,991	53,735	175,350
	13.8%	44.2%	37.4%	3.0%	1.6%	30.6%	8.2%
Other	NA	NA	NA	NA	NA	81,458	81,458
	--	--	--	--	--	100.0%	3.8%
Unknown	21,121	28,546	23,748	2,722	189	536,913	613,239
	27.7%	37.4%	31.1%	3.6%	0.3%	87.6%	28.5%
Total	199,030	369,239	203,887	41,859	15,559	1,319,452	2,149,025
	24.0%	44.5%	24.6%	5.0%	1.9%	61.4%	100.0%

*For each area of damage and known crash severity, the first data row shows the number of vehicles, and the second row shows the percentage of the total number of vehicles for which crash severities were known. For the "Unknown" column, the second data row shows the percentage of the total for each area of damage. For the "Total" column, the second data row shows the percentage of the grand total.



Note: Data taken from Table 3 (percentage of the total number of vehicles for which crash severities were known).

Due to the sharp rise of outcome severity as crash severity increases, the distribution of injuries to car occupants vs. crash severity differs markedly from the distribution of the crash frequency. Specifically, the injury distribution rises to a peak much faster, and drops much more slowly thereafter, than does the crash frequency distribution. For example, the injury proportions (not shown) in the five crash severity intervals used in Table 3 and Figure 3 are 5 percent, 30 percent, 28 percent, 23 percent, and 13 percent for frontal impacts, compared with the corresponding crash proportions of 24 percent, 44 percent, 24 percent, 6 percent, and 2 percent. However, although it is true that the injury proportions exceed the corresponding crash proportions at high crash severities, it is also true that the majority of the injuries occur at severities under 30 mph. For example, in frontal impacts 64 percent of the injuries to occupants occur at severities under 30 mph; the cumulative injury proportion under 30 mph is 75 percent and 78 percent for side and rear impacts, respectively.

Seating Position of Car Occupants

Every year, approximately 3.1 million people are involved in crashes as occupants of towed cars. Table 4 shows the distribution of occupant seating positions for towed cars from 1991 through 1993.

The distribution pattern—about 65 percent drivers, 22 percent right front passengers, and 13 percent all other—is roughly the same as for all cars regardless of crash involvement.

Table 4
Occupant Seating Positions in Towed Cars, 1991-1993

Car Occupants	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Drivers	15,714	65.4	6,069,682	65.2	2,060,504
Right Front Passengers	5,715	22.0	2,037,597	21.9	692,921
Second Seat Passengers	3,467	11.6	1,074,801	11.7	370,688
Other Passengers	390	1.1	100,098	1.1	34,824
Total	**25,306**	**100.0**	**9,282,178**	**100.0**	**3,158,936**

Functional Class and Size of Light Trucks

About 661,000 light trucks under 10,000 pounds gross vehicle weight rating are towed away from the scene of traffic crashes every year. Table 5 shows the distribution of these vehicles by functional class and size. The annual weighted average for these vehicles is 24 percent of all NASS/CDS towed vehicles. The remaining 76 percent are cars.

Table 5
Distribution of Towed Light Trucks by Vehicle Class and Size, 1991-1993

Vehicle Category and Size	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Compact Pickup	1,258	30.0	522,270	27.3	180,862
Standard Pickup	1,162	32.8	570,958	30.1	199,292
Unknown Size Pickup	85	1.1	18,735	1.1	7,086
Minivan	490	8.4	146,738	7.7	50,628
Standard Van	466	8.9	155,003	8.7	57,806
Unknown Size Van	51	0.7	11,530	0.6	4,137
Compact Utility Vehicle	619	11.8	205,816	14.0	92,874
Standard Utility Vehicle	347	6.4	111,070	10.4	68,741
Total	4,478	100.0	1,742,119	100.0	661,426

Light Truck Crash Modes and Areas of Damage

Crash mode and area of damage distributions for towed light trucks involved in crashes are generally similar to those for towed cars, except for rollover crashes. The proportion of rollovers for light trucks is 2.5 times that for passenger cars. Table 6 shows the distribution of towed light trucks among the primary crash modes and areas of damage.

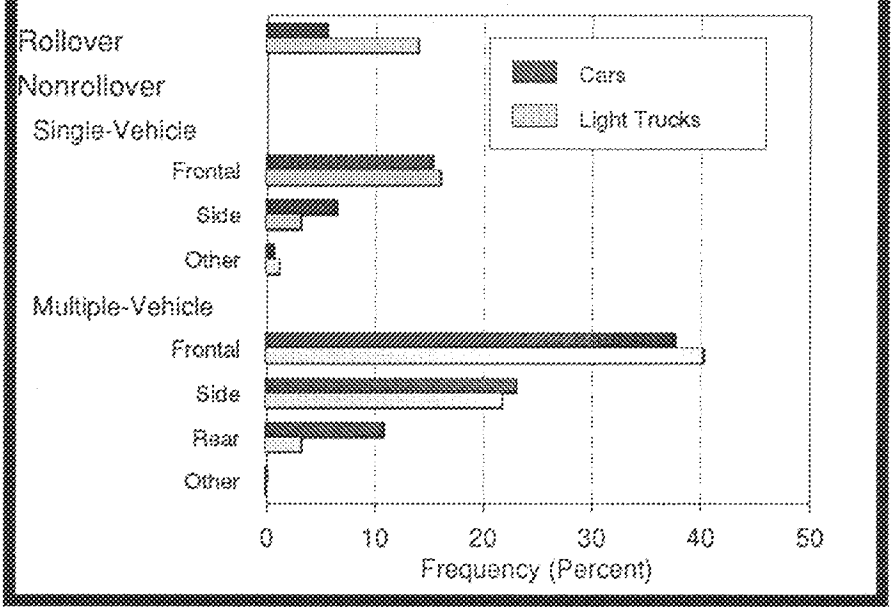
Table 6
Distribution of Towed Light Truck Crash Modes and Areas of Damage, 1991-1993

Crash Mode and Area of Damage	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Rollover					
1-3 Quarter Turns	485	10.0	174,173	8.9	59,166
4+ Quarter Turns	355	4.7	81,722	4.8	31,518
End Over End	26	0.3	4,650	0.3	2,077
Total Rollover	*866*	*15.0*	*260,546*	*14.0*	*92,761*
Nonrollover					
Single-Vehicle					
Frontal Damage	644	18.3	318,202	16.1	106,309
Side Damage	107	3.0	51,622	3.2	21,364
Rear, Top, or Under Damage	28	1.1	18,311	1.2	8,153
Total Single-Vehicle	779	22.3	388,135	20.5	135,826
Multiple-Vehicle					
Frontal Damage	1,927	41.6	725,404	40.3	266,481
Side Damage	722	18.0	313,046	21.8	144,011
Rear Damage	180	3.1	54,231	3.3	22,033
Top or Under Damage	4	0.0	757	0.0	314
Total Multiple-Vehicle	2,833	62.8	1,093,438	65.4	432,839
Total Nonrollover	*3,612*	*85.0*	*1,481,574*	*86.0*	*568,665*
Total Crashes	4,478	100.0	1,742,119	100.0	661,425

Figure 4 shows the distribution of crash modes and areas of damage for towed light trucks, compared with the distribution for towed cars for the years 1991 through 1993.

Most of the observations for car crash frequencies and injury as a function of crash mode and area of damage are also valid for these vehicles. Rollover is the major exception: rollover crashes for light trucks are both more frequent than car rollover crashes (14 percent and 6 percent, respectively) and result in a greater proportion of harmful outcomes to the vehicle occupants (42 percent and 17 percent, respectively). The proportion of harm-weighted injuries (42 percent) associated with rollover crashes is the average for three vehicle classes—pickups, vans, and sport/utility vehicles (see Table 22). For these three classes the proportion of harmful outcomes varies significantly: approximately 37 percent for pickups, 42 percent for vans, and 57 percent for sport/utility vehicles.

Figure 4
Distribution of Crash Modes and Areas of Damage: Comparison of Cars vs. Light Trucks, 1991-1993



Note: The "Other" category for single-vehicle crashes includes rear, top, and under damage. For multiple-vehicle crashes, "Other" includes top and under damage.

Light Truck Crash Severity

Table 7 shows the distribution of towed light truck crashes by crash severity (delta-v in miles per hour) and area of damage. Most of the observations made for towed car crash frequencies and injuries to occupants as a function of crash severity are also valid for these vehicles; the same general patterns are observed. For example, the injury proportions (not shown) in the five crash severity intervals used in Table 7 are 5 percent, 27 percent, 47 percent, 8 percent, and 13 percent for frontal impacts, and the corresponding crash proportions are 14 percent, 34 percent, 43 percent, 6 percent, and about 3 percent.

A large majority of the injuries to occupants in towed light truck crashes occur at crash severities under 30 mph. For example, in frontal impacts 79 percent of the injuries occur at severities under 30 mph. The cumulative injury proportion under 30 mph is 89 percent and 91 percent for side and rear impacts respectively.

The comment made in connection with car crash severities is even more important for these vehicles: great caution is recommended in the use and interpretation of crash severity data, for two reasons: (a) the large number of unknowns; and (b) the sharp reduction of the number of available cases as crash severity increases. For "Unknown" area of damage in Table 7, crash severity was calculated using the missing vehicle reconstruction algorithm.

Table 7
Distribution of Towed Light Trucks by Crash Severity (delta-v) and Area of Damage: Weighted Average per Year, 1991-1993

Area of Damage	Crash Frequency by Crash Severity*						
	1-10 mph	11-20 mph	21-30 mph	31-40 mph	>40 mph	Unknown	Total
Front	19,294	48,978	61,876	8,655	3,819	109,106	251,729
	13.5%	34.3%	43.4%	6.1%	2.7%	43.3%	38.1%
Side	12,034	10,852	6,019	523	148	62,001	91,577
	40.7%	36.7%	20.4%	1.8%	0.5%	67.7%	13.9%
Rear	413	4,018	5,530	22	102	8,873	18,958
	4.1%	39.8%	54.8%	0.2%	1.0%	46.8%	2.9%
Other	138	82	0	0	0	43,837	44,057
	62.8%	37.2%	--	--	--	99.5%	6.7%
Unknown	4,218	43,772	4,617	1,498	8	200,992	255,105
	7.8%	80.9%	8.5%	2.8%	0.0%	78.8%	38.6%
Total	36,096	107,702	78,042	10,698	4,078	424,809	661,426
	15.3%	45.5%	33.0%	4.5%	1.7%	64.2%	100.0%

*For each area of damage and known crash severity, the first data row shows the number of vehicles, and the second row shows the percentage of the total number of vehicles for which crash severities were known. For the "Unknown" column, the second data row shows the percentage of the total for each area of damage. For the "Total" column, the second data row shows the percentage of the grand total.

Seating Position of Light Truck Occupants

Approximately 931,000 people are involved in crashes as occupants of towed light trucks every year. Table 8 shows the distribution of occupant seating positions for these vehicles from 1991 through 1993.

The distribution pattern—about 66 percent drivers, 21 percent right front passengers, and 13 percent all other—is roughly the same as for all light trucks regardless of crash involvement. It is also similar to the corresponding distribution for towed car crashes (Table 4).

Table 8
Occupant Seating Positions in Towed Light Trucks, 1991-1993

Vehicle Occupants	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Drivers	4,463	67.0	1,739,648	66.0	617,479
Right Front Passengers	1,694	20.4	529,574	20.8	194,702
Second Seat Passengers	620	6.8	175,777	6.9	64,720
Other Passengers	460	5.8	151,437	6.3	59,112
Total	7,237	100.0	2,596,436	100.0	936,014

4. Occupant Injury Data

Crash-Involved Occupants by Injury Severity

Approximately 3,160,000 occupants are involved in towed car crashes every year. About 51 percent of them are uninjured, and 49 percent are injured at various severity levels. Similarly, about 936,000 occupants are involved in towed light truck crashes per year, with about 45 percent injured and 55 percent uninjured.

Given that each injured occupant usually has more than one injury, the severity of the occupant's most harmful injury is used to characterize the seriousness of the injuries resulting from the crash. The Abbreviated Injury Scale (AIS) is used to compare injury severities, as follows:

AIS	Severity of Injury
0	Not injured
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximum
7	Injured, Severity Unknown

The AIS scale reflects primarily the threat to life: approximately 99 percent for AIS=6; about 46 percent for AIS=5; about 31 percent for AIS=4; declining rapidly to 0 percent for AIS=1. However, the scale is also used to reflect the gravity of consequences for survivors.

The distribution of injury severities for injured crash-involved occupants is shown in Table 9 for cars and in Table 10 for light trucks. The two distributions are compared in Figure 5, where it is evident that there are no major differences at any given level of injury severity.

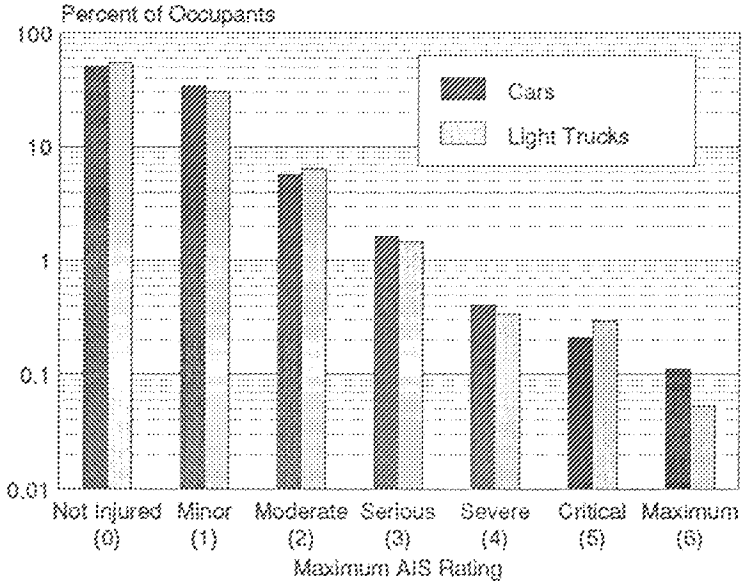
Table 9
Distribution of Crash-Involved
Car Occupants by Maximum Injury Severity:
Weighted Average per Year, 1991-1993

Maximum AIS Rating	Count	Percent
Not Injured (0)	1,601,943	50.7
Minor (1)	1,089,667	34.5
Moderate (2)	180,940	5.7
Serious (3)	51,930	1.6
Severe (4)	12,888	0.4
Critical (5)	6,648	0.2
Maximum (6)	3,552	0.1
Total, Known Severity	*2,947,568*	*93.4*
Injured, Severity Unknown (7)	167,705	5.3
Total	**3,158,936**	**100.0**

Table 10
Distribution of Crash-Involved
Light Truck Occupants by Maximum Injury Severity:
Weighted Average per Year, 1991-1993

Maximum AIS Rating	Count	Percent
Not Injured (0)	512,313	54.7
Minor (1)	286,744	30.6
Moderate (2)	60,365	6.4
Serious (3)	13,852	1.5
Severe (4)	3,206	0.3
Critical (5)	2,761	0.3
Maximum (6)	495	0.1
Total, Known Severity	*879,737*	*94.2*
Injured, Severity Unknown (7)	39,071	4.2
Total	**936,014**	**100.0**

Figure 5
Distribution of Crash-Involved Occupant Injuries
by Maximum Injury Severity: Cars vs. Light Trucks, 1991-1993



Use of Manual Restraints

Despite the recent implementation of automatic occupant restraints, the crash experience for 1991 through 1993, under consideration here, is associated primarily with the use of manual belts. The annual distribution of injuries to crash-involved car occupants by maximum injury severity and manual belt use is shown in Table 11. A similar joint distribution is shown in Table 12 for crash-involved light truck occupants.

Table 11
Distribution of Crash-Involved Car Occupants by Manual Safety Belt Use and Maximum Injury Severity: Weighted Average per Year, 1991-1993

Manual Belt Use	Frequency of Injury by Maximum AIS Rating*								
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7)	Total
None	367,235	447,210	91,115	31,902	5,617	4,066	1,499	51,143	1,013,130
	26.5%	42.6%	52.5%	64.3%	45.6%	67.0%	50.9%	49.5%	36.1%
Shoulder Belt	455	386	56	0	0	0	0	100	998
	0.0%	0.0%	0.0%	--	--	--	--	0.1%	0.0%
Lap Belt	177,080	113,046	12,812	2,942	903	314	214	8,511	316,673
	12.8%	10.8%	7.4%	5.9%	7.3%	5.2%	7.3%	8.2%	11.3%
Shoulder and Lap Belt	793,692	473,746	66,758	14,372	5,477	1,654	1,039	41,609	1,405,150
	57.4%	45.1%	38.5%	29.0%	44.4%	27.3%	35.2%	40.3%	50.1%
Belt Used, Type Unknown	8,195	5,595	1,214	55	259	0	62	1,166	16,969
	0.6%	0.5%	0.7%	0.1%	2.1%	--	2.1%	1.1%	0.6%
Belt With Child Seat	36,999	10,261	1,538	360	74	34	133	781	50,180
	2.7%	1.0%	0.9%	0.7%	0.6%	0.6%	4.5%	0.8%	1.8%
Total, Belt Used	*1,016,421*	*603,032*	*82,379*	*17,729*	*6,713*	*2,001*	*1,448*	*52,167*	*1,789,970*
	73.5%	*57.4%*	*47.5%*	*35.7%*	*54.4%*	*33.0%*	*49.1%*	*50.5%*	*63.9%*
Total Known	1,383,656	1,050,242	173,494	49,631	12,329	6,066	2,947	103,311	2,803,101
	86.4%	96.4%	95.9%	95.6%	95.7%	91.2%	83.0%	61.6%	88.7%
Unknown	218,287	39,425	7,446	2,299	559	582	605	64,396	355,836
	13.6%	3.6%	4.1%	4.4%	4.3%	8.8%	17.0%	38.4%	11.3%
Total	1,601,943	1,089,667	180,940	51,930	12,888	6,648	3,552	167,706	3,158,937
	50.7%	34.5%	5.7%	1.6%	0.4%	0.2%	0.1%	5.3%	100.0%

*For each known belt use category, the first data row shows the number of injuries and the second row shows the percentage of the "Total Known." For the "Total Known" and "Unknown" belt use categories, the first row shows the number of injuries and the second row shows the percentage of the column total. For the column totals, the first row shows the number of injuries and the second row shows the percentage of the total number of injuries. The row totals include the number of unknown injuries.

Overall, restraint use is approximately 64 percent for passenger car occupants and 71 percent for occupants of light trucks. These belt use rates are in agreement with the belt use rates obtained by individual state surveys reported to NHTSA each year. Not all states report belt usage rates each year. Therefore, to calculate the national safety belt use rate from the individual state use rates, each state's most recent rate is weighted by the state's proportion of the total U.S. population. Average state belt use rates were reported as 59 percent in 1991, 62 percent in 1992, and 66 percent in 1993.

Table 12
Distribution of Crash-Involved Light Truck Occupants by Manual Safety Belt Use and Maximum Injury Severity: Weighted Average per Year, 1991-1993

Manual Belt Use	Frequency of Injury by Maximum AIS Rating*								
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7)	Total
None	70,034	124,534	28,078	7,325	2,440	2,376	264	8,626	244,252
	15.6%	44.6%	48.2%	56.3%	79.7%	86.7%	57.4%	30.8%	29.3%
Shoulder Belt	0	0	0	187	0	0	0	0	187
	--	--	--	1.4%	--	--	--	--	0.0%
Lap Belt	32,946	15,616	5,068	255	0	161	26	165	54,286
	7.3%	5.6%	8.7%	2.0%	--	5.9%	6.1%	0.6%	6.5%
Shoulder and Lap Belt	283,442	133,888	24,228	4,671	612	203	151	18,497	465,801
	63.1%	48.2%	41.6%	35.9%	20.0%	7.4%	32.7%	66.0%	55.9%
Belt Used, Type Unknown	11,604	1,410	639	473	0	0	0	694	14,820
	2.6%	0.5%	1.1%	3.6%	--	--	--	2.5%	1.8%
Belt With Child Seat	51,397	2,296	218	103	11	0	18	62	54,104
	11.4%	0.8%	0.4%	0.8%	0.4%	--	3.8%	0.2%	6.5%
Total, Belt Used	*379,389*	*153,210*	*30,153*	*5,689*	*623*	*365*	*197*	*19,417*	*589,198*
	84.4%	*55.2%*	*51.8%*	*43.7%*	*20.3%*	*13.3%*	*42.6%*	*69.2%*	*70.7%*
Total Known	**449,423**	**277,744**	**58,231**	**13,013**	**3,063**	**2,741**	**461**	**28,045**	**833,450**
	87.7%	**96.9%**	**96.5%**	**93.9%**	**96.5%**	**99.3%**	**93.1%**	**71.8%**	**89.0%**
Unknown	62,890	9,000	2,134	839	143	21	34	11,027	102,564
	12.3%	3.1%	3.5%	6.1%	4.5%	0.7%	6.9%	28.2%	11.0%
Total	**512,313**	**286,745**	**60,366**	**13,852**	**3,206**	**2,761**	**495**	**39,071**	**936,015**
	54.7%	**30.6%**	**6.4%**	**1.5%**	**0.3%**	**0.3%**	**0.1%**	**4.2%**	**100.0%**

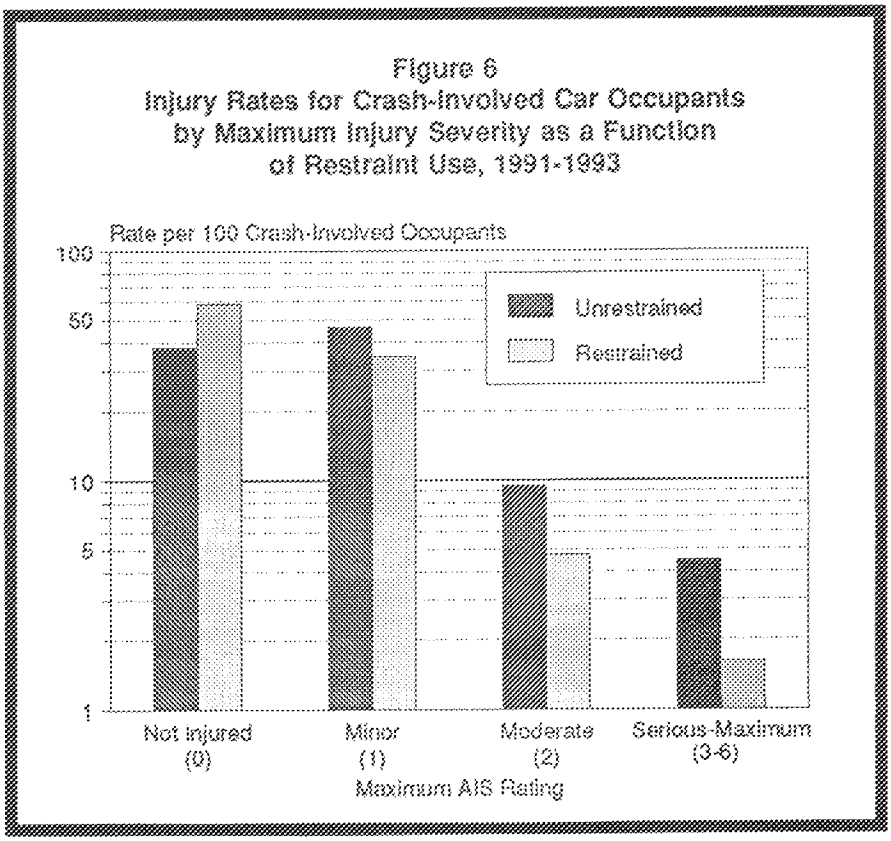
*For each known belt use category, the first data row shows the number of injuries and the second row shows the percentage of the "Total Known." For the "Total Known" and "Unknown" belt use categories, the first row shows the number of injuries and the second row shows the percentage of the column total. For the column totals, the first row shows the number of injuries and the second row shows the percentage of the total number of injuries. The row totals include the number of unknown injuries.

Effect of Restraint Use on Injury Risk

It is evident from Tables 11 and 12 that safety belt use reduces the risk of injury, especially serious injury. This is illustrated in Figure 6 for crash-involved car occupants. In this figure, AIS ratings 3, 4, 5, and 6 have been grouped together as "Serious-Maximum" in order to deal with the small sample sizes at these high severities. As seen in Figure 6, the risk of injury (expressed in injured people per 100 crash-involved car occupants) for occupants using restraints is lower than that for unrestrained occupants. Moreover, this advantage appears to increase as the injury severity increases.

A word of caution is necessary when interpreting the much lower risk associated with restrained versus unrestrained occupants at high injury severities. It is likely that restrained occupants, who usually have a higher awareness of safety than the unrestrained, are also the occupants who usually avoid crashes of high severities. Thus, the advantage of restrained occupants may be in part due to the fact that such occupants are exposed to lower crash severities, in addition to the crash protection provided by the restraints.

Figure 6
Injury Rates for Crash-Involved Car Occupants by Maximum Injury Severity as a Function of Restraint Use, 1991-1993



Injury Severity and Outcome

As discussed above (see Table 9), not all crash deaths are associated with untreatable injuries (AIS=6). Rather, the probability of death increases sharply with injury severity, and many fatalities occur as a result of one or more injuries that are generally considered survivable. Crash injury outcomes---fatality, hospitalization, needed emergency medical care, first aid treatment, and no treatment needed---are generally a function of the severity of an occupant's most severe injury, plus other factors, such as the number, severity, and type of additional injuries; the person's age and overall health; extrication time; etc.

The primary determinant of an outcome is the maximum injury severity. Table 13 shows the distribution of injuries to crash-involved car occupants according to the AIS values of maximum injury severity and the pertinent outcomes of maximum injury severities. This table also includes the number of days an occupant was hospitalized for injuries sustained in the crash as a result of the crash. An occupant may be hospitalized for observation or due to a pre-existing medical condition, as directed by the attending physician, without having received any injuries in the crash. Fatal injuries with AIS=1 are the result of incomplete medical information by which to code the data. A similar distribution is shown in Table 14 for crash-involved light truck occupants.

Table 13
Distribution of Crash-Involved Car Occupants by Treatment and Maximum Injury Severity: Weighted Average per Year, 1991-1993

Treatment	Frequency of Injury by Maximum AIS Rating*								
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7)	Total
None	1,522,477	295,795	6,040	0	0	0	0	15,178	1,844,358
	82.6%	16.1%	0.3%	--	--	--	--	0.8%	58.4%
Treated at Scene	25,720	130,615	14,691	286	0	0	0	10,750	183,517
	14.0%	71.3%	8.0%	0.2%	--	--	--	5.9%	5.8%
Transported and Released	49,419	608,801	94,501	7,346	241	0	0	44,556	805,725
	6.1%	75.6%	11.7%	0.9%	0.0%	--	--	5.5%	25.5%
Hospitalized									
1-2 Days	1,221	32,860	32,466	8,359	1,304	460	0	5,614	82,285
	1.5%	39.9%	39.5%	10.2%	1.6%	0.6%	--	6.8%	2.6%
3-7 Days	353	11,174	21,122	14,925	1,898	146	0	430	50,047
	0.7%	22.3%	42.2%	29.8%	3.8%	0.3%	--	0.9%	1.6%
8-14 Days	17	957	6,439	9,305	1,739	362	0	962	19,801
	0.1%	4.8%	32.5%	47.1%	8.8%	1.8%	--	4.8%	0.6%
15-30 Days	52	689	2,249	5,059	1,278	1,226	56	11	10,619
	0.5%	6.5%	21.2%	47.6%	12.0%	11.5%	0.5%	0.1%	0.3%
>30 Days	0	34	510	1,917	2,020	656	0	53	5,190
	--	0.7%	9.8%	36.9%	38.9%	12.6%	--	1.0%	0.2%
Fatal	0	957	2,376	4,635	4,395	3,643	3,496	2,758	22,268
	--	4.3%	10.7%	20.8%	19.8%	16.4%	15.7%	12.4%	0.7%
Unknown	2,685	7,785	544	69	12	156	0	87,404	135,115
	2.0%	5.9%	0.4%	0.1%	0.0%	0.1%	--	64.7%	4.3%
Total	1,601,943	1,089,667	180,940	51,930	12,888	6,648	3,552	167,706	3,156,935
	50.7%	34.5%	5.7%	1.6%	0.4%	0.2%	0.1%	5.3%	100.0%

*For each treatment category, the first data row shows the number of injuries and the second row shows the percentage of the row total.

Table 14
Distribution of Crash-Involved Light Truck Occupants by Treatment and Maximum Injury Severity: Weighted Average per Year, 1991-1993

Treatment	Frequency of Injury by Maximum AIS Rating*								
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7)	Total
None	494,993	95,891	5,068	0	0	0	0	4,008	601,505
	82.4%	16.0%	0.8%	--	--	--	--	0.7%	64.3%
Treated at Scene	9,684	34,740	4,737	309	0	0	0	2,053	51,523
	18.8%	67.5%	9.2%	0.6%	--	--	--	4.0%	5.5%
Transported and Released	6,927	143,825	26,983	1,076	69	0	0	4,262	183,238
	3.8%	78.5%	14.7%	0.6%	0.0%	--	--	2.3%	19.6%
Hospitalized									
1-2 Days	178	7,774	8,995	3,973	329	185	0	2,007	23,441
	0.8%	33.2%	38.4%	17.0%	1.4%	0.8%	--	8.6%	2.5%
3-7 Days	0	2,496	11,509	3,863	1,284	63	0	164	19,378
	--	12.9%	59.4%	19.9%	6.5%	0.4%	--	0.8%	2.1%
8-14 Days	0	770	1,315	2,668	564	175	0	0	5,512
	--	14.0%	23.9%	48.8%	10.2%	3.2%	--	--	0.6%
15-30 Days	0	52	225	965	236	314	0	31	1,822
	--	2.9%	12.4%	53.0%	12.9%	17.2%	--	1.7%	0.2%
>30 Days	0	174	95	134	169	1,300	0	258	2,129
	--	8.2%	4.5%	6.4%	7.5%	61.5%	--	12.2%	0.2%
Fatal	0	313	917	815	585	706	495	1,891	5,722
	--	5.5%	16.1%	14.3%	10.3%	12.4%	8.7%	33.0%	0.6%
Unknown	530	710	520	29	0	0	0	24,379	41,754
	1.4%	1.9%	1.4%	0.1%	--	--	--	58.4%	4.5%
Total	512,313	286,744	60,366	13,952	3,206	2,761	495	39,071	936,014
	54.7%	30.6%	6.4%	1.5%	0.3%	0.3%	0.1%	4.2%	100.0%

*For each treatment category, the first data row shows the number of injuries and the second row shows the percentage of the row total.

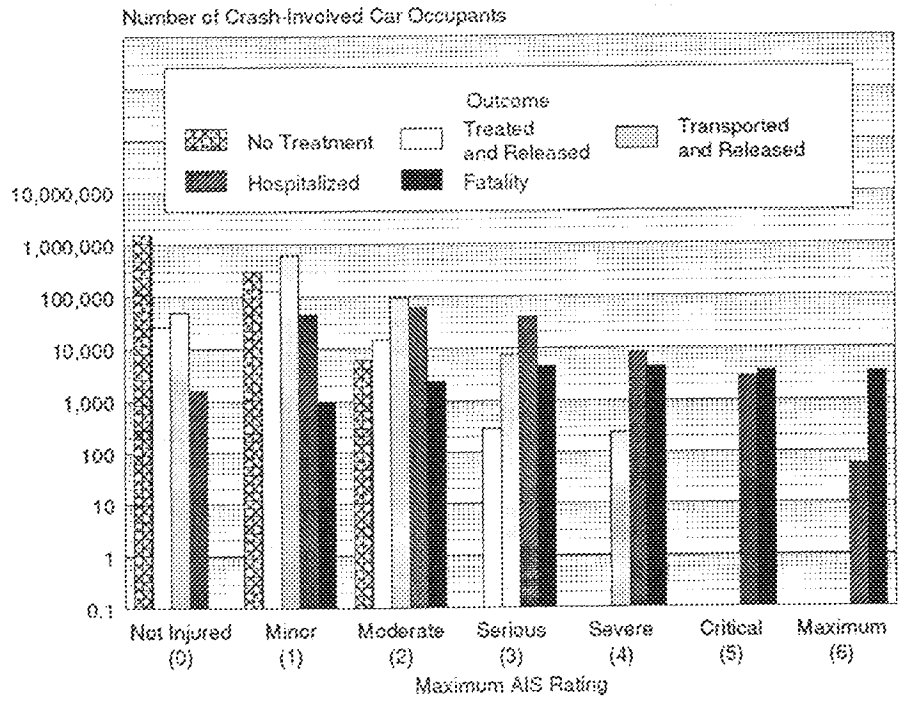
Table 13
Distribution of Crash-Involved Car Occupants by Treatment and Maximum Injury Severity: Weighted Average per Year, 1991-1993

Treatment	Frequency of Injury by Maximum AIS Rating*								
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7)	Total
None	1,522,477	295,795	6,040	0	0	0	0	15,178	1,844,358
	82.6%	16.1%	0.3%	--	--	--	--	0.8%	58.4%
Treated at Scene	25,720	130,615	14,691	286	0	0	0	10,750	183,517
	14.0%	71.3%	8.0%	0.2%	--	--	--	5.9%	5.8%
Transported and Released	49,419	608,801	94,501	7,346	241	0	0	44,556	805,725
	6.1%	75.6%	11.7%	0.9%	0.0%	--	--	5.5%	25.5%
Hospitalized									
1-2 Days	1,221	32,860	32,466	8,359	1,304	460	0	5,614	82,285
	1.5%	39.9%	39.5%	10.2%	1.6%	0.6%	--	6.8%	2.6%
3-7 Days	353	11,174	21,122	14,925	1,898	146	0	430	50,047
	0.7%	22.3%	42.2%	29.8%	3.8%	0.3%	--	0.9%	1.6%
8-14 Days	17	957	6,439	9,305	1,739	362	0	962	19,801
	0.1%	4.8%	32.5%	47.1%	8.8%	1.8%	--	4.8%	0.6%
15-30 Days	52	689	2,249	5,059	1,278	1,226	56	11	10,619
	0.5%	6.5%	21.2%	47.6%	12.0%	11.5%	0.5%	0.1%	0.3%
>30 Days	0	34	510	1,917	2,020	656	0	53	5,190
	--	0.7%	9.8%	36.9%	38.9%	12.6%	--	1.0%	0.2%
Fatal	0	957	2,376	4,635	4,395	3,643	3,496	2,758	22,268
	--	4.3%	10.7%	20.8%	19.8%	16.4%	15.7%	12.4%	0.7%
Unknown	2,685	7,785	544	69	12	156	0	87,404	135,115
	2.0%	5.9%	0.4%	0.1%	0.0%	0.1%	--	64.7%	4.3%
Total	1,601,943	1,089,667	180,940	51,930	12,888	6,648	3,552	167,706	3,156,935
	50.7%	34.5%	5.7%	1.6%	0.4%	0.2%	0.1%	5.3%	100.0%

*For each treatment category, the first data row shows the number of injuries and the second row shows the percentage of the row total.

The annual incidence of crash-involved car occupants as a function of maximum injury severity and injury outcome is shown in Figure 7. This figure illustrates how injury outcome progresses from "No Treatment" to "Fatality," as the maximum injury severity increases from "None" to "Untreatable" (Fatal). Similar comments apply for light truck occupants, as shown in Table 14.

Figure 7
Annual Incidence of Injured Crash-Involved Car Occupants
by Maximum Injury Severity and Treatment, 1991-1993



Body Regions Injured in Traffic Crashes

There are about 2,149,000 cars towed away from traffic crashes every year. The incidence of crash-involved occupants in these cars is about 3,159,000 per year. Of these, about 1,557,000 car occupants per year are injured, incurring about 4,200,000 injuries of various severities, in various body regions, and by various injury contacts. Table 15 shows the distribution of all injuries incurred by injured occupants of crash-involved cars (as opposed to the most severe injuries, reported in Tables 9-14) as a function of injury severity and injured body region. Table 16 shows the same distribution for injured occupants of light trucks.

The numbers for "injured, severity unknown" (AIS=7) are lower in these tables than in tables using maximum AIS (MAIS), because of the level of information available for coding the injuries. An AIS of 7 is assigned to an injury when there is not sufficient information about the injury available. An MAIS of 7 is assigned to an occupant when it is known that the occupant was injured, but no information about the injury is available. Therefore, an occupant with an MAIS of 7 may not have any associated injuries coded.

Table 15
Distribution of All Injuries to Crash-Involved Car Occupants by Body Region and Severity: Weighted Average per Year, 1991-1993

Body Region	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Head (Brain)	53,957	97,425	12,907	6,676	3,588	1,378	693	176,624
	30.6%	55.2%	7.3%	3.8%	2.0%	0.8%	0.4%	
	1.5%	24.5%	11.0%	23.1%	27.6%	22.8%	1.2%	
Head (Skull)	705	6,484	4,890	969	0	597	71	13,715
	5.1%	47.3%	35.7%	7.1%	--	4.4%	0.5%	
	0.0%	1.6%	4.2%	3.4%	--	9.9%	0.1%	
Head (Other)	19,499	32,597	11,999	8,276	3,447	487	13,724	90,129
	21.6%	36.3%	13.3%	9.2%	3.8%	0.5%	15.2%	
	0.5%	8.2%	10.2%	28.6%	26.6%	8.1%	22.8%	
Face	131,293	26,619	4,204	582	0	0	3,307	166,005
	79.1%	16.0%	2.5%	0.4%	--	--	2.0%	
	3.7%	6.7%	3.6%	2.0%	--	--	5.5%	
Neck	307,708	8,658	2,523	110	105	207	4,054	323,404
	95.2%	2.7%	0.8%	0.0%	0.0%	0.1%	1.3%	
	8.6%	2.2%	2.2%	0.4%	0.8%	3.4%	6.7%	
Chest	26,322	21,550	29,028	9,935	3,175	1,048	4,704	95,762
	27.5%	22.5%	30.3%	10.4%	3.3%	1.1%	4.9%	
	0.7%	5.4%	24.7%	34.4%	24.5%	17.4%	7.8%	
Shoulder and Back	278,155	43,911	4,344	0	48	0	8,112	334,569
	83.1%	13.1%	1.3%	--	0.0%	--	2.4%	
	7.8%	11.0%	3.7%	--	0.4%	--	13.5%	

*For each body region, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 15 (Continued)
Distribution of All Injuries to Crash-Involved Car Occupants by Body Region and Severity: Weighted Average per Year, 1991-1993

Body Region	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Abdomen	6,419	22,973	3,552	1,812	1,696	182	2,647	39,480
	16.3%	58.2%	9.0%	4.6%	4.8%	0.5%	6.7%	
	0.2%	5.8%	3.0%	6.3%	14.6%	3.0%	4.4%	
Spine	0	30	909	314	635	1,366	0	3,254
	--	0.9%	27.9%	9.6%	19.5%	42.0%	--	
	--	0.0%	0.8%	1.1%	4.9%	22.6%	--	
Upper Extremities	43,818	29,338	12,128	0	0	0	4,588	89,872
	48.8%	32.6%	13.5%	--	--	--	5.1%	
	1.2%	7.4%	10.3%	--	--	--	7.6%	
Pelvis	2,154	14,495	6,038	66	0	0	2,660	25,414
	8.5%	57.0%	23.8%	0.3%	--	--	10.5%	
	0.1%	3.6%	5.1%	0.2%	--	--	4.4%	
Lower Extremities	33,549	45,903	22,223	162	0	0	12,468	114,326
	29.4%	40.2%	19.4%	0.2%	--	--	10.9%	
	0.9%	11.5%	18.9%	0.6%	--	--	20.7%	
Skin	2,670,984	47,836	2,284	0	87	775	112	2,722,078
	98.1%	1.8%	0.1%	--	0.0%	0.0%	0.0%	
	74.6%	12.0%	1.9%	--	0.7%	12.8%	0.2%	
All Other	5,061	0	456	0	0	0	2,975	8,494
	59.6%	--	5.4%	--	--	--	35.0%	
	0.1%	--	0.4%	--	--	--	5.0%	
Total	3,579,623	397,958	117,487	38,922	12,992	6,040	60,114	4,203,127

*For each body region, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 16
Distribution of All Injuries to Crash-Involved Light Truck Occupants by Body Region and Severity: Weighted Average per Year, 1991-1993

Body Region	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Head (Brain)	19,199	26,380	2,827	1,354	814	152	320	51,046
	37.6%	51.7%	5.5%	2.7%	1.6%	0.3%	0.6%	
	1.8%	21.5%	8.7%	18.3%	17.2%	20.6%	2.2%	
Head (Skull)	0	2,554	1,433	298	0	200	0	4,485
	--	57.0%	32.0%	6.6%	--	4.5%	--	
	--	2.1%	4.4%	4.0%	--	27.0%	--	
Head (Other)	7,000	19,363	4,200	2,442	1,516	70	3,179	37,789
	18.5%	51.3%	11.1%	6.5%	4.0%	0.2%	8.4%	
	0.7%	15.8%	12.9%	33.0%	32.0%	9.5%	22.0%	
Face	28,326	6,451	632	72	0	0	763	36,444
	77.7%	17.7%	2.3%	0.2%	--	--	2.1%	
	2.7%	5.3%	2.6%	1.0%	--	--	5.3%	
Neck	75,759	2,543	1,984	52	0	0	1,071	81,409
	93.1%	3.1%	2.4%	0.1%	--	--	1.3%	
	7.2%	2.1%	6.1%	0.7%	--	--	7.4%	
Chest	9,615	6,588	5,847	1,796	745	143	2,046	26,781
	35.9%	24.6%	21.8%	6.7%	2.8%	0.5%	7.7%	
	0.9%	5.4%	17.9%	24.3%	15.7%	19.3%	14.2%	
Shoulder and Back	75,464	13,202	1,684	0	0	0	1,517	91,866
	82.2%	14.4%	1.8%	--	--	--	1.7%	
	7.2%	10.8%	5.2%	--	--	--	10.5%	

*For each body region, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 16 (Continued)
Distribution of All Injuries to Crash-Involved Light Truck Occupants by Body Region and Severity: Weighted Average per Year, 1991-1993

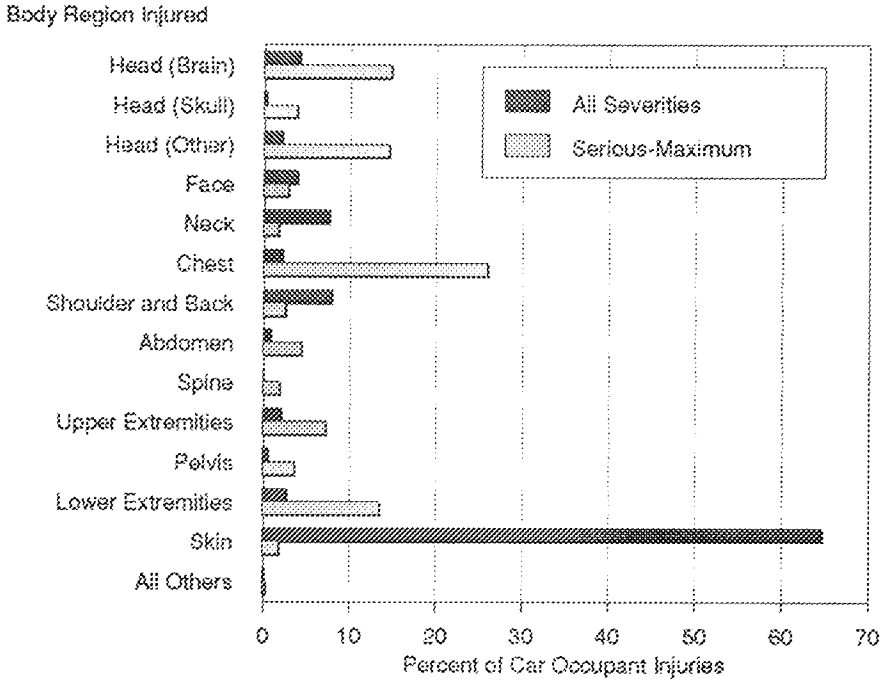
Body Region	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Abdomen	1,930	8,096	1,623	1,066	1,367	105	1,425	15,634
	12.4%	51.8%	10.4%	7.0%	8.7%	0.7%	9.1%	
	0.2%	6.6%	5.0%	14.7%	28.9%	14.3%	9.9%	
Spine	0	0	208	72	225	22	0	526
	--	--	39.5%	13.7%	42.7%	4.1%	--	
	--	--	0.6%	1.0%	4.7%	2.9%	--	
Upper Extremities	15,150	8,200	3,693	0	0	0	1,598	28,641
	52.9%	28.6%	12.9%	--	--	--	5.6%	
	1.4%	6.7%	11.3%	--	--	--	11.1%	
Pelvis	1,434	3,096	2,293	131	0	0	0	6,953
	20.6%	44.5%	33.0%	1.9%	--	--	--	
	0.1%	2.5%	7.0%	1.8%	--	--	--	
Lower Extremities	10,604	10,887	5,765	63	0	0	1,489	28,810
	36.8%	37.8%	20.0%	0.2%	--	--	5.2%	
	1.0%	8.9%	17.7%	0.9%	--	--	10.3%	
Skin	807,650	15,470	165	0	17	48	0	822,749
	98.1%	1.9%	0.0%	--	0.0%	0.0%	--	
	76.7%	12.6%	0.5%	--	0.4%	6.5%	--	
All Other	1,172	0	36	34	53	0	1,010	2,307
	50.8%	--	1.7%	1.5%	2.3%	--	43.8%	
	0.1%	--	0.1%	0.5%	1.1%	--	7.0%	
Total	1,052,705	122,847	32,591	7,401	4,735	740	14,420	1,235,440

*For each body region, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

It is apparent from Tables 15 and 16 that the body regions most frequently affected by injuries of all severities are markedly different from those most frequently affected by injuries of high severities (serious-maximum (AIS=3-6)). This is illustrated in Figure 8, where two distributions are shown: one for all severities and one for serious-maximum severities, each adding up to 100 percent.

It is evident in this figure that body regions such as neck, shoulder and back, and skin are injured with a high frequency in general, but occur at very low frequencies for serious to maximum severities. Conversely, other body regions, such as the head (brain/skull), chest, spine, and abdomen are injured frequently at high severities, but occur less significantly when all severities are considered.

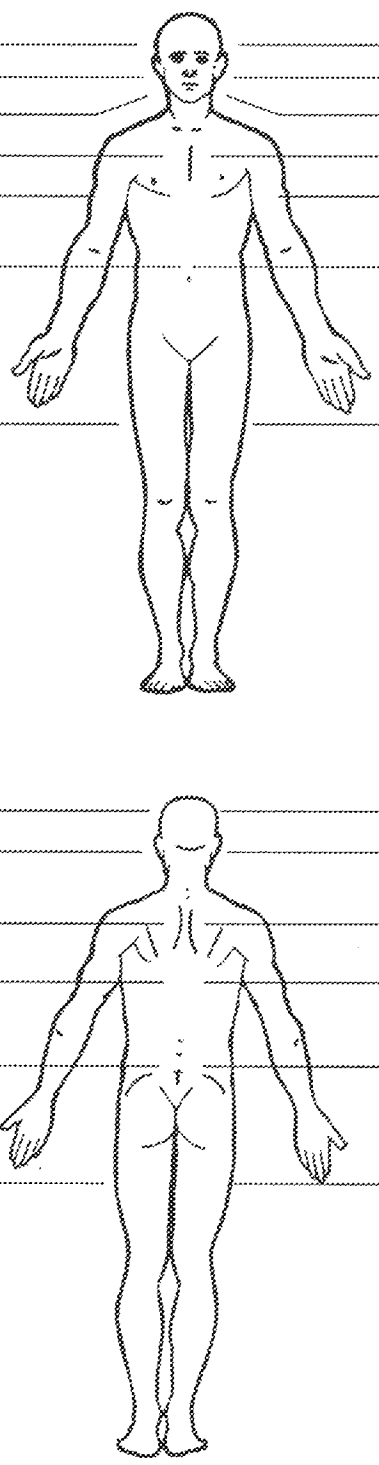
Figure 8
Distribution of Injuries to Crash-Involved Car Occupants by Affected Body Region and Severity of Injury, 1991-1993



Manual Restraint Use and Body Regions Injured

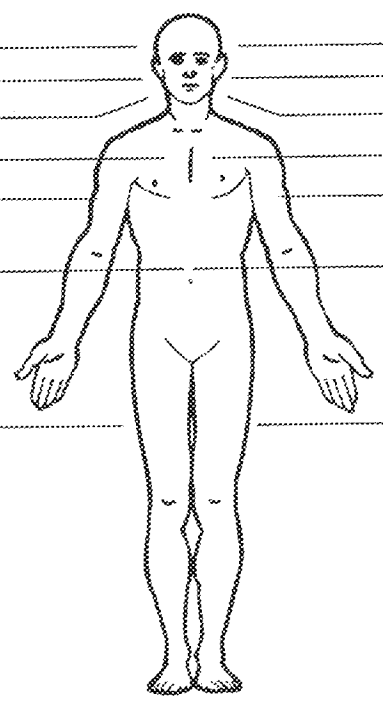
Figure 9 shows the distribution of crash-involved car occupants by injured body region and belt usage. An occupant may receive more than one injury to a given body region; however, this figure represents one injury per body region per occupant. An occupant may also receive injuries across more than one body region. Therefore, the number for each body region will add up to more than the number of injured occupants. For example, an occupant may have a contusion to the left side of the brain and a laceration to the right side of the brain. The figure counts only one of the injuries to the brain. If the occupant in the example sustained a contusion to the left side of the brain and a skull fracture, then both injuries would be included in the figure, and one injury would be counted in the brain body region while the other injury would be counted in the skull body region. To determine the number of belted occupants who sustained a brain injury, divide the number of occupants with a brain injury by the total number of occupants using a restraint system. The same methodology applies to the unbelted occupants. The percentages will not add to 100 percent, because the total number of occupants includes those who were not injured. Figure 10 shows a similar distribution of crash-involved occupants of light trucks by belt usage.

Figure 9
Distribution of Injuries by Body Region to Crash-Involved Car Occupants by Belt Usage: Weighted Average per Year, 1991-1993

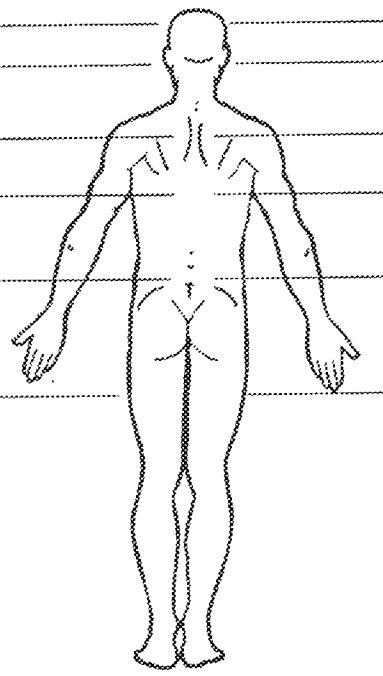


Belted	Unbelted
Brain: 63,913 (3.6%)	Brain: 94,792 (9.4%)
Other Head: 23,087 (1.3%)	Other Head: 47,372 (4.7%)
Face: 39,755 (2.2%)	Face: 61,503 (6.1%)
Chest: 32,305 (1.8%)	Chest: 34,659 (3.4%)
Upper Extremities: 37,086 (2.1%)	Upper Extremities: 31,052 (3.1%)
Abdomen: 13,296 (0.7%)	Abdomen: 12,861 (1.3%)
Skin: 569,252 (31.8%)	Skin: 515,551 (50.9%)
Skull: 5,222 (0.3%)	Skull: 5,394 (0.5%)
Neck: 196,199 (11.0%)	Neck: 114,496 (11.3%)
Shoulder and Back: 166,129 (9.3%)	Shoulder and Back: 105,137 (10.4%)
Spine: 1,266 (0.1%)	Spine: 1,492 (0.1%)
Pelvis: 6,989 (0.4%)	Pelvis: 11,417 (1.1%)
Lower Extremities: 41,961 (2.3%)	Lower Extremities: 41,931 (4.1%)
Total Belted Occupants: 1,789,970	**Total Unbelted Occupants: 1,013,138**

Figure 10
Distribution of Injuries by Body Region to Crash-Involved Light Truck Occupants by Belt Usage: Weighted Average per Year, 1991-1993



Belted	Unbelted
Brain: 14,976 (2.5%)	Brain: 32,050 (13.1%)
Other Head: 6,580 (1.5%)	Other Head: 21,373 (8.8%)
Face: 12,059 (2.0%)	Face: 12,122 (5.0%)
Chest: 6,876 (1.5%)	Chest: 13,377 (5.5%)
Upper Extremities: 14,549 (2.5%)	Upper Extremities: 8,374 (3.4%)
Abdomen: 3,246 (0.6%)	Abdomen: 6,024 (2.5%)
Skin: 167,829 (28.4%)	Skin: 142,758 (58.3%)



Belted	Unbelted
Skull: 542 (0.1%)	Skull: 2,397 (1.0%)
Neck: 43,014 (7.3%)	Neck: 36,179 (14.8%)
Shoulder and Back: 49,303 (8.4%)	Shoulder and Back: 22,894 (9.4%)
Spine: 217 (<0.1%)	Spine: 281 (0.1%)
Pelvis: 2,372 (0.4%)	Pelvis: 3,092 (1.3%)
Lower Extremities: 13,122 (2.2%)	Lower Extremities: 6,531 (3.5%)
Total Belted Occupants: 589,198	**Total Unbelted Occupants: 244,252**

Injury Contacts

In addition to data on injured body regions, crash protection practitioners need data concerning the various sources of injury (injury contacts). A summary of injury contacts for injuries to crash-involved occupants is presented in Table 17 for cars and in Table 18 for light trucks. Table 17 shows the distribution of all crash-involved car occupant injuries as a function of injury severity and injury contact. Table 18 shows the same distribution for light truck occupants.

Table 17
Distribution of All Injuries to Crash-Involved Car Occupants by Injury Contact and Severity: Weighted Average per Year, 1991-1993

Injury Contact	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Steering Assembly	403,507	56,669	18,369	4,873	1,961	514	4,045	489,938
	82.4%	11.6%	3.8%	1.0%	0.4%	0.1%	0.8%	
	11.3%	14.2%	15.6%	16.9%	15.1%	8.5%	6.7%	
Instrument Panel	650,947	43,230	16,811	1,342	495	234	5,016	718,077
	90.7%	6.0%	2.3%	0.2%	0.1%	0.0%	0.7%	
	18.2%	10.9%	14.3%	4.6%	3.8%	3.9%	8.3%	
Windshield	392,689	52,702	6,406	1,279	664	98	3,969	458,007
	85.8%	11.5%	1.4%	0.3%	0.1%	0.0%	0.9%	
	11.0%	13.2%	5.5%	4.4%	5.1%	1.6%	6.6%	
Interior Side Surface	237,292	43,506	20,011	5,185	2,861	251	1,820	310,925
	76.3%	14.0%	6.4%	1.7%	0.9%	0.1%	0.6%	
	6.6%	10.9%	17.0%	17.9%	22.0%	4.2%	3.0%	
Pillars	49,213	16,704	5,827	2,421	802	75	700	75,744
	65.0%	22.1%	7.7%	3.2%	1.1%	0.1%	0.9%	
	1.4%	4.2%	5.0%	8.4%	6.2%	1.3%	1.2%	
Restraint (Belt) System	293,106	21,940	2,907	1,400	233	62	769	320,417
	91.5%	6.9%	0.9%	0.4%	0.1%	0.0%	0.2%	
	8.2%	5.5%	2.5%	4.8%	1.8%	1.0%	1.3%	
Child Seat	9,946	679	706	0	0	0	0	11,332
	87.8%	6.0%	6.2%	--	--	--	--	
	0.3%	0.2%	0.6%	--	--	--	--	
Airbag	48,762	1,651	243	215	285	11	567	51,735
	94.3%	3.2%	0.5%	0.4%	0.6%	0.0%	1.1%	
	1.4%	0.4%	0.2%	0.7%	2.2%	0.2%	0.9%	
Head Restraints	26,382	2,500	413	873	24	0	362	30,553
	86.4%	8.2%	1.4%	2.9%	0.1%	--	1.2%	
	0.7%	0.6%	0.4%	3.0%	0.2%	--	0.6%	
Seat Back	145,536	9,792	3,054	611	811	115	1,556	161,475
	90.1%	6.1%	1.9%	0.4%	0.5%	0.1%	1.0%	
	4.1%	2.5%	2.6%	2.1%	6.3%	1.9%	2.5%	
Roof	48,577	16,626	5,471	2,143	781	2,270	1,888	77,755
	62.5%	21.4%	7.0%	2.8%	1.0%	2.9%	2.4%	
	1.4%	4.2%	4.7%	7.4%	6.0%	37.6%	3.1%	

*For each injury contact, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 17 (Continued)
Distribution of All Injuries to Crash-Involved Car Occupants by Injury Contact and Severity: Weighted Average per Year, 1991-1993

Injury Contact	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Floor	64,465	20,906	6,297	0	0	0	25	91,693
	70.3%	22.8%	6.9%	--	--	--	0.0%	
	1.8%	5.3%	5.4%	--	--	--	0.0%	
Non-Contact Injuries	397,078	4,024	1,009	0	35	22	392	402,550
	98.6%	1.0%	0.3%	--	0.0%	0.0%	0.1%	
	11.1%	1.0%	0.9%	--	0.2%	0.4%	0.7%	
Fire in Vehicle	918	99	185	143	111	734	115	2,305
	39.8%	4.3%	8.0%	6.2%	4.8%	31.9%	5.0%	
	0.0%	0.0%	0.2%	0.5%	0.9%	12.2%	0.2%	
Ground	40,540	10,776	4,240	1,000	425	146	1,062	58,189
	69.7%	18.5%	7.3%	1.7%	0.7%	0.3%	1.8%	
	1.1%	2.7%	3.6%	3.5%	3.3%	2.4%	1.6%	
Exterior (Occupant's Vehicle)	1,906	1,601	525	326	249	90	120	5,016
	38.0%	35.9%	10.5%	6.5%	5.0%	1.8%	2.4%	
	0.1%	0.5%	0.5%	1.1%	1.9%	1.5%	0.2%	
Exterior (Other Vehicle or Exterior Object)	9,598	3,841	3,429	1,732	955	407	218	20,180
	47.6%	19.0%	17.0%	8.6%	4.7%	2.0%	1.1%	
	0.3%	1.0%	2.9%	6.0%	7.4%	6.7%	0.4%	
Side and Rear Glazing	93,273	10,460	916	268	187	32	896	106,032
	88.0%	9.9%	0.9%	0.3%	0.2%	0.0%	0.9%	
	2.6%	2.6%	0.8%	0.9%	1.4%	0.5%	1.5%	
All Others	179,590	17,335	3,763	1,076	181	39	547	202,531
	88.7%	8.6%	1.9%	0.5%	0.1%	0.0%	0.3%	
	5.0%	4.4%	3.2%	3.7%	1.4%	0.7%	0.9%	
Unknown	466,099	62,715	16,906	4,036	1,931	938	36,048	608,673
	76.9%	10.3%	2.8%	0.7%	0.3%	0.2%	5.9%	
	13.6%	15.8%	14.4%	14.0%	14.9%	15.5%	60.0%	
Total	3,579,623	397,959	117,467	28,922	12,962	6,040	60,115	4,203,127

*For each injury contact, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 18
Distribution of All Injuries to Crash-Involved Light Truck Occupants by Injury Contact and Severity: Weighted Average per Year, 1991-1993

Injury Contact	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Steering Assembly	94,012	10,692	4,821	1,246	1,500	106	1,543	113,921
	82.5%	9.5%	4.1%	1.1%	1.3%	0.1%	1.4%	
	8.9%	8.9%	14.2%	16.9%	31.7%	14.3%	10.7%	
Instrument Panel	157,928	8,153	5,458	20	459	0	427	172,444
	91.6%	4.7%	3.2%	0.0%	0.3%	--	0.3%	
	15.0%	6.6%	16.8%	0.3%	9.7%	--	3.0%	
Windshield	92,610	10,917	511	212	62	10	945	105,268
	88.0%	10.4%	0.5%	0.2%	0.1%	0.0%	0.9%	
	8.8%	8.9%	1.6%	2.9%	1.3%	1.4%	6.6%	
Interior Side Surface	65,517	11,004	2,606	778	208	0	696	80,809
	81.1%	13.6%	3.2%	1.0%	0.3%	--	0.9%	
	6.2%	9.0%	8.0%	10.5%	4.4%	--	4.8%	
Pillars	8,582	3,090	1,815	364	217	128	681	14,878
	57.7%	20.8%	12.2%	2.4%	1.5%	0.9%	4.6%	
	0.8%	2.5%	5.6%	4.9%	4.6%	17.3%	4.7%	
Restraint (Belt) System	71,031	6,012	2,316	107	22	0	123	79,612
	89.2%	7.6%	2.9%	0.1%	0.0%	--	0.2%	
	6.8%	4.9%	7.1%	1.4%	0.5%	--	0.9%	
Child Seat	1,388	24	0	0	0	0	0	1,412
	98.3%	1.7%	--	--	--	--	--	
	0.1%	0.0%	--	--	--	--	--	
Airbag	2,220	0	0	0	0	0	0	2,220
	100.0%	--	--	--	--	--	--	
	0.2%	--	--	--	--	--	--	
Head Restraints	1,150	181	46	0	0	0	0	1,377
	83.5%	13.2%	3.3%	--	--	--	--	
	0.1%	0.2%	0.1%	--	--	--	--	
Seat Back	23,100	1,454	67	0	0	0	342	24,984
	92.5%	5.8%	0.4%	--	--	--	1.4%	
	2.2%	1.2%	0.3%	--	--	--	2.4%	
Roof	38,461	5,549	1,388	244	179	119	820	46,760
	82.3%	11.9%	3.0%	0.5%	0.4%	0.3%	1.8%	
	3.7%	4.5%	4.3%	3.3%	3.8%	16.1%	5.7%	

*For each injury contact, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 18 (Continued)
Distribution of All Injuries to Crash-Involved Light Truck Occupants by Injury Contact and Severity: Weighted Average per Year, 1991-1993

Injury Contact	Frequency of Injury by AIS Rating*							
	1	2	3	4	5	6	7	Total
Floor	11,635	2,452	668	0	0	0	0	14,775
	78.8%	16.6%	4.7%	--	--	--	--	
	1.1%	2.0%	2.1%	--	--	--	--	
Non-Contact Injuries	94,842	1,315	266	42	62	0	182	96,708
	98.1%	1.4%	0.3%	0.0%	0.1%	--	0.2%	
	9.0%	1.1%	0.8%	0.6%	1.3%	--	1.3%	
Fire in Vehicle	446	40	29	0	20	39	0	575
	77.6%	7.0%	5.1%	--	3.4%	6.9%	--	
	0.0%	0.0%	0.1%	--	0.4%	5.3%	--	
Ground	45,158	10,975	2,848	2,265	893	61	403	62,603
	72.1%	17.5%	4.6%	3.6%	1.4%	0.1%	0.6%	
	4.3%	8.9%	8.7%	30.6%	18.9%	8.2%	2.8%	
Exterior (Occupant's Vehicle)	3,753	1,699	765	272	347	45	308	7,189
	52.2%	23.6%	10.6%	3.8%	4.8%	0.6%	4.3%	
	0.4%	1.4%	2.4%	3.7%	7.3%	6.0%	2.1%	
Exterior (Other Vehicle or Exterior Object)	45,527	7,276	1,045	375	287	98	52	54,659
	83.3%	13.3%	1.9%	0.7%	0.5%	0.2%	0.1%	
	4.3%	5.9%	3.2%	5.1%	6.1%	13.3%	0.4%	
Side and Rear Glazing	37,154	8,543	1,197	175	78	32	456	47,634
	78.0%	17.9%	2.5%	0.4%	0.2%	0.1%	1.0%	
	3.5%	7.0%	3.7%	2.4%	1.7%	4.4%	3.2%	
All Others	44,320	4,886	544	224	0	0	187	50,161
	88.4%	9.7%	1.1%	0.5%	--	--	0.4%	
	4.2%	4.0%	1.7%	3.0%	--	--	1.3%	
Unknown	213,873	28,387	6,361	1,075	400	102	7,256	257,454
	83.1%	11.0%	2.5%	0.4%	0.2%	0.0%	2.8%	
	20.3%	23.1%	19.5%	14.5%	8.5%	13.7%	50.3%	
Total	**1,052,705**	**122,647**	**32,591**	**7,401**	**4,735**	**746**	**14,420**	**1,235,440**

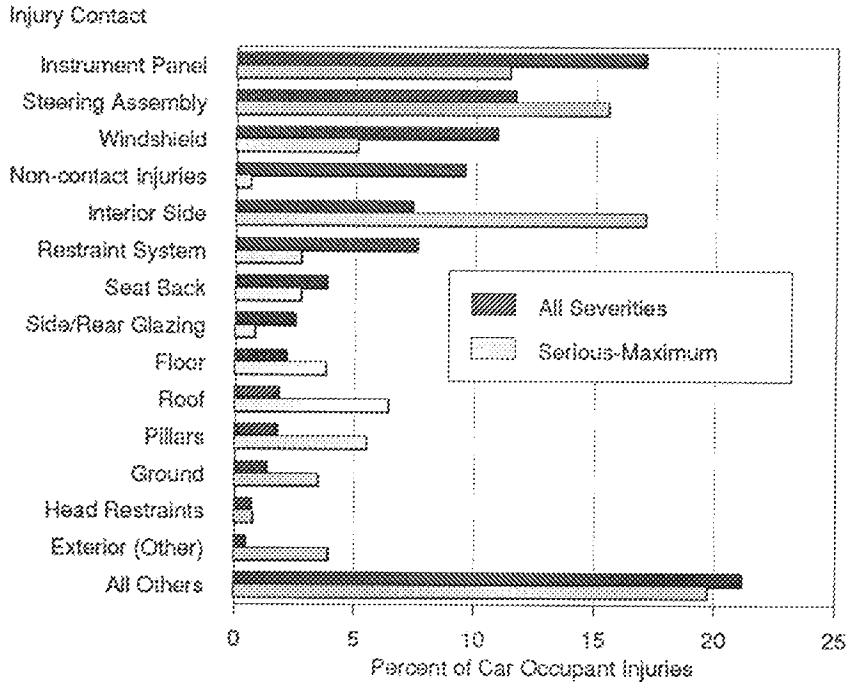
*For each injury contact, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

It is evident from Tables 17 and 18 that the most frequent injury contacts for injuries of all severities are not necessarily the same as those that are most frequently involved in serious to maximum injuries. This is illustrated in Figure 11, where two distributions are shown: one for all severities and one for serious to maximum severities, each adding up to 100 percent.

As can be seen in this figure, the restraint system and windshield as injury contacts have high frequencies in general but relatively low frequencies for serious to maximum injuries. The converse is observed for the interior side, floor, roof, and pillars.

A large disparity between all severities and serious-maximum severities is also observed for other injury contacts. Included in Figure 11 under "Other" are exterior contacts (e.g., the ground when occupants are ejected from the crash-involved vehicle), which generate a significant fraction of critical injuries.

Figure 11
Distribution of Injuries to Crash-Involved Car Occupants by Injury Contact and Severity of Injury, 1991-1993



Occupant Ejection and Entrapment

Table 19 shows the rates of occupant ejections from and entrapment in crash-involved towed cars. Two degrees of ejection are distinguished: complete and partial. The results in Table 19 are shown by primary crash modes and areas of damage. Similar data for light trucks are shown in Table 20. Ejection rates by degree of ejection are also shown in Figure 12. Ejection occurs most frequently in rollover crashes, followed by side impacts.

Table 19
Occupant Ejection and Entrapment in Crash-Involved Towed Cars by Degree of Ejection, Crash Mode, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1991-1993

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	10,386	9,027	804	173,183
	6.0%	1.7%	0.5%	5.5%
Nonrollover				
Single-Vehicle				
Front	1,682	5,754	1,424	463,474
	0.4%	1.2%	0.3%	14.7%
Side	1,060	1,231	1,127	212,504
	0.5%	0.6%	0.5%	6.7%
Rear, Top, or Under	110	717	439	27,575
	0.4%	2.6%	1.6%	0.9%
Multiple-Vehicle				
Front	1,308	1,663	4,645	1,161,976
	0.1%	0.1%	0.4%	36.8%
Side	2,167	4,115	1,928	710,378
	0.3%	0.6%	0.3%	22.5%
Rear	685	491	2,983	406,337
	0.2%	0.1%	0.7%	12.9%
Top or Under	0	0	24	3,510
	--	--	--	0.1%
Total	17,397	16,999	13,374	3,158,936
	0.6%	0.5%	0.4%	100.0%

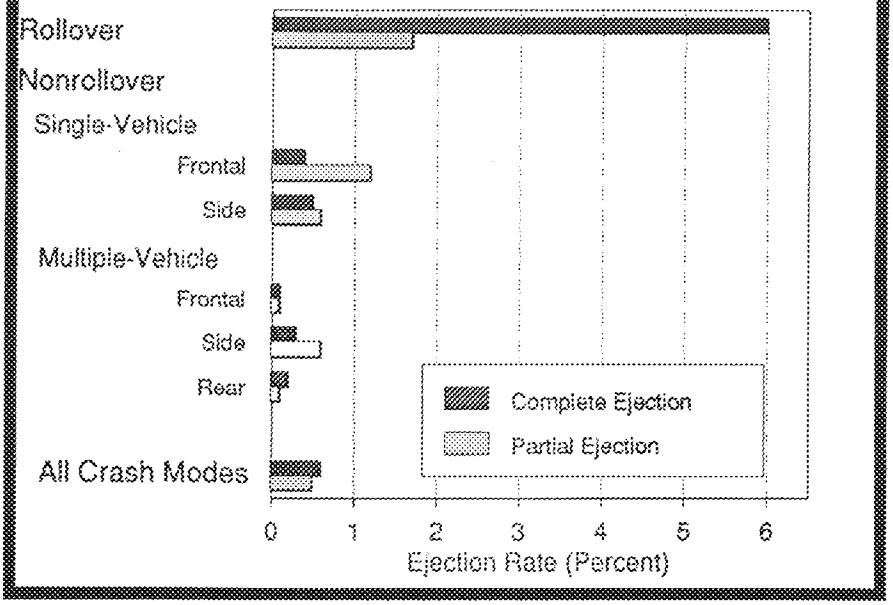
*For each crash mode, the first data row shows the number of occupants ejected or entrapped and the second row shows the percentage of the row total.
Note: Damage Area "Unknown" has been imputed into the known damage areas.

Table 20
Occupant Ejection and Entrapment in Crash-Involved Towed Light Trucks by Degree of Ejection, Crash Mode, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1991-1993

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	11,161	2,634	624	136,408
	8.2%	1.9%	0.5%	14.6%
Nonrollover				
Single-Vehicle				
Front	2,137	1,933	299	158,560
	1.3%	1.2%	0.2%	16.9%
Side	906	551	49	36,717
	2.5%	1.5%	0.1%	3.9%
Rear, Top, or Under	393	2,249	63	21,282
	1.8%	10.6%	0.3%	2.3%
Multiple-Vehicle				
Front	513	426	598	376,175
	0.1%	0.1%	0.2%	40.2%
Side	573	272	69	160,527
	0.4%	0.2%	0.0%	17.2%
Rear	468	129	0	46,007
	1.0%	0.3%	0.0%	4.9%
Top or Under	0	0	0	339
	--	--	--	0.0%
Total	16,152	8,195	1,701	936,014
	1.7%	0.9%	0.2%	100.0%

*For each crash mode, the first data row shows the number of occupants ejected or entrapped and the second row shows the percentage of the row total.
Note: Damage Area "Unknown" has been imputed into the known damage areas.

Figure 12
Towed Car Occupant Ejection Rates
by Crash Mode and Degree of Ejection, 1991-1993



The ejection rates shown in Tables 19 and 20 are generally small, except in car rollovers. However, due to the very harmful outcomes of occupant ejections, the rate of injuries associated with occupant ejections is significantly higher, as shown in Tables 21 and 22, which show injury-weighted (using Harm—see Appendix F) ejection and entrapment data for crash-involved towed vehicles, and Figure 13, which shows ejection-induced injury rates for towed vehicles. Crashes that involve ejection are generally more severe crashes; therefore, injuries to ejected occupants may be due to higher crash forces as well as the ejection itself.

Table 21
Injury-Weighted Occupant Ejection and Entrapment Rates for Crash-Involved Towed Cars by Degree of Ejection, Crash Mode, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1991-1993

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	1,379,534	501,139	227,403	4,378,848
	31.5%	11.4%	5.2%	16.7%
Nonrollover				
Single-Vehicle				
Front	188,563	312,039	131,484	3,936,114
	4.8%	7.9%	3.3%	15.0%
Side	160,470	345,998	202,561	1,676,519
	9.6%	18.4%	10.8%	7.2%
Rear, Top, or Under	6,755	105,854	105,431	278,589
	3.1%	38.0%	37.8%	1.1%
Multiple-Vehicle				
Front	83,302	283,061	737,913	7,475,569
	1.1%	3.8%	9.9%	28.6%
Side	310,265	678,051	534,551	7,066,490
	4.4%	9.6%	7.6%	27.0%
Rear	56,501	11,430	112,865	1,135,229
	5.0%	1.0%	9.9%	4.3%
Top or Under	0	0	6,766	9,941
	--	--	68.1%	0.0%
Total	2,187,391	2,237,572	2,059,075	26,160,000
	8.4%	8.6%	7.9%	100.0%

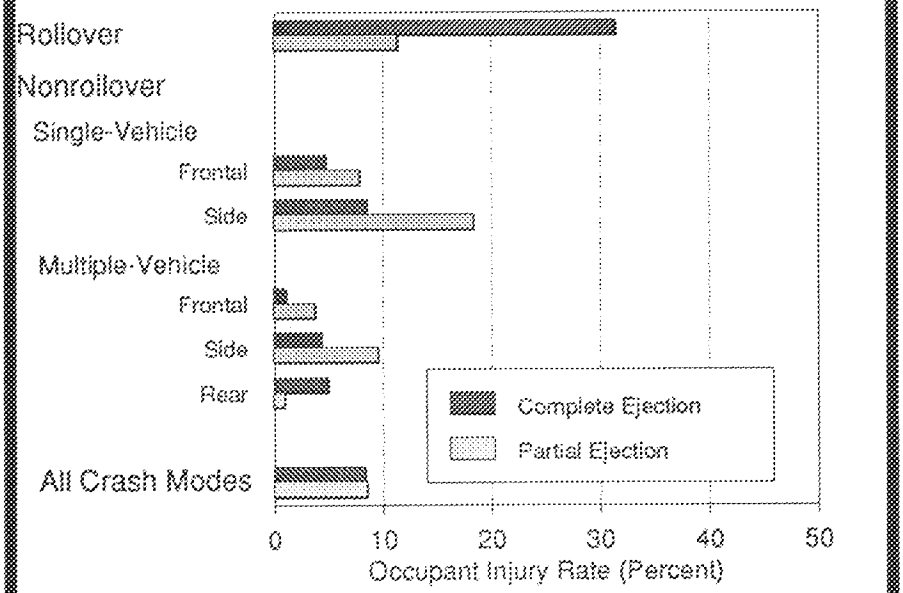
*For each crash mode, the first data row shows the number of occupants ejected or entrapped and the second row shows the percentage of the row total.

Table 22
Injury-Weighted Occupant Ejection and Entrapment Rates for Crash-Involved Towed Light Trucks by Degree of Ejection, Crash Mode, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1991-1993

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	1,402,519	327,216	229,598	2,916,044
	48.1%	11.2%	7.9%	42.2%
Nonrollover				
Single-Vehicle				
Front	91,515	38,917	44,516	951,089
	9.6%	4.1%	4.7%	13.8%
Side	30,146	7,529	10,539	175,392
	17.2%	4.3%	6.0%	2.5%
Rear, Top, or Under	4,140	17,219	14,539	81,793
	5.1%	21.1%	17.8%	1.2%
Multiple-Vehicle				
Front	38,535	79,969	100,184	1,952,056
	2.0%	4.1%	5.1%	28.3%
Side	52,188	24,710	36,222	693,064
	7.5%	3.6%	5.2%	10.0%
Rear	29,525	251	0	129,739
	22.8%	0.2%	--	1.9%
Top or Under	0	0	0	6,527
	--	--	--	0.1%
Total	1,648,568	495,811	435,598	6,905,703
	23.9%	7.2%	6.3%	100.0%

*For each crash mode, the first data row shows the number of occupants ejected or entrapped and the second row shows the percentage of the row total.

Figure 13
Ejection-Induced Occupant Injury Rates for Crash-Involved Towed Cars by Degree of Ejection and Crash Mode, 1991-1993



5. Data on Injuries to Children

Crash-Involved Children by Body Type of Passenger Vehicles

Each year approximately 412,00 children are involved in crashes as occupants of towed passenger vehicles. This section focuses on children less than 16 years of age who are not drivers. Table 23 shows the distribution of children by age group and vehicle type of the passenger vehicle. Overall, more than three-quarters of the children involved in crashes are occupants of passenger cars.

Table 23
Distribution of Child Occupants of Crash-Involved Passenger Vehicles by Vehicle Type and Age Group: Weighted Average per Year, 1991-1993

	Age Group (Years)*			
Vehicle Type	0-4	5-9	10-15	Total
Passenger Cars	101,202	91,945	126,633	**319,780**
	31.6%	28.8%	39.6%	**77.7%**
Light Trucks	35,150	17,587	39,222	**91,959**
	38.2%	19.1%	42.7%	**22.3%**
Total	**136,532**	**109,531**	**165,856**	**411,739**
	33.1%	**26.6%**	**40.3%**	**100.0%**

*For each vehicle type and age group, the first data row shows the number of child occupants involved, and the second row shows the percentage of the total number of child occupants involved for that vehicle type (the row total). For the "Total" column, the second data row shows the percentage of the grand total.

Crash Modes and Areas of Damage

Table 24 shows the distribution of towed passenger vehicles in which child occupants were involved among the primary areas of damage by crash severity (delta-v in miles per hour). Crash frequency rises sharply to a peak located between 11 and 20 mph and drops sharply following the peak; cumulative frequency beyond 40 mph is about 1 percent. The same general pattern holds for all areas of damage in nonrollover crashes, and it is particularly marked for front and rear damage.

Table 24
Distribution of Towed Passenger Vehicles in Which Child Occupants Were Involved by Crash Severity (delta-v) and Area of Damage: Weighted Average per Year, 1991-1993

Area of Damage	Crash Frequency by Crash Severity*						
	1-10 mph	11-20 mph	21-30 mph	31-40 mph	>40 mph	Unknown	Total
Front	7,901	27,228	8,505	1,219	382	47,861	93,096
	17.5%	60.2%	18.8%	2.7%	0.8%	51.4%	40.8%
Side	6,737	9,280	2,990	406	35	22,419	41,867
	34.6%	47.7%	15.4%	2.1%	0.2%	53.6%	18.4%
Rear	621	6,512	1,086	173	271	3,090	11,752
	7.2%	75.2%	12.5%	2.0%	3.1%	26.3%	5.2%
Other	NA	NA	NA	NA	NA	8,954	8,954
	--	--	--	--	--	100.0%	3.9%
Unknown	1,579	1,515	1,689	3	0	67,636	72,422
	33.0%	31.7%	35.3%	0.1%	--	93.4%	31.8%
Total	**16,838**	**44,534**	**14,270**	**1,801**	**688**	**149,960**	**228,091**
	21.6%	**57.0%**	**18.3%**	**2.3%**	**0.9%**	**65.7%**	**100.0%**

*For each area of damage and known crash severity, the first data row shows the number of vehicles, and the second row shows the percentage of the total number of vehicles for which crash severities were known. For the "Unknown" column, the second data row shows the percentage of the total for each area of damage. For the "Total" column, the second data row shows the percentage of the grand total. Area of damage "other" includes top and undercarriage, which are outside the scope of the reconstruction algorithm (see Appendix E).

Seating Positions of Child Occupants

As shown in Table 25, approximately 42 percent of the very young children (0 to 4 years old) involved in vehicle crashes were seated in the one of the front passenger positions, and 53 percent were seated in the various positions of the second seat; about 37 percent were seated in the right front passenger position. Children between 5 and 9 years old were more likely to be sitting in the second seat, whereas children 10 to 15 years old were more likely to be in the front seat.

Table 25
Distribution of Child Occupants of Crash-Involved Passenger Vehicles by Seating Position and Age Group: Weighted Average per Year, 1991-1993

Seating Position	Age Group (Years)*			
	0-4	5-9	10-15	Total
Front Seat				
Middle	22,953	1,497	2,902	27,352
	83.9%	5.5%	10.6%	6.6%
Right	32,027	35,769	83,368	151,164
	21.2%	23.7%	55.2%	36.7%
Other	2,205	451	89	2,745
	80.3%	16.4%	3.2%	0.7%
Total Front Seat	*57,186*	*37,717*	*86,360*	*181,261*
	31.5%	*20.8%*	*47.6%*	*44.0%*
Second Seat				
Left	25,192	28,567	21,241	74,999
	33.6%	38.1%	28.3%	18.2%
Middle	20,550	11,563	9,608	41,721
	49.3%	27.7%	23.0%	10.1%
Right	25,857	20,520	37,109	83,485
	31.0%	24.6%	44.4%	20.3%
Other	1,046	209	292	1,547
	67.6%	13.5%	18.9%	0.4%
Total Second Seat	*72,646*	*60,860*	*68,251*	*201,752*
	36.0%	*30.2%*	*33.8%*	*49.0%*
Other Seats	6,522	10,956	11,248	28,726
	22.7%	38.1%	39.2%	7.0%
Total	136,352	109,531	165,858	411,739
	33.1%	26.6%	40.3%	100.0%

*For each seating position and age group, the first data row shows the number of child occupants involved, and the second row shows the percentage of the total number of child occupants involved for that seating position (the row total). For the "Total" column, the second data row shows the percentage of the grand total.

Restraint Use for Child Occupants

Table 26 shows the distribution of child occupants of passenger vehicles involved in traffic crashes according to the use of restraints (seat belts and child seats). Approximately 68 percent of all the children involved in vehicle crashes were restrained at the time of the crash. Restraint use varied among the different age groups. Among very young children, 85 percent used some sort of restraint system: 25 percent used seat belts and 60 percent child seats. For children 5 to 9 years old, 66 percent used seat belts and 0.5 percent used child seats. In the 10 to 15 year age group, 56 percent of the children were using seat belts at the time of the crash.

Table 26
Distribution of Child Occupants of Crash-Involved Passenger Vehicles by Restraint Use and Age Group: Weighted Average per Year, 1991-1993

Restraint Use	Age Group (Years)*			
	0-4	5-9	10-15	Total
None	17,705	34,728	64,530	**116,962**
	14.9%	33.4%	43.8%	**31.6%**
Manual Seat Belt	30,064	68,768	82,817	**181,649**
	25.3%	66.1%	56.2%	**49.1%**
Child Seat	70,938	508	0	**71,446**
	59.8%	0.5%	--	**19.3%**
Total Known	*118,707*	*104,005*	*147,348*	***370,058***
	87.1%	*95.0%*	*88.8%*	***89.9%***
Unknown	17,644	5,527	18,510	**41,681**
	12.9%	5.0%	11.2%	**10.1%**
Total	**136,352**	**109,531**	**165,856**	**411,739**
	33.1%	**26.6%**	**40.3%**	**100.0%**

*For each known restraint use category and age group (including the "Total" column), the first data row shows the number of child occupants involved, and the second row shows the percentage of the "Total Known" number of child occupants involved for that category. For the "Total Known" and "Unknown" rows, the second data row shows the percentage of the total for each column.

Distribution of Injuries to Child Occupants

Table 27 shows the distribution of maximum injury severities to children who were occupants of passenger vehicles involved in traffic crashes. Almost 58 percent of the children involved in crashes were not injured. Of those that were injured, 77 percent received minor injuries. Forty-seven percent of the severe injuries (AIS=3-6) were sustained by children 10 to 15 years old.

Table 27
Distribution of Child Occupants of Crash-Involved Passenger Vehicles by Maximum Injury Severity and Age Group: Weighted Average per Year, 1991-1993

Maximum AIS Rating	Age Group (Years)*			
	0-4	5-9	10-15	Total
Not Injured (0)	100,489	59,695	76,955	237,139
	73.7%	54.5%	46.4%	57.6%
Minor (1)	27,118	43,766	62,970	133,854
	19.9%	40.0%	38.0%	32.5%
Moderate (2)	2,349	2,502	10,917	15,767
	1.7%	2.3%	6.6%	3.8%
Serious-Maximum (3-6)	1,138	923	1,838	3,898
	0.8%	0.8%	1.1%	0.9%
Injured, Severity Unknown (7)	4,973	2,416	12,044	19,433
	3.6%	2.2%	7.3%	4.7%
Total	136,352	109,531	165,856	411,739
	33.1%	26.6%	40.3%	100.0%

*For each injury severity and age group (including the "Total" column), the first data row shows the number of child occupants involved, and the second row shows the percentage of the total for that age group. For the "Total" row, the second data row shows the percentage of the grand total.

Table 28 shows the distribution of maximum injury severities to children who were occupants of crash-involved passenger vehicles and the outcome of the injuries according to the types of treatment the children received. Children who are hospitalized with no injury usually are admitted by the attending physician for observation only and stay in the hospital for 1 to 2 days. Of the children who were injured, 56 percent were treated and released from the hospital.

Table 28
Distribution of Child Occupants of Crash-Involved Passenger Vehicles by Maximum Injury Severity and Treatment: Weighted Average per Year, 1991-1993

Maximum AIS Rating	Treatment*						
	None	Treated at Scene	Transported and Released	Hospitalized	Fatal	Unknown	Total
Not Injured (0)	221,401	2,438	12,990	176	0	133	237,139
	85.1%	22.0%	11.6%	1.3%	--	0.9%	57.6%
Minor (1)	36,237	8,128	84,128	4,344	85	931	133,854
	13.9%	73.2%	75.3%	31.7%	9.4%	6.6%	32.5%
Moderate (2)	149	0	9,637	5,718	60	3	15,767
	0.1%	--	8.6%	41.7%	6.7%	0.0%	3.8%
Serious-Maximum (3-5)	0	0	473	2,762	606	57	3,898
	--	--	0.4%	20.1%	67.3%	0.4%	0.9%
Injured, Severity Unknown (7)	2,067	540	3,881	721	150	12,074	19,433
	0.8%	4.9%	3.5%	5.3%	16.6%	85.3%	4.7%
Total	**260,127**	**11,106**	**111,722**	**13,722**	**901**	**14,160**	**411,739**
	63.2%	**2.7%**	**27.1%**	**3.3%**	**0.2%**	**3.4%**	**100.0%**

*For each injury severity and treatment group (including the "Total" column), the first data row shows the number of child occupants involved, and the second row shows the percentage of the total for that age group. For the "Total" row, the second data row shows the percentage of the grand total.

Every year, about 2,810,000 passenger vehicles are towed away from traffic crashes. The number of crash-involved children in those towed vehicles is about 412,000 per year. Of these, about 175,000 children are injured, incurring about 321,000 injuries of various injury severities, in various body regions, and from various injury contacts. Table 29 shows the distribution of all injuries to child occupants of passenger vehicles involved in traffic crashes over the 1991-1993 period. More than half (56 percent) of all the injuries were to children between 10 and 15 years old.

The numbers for "injured, severity unknown" (AIS=7) are lower in these tables than in tables using maximum AIS (MAIS), because of the level of information available for coding the injuries. An AIS of 7 is assigned to an injury when there is not sufficient information about the injury available. An MAIS of 7 is assigned to an occupant when it is known that the occupant was injured, but no information about the injury is available. Therefore, an occupant with an MAIS of 7 may not have any associated injuries coded.

Table 29
Distribution of All Injuries to Child Occupants of Crash-Involved Passenger Vehicles by Injury Severity and Age Group: Weighted Average per Year, 1991-1993

AIS Rating	Age Group (Years)*			
	0-4	5-9	10-15	Total
Minor (1)	54,878 88.9%	73,343 92.8%	159,932 88.9%	**288,154** **89.9%**
Moderate (2)	4,037 6.5%	3,184 4.0%	14,885 8.3%	**22,106** **6.9%**
Serious (3)	1,532 2.5%	732 0.9%	2,801 1.6%	**5,065** **1.6%**
Severe (4)	554 0.9%	252 0.3%	536 0.3%	**1,342** **0.4%**
Critical (5)	457 0.7%	100 0.1%	154 0.1%	**710** **0.2%**
Maximum (6)	180 0.3%	11 0.0%	44 0.0%	**235** **0.1%**
Serious-Maximum (3-6)	*2,723* *4.4%*	*1,095* *1.4%*	*3,535* *2.0%*	***7,352*** ***2.3%***
Injured, Severity Unknown (7)	118 0.2%	1,382 1.7%	1,471 0.8%	**2,971** **0.9%**
Total	**61,756** **100.0%**	**79,004** **100.0%**	**179,823** **100.0%**	**320,583** **100.0%**

*For each injury severity and age group (including the "Total" column), the first data row shows the number of child occupants involved, and the second row shows the percentage of the total for that age group.

Distribution of Injuries to Children by Body Region

Table 30 shows the distribution of all injuries to child occupants of crash-involved passenger vehicles as a function of injury severity and injured body region. Of the serious to maximum (AIS=3-6) injuries, almost 21 percent were injuries to the chest, and 18 percent were injuries to the brain. Excluding injuries to the skin, injuries to the face accounted for about 21 percent of the total, injuries to the shoulder and back accounted for about 18 percent, and neck injuries accounted for 15 percent.

Table 30
Distribution of All Injuries to Child Occupants
of Crash-Involved Passenger Vehicles by Body Region and Severity:
Weighted Average per Year, 1991-1993

Body Region	Frequency of Injury by AIS Rating*				
	1	2	3-6	7	Total
Head (Brain)	2,921	4,822	1,294	0	9,037
	32.3%	53.4%	14.3%	--	
	1.0%	21.8%	17.6%	--	
Head (Skull)	19	1,509	866	0	2,393
	0.8%	63.1%	36.2%	--	
	0.0%	6.8%	11.8%	--	
Head (Other)	3,866	1,418	687	2,014	7,984
	48.4%	17.8%	8.6%	25.2%	
	1.3%	6.4%	9.3%	67.8%	
Face	15,370	1,422	454	443	17,689
	86.9%	8.0%	2.6%	2.5%	
	5.3%	6.4%	6.2%	14.9%	
Neck	11,613	772	97	9	12,491
	93.0%	6.2%	0.8%	0.1%	
	4.0%	3.5%	1.3%	0.3%	
Chest	784	274	1,522	51	2,630
	29.8%	10.4%	57.9%	1.9%	
	0.3%	1.2%	20.7%	1.7%	
Shoulder and Back	12,189	2,387	32	216	14,824
	82.2%	16.1%	0.2%	1.5%	
	4.2%	10.8%	0.4%	7.3%	

*For each body region, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 30 (Continued)
Distribution of All Injuries to Child Occupants
of Crash-Involved Passenger Vehicles by Body Region and Severity:
Weighted Average per Year, 1991-1993

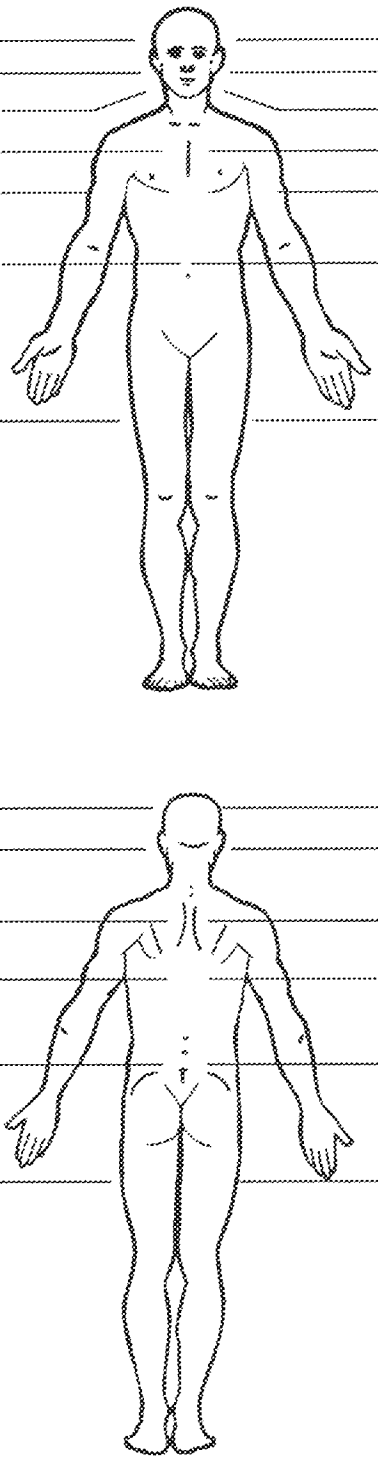
Body Region	Frequency of Injury by AIS Rating*				
	1	2	3-6	7	Total
Abdomen	157	1,413	428	223	2,221
	7.1%	63.6%	19.3%	10.0%	
	0.1%	6.4%	5.8%	7.5%	
Spine	0	0	95	0	95
	--	--	100.0%	--	
	--	--	1.3%	--	
Upper Extremities	3,044	3,119	749	0	6,912
	44.0%	45.1%	10.8%	--	
	1.1%	14.1%	10.2%	--	
Pelvis	202	741	222	0	1,165
	17.3%	63.6%	19.1%	--	
	0.1%	3.4%	3.0%	--	
Lower Extremities	1,591	2,578	839	14	5,023
	31.7%	51.3%	16.7%	0.3%	
	0.6%	11.7%	11.4%	0.5%	
Skin	236,346	1,653	55	0	238,053
	99.3%	0.7%	0.0%	--	
	82.0%	7.5%	0.7%	--	
All Other	54	0	12	0	66
	81.8%	--	18.2%	--	
	0.0%	--	0.2%	--	
Total	288,154	22,106	7,352	2,971	320,583

*For each body region, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Restraint Use and Body Regions Injured

Figure 14 shows the distribution of child occupants of crash-involved passenger vehicles by injured body region and belt usage. A child may receive more than one injury to a given body region; however, this figure represents one injury per body region per child occupant. A child may also receive injuries across more than one body region. Therefore, the number for each body region will add up to more than the number of injured child occupants. For example, a child may have a contusion to the left side of the brain and a laceration to the right side of the brain. The figure counts only one of the injuries to the brain. If the child in the example sustained a contusion to the left side of the brain and a skull fracture, then both injuries would be included in the figure, and one injury would be counted in the brain body region while the other injury would be counted in the skull body region. To determine the number of belted child occupants who sustained a brain injury, divide the number of child occupants with a brain injury by the total number of child occupants using a restraint system. The same methodology applies to the unbelted child occupants. The percentages will not add to 100 percent, because the total number of child occupants includes those who were not injured.

Figure 14
Distribution of Injuries by Body Region to Child Occupants of Crash-Involved Passenger Vehicles by Belt Usage: Weighted Average per Year, 1991-1993



Injury Contacts

Table 31 shows the distribution of all injuries to child occupants of crash-involved passenger vehicles as a function of injury severity and injury contact (sources of injury). The instrumental panel was the cause of almost 14 percent of all injuries to children, and 20 percent of the serious-maximum (AIS=3-6) injuries. The restraint system used by children resulted in 6 percent of all injuries, of which 96 percent were minor injuries. The seat back caused approximately 15 percent of all injuries to children, of which more than 91 percent were minor injuries.

Table 31
Distribution of All Injuries to Child Occupants of Crash-Involved Passenger Vehicles by Injury Contact and Severity: Weighted Average per Year, 1991-1993

Injury Contact	Frequency of Injury by AIS Rating*				
	1	2	3-6	7	Total
Steering Assembly	204	56	0	0	261
	78.2%	21.5%	--	--	
	0.1%	0.3%	--	--	
Instrument Panel	41,368	1,405	1,496	111	44,382
	93.2%	3.2%	3.4%	0.3%	
	14.4%	6.4%	20.4%	3.7%	
Windshield	15,836	1,252	69	802	17,957
	88.2%	7.0%	0.4%	4.5%	
	5.5%	5.7%	0.9%	27.0%	
Interior Side Surface	19,413	2,554	574	0	22,541
	86.1%	11.3%	2.5%	--	
	6.7%	11.6%	7.8%	--	
Pillars	2,687	1,626	432	54	4,799
	56.0%	33.9%	9.0%	1.1%	
	0.9%	7.4%	5.9%	1.8%	
Restraint (Belt) System	18,374	487	241	0	19,102
	96.2%	2.5%	1.3%	--	
	6.4%	2.2%	3.3%	--	
Child Seat	10,023	270	227	0	10,520
	95.3%	2.6%	2.2%	--	
	3.5%	1.2%	3.1%	--	
Airbag	88	0	0	0	88
	100.0%	--	--	--	
	0.0%	--	--	--	
Head Restraints	1,280	0	21	0	1,301
	98.4%	--	1.6%	--	
	0.4%	--	0.3%	--	

*For each injury contact, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Table 31 (Continued)
Distribution of All Injuries to Child Occupants of Crash-Involved Passenger Vehicles by Injury Contact and Severity: Weighted Average per Year, 1991-1993

Injury Contact	Frequency of Injury by AIS Rating*				
	1	2	3-6	7	Total
Seat Back	43,519	2,259	830	790	47,397
	91.8%	4.8%	1.8%	1.7%	
	15.1%	10.2%	11.3%	25.6%	
Roof	3,649	747	414	67	4,878
	74.8%	15.3%	8.5%	1.4%	
	1.3%	3.4%	5.6%	2.3%	
Floor	566	636	0	0	1,200
	47.1%	53.0%	--	--	
	0.2%	2.9%	--	--	
Non-Contact Injuries	27,603	224	12	75	27,915
	98.9%	0.8%	0.0%	0.3%	
	9.6%	1.0%	0.2%	2.5%	
Fire in Vehicle	13	58	20	0	91
	14.3%	63.7%	22.0%	--	
	0.0%	0.3%	0.3%	--	
Ground	16,510	3,087	772	50	20,418
	80.9%	15.1%	3.8%	0.2%	
	5.7%	14.0%	10.5%	1.7%	
Exterior (Occupant's Vehicle)	249	27	22	0	298
	83.6%	9.1%	7.4%	--	
	0.1%	0.1%	0.3%	--	
Exterior (Other Vehicle or Exterior Object)	354	357	370	0	1,080
	32.8%	33.1%	34.3%	--	
	0.1%	1.6%	5.0%	--	
Side and Rear Glazing	13,065	834	117	0	14,016
	93.2%	6.0%	0.8%	--	
	4.5%	3.8%	1.6%	--	
All Others	25,537	1,097	107	0	26,741
	95.5%	4.1%	0.4%	--	
	8.9%	5.0%	1.5%	--	
Unknown	47,820	5,131	1,625	1,023	55,599
	86.0%	9.2%	2.9%	1.8%	
	16.6%	23.2%	22.1%	34.4%	
Total	288,154	22,106	7,352	2,971	320,583

*For each injury contact, the first data row shows the number of injuries, the second row shows the percentage of the row total, and the third row shows the percentage of the column total.

Ejection and Entrapment

Table 32 shows the numbers and rates of child occupant ejections from and entrapment in crash-involved towed passenger vehicles. Two degrees of ejection are distinguished: complete and partial. The results in Table 32 are shown by primary crash modes and areas of damage. Ejection of child occupants occurs most frequently in rollover crashes, followed by frontal impacts.

Table 32
Child Occupant Ejection and Entrapment
in Crash-Involved Towed Passenger Vehicles
by Degree of Ejection, Crash Mode, and Area of Damage:
Weighted Average of Nationally Weighted Counts per Year, 1991-1993

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	4,136	279	80	**30,048**
	13.7%	0.9%	0.3%	
Nonrollover				
Single-Vehicle				
Front	359	24	44	**45,481**
	0.7%	0.1%	0.1%	
Side	237	31	0	**16,939**
	1.4%	0.2%	--	
Rear, Top, or Under	51	0	0	**3,030**
	1.7%	--	--	
Multiple-Vehicle				
Front	342	201	238	**184,862**
	0.2%	0.1%	0.1%	
Side	255	158	192	**77,584**
	0.3%	0.2%	0.3%	
Rear	77	0	46	**53,714**
	0.1%	--	0.1%	
Top or Under	0	0	0	**80**
	--	--	--	
Total	**5,458**	**692**	**600**	**411,739**
	1.3%	0.2%	0.1%	

*For each crash mode, the first data row shows the number of occupants ejected or entrapped and the second row shows the percentage of the row total.

The ejection rates shown in Table 32 are generally small, except in rollover crashes. However, due to the very harmful outcomes of occupant ejections, the rate of injuries associated with occupant ejections is significantly higher, as shown in Table 33, which shows injury-weighted (using Harm—see Appendix F) ejection and entrapment data for child occupants of crash-involved towed passenger vehicles. Crashes that involve ejection are generally more severe crashes; therefore, injuries to ejected child occupants may be due to higher crash forces as well as the ejection itself.

Table 33
Injury-Weighted Child Occupant Ejection and Entrapment In Crash-Involved Towed Passenger Vehicles by Degree of Ejection, Crash Mode, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1991-1993

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	1,268,253	493,200	603,680	**3,967,215**
	32.0%	12.4%	15.2%	
Nonrollover				
Single-Vehicle				
Front	137,609	0	1,517	**1,136,125**
	12.1%	--	0.1%	
Side	78,463	10,977	0	**178,869**
	44.1%	6.2%	--	
Rear, Top, or Under	563,274	0	0	**630,596**
	93.5%	--	--	
Multiple-Vehicle				
Front	7,163	23,539	22,342	**1,741,292**
	0.4%	1.4%	1.3%	
Side	562,747	229,794	34,705	**1,971,683**
	28.5%	11.7%	1.8%	
Rear	310	0	118,738	**228,873**
	0.1%	--	51.9%	
Top or Under	5,347	27,071	41,985	**125,249**
	4.3%	21.6%	33.5%	
Total	**2,623,165**	**794,581**	**822,966**	**9,979,076**
	26.3%	7.9%	8.2%	

*For each crash mode, the first data row shows the number of occupants ejected or entrapped and the second row shows the percentage of the row total.

Appendix A. Glossary

AIS (Abbreviated Injury Scale)
An integer scale developed by the Association for the Advancement of Automotive Medicine to rate the severity of individual injuries. The AIS includes: 1=minor, 2=moderate, 3=serious, 4=severe, 5=critical, and 6=maximum (virtually untreatable). The scale does not explicitly denote a fatal injury. An AIS rating of 7 (injured, severity unknown) is used when sufficient information about an injury is not available.

Body Type
Refers to the individual classifications of motor vehicles by their design structure based on definitions developed by the Society of Automotive Engineers.

Crash
An event that produces injury and/or damage, involves a motor vehicle in transport, and occurs on a trafficway or while the vehicle is still in motion after running off the trafficway. In this report, crash and motor vehicle crash are synonymous. To qualify for the CDS, all crashes must be reported by the police to the state and involve a towed CDS applicable vehicle.

Crash Severity (delta-v is used as a measure of crash severity)
CRASHPC and OLDMISSPC are computer models that provide a measure of crash severity in terms of delta-v (see Appendix E). In vehicle-to-vehicle crashes, the models assume that the two vehicles approach each other at an impact velocity, reach a common velocity, and then separate. Delta-v is equal to the impact velocity minus the separation velocity. Other factors being equal, the greater the delta-v during a collision, the greater the potential for occupant injury.

Crashworthiness Data System Applicable Motor Vehicle
Refers to those motor vehicles classified as automobiles, automobile derivatives and short utility vehicles, van-based light trucks, and light conventional trucks where the qualifying trucks must have a gross vehicle weight rating (GVWR) of less than or equal to 10,000 pounds.

Ejection
Refers to persons being completely or partially thrown from the vehicle as a result of an impact or rollover. Partial ejection refers to a situation where part of the occupant's body remains *in* the vehicle. This does not apply to occupants who are not initially in the seating compartment of the vehicle (e.g., persons riding in pickup beds, boots of convertibles, or open tailgates), since any ejection for them is coded as complete ejection.

Entrapment
Refers to persons being partially or completely *in* the vehicle and mechanically restrained by a damaged vehicle component. Jammed doors and immobilizing injuries, by themselves, do not constitute entrapment. Occupants pinned by cargo shift are not considered to be entrapped. Occupants who are completely or partially ejected and subsequently become pinned by their own vehicle and any surface other than their own vehicle are not considered entrapped. An occupant whose seat belt buckle release mechanism is jammed as a result of a crash is not considered entrapped.

Fatally Injured Occupant
A death caused by injuries sustained by an occupant within 30 days of a CDS applicable motor vehicle crash.

Fatal Motor Vehicle Traffic Crash
A crash in which at least one occupant of a CDS applicable motor vehicle dies within 30 days of the crash as a result of injuries sustained in the crash.

Fixed Object
An object attached to the terrain (trees, abutments) or stationary objects intentionally placed for a particular purpose (e.g., poles, barriers).

Gross Vehicle Weight Rating (GVWR)
The maximum capacity of a vehicle, including the weight of the base vehicle, all added equipment, driver and passengers, and all cargo loaded into or onto the vehicle. Actual weight may be less than or greater than GVWR.

Injured Occupant
Occupant of a CDS applicable motor vehicle sustaining any type of injury as a result of a crash, including injuries from non-impact forces.

Light Trucks
Includes utility vehicles, pickups, vans, and truck-based station wagons, with a GVWR less than 10,000 pounds.

Maximum AIS
Represents the highest AIS level sustained by an injured occupant of a CDS applicable motor vehicle.

Motor Vehicle in Transport
A CDS applicable motor vehicle on a roadway or in motion within a trafficway.

Non-Fixed Objects
Objects that are movable or moving but are not motor vehicles, pedestrians, pedalcyclists, animals, or trains.

Occupant
Any person who is in a CDS applicable motor vehicle in transport.

Passenger Car
Any motor vehicle that is an automobile, auto-based pickup, large limousine, or three-wheel automobile or automobile derivative.

Passenger Vehicles
Includes passenger cars, pickup trucks, vans, and sport/utility vehicles with a GVWR less than 10,000 pounds. Equivalent to CDS applicable vehicles.

Police-Reported Crash
A crash investigated or reported by a police officer, documented with a completed form which is signed by the investigating officer, and reported to the state. Driver reports submitted only to motor vehicle officials are excluded.

Primary Sampling Unit (PSU)
A city, county, or group of contiguous counties with an aggregate population of at least 50,000 which defines a geographic area for crash investigation. PSU selection is the first stage in the probability sampling of crashes for the CDS.

Restraint Usage
Manually operated restraint systems include shoulder belts, lap belts, lap and shoulder belt combinations, or child safety seats. Automatic restraint systems include passive belts and air bag systems.

Roadway
That part of a trafficway used for motor vehicle travel or, where travel by various classes of motor vehicles is segregated, that part of a trafficway used by a particular class. The roadway excludes shoulders, designated parking lanes, and median areas.

Serious Injury
Injury severity of AIS=3 or greater, including, for example, compound fractures and internal organ injuries. Unless otherwise noted, summary statistics in this report include all fatally injured persons as seriously injured, but exclude those with unknown injury severity level (see AIS).

Towaway Crash
A crash which is noted on the police report as involving at least one CDS applicable vehicle that was towed from the crash scene as a result of damage from the crash. For those crashes involving injury or fatality, the injured or killed person must be an occupant of the towed CDS applicable vehicle to qualify for the CDS.

Towed Vehicle
A CDS applicable motor vehicle that was involved in a crash and removed from the crash scene due to damage resulting from the crash by means other than its own power.

Trafficway

Any right-of-way open to the public as a matter of right or custom for moving persons or property from one place to another, including the entire width between property lines or other boundaries.

Vehicle Type

Refers to a series of CDS applicable motor vehicle body types that have been grouped together because of design similarities. The principal vehicle types used in this report are passenger cars, light trucks, vans, and sport/utility vehicles.

Appendix B. NASS/CDS Sample Design

The crashes investigated in NASS/CDS are a probability sample of all police-reported crashes in the United States. Each such crash that occurs within a CDS team's area has a chance of being included in the sample. This design makes it possible to compute not only national estimates but also probable errors associated with those estimates. Many other features of the design have a significant impact on CDS data analysis, the most important of which are highlighted in this appendix.

The selection of sample crashes for CDS is accomplished in stages. The first stage is the selection of geographic areas called primary sample units (PSUs). Each PSU is composed of a large city, a county, or a group of contiguous counties. The United States was divided into 1,195 PSUs. The PSUs were then grouped into 12 categories described by geographic region and degree of urbanization. Two PSUs were selected from each category with probability proportional to its 1983 population. These 24 PSUs are the first stage in the selection of CDS sample crashes.

If every crash in each of the 24 PSUs were investigated, a national estimate could be obtained by weighting each crash in the PSU by the inverse of the probability of selection of the PSU. For example, if a sample PSU had 1 chance in 40 of being selected, then each crash from the PSU would be weighted by a factor of 40. This is called the first-stage expansion factor.

It is not practical to investigate every crash in each sample PSU, so additional stages of sampling are performed. The police agencies in a PSU are categorized by the number and type of police crash reports they process. Sample police agencies are then selected randomly from each category. The fraction of the agencies selected increases as the number and severity of crashes reported by the agency increases. This is called the second-stage expansion factor.

The final stage of sampling is the selection of crashes from all crashes reported in the sample police agencies. A simple random selection of all reported towaway crashes would result in a large percentage of sample crashes with property damage and few injuries, since these constitute such a large fraction of all crashes. This type of sample would not be effective in providing the detailed and accurate information needed for the mitigation of crash consequences. Rather, a substantial sample of serious injury crashes is needed for NASS/CDS.

The procedure used to obtain the desired sample by type and severity of crashes is an unequal probability selection. This required listing police accident reports in categories defined by most severe police-reported injury to an occupant of a towed CDS applicable motor vehicle, disposition of the injured, and model year of the towed CDS applicable motor vehicle. A weighting factor was assigned to crashes in each category to increase or decrease the probability of selection. A random selection was made from the total crashes listed in all categories. In addition to the probabilities of selection varying by type of crash, other factors affected the selection probabilities at this stage, such as the number of crashes listed, the date and time of the crash, and the police agencies from which the

crash was listed. The result was that each sampled crash from a PSU has a unique selection probability.

The inverse of this probability is called the third-stage expansion factor. If each sample crash in a PSU is multiplied by its second- and third-stage expansion factors, an unbiased estimate of the total number of crashes in the PSU is obtained. To produce the national estimates, the PSU level estimates are inflated by the first-stage expansion factor. Thus, the national expansion factor is the product of the first-, second-, and third-stage expansion factors.

The national estimates equal the inverse of the probability of the PSUs being selected, the probability of the police agencies being selected, and the probability of the crash being selected for that day. Since the number of crashes in the sample is predetermined, the national estimate for each crash within a stratum is different. To account for this bias, a ratio weight was developed. The ratio weight is the national estimate multiplied by a ratio factor. For each stratum, this ratio factor is equal to the total number of crashes listed in all of the police jurisdictions (sampled and non-sampled) divided by the number of crashes selected. There are instances where very few or no crashes are listed. To account for this, the similar PSUs were grouped together, based on the stratum from which they were originally selected.

Appendix C. NASS/CDS Zone Centers and Primary Sampling Units

Zone Centers

Buffalo, NY
Indiana University, IN

Primary Sampling Units

Bibb and Tuscaloosa Counties, AL
Gila, Graham, and Greenlee Counties, AZ
Yuma and LaPaz Counties, AZ
Los Angeles, CA
Gilpen and Jefferson Counties, CO
Fort Lauderdale and Hollywood Cities, FL
Chicago, IL
Lake County, IN
Charles and Prince Georges Counties, MD
Genesee County, MI
Muskegon County, MI
Washtenaw County, MI
Douglas County, NE
Wake County, NC
Ocean County, NJ
Kings County, NY
Ulster County, NY
Allegheny County, PA
Montgomery County, PA
Philadelphia, PA
Knox County, TN
Dallas, TX
King County, WA
Seattle, WA

Appendix D. NASS/CDS Data Elements

The data are collected on six forms: the Accident Form, the General Vehicle Form, the Exterior Vehicle Form, the Interior Vehicle Form, the Occupant Assessment Form, and the Occupant Injury Form. There are 310 different data elements in the NASS/CDS that characterize the accident, vehicles, and the people involved. This appendix includes the forms used for each crash in the CDS.

U.S. Department of Transportation
National Highway Traffic Safety Administration

ACCIDENT FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

1. Primary Sampling Unit Number _____
2. Case Number - Stratum _____ _____

IDENTIFICATION

3. Number of General Vehicle Forms Submitted _____
4. Date of Accident (Month,Day,Year) _____ _____ / _____ _____ / 9 3
5. Time of Accident _____

Code reported military time of accident.

NOTE: Midnight = 2400
Unknown = 9999

SPECIAL STUDIES - INDICATORS

Check (✓) each special study (SS14-SS18 below) that has been completed; code 1 for the checked special studies and 0 for the special studies not checked.

6. ____SS14 Fatal AOPS ____
7. ____SS15 Administrative Use ____
8. ____SS16 _____ ____
9. ____SS17 _____ ____
10. ____SS18 _____ ____

NUMBER OF EVENTS

11. Number of Recorded Events in This Accident _____

Code the number of events which occurred in this accident.

ACCIDENT EVENTS

For each event that occurred in the accident, code the lowest numbered vehicle in the left columns and the other involved vehicle or object on the right.

Accident Event Sequence Number	Vehicle Number	Class Of Vehicle	General Area of Damage	Vehicle Number or Object Contacted	Class Of Vehicle	General Area of Damage
12. 0 1	13. _____	14. _____	15. _____	16. _____	17. _____	18. _____
19. 0 2	20. _____	21. _____	22. _____	23. _____	24. _____	25. _____
26. 0 3	27. _____	28. _____	29. _____	30. _____	31. _____	32. _____
33. 0 4	34. _____	35. _____	36. _____	37. _____	38. _____	39. _____
40. 0 5	41. _____	42. _____	43. _____	44. _____	45. _____	46. _____

IF GREATER THAN FIVE EVENTS, CONTINUE CODING ON THE ACCIDENT EVENT SUPPLEMENT

HS Form 434 (Rev. 1/93)

CODES FOR CLASS OF VEHICLE

(00) Not a motor vehicle
(01) Subcompact/mini (wheelbase < 254 cm)
(02) Compact (wheelbase ≥ 254 but < 265 cm)
(03) Intermediate (wheelbase ≥ 265 but < 278 cm)
(04) Full size (wheelbase ≥ 278 but < 291 cm)
(05) Largest (wheelbase ≥ 291 cm)
(09) Unknown passenger car size
(11) Compact utility vehicle
(12) Large utility vehicle (≤ 4,500 kgs GVWR)
(13) Passenger van (≤ 4,500 kgs GVWR)
(14) Other van (≤ 4,500 kgs GVWR)
(15) Pickup truck (≤ 4,500 kgs GVWR)
(18) Other truck (≤ 4,500 kgs GVWR)
(19) Unknown light truck type
(20) School bus
(21) Other bus
(22) Truck (> 4,500 kgs GVWR)
(23) Tractor without trailer
(24) Tractor-trailer(s)
(25) Motored cycle
(28) Other vehicle
(99) Unknown

CODES FOR GENERAL AREA OF DAMAGE (GAD)

CDS APPLICABLE AND OTHER VEHICLES	TDC APPLICABLE VEHICLES
(0) Not a motor vehicle	(0) Not a motor vehicle
(N) Noncollision	(N) Noncollision
(F) Front	(F) Front
(R) Right side	(R) Right side
(L) Left side	(L) Left side
(B) Back	(B) Back of unit with cargo area (rear of trailer or straight truck)
(T) Top	(O) Back (rear of tractor)
(U) Undercarriage	(C) Rear of cab
(9) Unknown	(V) Front of cargo area
	(T) Top
	(U) Undercarriage
	(9) Unknown

CODES FOR VEHICLE NUMBER OR OBJECT CONTACTED

(01-30) — Vehicle Number

Noncollision
(31) Overturn — rollover
(32) Fire or explosion
(33) Jackknife
(34) Other intraunit damage (specify): _____
(35) Noncollision injury
(38) Other noncollision (specify): _____
(39) Noncollision — details unknown

Collision With Fixed Object
(41) Tree (≤ 10 cm in diameter)
(42) Tree (> 10 cm in diameter)
(43) Shrubbery or bush
(44) Embankment

(45) Breakaway pole or post (any diameter)

Nonbreakaway Pole or Post
(50) Pole or post (≤ 10 cm in diameter)
(51) Pole or post (> 10 cm but ≤ 30 cm in diameter)
(52) Pole or post (> 30 cm in diameter)
(53) Pole or post (diameter unknown)

(54) Concrete traffic barrier
(55) Impact attenuator
(56) Other traffic barrier (includes guardrail) (specify): _____
(57) Fence
(58) Wall
(59) Building
(60) Ditch or culvert
(61) Ground
(62) Fire hydrant
(63) Curb
(64) Bridge
(68) Other fixed object (specify): _____
(69) Unknown fixed object

Collision with Nonfixed Object
(71) Motor vehicle not in-transport
(72) Pedestrian
(73) Cyclist or cycle
(74) Other nonmotorist or conveyance _____
(75) Vehicle occupant
(76) Animal
(77) Train
(78) Trailer, disconnected in transport
(88) Other nonfixed object (specify): _____
(89) Unknown nonfixed object

(98) Other event (specify): _____
(99) Unknown event or object

U.S. Department of Transportation
National Highway Traffic Safety Administration

GENERAL VEHICLE FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

1. Primary Sampling Unit Number ____ ____

2. Case Number - Stratum ____ ____ ____ ____

3. Vehicle Number ____ ____

VEHICLE IDENTIFICATION

4. Vehicle Model Year ____ ____
Code the last two digits of the model year
(99) Unknown

5. Vehicle Make (specify): ____ ____
_____
Applicable codes are found in your NASS Data Collection, Coding and Editing Manual.
(99) Unknown

6. Vehicle Model (specify): ____ ____ ____
_____
Applicable codes are found in your NASS Data Collection, Coding and Editing Manual.
(999) Unknown

7. Body Type ____ ____
Note: Applicable codes may be found on the back of this page.

8. Vehicle Identification Number
____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____
Left justify; Slash zeros and letter Z (Ø and Z)
No VIN—Code all zeros
Unknown—Code all nine's

OFFICIAL RECORDS

9. Police Reported Vehicle Disposition ____
(0) Not towed due to vehicle damage
(1) Towed due to vehicle damage
(9) Unknown

10. Police Reported Travel Speed ____ ____ ____
Code to the nearest kph (NOTE: 000 means less than 0.5 kph)
(160) 159.5 kph and above
(999) Unknown
____ ____ mph X 1.6093 = ____ ____ ____ kph

11. Police Reported Alcohol Presence ____
(0) No alcohol present
(1) Yes (alcohol present)
(7) Not reported
(8) No driver present
(9) Unknown

Note: See variables 37 through 55 (Page 4) for information on Other Drugs

12. Alcohol Test Result For Driver ____ ____
Code actual value (decimal implied before first digit—0.xx)
(95) Test refused
(96) None given
(97) AC test performed, results unknown
(98) No driver present
(99) Unknown

Source: _____

ACCIDENT RELATED

13. Speed Limit ____ ____ ____
(000) No statutory limit
Code posted or statutory speed limit in kph
(999) Unknown
____ ____ mph X 1.6093 = ____ ____ ____ kph

14. Attempted Avoidance Maneuver ____ ____
(00) No impact
(01) No avoidance actions
(02) Braking (no lockup)
(03) Braking (lockup)
(04) Braking (lockup unknown)
(05) Releasing brakes
(06) Steering left
(07) Steering right
(08) Braking and steering left
(09) Braking and steering right
(10) Accelerating
(11) Accelerating and steering left
(12) Accelerating and steering right
(97) No driver present
(98) Other action (specify):
_____
(99) Unknown

15. Accident Type ____ ____
Applicable codes may be found on the back of page two of this field form
(00) No impact
Code the number of the diagram that best describes the accident circumstance
(98) Other accident type (specify):
_____
(99) Unknown

****** SKIP TO VARIABLE GV37 IF GV07 DOES NOT EQUAL 01-49 ******

HS Form 435 (Rev. 1/93)

CODES FOR BODY TYPE

CDS APPLICABLE VEHICLES

Automobiles

(01) Convertible (excludes sun-roof, t-bar)
(02) 2-door sedan, hardtop, coupe
(03) 3-door/2-door hatchback
(04) 4-door sedan, hardtop
(05) 5-door/4-door hatchback
(06) Station wagon (excluding van and truck based)
(07) Hatchback, number of doors unknown
(08) Other automobile type (specify): _____
(09) Unknown automobile type

Automobile Derivatives

(10) Auto based pickup (includes El Camino, Caballero, Ranchero, Brat, and Rabbit pickup)
(11) Auto based panel (cargo station wagon, auto based ambulance/hearse)
(12) Large limousine - more than four side doors or stretched chassis
(13) Three-wheel automobile or automobile derivative

Utility Vehicles (≤ 4,500 kgs GVWR)

(14) Compact utility (Jeep CJ-2 - CJ-7, Scrambler, Golden Eagle, Renegade, Laredo, Wrangler, Cherokee (84 and after), Dispatcher, Raider, Bronco II, Bronco (76 and before), Explorer, S-10 Blazer, Geo Tracker, Bravada, S-15 Jimmy, Thing, Pathfinder, Trooper, Trooper II, Rodeo, Amigo, Navajo, 4-Runner, Montero, Samurai, Sidekick, Rocky)
(15) Large utility (includes Jeep Cherokee (83 and before), Ramcharger, Trailduster, Bronco-fullsize (78 and after), fullsize Blazer, fullsize Jimmy, Landcruiser, Rover, Scout)
(16) Utility station wagon (Chevy Suburban, GMC Suburban, Travelall, Grand Wagoneer, includes suburban limousine)
(19) Utility, unknown body type

Van Based Light Trucks (≤ 4,500 kgs GVWR)

(20) Minivan (Chrysler Town and Country, Caravan, Grand Caravan, Voyager, Grand Voyager, Mini-Ram, Dodge/Plymouth Vista, Aerostar, Villager, Lumina APV, Trans Sport, Silhouette, Astro, Safari, Toyota Van, Toyota Minivan, Previa, Nissan Minivan, Quest, Mitsubishi Minivan, Vanagon/Camper.)
(21) Large van (B150-B350, Sportsman, Royal, Maxiwagon, Ram, Tradesman, Voyager (83 and before), E150-E350, Econoline, Clubwagon, Chateau, G10-G30, Chevy Van, Beauville, Sport Van, G15-G35, Rally Van, Vandura.)
(22) Step van or walk-in van (≤ 4,500 kgs GVWR)
(23) Van based motorhome (≤ 4,500 kgs GVWR)
(24) Van based school bus (≤ 4,500 kgs GVWR)
(25) Van based other bus (≤ 4,500 kgs GVWR)
(28) Other van type (Hi-Cube Van, Kary) (specify): _____
(29) Unknown van type

Light Conventional Trucks (Pickup style cab, ≤ 4,500 kgs GVWR)

(30) Compact pickup (D50, Colt P/U, Ram 50, Dakota, Arrow Pickup (foreign), Ranger, Courier, S-10 , T-10, LUV, S-15, T-15, Sonoma, Datsun/Nissan Pickup, P'up, Mazda Pickup, Toyota Pickup, Mitsubishi Pickup)
(31) Large Pickup (Jeep Pickup, Comanche, Ram Pickup, D100-D350, W100-W350, F100-F350, C10-C35, K10-K35, R10-R35, V10-V35, Silverado, Sierra, R100-R500,)
(32) Pickup with slide-in camper
(33) Convertible pickup
(39) Unknown pickup style light conventional truck type

Other Light Trucks (≤ 4,500 kgs GVWR)

(40) Cab chassis based (includes rescue vehicles, light stake, dump, and tow truck)
(41) Truck based panel
(42) Light truck based motorhome (chassis mounted)
(48) Other light conventional truck type
(48) Unknown light truck type
(49) Unknown light vehicle type (automobile, utility, van, or light truck)

OTHER VEHICLES

Buses (Excludes Van Based)

(50) School bus (designed to carry students, not cross country or transit)
(58) Other bus type (e.g., transit, intercity, bus based motorhome) (specify): _____
(59) Unknown bus type

Medium/Heavy Trucks (> 4,500 kgs GVWR)

(60) Step van (> 4,500 kgs GVWR)
(61) Single unit straight truck (4,500 kgs < GVWR ≤ 8,860 kgs)
(62) Single unit straight truck (8,860 kgs < GVWR ≤ 12,000 kgs)
(63) Single unit straight truck (> 12,000 kgs GVWR)
(64) Single unit straight truck, GVWR unknown
(65) Medium/heavy truck based motorhome
(67) Truck-tractor with no cargo trailer
(68) Truck-tractor pulling one trailer
(69) Truck-tractor pulling two or more trailers
(70) Truck-tractor (unknown if pulling trailer)
(78) Unknown medium/heavy truck type
(79) Unknown truck type (light/medium/heavy)

Motored Cycles (Does Not Include All-Terrain Vehicles/Cycles)

(80) Motorcycle
(81) Moped (motorized bicycle)
(82) Three-wheel motorcycle or moped
(88) Other motored cycle (minibike, motorscooter) (specify): _____
(89) Unknown motored cycle type

Other Vehicles

(90) ATV (All-Terrain Vehicle) and ATC (All-Terrain Cycle)
(91) Snowmobile
(92) Farm equipment other than trucks
(93) Construction equipment other than trucks
(97) Other vehicle type
(99) Unknown body type

National Accident Sampling System-Crashworthiness Data System: General Vehicle Form — Page 2

OCCUPANT RELATED

16. Driver Presence in Vehicle ____
(0) Driver not present
(1) Driver present
(9) Unknown

17. Number of Occupants This Vehicle ____ ____
(00-96) Code actual number of occupants for this vehicle
(97) 97 or more
(99) Unknown

18. Number of Occupant Forms Submitted ____ ____

VEHICLE WEIGHT ITEMS

19. Vehicle Curb Weight ____,____ ____ 0
____Code weight to nearest 10 kilograms.
(045) Less than 450 kilograms
(616) 6,100 kilograms or more
(999) Unknown

____ ____,____ ____ ____ lbs X .4536 = ____,____ kgs

Source:_____

20. Vehicle Cargo Weight ____, ____ ____ 0
____Code weight to nearest 10 kilograms.
(000) Less than 5 kilograms
(450) 4,500 kilograms or more
(999) Unknown

____ ____,____ ____ ____ lbs X .4536 = ____,____ ____ ____ kgs

RECONSTRUCTION DATA

21. Towed Trailing Unit ____
(0) No towed unit
(1) Yes—towed trailing unit
(9) Unknown

32. Documentation of Trajectory Data for This Vehicle ____
(0) No
(1) Yes

23. Post Collision Condition of Tree or Pole (For Highest Delta V) ____
(0) Not collision (for highest delta V) with tree or pole
(1) Not damaged
(2) Cracked/sheared
(3) Tilted <45 degrees
(4) Tilted ≥45 degrees
(5) Uprooted tree
(6) Separated pole from base
(7) Pole replaced
(8) Other (specify):
_____
(9) Unknown

24. Rollover ____
(0) No rollover (no overturning)

Rollover (primarily about the longitudinal axis)
(1) Rollover, 1 quarter turn only
(2) Rollover, 2 quarter turns
(3) Rollover, 3 quarter turns
(4) Rollover, 4 or more quarter turns (specify):
_____

(5) Rollover--end-over-end (i.e., primarily about the lateral axis)
(9) Rollover (overturn), details unknown

OVERRIDE/UNDERRIDE (THIS VEHICLE)

25. Front Override/Underride (this Vehicle) ____

26. Rear Override/Underride (this Vehicle) ____

(0) No override/underride, or not an end-to-end impact

Override (see specific CDC)
(1) 1st CDC
(2) 2nd CDC
(3) Other not automated CDC (specify):
_____

Underride (see specific CDC)
(4) 1st CDC
(5) 2nd CDC
(6) Other not automated CDC (specify):
_____

(7) Medium/heavy truck or bus override
(9) Unknown

HEADING ANGLE AT IMPACT FOR HIGHEST DELTA V

Values: (000)-(359) Code actual value
(997) Noncollision
(998) Impact with object
(999) Unknown

27. Heading Angle For This Vehicle ____ ____ ____

28. Heading Angle For Other Vehicle ____ ____ ____

National Accident Sampling System-Crashworthiness Data System: General Vehicle Form Page 3

29. Basis for Total Delta V (highest) ____

Delta V Calculated
(1) CRASH program—damage only routine
(2) CRASH program—damage and trajectory routine
(3) Missing vehicle algorithm

Delta V Not Calculated
(4) At least one vehicle (which may be this vehicle) is beyond the scope of an acceptable reconstruction program, regardless of collision conditions.
(5) All vehicles within scope (CDC applicable) of CRASH program but one of the collision conditions is beyond the scope of the CRASH program or other acceptable reconstruction technique, regardless of adequacy of damage data.
(6) All vehicle and collision conditions are within scope of one of the acceptable reconstruction programs, but there is insufficient data available.

COMPUTER GENERATED DELTA V

	Secondary	Highest
30. Total Delta V	____	____
____ Nearest kph		

(NOTE: 000 means less than 0.5 kph)
(160) 159.5 kph and above
(999) Unknown

	Secondary	Highest
31. Longitudinal Component of Delta V (+ / −)	____	____
____ Nearest kph		

(NOTE: ___000 means greater than −0.5 kph and less than +0.5 kph)
(±160) ±159.5 kph and above
(___999) Unknown

	Secondary	Highest
32. Lateral Component of Delta V (+ / −)	____	____
____ Nearest kph		

(NOTE: ___000 means greater than −0.5 kph and less than +0.5 kph)
(±160) ±159.5 kph and above
(___999) Unknown

33. Energy Absorption ____ ____ ____, ___ 0 0

____ Nearest 100 joules ____

(NOTE: 0000 means less than 50 joules)
(9997) 999,650 joules or more
(9999) Unknown

34. Confidence In Reconstruction Program Results (For Highest Delta V) ____
(0) No reconstruction
(1) Collision fits model — results appear reasonable
(2) Collision fits model — results appear high
(3) Collision fits model — results appear low
(4) Borderline reconstruction — results appear reasonable

35. Type of Vehicle Inspection ____
(0) No inspection
(1) Complete inspection
(2) Partial inspection (specify):
____

36. Is this an AOPS Vehicle? ____
(0) No
(1) Yes - researcher determined
(2) VIN determined air bag system
(3) VIN determined automatic (passive) belts
(4) VIN determined air bag and automatic (passive) belts

IS OLDMISS APPLICABLE FOR THIS VEHICLE? [ ] YES [ ] NO

IF YES: IS A COMPLETED OLDMISS PROGRAM SUMMARY INCLUDED? [ ] YES [ ] NO

National Accident Sampling System-Crashworthiness Data System: General Vehicle Form Page 4

37. Police Reported Other Drug Presence ____
(0) No other drugs present
(1) Yes (other drug present)
(7) Not reported
(8) No driver present
(9) Unknown

38. Police Reported Drug Evaluation Classification (DEC) Test For Driver ____
(0) No DEC process available or given
(1) DEC process given, results known
(2) DEC process given, results unknown
(3) DEC process available, unknown if given
(8) No driver present

39. Other Drug Specimen Test Type For Driver ____
(0) No specimen test given
(1) Blood test
(2) Urine test
(3) Other specimen tests (specify):
_____
(7) Unspecified specimen test
(8) No driver present
(9) Unknown if specimen test given

DRUG EVALUATION CLASSIFICATION
OTHER DRUGS TEST RESULTS FOR DRIVER

	DEC Test Results	Specimen Test Results
Narcotic Drug	40. ____	41. ____
Depressant Drug	42. ____	43. ____
Stimulant Drug	44. ____	45. ____
Hallucinogen Drug	46. ____	47. ____
Cannabinoid Drug	48. ____	49. ____
Phencyclidine (PCP)	50. ____	51. ____
Inhalant Drug	52. ____	53. ____
Other Drug (Excluding Nicotine, Aspirin, Alcohol, Drugs Administered Post-Crash)	54. ____	55. ____

Codes For DEC Test Results

(0) No DEC test given
(1) Passed DEC test
(2) Failed DEC test
(3) DEC test given—results unknown
(8) No driver present
(9) Unknown if DEC test given

Codes for Specimen Test Results

(0) No specimen test given
(1) Drug not found in specimen
(2) Drug found in specimen
(7) Specimen test given, results unknown or not obtained
(8) No driver present
(9) Unknown if specimen test given

National Accident Sampling System-Crashworthiness Data System: General Vehicle Form Page 5

OTHER DATA

56. Driver's Zip Code _____

(00000) Driver not present
(00001) Driver not a resident of U.S. or territories
_____ Code actual 5-digit zip code
(99999) Unknown

57. Driver's Race/Ethnic Origin _____
(0) Driver not present
(1) White (non-Hispanic)
(2) Black (non-Hispanic)
(3) White (Hispanic)
(4) Black (Hispanic)
(5) American Indian, Eskimo or Aleut
(6) Asian or Pacific Islander
(8) Other (specify):
_____
(9) Unknown

58. Vehicle Special Use (This Trip) _____
(0) No special use
(1) Taxi
(2) Vehicle used as school bus
(3) Vehicle used as other bus
(4) Military
(5) Police
(6) Ambulance
(7) Fire truck or car
(8) Other (specify): _____
(9) Unknown

ROLLOVER DATA

If GV07 (Body Type) ≠ 1-49, leave GV59-GV63 blank.
If GV24 (Rollover) = 0, then GV59-GV62 must equal 0.
If GV24 = 9, then GV59-GV63 must equal 9.

59. Rollover Initiation Type _____
(0) No rollover
(1) Trip-over
(2) Flip-over
(3) Turn-over
(4) Climb-over
(5) Fall-over
(6) Bounce-over
(7) Collision with another vehicle
(8) Other rollover initiation type specify):
_____
(9) Unknown rollover initiation type

60. Location of Rollover Initiation _____

(0) No rollover
(1) On roadway
(2) On shoulder—paved
(3) On shoulder—unpaved
(4) On roadside or divided trafficway median
(9) Unknown

61. Rollover Initiation Object Contacted _____ _____

62. Location on Vehicle Where Initial Principal Tripping Force Is Applied _____

(0) No rollover
(1) Wheels/tires
(2) Side plane
(3) End plane
(4) Undercarriage
(5) Other location on vehicle (specify):
_____
(8) Non-contact rollover forces (specify):
_____
(9) Unknown

63. Direction of Initial Roll _____

(0) No rollover
(1) Roll right - primarily about the longitudinal axis
(2) Roll left - primarily about the longitudinal axis

(5) End-over-end (i.e., primarily about the lateral axis)
(9) Unknown roll direction

PRECRASH DATA

64. Pre-Event Movement (Prior to Recognition of Critical Event) _____ _____

(01) Going straight
(02) Slowing or stopping in traffic lane
(03) Starting in traffic lane
(04) Stopped in traffic lane
(05) Passing or overtaking another vehicle
(06) Disabled or parked in travel lane
(07) Leaving a parking position
(08) Entering a parking position
(09) Turning right
(10) Turning left
(11) Making a U-turn
(12) Backing up (other than for parking position)
(13) Negotiating a curve
(14) Changing lanes
(15) Merging
(16) Successful avoidance maneuver to a previous critical event
(97) Other (specify):
_____
(98) No driver present
(99) Unknown

CODES FOR ROLLOVER INITIATION OBJECT CONTACTED

(00) No rollover
(01-30) — Vehicle Number

Noncollision
(31) Turn-over — fall-over
(33) Jackknife

Collision With Fixed Object
(41) Tree (≤ 10 cm in diameter)
(42) Tree (> 10 cm in diameter)
(43) Shrubbery or bush
(44) Embankment

(45) Breakaway pole or post (any diameter)

Nonbreakaway Pole or Post
(50) Pole or post (≤ 10 cm in diameter)
(51) Pole or post (> 10 cm but ≤ 30 cm in diameter)
(52) Pole or post (> 30 cm in diameter)
(53) Pole or post (diameter unknown)

(54) Concrete traffic barrier
(55) Impact attenuator
(56) Other traffic barrier (includes guardrail) (specify):_____

(57) Fence
(58) Wall
(59) Building
(60) Ditch or culvert
(61) Ground
(62) Fire hydrant
(63) Curb
(64) Bridge
(68) Other fixed object (specify):

_____

(69) Unknown fixed object

Collision with Nonfixed Object
(71) Motor vehicle not in-transport
(76) Animal
(77) Train
(78) Trailer, disconnected in transport
(88) Other nonfixed object (specify):

_____

(89) Unknown nonfixed object

(88) Other event (specify):

_____

(89) Unknown event or object

National Accident Sampling System-Crashworthiness Data System: General Vehicle Form Page 6

PRECRASH DATA (Continued)

65. Critical Precrash Event ____ ____

This Vehicle Loss of Control Due To:
(01) Blow out or flat tire
(02) Stalled engine
(03) Disabling vehicle failure (e.g., wheel fell off) (specify): _____
(04) Non-disabling vehicle problem (e.g., hood flew up) (specify): _____
(05) Poor road conditions (puddle, pot hole, ice, etc.) (specify): _____
(06) Traveling too fast for conditions
(08) Other cause of control loss (specify): _____
(09) Unknown cause of control loss

This Vehicle Traveling
(10) Over the lane line on left side of travel lane
(11) Over the lane line on right side of travel lane
(12) Off the edge of the road on the left side
(13) Off the edge of the road on the right side
(14) End departure
(15) Turning left at intersection
(16) Turning right at intersection
(17) Crossing over (passing through) intersection
(19) Unknown travel direction

Other Motor Vehicle in Lane
(50) Stopped
(51) Traveling in same direction with lower speed (i.e., lower steady speed or decelerating)
(52) Traveling in same direction with higher speed
(53) Traveling in opposite direction
(54) In crossover
(55) Backing
(59) Unknown travel direction of other motor vehicle in lane

Other Motor Vehicle Encroaching into Lane
(60) From adjacent lane (same direction)—over left lane line
(61) From adjacent lane (same direction)—over right lane line
(62) From opposite direction—over left lane line
(63) From opposite direction—over right lane line
(64) From parking lane
(65) From crossing street, turning into same direction
(66) From crossing street, across path
(67) From crossing street, turning into opposite direction
(68) From crossing street, intended path not known
(70) From driveway, turning into same direction
(71) From driveway, across path
(72) From driveway, turning into opposite direction
(73) From driveway, intended path not known
(74) From entrance to limited access highway
(78) Encroachment by other vehicle—details unknown

Pedestrian or Pedalcyclist, or Other Nonmotorist
(80) Pedestrian in roadway
(81) Pedestrian approaching roadway
(82) Pedestrian - unknown location
(83) Pedalcyclist or other nonmotorist in roadway (specify): _____
(84) Pedalcyclist or other nonmotorist approaching roadway (specify): _____
(85) Pedalcyclist or other nonmotorist—unknown location (specify): _____

Object or Animal
(87) Animal in roadway
(88) Animal approaching roadway
(89) Animal—unknown location
(90) Object in roadway
(91) Object approaching roadway
(92) Object—unknown location

(98) Other critical precrash event (specify): _____
(99) Unknown

For Corrective Actions Attempted see variable GV14 (Attemped Avoidance Maneuver)

66 Precrash Stability After Avoidance Maneuver ____
(0) No avoidance maneuver
(1) Tracking
(2) Skidding longitudinally—rotation less than 30 degrees
(3) Skidding laterally—clockwise rotation
(4) Skidding laterally—counterclockwise rotation
(7) Other vehicle loss-of-control (specify): _____
(8) No driver present
(9) Precrash stability unknown

67. Precrash Directional Consequences of Avoidance Maneuver (Corrective Action) ____
(0) No avoidance maneuver
(1) Vehicle stayed in travel lane where avoidance maneuver was initiated
(2) Vehicle stayed on roadway but left travel lane where avoidance maneuver was initiated
(3) Vehicle stayed on roadway, not known if left travel lane where avoidance maneuver was initiated
(4) Vehicle departed roadway
(5) Avoidance maneuver initiated off roadway
(8) No driver present
(9) Directional consequences unknown

*** IF THE CDS APPLICABLE VEHICLE WAS NOT INSPECTED (I.E., GV35 = 0), ***
DO NOT COMPLETE THE EXTERIOR AND INTERIOR VEHICLE FORMS.

*** IF GV07 DOES NOT EQUAL 01-49, DO NOT COMPLETE ***
THE EXTERIOR VEHICLE, INTERIOR VEHICLE,
OCCUPANT ASSESSMENT, AND OCCUPANT INJURY FORMS.

U.S. Department of Transportation
National Highway Traffic Safety Administration

EXTERIOR VEHICLE FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

1. Primary Sampling Unit Number _____
2. Case Number - Stratum _____
3. Vehicle Number _____

VEHICLE IDENTIFICATION

VIN _____ Model Year _____

Vehicle Make (specify): _____ Vehicle Model (specify): _____

LOCATOR

Locate the end of the damage with respect to the vehicle longitudinal center line or bumper corner for end impacts or an undamaged axle for side impacts.

Specific Impact No.	Location of Direct Damage	Location of Field L

CRUSH PROFILE IN CENTIMETERS

NOTES: Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, etc.) and label adjustments (e.g., free space).

Measure and document on the vehicle diagram the location of maximum crush.

Measure C1 to C6 from driver to passenger side in front or rear impacts and rear to front in side impacts.

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

Use as many lines/columns as necessary to describe each damage profile.

Specific Impact Number	Plane of Impact C-Measurements	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	±D
		Width (CDC)	Max Crush								

HS Form 439A (Rev. 1/93)

ORIGINAL SPECIFICATIONS WORK SHEET

Wheelbase	____ ____ ____.____	inches	x	2.54	=	____ ____ ____	cm
Overall Length	____ ____ ____.____	inches	x	2.54	=	____ ____ ____	cm
Maximum Width	____ ____ ____.____	inches	x	2.54	=	____ ____ ____	cm
Curb Weight	____ ____,____ ____ ____	pounds	x	.4536	=	____,____ ____ ____	kg
Average Track	____ ____ ____.____	inches	x	2.54	=	____ ____ ____	cm
Front Overhang	____ ____ ____.____	inches	x	2.54	=	____ ____ ____	cm
Rear Overhang	____ ____ ____.____	inches	x	2.54	=	____ ____ ____	cm
Undeformed End Width	____ ____ ____.____	inches	x	2.54	=	____ ____ ____	cm
Engine Size: cyl./displ.	____ ____ ____ ____	cc	x	.001	=	____.____	L
	____ ____ ____	CID	x	.0164	=	____.____	L

National Accident Sampling System-Crashworthiness Data System: Exterior Vehicle Form Page 2

VEHICLE DAMAGE SKETCH

TIRE—WHEEL DAMAGE

a. Rotation physically restricted

RF ____
LF ____
RR ____
LR ____

b. Tire deflated

RF ____
LF ____
RR ____
LR ____

(1) Yes (2) No (8) NA (9) Unk.

TYPE OF TRANSMISSION

☐ Manual ☐ Automatic

ORIGINAL SPECIFICATIONS

Wheelbase	____	cm
Overall Length	____	cm
Maximum Width	____	cm
Curb Weight	____	kg
Average Track	____	cm
Front Overhang	____	cm
Rear Overhang	____	cm
Undeformed End Width	____	cm
Engine Size: cyl./displ.	____	L

WHEEL STEER ANGLES
(For locked front wheels or displaced rear axles only)

RF ± ____ ____ °
LF ± ____ ____ °
RR ± ____ ____ °
LR ± ____ ____ °

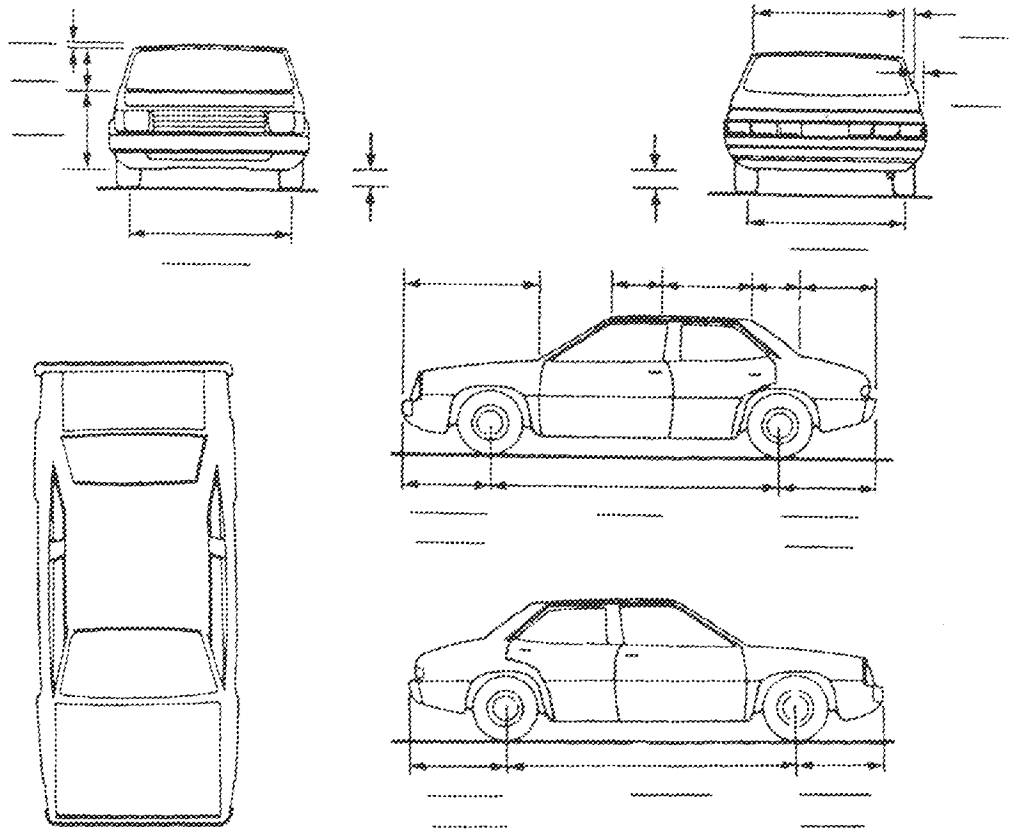
Within ± 5 degrees

DRIVE WHEELS

☐ FWD ☐ RWD ☐ 4WD

Approximate Cargo Weight ____ kg

MEASUREMENTS IN CENTIMETERS



NOTES: Sketch new perimeter and cross hatch direct damage and single hatch induced damage on all views. Annotate observations which might be useful in reconstructing the accident (e.g., grass in tire bead, direction of striations, scuff on sidewalls, etc.). If pulling trailer, sketch type of trailer and damage received on the back of this page.

Annotate any damage caused by extrication such as components removed by torching, prying, or hydraulic shears.

National Accident Sampling System-Crashworthiness Data System: Exterior Vehicle Form — Page 3

CDC WORKSHEET

CODES FOR OBJECT CONTACTED

(01-30) — Vehicle Number

Noncollision
- (31) Overturn — rollover
- (32) Fire or explosion
- (33) Jackknife
- (34) Other intraunit damage (specify): _____
- (35) Noncollision injury
- (38) Other noncollision (specify): _____
- (39) Noncollision — details unknown

Collision With Fixed Object
- (41) Tree (≤ 10 cm in diameter)
- (42) Tree (> 10 cm in diameter)
- (43) Shrubbery or bush
- (44) Embankment
- (45) Breakaway pole or post (any diameter)

Nonbreakaway Pole or Post
- (50) Pole or post (≤ 10 cm in diameter)
- (51) Pole or post (> 10 cm but ≤ 30 cm in diameter)
- (52) Pole or post (> 30 cm in diameter)
- (53) Pole or post (diameter unknown)
- (54) Concrete traffic barrier
- (55) Impact attenuator
- (56) Other traffic barrier (includes guardrail) (specify): _____
- (57) Fence
- (58) Wall
- (59) Building
- (60) Ditch or culvert
- (61) Ground
- (62) Fire hydrant
- (63) Curb
- (64) Bridge
- (66) Other fixed object (specify): _____
- (69) Unknown fixed object

Collision with Nonfixed Object
- (71) Motor vehicle not in-transport
- (72) Pedestrian
- (73) Cyclist or cycle
- (74) Other nonmotorist or conveyance _____
- (75) Vehicle occupant
- (76) Animal
- (77) Train
- (78) Trailer, disconnected in transport
- (88) Other nonfixed object (specify): _____
- (89) Unknown nonfixed object
- (98) Other event (specify): _____
- (99) Unknown event or object

DEFORMATION CLASSIFICATION BY EVENT NUMBER

Accident Event Sequence Number	Object Contacted	(1) (2) Direction of Force (degrees)	Incremental Value of Shift	(3) Deformation Location	(4) Specific Longitudinal or Lateral Location	(5) Specific Vertical or Lateral Location	(6) Type of Damage Distribution	(7) Deformation Extent

National Accident Sampling System-Crashworthiness Data System: Exterior Vehicle Form — Page 4

COLLISION DEFORMATION CLASSIFICATION

HIGHEST DELTA "V"

Accident Event Sequence Number	Object Contacted	(1) (2) Direction of Force	(3) Deformation Location	(4) Longitudinal or Lateral Location	(5) Vertical or Lateral Location	(6) Type of Damage Distribution	(7) Deformation Extent
4.	5.	6.	7.	8.	9.	10.	11.

Second Highest Delta "V"

12.	13.	14.	15.	16.	17.	18.	19.

CRUSH PROFILE IN CENTIMETERS

The crush profile for the damage described in the CDC(s) above should be documented in the appropriate space below. (ALL MEASUREMENTS ARE IN CENTIMETERS.)

HIGHEST DELTA "V"

20. L	21. C_1	C_2	C_3	C_4	C_5	C_6	22. ±D
							+ / -

Second Highest Delta "V"

23. L	24. C_1	C_2	C_3	C_4	C_5	C_6	25. ±D
							+ / -

26. Are CDCs Documented but Not Coded on The Automated File?
(0) No
(1) Yes

27. Researcher's Assessment of Vehicle Disposition
(0) Not towed due to vehicle damage
(1) Towed due to vehicle damage
(8) Unknown

28. Original Wheelbase
Code to the nearest centimeter
(999) Unknown

. inches X 2.54 = centimeters

National Accident Sampling System-Crashworthiness Data System: Exterior Vehicle Form — Page 5

29. Is This A Multi-Stage Manufactured Vehicle And/Or A Certified Altered Vehicle? ____
(0) No post manufacturer modifications
(1) Yes - post manufacturer modifications (specify): _____
_____
_____
(Include photograph of CERTIFICATION PLACARD in case report)
(9) Unknown if vehicle is modified

30. Fire Occurrence ____
(0) No fire

Yes, fire occurred
(1) Minor
(2) Major
(9) Unknown

31. Origin of Fire ____
(0) No fire
(1) Vehicle exterior (front, side, back, top)
(2) Exhaust system
(3) Fuel tank (and other fuel retention system parts)
(4) Engine compartment
(5) Cargo/trunk compartment
(6) Instrument panel
(7) Passenger compartment area
(8) Other location (specify): _____
(9) Unknown

32. Type of Fuel Tank ____
(0) No fuel tank (electrical vehicle)
(1) Metallic
(2) Non-metallic
(9) Unknown

*** STOP: IF THE CDS APPLICABLE VEHICLE WAS NOT TOWED AND WAS NOT AN AOPS *** (I.E., GV09 = 0 OR 9 AND GV36 = 0), DO NOT COMPLETE THE INTERIOR VEHICLE FORM.

U.S. Department of Transportation
National Highway Traffic Safety Administration

INTERIOR VEHICLE FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

1. Primary Sampling Unit Number _____ _____

2. Case Number - Stratum _____ _____ _____ _____

3. Vehicle Number _____ _____

INTEGRITY

4. Passenger Compartment Integrity _____ _____
(00) No integrity loss

Yes, Integrity Was Lost Through
(01) Windshield
(02) Door (side)
(03) Door/hatch (back door)
(04) Roof
(05) Roof glass
(06) Side window
(07) Rear window (backlight)
(08) Roof and roof glass
(09) Windshield and door (side)
(10) Windshield and roof
(11) Side and rear window (side window and backlight)
(12) Windshield and side window
(13) Door and side window
(98) Other combination of above (specify):
_____
(99) Unknown

Door, Tailgate or Hatch Opening

5. LF____ 6. RF____ 7. LR____ 8. RR____ 9. TG/H____

(0) No door/gate/hatch
(1) Door/gate/hatch remained closed and operational
(2) Door/gate/hatch came open during collision
(3) Door/gate/hatch jammed shut
(8) Other (specify):
_____
(9) Unknown

Damage/Failure Associated with Door, Tailgate or Hatch Opening in Collision. If IV05-IV09 ≠ 2, Then code Ø

10. LF____ 11. RF____ 12. LR____ 13. RR____ 14. TG/H____

(0) No door/gate/hatch or door not opened

Door, Tailgate or Hatch Came Open During Collision
(1) Door operational (no damage)
(2) Latch/striker failure due to damage
(3) Hinge failure due to damage
(4) Door structure failure due to damage
(5) Door support (i.e., pillar, sill, roof side rail, etc.) failure due to damage
(6) Latch/striker and hinge failure due to damage
(8) Other failure (specify):
_____
(9) Unknown

GLAZING

Glazing Damage from Impact Forces

15. WS___ 16. LF___ 17. RF___ 18. LR___ 19. RR___

20. BL___ 21. Roof___ 22. Other___

(0) No glazing damage from impact forces
(2) Glazing in place and cracked from impact forces
(3) Glazing in place and holed from impact forces
(4) Glazing out-of-place (cracked or not) and not holed from impact forces
(5) Glazing out-of-place and holed from impact forces
(6) Glazing disintegrated from impact forces
(7) Glazing removed prior to accident
(8) No glazing
(9) Unknown if damaged

Glazing Damage from Occupant Contact

23. WS___ 24. LF___ 25. RF___ 26. LR___ 27. RR___

28. BL___ 29. Roof___ 30. Other___

(0) No occupant contact to glazing or no glazing
(1) Glazing contacted by occupant but no glazing damage
(2) Glazing in place and cracked by occupant contact
(3) Glazing in place and holed by occupant contact
(4) Glazing out-of-place (cracked or not) by occupant contact and not holed by occupant contact
(5) Glazing out-of-place by occupant contact and holed by occupant contact
(6) Glazing disintegrated by occupant contact
(9) Unknown if contacted by occupant

If No Glazing Damage *And* No Occupant Contact or No Glazing, Then Code IV31 Through IV46 As Ø

Type of Window/Windshield Glazing

31. WS___ 32. LF___ 33. RF___ 34. LR___ 35. RR___

36. BL___ 37. Roof___ 38. Other___

(0) No glazing contact and no damage, or no glazing
(1) AS-1 -- Laminated
(2) AS-2 -- Tempered
(3) AS-3 -- Tempered-tinted
(4) AS-14 -- Glass/Plastic
(8) Other (specify):
_____
(9) Unknown

Window Precrash Glazing Status

39. WS___ 40. LF___ 41. RF___ 42. LR___ 43. RR___

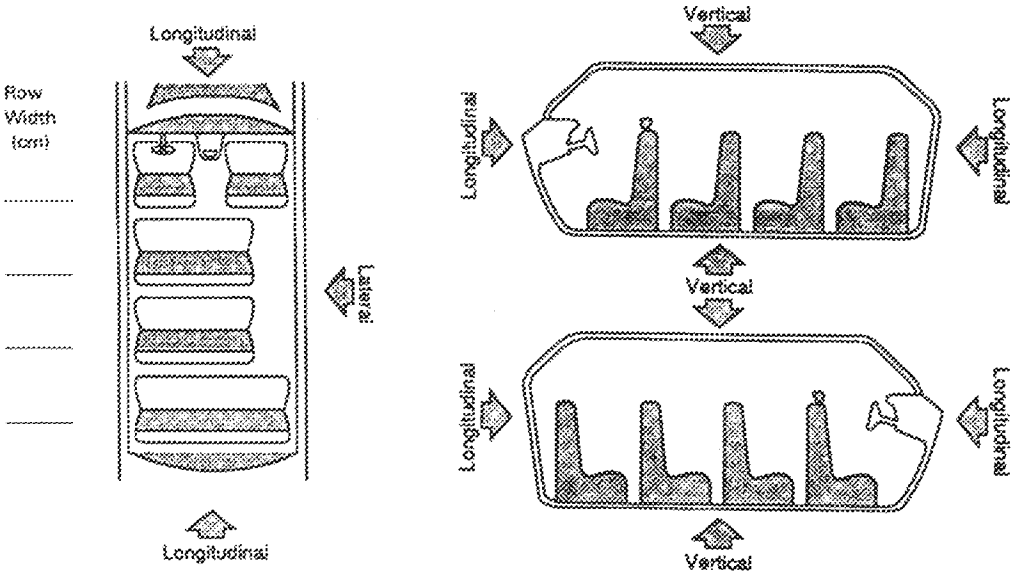
44. BL___ 45. Roof___ 46. Other___

(0) No glazing contact and no damage, or no glazing
(1) Fixed
(2) Closed
(3) Partially opened
(4) Fully opened
(9) Unknown

HS Form 435C (Rev. 1/93)

INTRUSION WORKSHEET

Note: Sketch intruded areas



(All Measurements Are In Centimeters)

LOCATION OF INTRUSION	INTRUDED COMPONENT	COMPARISON VALUE	—	INTRUDED VALUE	=	INTRUSION	DOMINANT CRUSH DIRECTION
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		
			—		=		

Document no more than the 15 most severe intrusions

National Accident Sampling System-Crashworthiness Data System: Interior Vehicle Form **Page 2**

OCCUPANT AREA INTRUSION

Note: If no intrusions, leave variables IV47-IV86 blank.

	Location of Intrusion	Intruding Component	Magnitude of Intrusion	Dominant Crush Direction
1st	47.____	48.____	49.____	50.____
2nd	51.____	52.____	53.____	54.____
3rd	55.____	56.____	57.____	58.____
4th	59.____	60.____	61.____	62.____
5th	63.____	64.____	65.____	66.____
6th	67.____	68.____	69.____	70.____
7th	71.____	72.____	73.____	74.____
8th	75.____	76.____	77.____	78.____
9th	79.____	80.____	81.____	82.____
10th	83.____	84.____	85.____	86.____

LOCATION OF INTRUSION

Front Seat
- (11) Left
- (12) Middle
- (13) Right

Second Seat
- (21) Left
- (22) Middle
- (23) Right

Third Seat
- (31) Left
- (32) Middle
- (33) Right

Fourth Seat
- (41) Left
- (42) Middle
- (43) Right

- (97) Catastrophic
- (98) Other enclosed area (specify) _____
- (99) Unknown

INTRUDING COMPONENT

Interior Components
- (01) Steering assembly
- (02) Instrument panel left
- (03) Instrument panel center
- (04) Instrument panel right
- (05) Toe pan
- (06) A (A1/A2)-pillar
- (07) B-pillar
- (08) C-pillar
- (09) D-pillar
- (10) Door panel (side)
- (12) Roof (or convertible top)
- (13) Roof side rail
- (14) Windshield
- (15) Windshield header
- (16) Window frame
- (17) Floor pan (includes sill)
- (18) Backlight header
- (19) Front seat back
- (20) Second seat back
- (21) Third seat back
- (22) Fourth seat back
- (23) Fifth seat back
- (24) Seat cushion
- (25) Back door/panel (e.g., tailgate)
- (26) Other interior component (specify): _____
- (27) Side panel - forward of the A (A2)-pillar
- (28) Side panel - rear of the A (A2)-pillar

Exterior Components
- (30) Hood
- (31) Outside surface of this vehicle (specify): _____
- (32) Other exterior object in the environment (specify): _____
- (33) Unknown exterior object
- (97) Catastrophic
- (98) Intrusion of unlisted component(s) (specify): _____
- (99) Unknown

MAGNITUDE OF INTRUSION
- (1) ≥ 3 centimeters but < 8 centimeters
- (2) ≥ 8 centimeters but < 15 centimeters
- (3) ≥ 15 centimeters but < 30 centimeters
- (4) ≥ 30 centimeters but < 46 centimeters
- (5) ≥ 46 centimeters but < 61 centimeters
- (6) ≥ 61 centimeters
- (7) Catastrophic
- (9) Unknown

DOMINANT CRUSH DIRECTION
- (1) Vertical
- (2) Longitudinal
- (3) Lateral
- (7) Catastrophic
- (9) Unknown

STEERING RIM/SPOKE DEFORMATION

(All Measurements Are In Centimeters)

COMPARISON VALUE	—	DAMAGE VALUE	=	DEFORMATION
	—		=	
	—		=	
	—		=	
	—		=	

National Accident Sampling System-Crashworthiness Data System: Interior Vehicle Form **Page 3**

STEERING COLUMN

87. Steering Column Type .....
(1) Fixed column
(2) Tilt column
(3) Telescoping column
(4) Tilt and telescoping column
(8) Other column type (specify):
_____
(9) Unknown

88. Blank X X
(This variable is left blank so that numbering consistency can be maintained with the 1988-93 CDS.

89. Blank X X X
(This variable is left blank so that numbering consistency can be maintained with the 1988-93 CDS.

90. Blank X X X
(This variable is left blank so that numbering consistency can be maintained with the 1988-93 CDS.

91. Blank X X X
(This variable is left blank so that numbering consistency can be maintained with the 1988-93 CDS.

92. Steering Rim/Spoke Deformation ____ ____
_____Code actual measured deformation to the nearest centimeter
(00) No steering rim deformation
(01-14) Actual measured value in centimeters
(15) 15 centimeters or more
(98) Observed deformation cannot be measured
(99) Unknown

93. Location of Steering Rim/Spoke Deformation ____ ____
(00) No steering rim deformation

Quarter Sections
(01) Section A
(02) Section B
(03) Section C
(04) Section D

Half Sections
(05) Upper half of rim/spoke
(06) Lower half of rim/spoke
(07) Left half of rim/spoke
(08) Right half of rim/spoke

(09) Complete steering wheel collapse
(10) Undetermined location
(99) Unknown

INSTRUMENT PANEL

94. Odometer Reading ____ ____ ____,000
_____kilometers—Code to the nearest 1,000 kilometers
(000) No odometer
(001) Less than 1,500 kilometers
(500) 499,500 kilometers or more
(999) Unknown

___ ___ ___, ___ ___ ___ miles X 1.6093 = ___ ___ ___, ___ ___ ___ kilometers

Source:_____

95. Instrument Panel Damage from Occupant Contact? ____
(0) No
(1) Yes
(9) Unknown

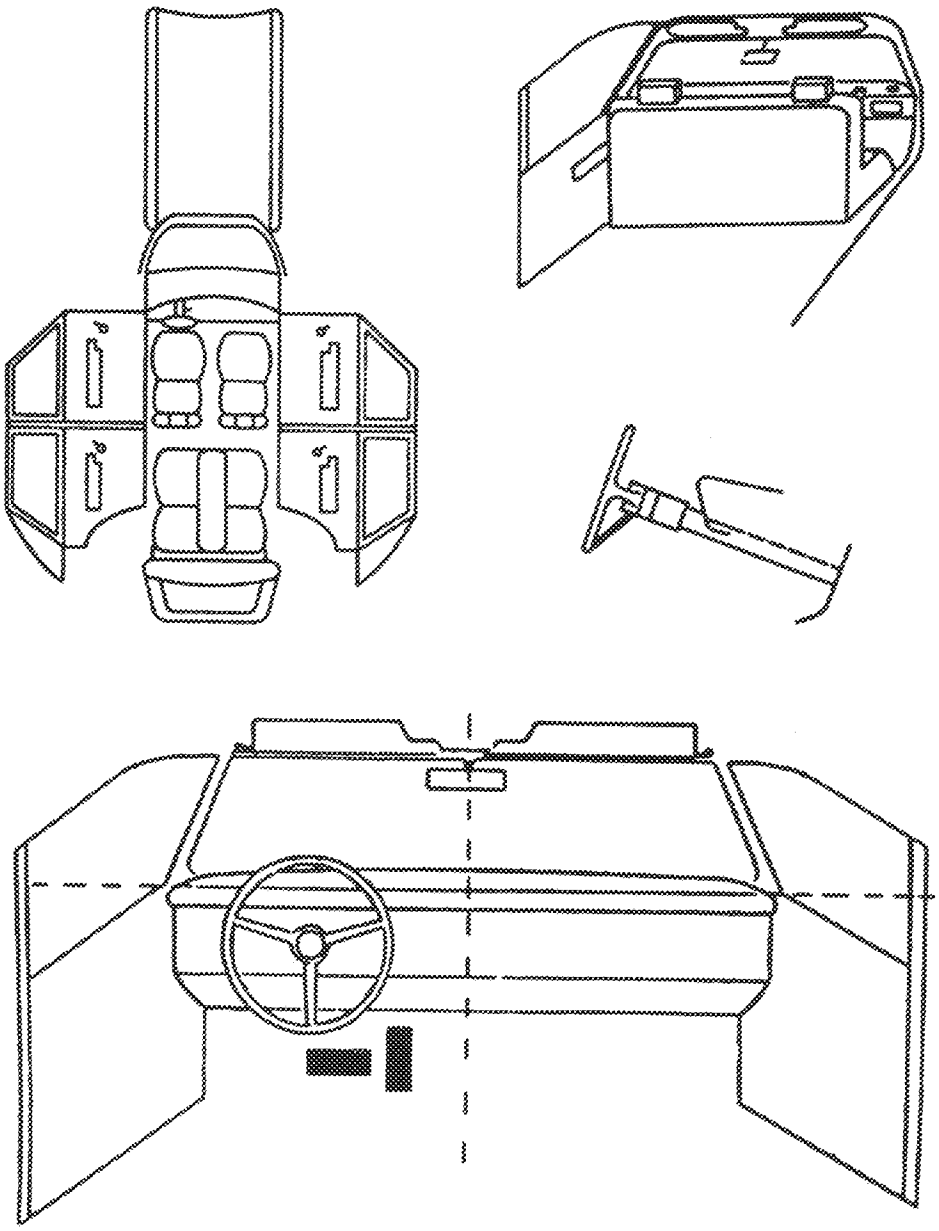
96. Knee Bolsters Deformed from Occupant Contact? .....
(0) No
(1) Yes
(8) Not present
(9) Unknown

97. Did Glove Compartment Door Open During Collision(s)? ____
(0) No
(1) Yes
(8) Not present
(9) Unknown

National Accident Sampling System-Crashworthiness Data System: Interior Vehicle Form Page 4

VEHICLE INTERIOR SKETCHES

Note area of ejection/entrapment



Sketch windshield contact(s) and the damaged area(s) on the instrument panel outline (e.g., radio, glove compartment, damage to instrument panel structure.
Cross hatch contact points, draw spider webs or use other annotation as may be appropriate.
Annotate the contacted area with a letter (begin with A) and list on the Points of Occupant Contact page.

National Accident Sampling System-Crashworthiness Data System: Interior Vehicle Form **Page 5**

POINTS OF OCCUPANT CONTACT

Contact	Interior Component Contacted	Occupant No. If Known	Body Region If Known	Supporting Physical Evidence	Confidence Level of Contact Point
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					

CODES FOR INTERIOR COMPONENTS

FRONT
- (01) Windshield
- (02) Mirror
- (03) Sunvisor
- (04) Steering wheel rim
- (05) Steering wheel hub/spoke
- (06) Steering wheel (combination of codes 04 and 05)
- (07) Steering column, transmission selector lever, other attachment
- (08) Add on equipment (e.g., CB, tape deck, air conditioner)
- (09) Left instrument panel and below
- (10) Center instrument panel and below
- (11) Right instrument panel and below
- (12) Glove compartment door
- (13) Knee bolster
- (14) Windshield including one or more of the following: front header, A (A1/A2)-pillar, instrument panel, mirror, or steering assembly (driver side only)
- (15) Windshield including one or more of the following: front header, A (A1/A2)-pillar, instrument panel, or mirror (passenger side only)
- (16) Driver side air bag compartment cover
- (17) Passenger side air bag compartment cover
- (18) Windshield reinforced by exterior object (specify):_____
- (19) Other front object (specify):

LEFT SIDE
- (20) Left side interior surface, excluding hardware or armrests
- (21) Left side hardware or armrest
- (22) Left A (A1/A2)-pillar
- (23) Left B-pillar
- (24) Other left pillar (specify):
- (25) Left side window glass or frame
- (26) Left side window glass including one or more of the following: frame, window sill, A (A1/A2)-pillar, B-pillar, or roof side rail.
- (27) Other left side object (specify):
- (28) Left side window sill

RIGHT SIDE
- (30) Right side interior surface, excluding hardware or armrests
- (31) Right side hardware or armrest
- (32) Right A (A1/A2)-pillar
- (33) Right B-pillar
- (34) Other right pillar (specify):
- (35) Right side window glass or frame
- (36) Right side window glass including one or more of the following: frame, window sill, A (A1/A2)-pillar, B pillar, or roof side rail.
- (37) Other right side object (specify):
- (38) Right side window sill

INTERIOR
- (40) Seat, back support
- (41) Belt restraint webbing/buckle
- (42) Belt restraint B-pillar attachment point
- (43) Other restraint system component (specify):_____
- (44) Head restraint system
- (45) Air bag (use codes "16" and "17" for injuries sustained from air bag compartment covers)
- (46) Other occupants (specify):
- (47) Interior loose objects
- (48) Child safety seat (specify):
- (49) Other interior object (specify):

ROOF
- (60) Front header
- (61) Rear header
- (62) Roof left side rail
- (63) Roof right side rail
- (64) Roof or convertible top

FLOOR
- (68) Floor (including toe pan)
- (67) Floor or console mounted transmission lever, including console
- (68) Parking brake handle
- (69) Foot controls including parking brake

REAR
- (80) Backlight (rear window)
- (81) Backlight storage rack, door, etc.
- (82) Other rear object (specify):

CONFIDENCE LEVEL OF CONTACT POINT
- (1) Certain
- (2) Probable
- (3) Possible
- (9) Unknown

AUTOMATIC RESTRAINTS

NOTES: Encode the data for each applicable front seat position. The attribute for the variables may be found below. Restraint systems should be assessed during the vehicle inspection then coded on the Occupant Assessment Form.

AIR BAGS

		Left	Right
FIRSTY	Availability/Function		
	Deployment		
	Failure		

Air Bag System Availability/Function
- (0) Not equipped/not available
- (1) Air bag

Non-functional
- (2) Air bag disconnected (specify): _____
- (3) Air bag not reinstalled
- (9) Unknown

Air Bag System Deployment
- (0) Not equipped/not available
- (1) Air bag deployed during accident (as a result of impact)
- (2) Air bag deployed inadvertently just prior to accident
- (3) Air bag deployed, accident sequence undetermined
- (4) Nondeployed
- (8) Unknown if deployed
- (8) Air bag deployed as a result of a nonCollision event during accident sequence (e.g., fire, explosion, electrical)
- (9) Unknown

Did Air Bag System Fail?
- (0) Not equipped/not available
- (1) No
- (2) Yes (specify): _____
- (9) Unknown

AUTOMATIC BELTS

		Left	Right
FIRSTY	Availability/Function		
	Use		
	Type		
	Proper Use		
	Failure Modes		

Automatic (Passive) Belt System Availability/Function
- (0) Not equipped/not available
- (1) 2 point automatic belts
- (2) 3 point automatic belts
- (3) Automatic belts - type unknown

Non-functional
- (4) Automatic belts destroyed or rendered inoperative
- (9) Unknown

Automatic (Passive) Belt System Use
- (0) Not equipped/not available/destroyed or rendered inoperative
- (1) Automatic belt in use
- (2) Automatic belt not in use (manually disconnected, motorized track inoperative)
- (3) Automatic belt use unknown
- (9) Unknown

Automatic (Passive) Belt System Type
- (0) Not equipped/not available
- (1) Non-motorized system
- (2) Motorized system
- (9) Unknown

Proper Use of Automatic (Passive) Belt System
- (0) Not equipped/not available/not used
- (1) Automatic belt used properly
- (2) Automatic belt used properly with child safety seat

Automatic Belt Used Improperly
- (3) Automatic shoulder belt worn under arm
- (4) Automatic shoulder belt worn behind back
- (5) Automatic belt worn around more than one person
- (6) Lap portion of automatic belt worn on abdomen
- (7) Automatic lap and shoulder belt or automatic shoulder belt used improperly with child safety seat (specify): _____
- (8) Other improper use of automatic belt system (specify): _____
- (9) Unknown

Automatic (Passive) Belt Failure Modes During Accident
- (0) Not equipped/not available/not in use
- (1) No automatic belt failure(s)
- (2) Torn webbing (stretched webbing not included)
- (3) Broken buckle or latchplate
- (4) Upper anchorage separated
- (5) Other anchorage separated (specify): _____
- (6) Broken retractor
- (7) Combination of above (specify): _____
- (8) Other automatic belt failure (specify): _____
- (9) Unknown

National Accident Sampling System-Crashworthiness Data System: Interior Vehicle Form Page 6

MANUAL RESTRAINTS

NOTES: Encode the applicable data **for each seat position** in the vehicle. The attribute for the variable may be found below. Restraint systems should be assessed during the vehicle inspection then coded on the Occupant Assessment Form.

If a Child safety seat is present, encode the data on the back of this page.

If the vehicle has automatic restraints available, encode the appropriate data on the back of the previous page.

		Left	Center	Right
FIRST	Availability			
	Use			
	Failure Modes			
SECOND	Availability			
	Use			
	Failure Modes			
THIRD	Availability			
	Use			
	Failure Modes			
OTHER	Availability			
	Use			
	Failure Modes			

Manual (Active) Belt System Availability
- (0) None available
- (1) Belt removed/destroyed
- (2) Shoulder belt
- (3) Lap belt
- (4) Lap and shoulder belt
- (5) Belt available - type unknown

Integral Belt Partially Destroyed
- (6) Shoulder belt (lap belt destroyed/removed)
- (7) Lap belt (shoulder belt destroyed/removed)
- (8) Other belt (specify): _____
- (9) Unknown

Manual (Active) Belt System Use
- (00) None used, not available, or belt removed/destroyed
- (01) Inoperable (specify): _____
- (02) Shoulder belt
- (03) Lap belt
- (04) Lap and shoulder belt
- (05) Belt used - type unknown
- (06) Other belt used (specify): _____
- (12) Shoulder belt used with child safety seat
- (13) Lap belt used with child safety seat
- (14) Lap and shoulder belt used with child safety seat
- (15) Belt used with child safety seat - type unknown
- (16) Other belt used with child safety seat (specify): _____
- (99) Unknown if belt used

Manual (Active) Belt Failure Modes During Accident
- (0) No manual belt used or not available
- (1) No manual belt failure(s)
- (2) Torn webbing (stretched webbing not included)
- (3) Broken buckle or latchplate
- (4) Upper anchorage separated
- (5) Other anchorage separated (specify): _____
- (6) Broken retractor
- (7) Combination of above (specify): _____
- (8) Other manual belt failure (specify): _____
- (9) Unknown

CHILD SAFETY SEAT FIELD ASSESSMENT

When a child safety seat is present enter the occupant's number in the first row and complete the column below the occupant's number using the codes listed below. Complete a column for each child safety seat present.

Occupant Number						
1. Type of Child Safety Seat						
2. Child Safety Seat Orientation						
3. Child Safety Seat Harness Usage						
4. Child Safety Seat Shield Usage						
5. Child Safety Seat Tether Usage						
6. Child Safety Seat Make/Model	Specify Below for Each Child Safety Seat					

1. Type of Child Safety Seat

   (0) No child safety seat
   (1) Infant seat
   (2) Toddler seat
   (3) Convertible seat
   (4) Booster seat
   (7) Other type child safety seat (specify):

   _____
   (8) Unknown child safety seat type
   (9) Unknown if child safety seat used

2. Child Safety Seat Orientation

   (00) No child safety seat

   Designed for Rear Facing for This Age/Weight
   (01) Rear facing
   (02) Forward facing
   (08) Other orientation (specify):

   _____
   (09) Unknown orientation

   Designed for Forward Facing for This Age/Weight
   (11) Rear facing
   (12) Forward facing
   (18) Other orientation (specify):

   _____
   (19) Unknown orientation

   Unknown Design or Orientation For This Age/Weight, or Unknown Age/Weight
   (21) Rear facing
   (22) Forward facing
   (28) Other orientation (specify):

   _____
   (29) Unknown orientation

   (99) Unknown if child safety seat used

3. Child Safety Seat Harness Usage

4. Child Safety Seat Shield Usage

5. Child Safety Seat Tether Usage
   Note: Options Below Are Used for Variables 3-5.

   (00) No child safety seat

   Not Designed with Harness/Shield/Tether
   (01) After market harness/shield/tether added, not used
   (02) After market harness/shield/tether used
   (03) Child safety seat used, but no after market harness/shield/tether added
   (09) Unknown if harness/shield/tether added or used

   Designed With Harness/Shield/Tether
   (11) Harness/shield/tether not used
   (12) Harness/shield/tether used
   (19) Unknown if harness/shield/tether used

   Unknown If Designed With Harness/Shield/Tether
   (21) Harness/shield/tether not used
   (22) Harness/shield/tether used
   (29) Unknown if harness/shield/tether used

   (99) Unknown if child safety seat used

6. Child Safety Seat Make/Model
   (Specify make/model and occupant number)

   _____
   _____
   _____
   _____

National Accident Sampling System-Crashworthiness Data System: Interior Vehicle Form — Page 7

HEAD RESTRAINTS/SEAT EVALUATION

NOTES: Encode the applicable data for **each seat position** in the vehicle. The attribute for these variables may be found at the bottom of the page. Head restraint type/damage and seat type/performance should be assessed during the vehicle inspection then coded on the Occupant Assessment Form.

		Left	Center	Right
FIRST	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
	Seat Orientation			
SECOND	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
	Seat Orientation			
THIRD	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
	Seat Orientation			
OTHER	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
	Seat Orientation			

Head Restraint Type/Damage by Occupant at This Occupant Position

(0) No head restraints
(1) Integral — no damage
(2) Integral — damaged during accident
(3) Adjustable — no damage
(4) Adjustable — damaged during accident
(5) Add-on — no damage
(6) Add-on — damaged during accident
(8) Other Specify): _____
(9) Unknown

Seat Type (this Occupant Position)

(00) Occupant not seated or no seat
(01) Bucket
(02) Bucket with folding back
(03) Bench
(04) Bench with separate back cushions
(05) Bench with folding back(s)
(06) Split bench with separate back cushions
(07) Split bench with folding back(s)
(08) Pedestal (i.e., column supported)
(09) Other seat type (specify): _____
(10) Box mounted seat (i.e., van type)
(99) Unknown

Seat Performance (this Occupant Position)

(0) Occupant not seated or no seat
(1) No seat performance failure(s)
(2) Seat adjusters failed
(3) Seat back folding locks or "seat back" failed specify: _____
(4) Seat tracks/anchors failed
(5) Deformed by impact of occupant
(6) Deformed by passenger compartment intrusion (specify): _____
(7) Combination of above (specify): _____
(8) Other (specify): _____
(9) Unknown

Seat Orientation (this Occupant Position)

(0) Occupant not seated or no seat
(1) Forward facing seat
(2) Rear facing seat
(3) Side facing seat (inward)
(4) Side facing seat (outward)
(8) Other (specify): _____
(9) Unknown

DESCRIBE ANY INDICATION OF ABNORMAL OCCUPANT POSTURE (I.E., UNUSUAL OCCUPANT CONTACT PATTERN)

National Accident Sampling System-Crashworthiness Data System: Interior Vehicle Form Page 8

EJECTION/ENTRAPMENT DATA

Complete the following if the researcher has any indication that an occupant was either ejected from or entrapped in the vehicle. Code the appropriate data on the Occupant Assessment Form.

EJECTION No [ ] Yes [ ]

Describe indications of ejection and body parts involved in partial ejection(s):

Occupant Number						
Ejection						
(Note on Vehicle Interior Sketch) Ejection Area						
Ejection Medium						
Medium Status						

Ejection
(1) Complete ejection
(1) Partial ejection
(3) Ejection, Unknown degree
(9) Unknown

Ejection Area
(1) Windshield
(2) Left front
(3) Right front
(4) Left rear
(5) Right rear
(6) Rear
(7) Roof
(8) Other area (e.g., back of pickup, etc.) (specify):
(9) Unknown

Ejection Medium
(1) Door/hatch/tailgate
(2) Nonfixed roof structure
(3) Fixed glazing
(4) Nonfixed glazing (specify):
(5) Integral structure
(8) Other medium (specify):
(9) Unknown

Medium Status (Immediately Prior to Impact)
(1) Open
(2) Closed
(3) Integral structure
(9) Unknown

ENTRAPMENT No [ ] Yes [ ]

Describe entrapment mechanism:

Component(s):

(Note in vehicle interior diagram)

National Accident Sampling System-Crashworthiness Data System: Occupant Assessment Form Page 2

EJECTION/ENTRAPMENT

12. Ejection ____
(0) No ejection
(1) Complete ejection
(2) Partial ejection
(3) Ejection, unknown degree
(9) Unknown

13. Ejection Area ____
(0) No ejection
(1) Windshield
(2) Left front
(3) Right front
(4) Left rear
(5) Right rear
(6) Rear
(7) Roof
(8) Other area (e.g., back of pickup, etc.)
(specify):_____
(9) Unknown

14. Ejection Medium ____
(0) No ejection
(1) Door/hatch/tailgate
(2) Nonfixed roof structure
(3) Fixed glazing
(4) Nonfixed glazing (specify):
_____
(5) Integral structure
(8) Other medium (specify):
_____
(9) Unknown

15. Medium Status (Immediately Prior To Impact) ____
(0) No ejection
(1) Open
(2) Closed
(3) Integral structure
(9) Unknown

16. Entrapment ____
(NOTE: Entrapped means that part of the person was in the vehicle and mechanically restrained; jammed doors and immobilizing injuries by themselves are not sufficient to constitute entrapment.)
(0) Not entrapped
(1) Entrapped
(9) Unknown

National Accident Sampling System-Crashworthiness Data System: Occupant Assessment Form **Page 3**

RESTRAINT SYSTEM EVALUATION

17. Manual (Active) Belt System Availability ____
(0) None available
(1) Belt removed/destroyed
(2) Shoulder belt
(3) Lap belt
(4) Lap and shoulder belt
(5) Belt available—type unknown

Integral Belt Partially Destroyed
(6) Shoulder belt (lap belt destroyed/removed)
(7) Lap belt (shoulder belt destroyed/removed)

(8) Other belt (specify):
_____
(9) Unknown

18. Manual (Active) Belt System Use ____ ____
(00) None used, not available, or belt removed/destroyed
(01) Inoperative (specify):
_____
(02) Shoulder belt
(03) Lap belt
(04) Lap and shoulder belt
(05) Belt used—type unknown
(08) Other belt used (specify):
_____
(12) Shoulder belt used with child safety seat
(13) Lap belt used with child safety seat
(14) Lap and shoulder belt used with child safety seat
(15) Belt used with child safety seat—type unknown
(18) Other belt used with child safety seat (specify):_____
(99) Unknown if belt used

19. Proper Use of Manual (Active) Belts ____
(0) None used or not available
(1) Belt used properly
(2) Belt used properly with child safety seat

Belt Used Improperly
(3) Shoulder belt worn under arm
(4) Shoulder belt worn behind back or seat
(5) Belt worn around more than one person
(6) Lap belt worn on abdomen
(7) Lap belt or lap and shoulder belt used improperly with child safety seat (specify):
_____
(8) Other improper use of manual belt system (specify):
_____
(9) Unknown

20. Manual (Active) Belt Failure Modes During Accident ____
(0) No manual belt used
(1) No manual belt failure(s)
(2) Torn webbing (stretched webbing not included)
(3) Broken buckle or latchplate
(4) Upper anchorage separated
(5) Other anchorage separated (specify):
_____
(6) Broken retractor
(7) Combination of above (specify):
_____
(8) Other manual belt failure (specify):
_____
(9) Unknown

21. Air Bag System Availability/Function ____
(0) Not equipped/not available
(1) Air bag

Non-functional
(2) Air bag disconnected (specify):
_____
(3) Air bag not reinstalled
(9) Unknown

22. Air Bag System Deployment ____
(0) Not equipped/not available
(1) Air bag deployed during accident (as a result of impact)
(2) Air bag deployed inadvertently just prior to accident
(3) Air bag deployed, accident sequence undetermined
(4) Nondeployed
(5) Unknown if deployed
(6) Air bag deployed as a result of a noncollision event during accident sequence (e.g., fire, explosion, electrical)
(8) Unknown

23. Are There Indications of Air Bag System Failure? ____
(0) Not equipped/not available
(1) No
(2) Yes (specify):
_____
(8) Unknown

Note: See Variables 44 through 48 (Page 5) for Information on Automatic Belts

24. Police Reported Restraint Use ____
(0) None used
(1) Police did not indicate restraint use
(2) Shoulder belt
(3) Lap belt
(4) Lap and shoulder belt
(5) Belt used, type not specified
(6) Child safety seat
(7) Other or automatic restraint (specify):
_____
(8) Restrained, type unknown
(9) Police indicated "unknown"

National Accident Sampling System-Crashworthiness Data System: Occupant Assessment Form Page 4

HEAD RESTRAINT AND SEAT EVALUATION

25. Head Restraint Type/Damage by Occupant at This Occupant Position ____
(0) No head restraints
(1) Integral—no damage
(2) Integral—damaged during accident
(3) Adjustable—no damage
(4) Adjustable—damaged during accident
(5) Add-on—no damage
(6) Add-on—damaged during accident
(8) Other (specify):
_____
(9) Unknown

26. Seat Type (this Occupant Position) ____ ____
(00) Occupant not seated or no seat
(01) Bucket
(02) Bucket with folding back
(03) Bench
(04) Bench with separate back cushions
(05) Bench with folding back(s)
(06) Split bench with separate back cushions
(07) Split bench with folding back(s)
(08) Pedestal (i.e., column supported)
(09) Other seat type (specify):
_____
(10) Box mounted seat (i.e., van type)
(99) Unknown

27. Seat Performance (this Occupant Position) ____
(0) Occupant not seated or no seat
(1) No seat performance failure(s)
(2) Seat adjusters failed
(3) Seat back folding locks or "seat back" failed
(4) Seat track/anchors failed
(5) Deformed by impact of occupant
(6) Deformed by passenger compartment intrusion (specify):
_____
_____
_____
(7) Combination of above (specify):
_____
(8) Other (specify):
_____
(9) Unknown

National Accident Sampling System-Crashworthiness Data System: Occupant Assessment Form **Page 5**

CHILD SAFETY SEAT

28. Child Safety Seat Make/Model ____ ____ ____
(000) No child safety seat
Applicable codes are found in your NASS CDS Data Collection, Coding and Editing
(950) Built-in child safety seat
(997) Other make/model (specify):
_____
(998) Unknown make/model
(999) Unknown if child safety seat used

29. Type of Child Safety Seat ____
(0) No child safety seat
(1) Infant seat
(2) Toddler seat
(3) Convertible seat
(4) Booster seat
(7) Other type child safety seat (specify):
_____
(8) Unknown child safety seat type
(9) Unknown if child safety seat used

30. Child Safety Seat Orientation ____ ____
(00) No child safety seat

Designed for Rear Facing for This Age/Weight
(01) Rear facing
(02) Forward facing
(08) Other orientation (specify):
_____
(09) Unknown orientation

Designed For Forward Facing for This Age/Weight
(11) Rear facing
(12) Forward facing
(18) Other orientation (specify):
_____
(19) Unknown orientation

Unknown Design or Orientation For This Age/Weight, or Unknown Age/Weight
(21) Rear facing
(22) Forward facing
(28) Other orientation (specify):
_____
(29) Unknown orientation

(99) Unknown if child safety seat used

31. Child Safety Seat Harness Usage ____ ____

32. Child Safety Seat Shield Usage ____ ____

33. Child Safety Seat Tether Usage ____ ____

Note: Options below applicable to Variables OA31-OA33.
(00) No child safety seat

Not Designed With Harness/Shield/Tether
(01) After market harness/shield/tether added, not used
(02) After market harness/shield/tether used
(03) Child safety seat used, but no after market harness/shield/tether added
(09) Unknown if harness/shield/tether *added or* used

Designed With Harness/Shield/Tether
(11) Harness/shield/tether not used
(12) Harness/shield/tether used
(19) Unknown if harness/shield/tether used

Unknown If Designed With Harness/Shield/Tether
(21) Harness/shield/tether not used
(22) Harness/shield/tether used
(29) Unknown if harness/shield/tether used

(99) Unknown if child safety seat used

National Accident Sampling System-Crashworthiness Data System: Occupant Assessment Form Page 6

INJURY CONSEQUENCES

34. Injury Severity (Police Rating) ____

(0) O - No injury
(1) C - Possible injury
(2) B - Nonincapacitating injury
(3) A - Incapacitating injury
(4) K - Killed
(5) U - Injury, severity unknown
(6) Died prior to accident
(9) Unknown

35. Treatment - Mortality ____

(0) No treatment
(1) Fatal
(2) Fatal - ruled disease (specify):
.....

Nonfatal
(3) Hospitalization
(4) Transported and released
(5) Treatment at scene - nontransported
(6) Treatment later
(8) Treatment - other (specify):
.....
(9) Unknown

36. Type Of Medical Facility (for Initial Treatment) ____

(0) Not treated at a medical facility
(1) Trauma center
(2) Hospital
(3) Medical clinic
(4) Physician's office
(5) Treatment later at medical facility
(8) Other (specify):
.....
(9) Unknown

37. Hospital Stay ____ ____

(00) Not Hospitalized
_____Code the number of days (up through 60) that the occupant stayed in hospital.
(61) 61 days or more
(99) Unknown

38. Working Days Lost ____ ____

_____Code the number of days (up through 60) that the occupant lost from work due to the accident
(00) No working days lost
(61) 61 days or more
(62) Fatally injured
(97) Not working prior to accident
(99) Unknown

STOP - GO TO VARIABLE 44 ON PAGE 7

VARIABLES 39 THROUGH 43 ARE COMPLETED BY THE ZONE CENTER

39. Time to Death ____ ____

_____Code number of hours from time of accident to time of death up through 24 hours. If time of death is greater than 24 hours, code number of days. (Note: 1 day = 31, 2 days = 32, ... n days = 30 +n up through 30 days = 60)
(00) Not fatal
(96) Fatal - ruled disease
(99) Unknown

40. 1st Medically Reported Cause of Death ____ ____

41. 2nd Medically Reported Cause of Death ____ ____

42. 3rd Medically Reported Cause of Death ____ ____

_____Code the Occupant Injury from line number(s) for the medically reported injury(s) which reportedly contributed to this occupant's death
(00) Not fatal or no additional causes
(97) Other result (includes fatal ruled disease) (specify):
.....
(99) Unknown

43. Number of Recorded Injuries for This Occupant ____ ____

_____Code the actual number of injuries recorded for this occupant.
(00) No recorded injuries
(97) Injured, details unknown
(99) Unknown if injured

National Accident Sampling System-Crashworthiness Data System: Occupant Assessment Form Page 7

AUTOMATIC BELT SYSTEM

44. Automatic (Passive) Belt System Availability/ Function .....
(0) Not equipped/not available
(1) 2 point automatic belts
(2) 3 point automatic belts
(3) Automatic belts - type unknown

Non-functional
(4) Automatic belts destroyed or rendered inoperative
(9) Unknown

45. Automatic (Passive) Belt System Use .....
(0) Not equipped/not available/destroyed or rendered inoperative
(1) Automatic belt in use
(2) Automatic belt not in use (manually disconnected, motorized track inoperative) (specify):
_____
(3) Automatic belt use unknown
(9) Unknown

46. Automatic (Passive) Belt System Type .....
(0) Not equipped/not available
(1) Non-motorized system
(2) Motorized system
(9) Unknown

47. Proper Use of Automatic (Passive Belt System .....
(0) Not equipped/not available/not used
(1) Automatic belt used properly
(2) Automatic belt used properly with child safety seat

Automatic Belt Used Improperly
(3) Automatic shoulder belt worn under arm
(4) Automatic shoulder belt worn behind back
(5) Automatic belt worn around more than one person
(6) Lap portion of automatic belt worn on abdomen
(7) Automatic lap and shoulder belt or automatic shoulder belt used improperly with child safety seat (specify):
_____
(8) Other improper use of automatic belt system (specify):_____
(9) Unknown

48. Automatic (Passive) Belt Failure Modes During Accident .....
(0) Not equipped/not available/not in use
(1) No automatic belt failure(s)
(2) Torn webbing (stretched webbing not included)
(3) Broken buckle or latchplate
(4) Upper anchorage separated
(5) Other anchorage separated (specify):
_____
(6) Broken retractor
(7) Combination of above (specify):
(8) Other automatic belt failure (specify):
_____
(9) Unknown

49. Seat Orientation (this Occupant Position) .....
(0) Occupant not seated or no seat
(1) Forward facing seat
(2) Rear facing seat
(3) Side facing seat (inward)
(4) Side facing seat (outward)
(8) Other (specify):
_____
(9) Unknown

STOP - VARIABLES 50 THROUGH 52 ARE COMPLETED BY THE ZONE CENTER

TRAUMA DATA

50. Glasgow Coma Scale (GCS) Score (at Medical Facility) ....
(00) Not injured
(01) Injured - not treated at medical facility
(02) No GCS Score at medical facility
(03-15) Code the actual value of the initial GCS Score recorded at medical facility.
(97) Injured, details unknown
(99) Unknown if injured

51. Was the Occupant Given Blood? .....
(1) No - blood not given
(2) Yes - blood given (specify units):_____
(9) Unknown if blood given

52. Arterial Blood Gases (ABG) - HCO_3 ....
(00) Not injured
(01) Injured, ABGs not measured or reported
(02-50) Code the actual value of the HCO_3
(96) ABGs reported , HCO_3 unknown
(97) Injured, details unknown
(99) Unknown if injured

ARE ALL APPLICABLE MEDICAL RECORDS INCLUDED WITH INITIAL SUBMISSION? NO [ ] YES [ ]

UPDATE CANDIDATE? NO [ ] YES [ ]

U.S. Department of Transportation
National Highway Traffic Safety Administration

OCCUPANT INJURY FORM

Form Approved
O.M.B. No. 2127-0021
NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

1. Primary Sampling Unit Number _____
2. Case Number - Stratum _____
3. Vehicle Number _____
4. Occupant Number _____

INJURY DATA

Record below the actual injuries sustained by this occupant that were identified from the official and unofficial data sources. Remember not to double count an injury just because it was identified from two different sources. If greater than ten injuries have been documented, encode the balance on the Occupant Injury Supplement.

	Source of Injury Data	O.I.C.-A.I.S. Body Region	O.I.C.-A.I.S. Type of Anatomic Structure	O.I.C.-A.I.S. Specific Anatomic Structure	O.I.C.-A.I.S. Level of Injury	A.I.S. Severity	Aspect	Injury Source	Injury Source Confidence Level	Direct/ Indirect Injury	Occupant Area Intrusion Number
1st	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
2nd	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.
3rd	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.
4th	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.
5th	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.	59.
6th	60.	61.	62.	63.	64.	65.	66.	67.	68.	69.	70.
7th	71.	72.	73.	74.	75.	76.	77.	78.	79.	80.	81.
8th	82.	83.	84.	85.	86.	87.	88.	89.	90.	91.	92.
9th	93.	94.	95.	96.	97.	98.	99.	100.	101.	102.	103.
10th	104.	105.	106.	107.	108.	109.	110.	111.	112.	113.	114.

HS Form 453B (1/93)

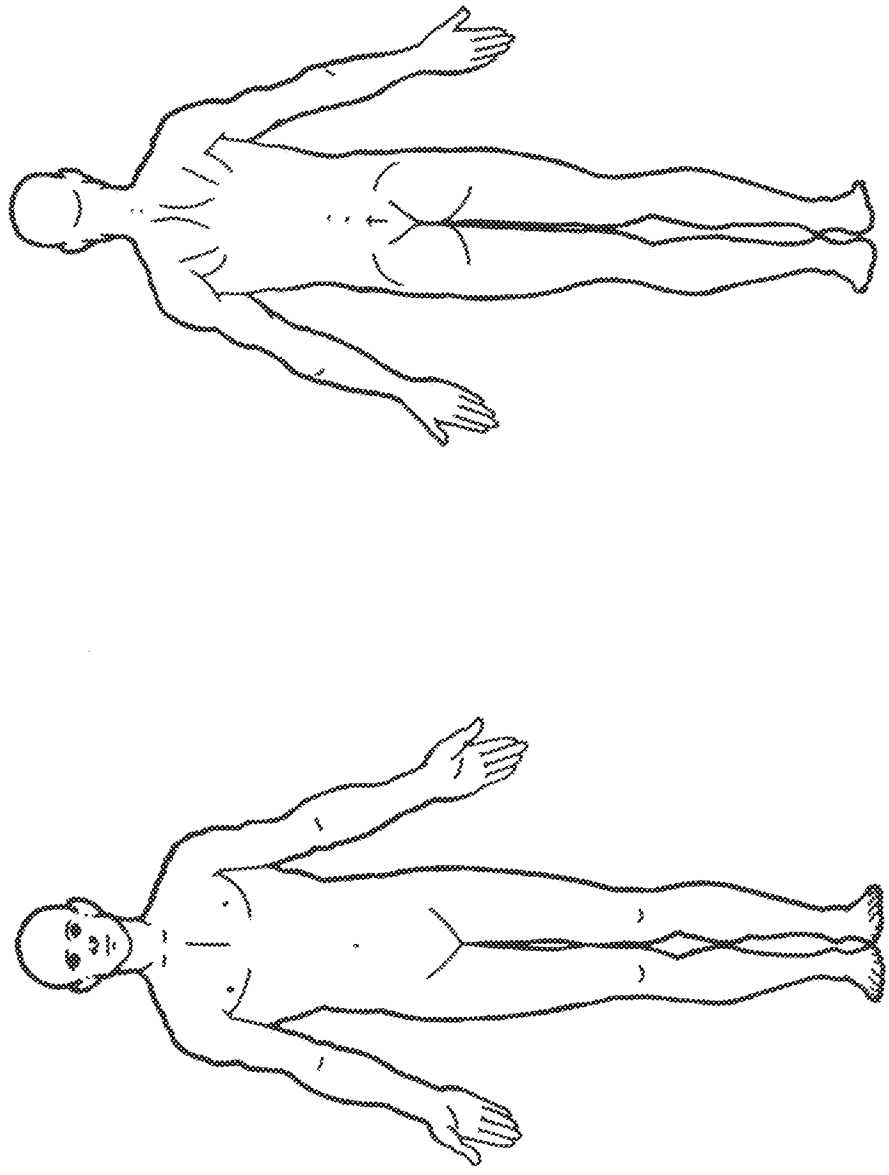
This report is authorized by P.L. 89-563, Title 1, Section 106, 108, and 112. While you are not required to respond, your cooperation is needed to make the results of this data collection effort comprehensive, accurate, and timely.

OCCUPANT INJURY DATA

	Source of Injury Data	O.I.C.-A.I.S Body Region	Type of Anatomic Structure	Specific Anatomic Structure	Level of Injury	A.I.S. Severity	Aspect	Injury Source	Injury Source Confidence Level	Direct/ Indirect Injury	Occupant Area Intrusion Number
11th											
12th											
13th											
14th											
15th											
16th											
17th											
18th											
19th											
20th											
21st											
22nd											
23rd											
24th											
25th											

OFFICIAL INJURY DATA — SOFT TISSUE INJURIES

Indicate the Location, Specific Anatomic Structure, Detail (size, depth, fracture type, head injury clinical signs and neurological deficits), and Source of all injuries indicated by official sources (or from PAR or other unofficial sources if medical records and interviewee data are unavailable.)



SOURCE OF INJURY DATA

OFFICIAL
(1) Autopsy records with or without hospital/medical records
(2) Hospital/medical records other than emergency room (e.g., discharge summary)
(3) Emergency room records only (including associated X-rays or other lab reports)
(4) Private physician, walk-in or emergency clinic

UNOFFICIAL
(5) Lay coroner report
(6) E.M.S. personnel
(7) Interviewee
(8) Other source (specify):
_____
(9) Police

INJURY SOURCE

FRONT
(01) Windshield
(02) Mirror
(03) Sunvisor
(04) Steering wheel rim
(05) Steering wheel hub/spoke
(06) Steering wheel (combination of codes 04 and 05)
(07) Steering column, transmission selector lever, other attachment
(08) Add on equipment (e.g., CB, tape deck, air conditioner)
(09) Left instrument panel and below
(10) Center instrument panel and below
(11) Right instrument panel and below
(12) Glove compartment door
(13) Knee bolster
(14) Windshield including one or more of the following: front header, A (A1/A2) pillar, instrument panel, mirror, or steering assembly (driver side only)
(15) Windshield including one or more of the following: front header, A (A1/A2) pillar, instrument panel, or mirror (passenger side only)
(16) Driver side air bag compartment cover
(17) Passenger side air bag compartment cover
(18) Windshield reinforced by exterior object (specify):_____
(19) Other front object (specify):
_____

LEFT SIDE
(20) Left side interior surface, excluding hardware or armrests
(21) Left side hardware or armrest
(22) Left A (A1/A2)-pillar
(23) Left B-pillar
(24) Other left pillar (specify):
_____
(25) Left side window glass or frame
(26) Left side window glass including one or more of the following: frame, window sill, A (A1/A2)-pillar, B-pillar, or roof side rail.
(27) Other left side object (specify):
_____
(28) Left side window sill

RIGHT SIDE
(30) Right side interior surface, excluding hardware or armrests
(31) Right side hardware or armrest
(32) Right A (A1/A2)-pillar
(33) Right B-pillar
(34) Other right pillar (specify):
_____
(35) Right side window glass or frame
(36) Right side window glass including one or more of the following: frame, window sill, A (A1/A2) pillar, B-pillar, or roof side rail.
(37) Other right side object (specify):
_____
(38) Right side window sill

INTERIOR
(40) Seat, back support
(41) Belt restraint webbing/buckle
(42) Belt restraint B-pillar or door frame attachment point
(43) Other restraint system component (specify):_____
(44) Head restraint system
(45) Air bag (see codes "16" and "17" for injuries sustained from air bag compartment covers)
(46) Other occupants (specify):
_____
(47) Interior loose objects
(48) Child safety seat (specify):
_____
(49) Other interior object (specify):
_____

ROOF
(50) Front header
(51) Rear header
(52) Roof left side rail
(53) Roof right side rail
(54) Roof or convertible top

FLOOR
(56) Floor (including toe pan)
(57) Floor or console mounted transmission lever, including console
(58) Parking brake handle
(59) Foot controls including parking brake

REAR
(60) Backlight (rear window)
(61) Backlight storage rack, door, etc.
(62) Other rear object (specify):
_____

EXTERIOR of OCCUPANT'S VEHICLE
(66) Hood
(69) Outside hardware (e.g., outside mirror, antenna)
(67) Other exterior surface or tires (specify):_____
(68) Unknown exterior objects

EXTERIOR OF OTHER MOTOR VEHICLE
(70) Front bumper
(71) Hood edge
(72) Other front of vehicle (specify)
_____
(73) Roof
(74) Hood ornament
(75) Windshield, roof rail, A-pillar
(76) Side surface
(77) Side mirror
(78) Other side protrusions (specify)
_____
(79) Rear surface
(90) Undercarriage
(81) Tires and wheels
(82) Other exterior of other motor vehicle (specify):
_____
(83) Unknown exterior of other motor vehicle

OTHER VEHICLE OR OBJECT IN THE ENVIRONMENT
(84) Ground
(85) Other vehicle or object (specify)
_____
(86) Unknown vehicle or object

NONCONTACT INJURY
(80) Fire in vehicle
(81) Flying glass
(92) Other noncontact injury source (specify):_____
(93) Air bag exhaust gases
(87) Injured, unknown source

INJURY SOURCE CONFIDENCE LEVEL

(1) Certain
(2) Probable
(3) Possible
(9) Unknown

DIRECT/INDIRECT INJURY

(1) Direct contact injury
(2) Indirect contact injury
(3) Noncontact injury
(7) Injured, unknown source

OCCUPANT INJURY CLASSIFICATION

Body Region

(1) Head
(2) Face
(3) Neck
(4) Thorax
(5) Abdomen
(6) Spine
(7) Upper Extremity
(8) Lower Extremity
(9) Unspecified

Type of Anatomic Structure

(1) Whole Area
(2) Vessels
(3) Nerves
(4) Organs (includes muscles/ligaments)
(5) Skeletal (includes joints)
(6) Head - LOC
(9) Skin

Specific Anatomic Structure

Whole Area
(01) Skin - Abrasion
(04) Skin - Contusion
(06) Skin - Laceration
(08) Skin - Avulsion
(10) Amputation
(20) Burn
(30) Crush
(40) Degloving
(50) Injury - NFS
(80) Trauma, other than mechanical

Head - LOC
(02) Length of LOC
(04, 06, 08) Level of Consciousness
(10) Concussion

Spine
(02) Cervical
(04) Thoracic
(06) Lumbar

Vessels, Nerves, Organs, Bones, Joints are assigned consecutive two-digit numbers beginning with 02

Level of Injury

Specific injuries are assigned consecutive two-digit numbers beginning with 02

To the extent possible, within the organizational framework of the AIS, 00 is assigned to an injury NFS as to severity or where only one injury is given in the dictionary for that anatomic structure. 99 is assigned to any injury NFS as to lesion or severity.

Abbreviated Injury Scale

(1) Minor injury
(2) Moderate injury
(3) Serious injury
(4) Severe injury
(5) Critical injury
(6) Maximum (untreatable)
(7) Injured, unknown severity

Aspect

(1) Right
(2) Left
(3) Bilateral
(4) Central
(5) Anterior
(6) Posterior
(7) Superior
(8) Inferior
(9) Unknown
(0) Whole region

National Accident Sampling System-Crashworthiness Data System: Occupant Injury Form

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OFFICIAL INJURY DATA — SKELETAL INJURIES

Restrained?

____ No

____ Yes

Blood Alcohol Level (mg/dl)

BAL = ______

Glasgow Coma Scale Score

GCSS = ______

Units of Blood Given

Units = ______

Arterial Blood Gases

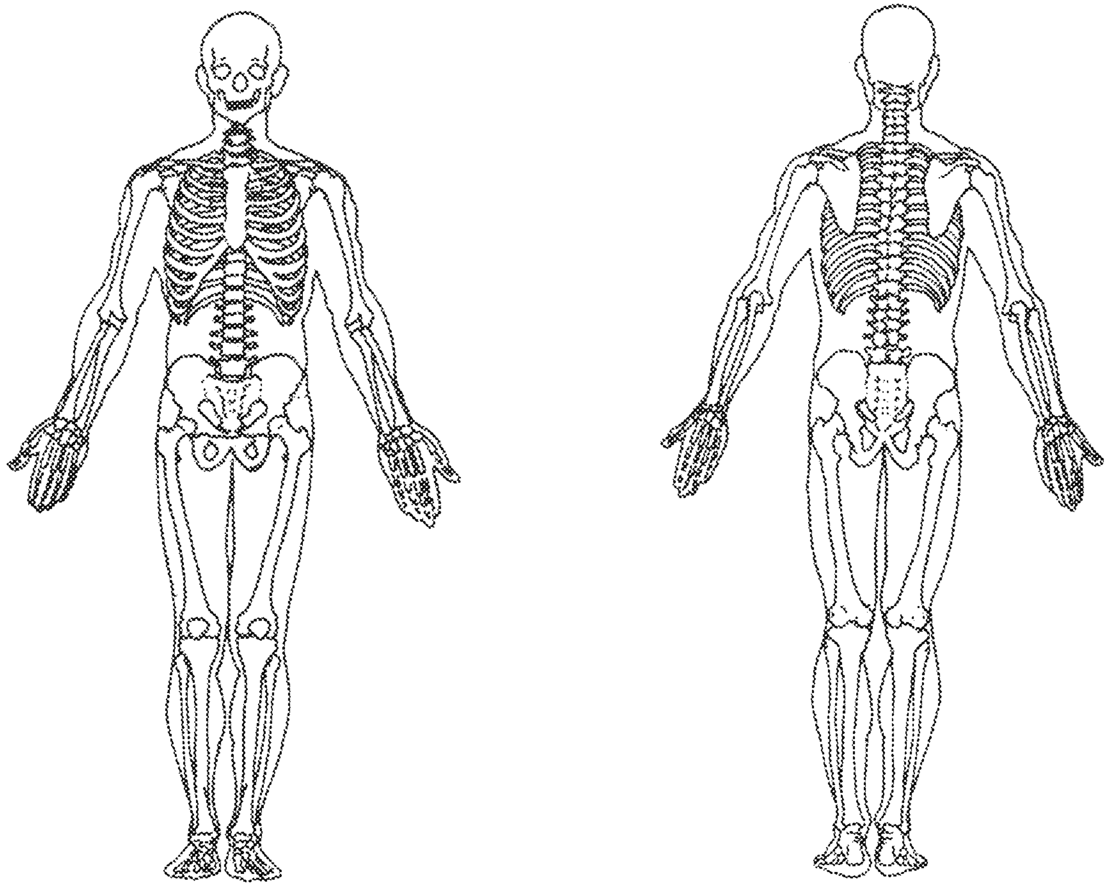
pH = ___.___

PO_2 = ______

PCO_2 ______

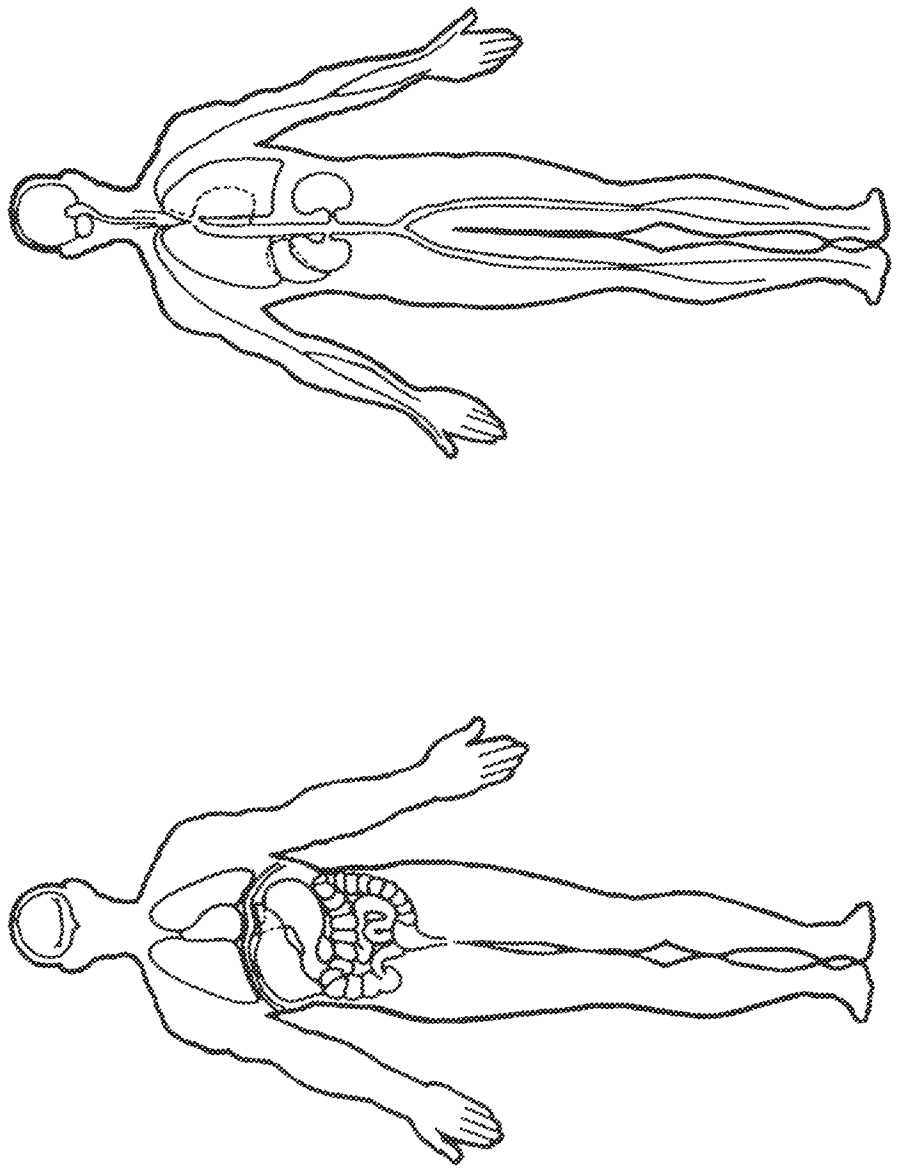
HCO_3 ______

Indicate the Location, Specific Anatomic Structure, Detail (size, depth, fracture type, head injury clinical signs and neurological deficits), and Source of all injuries indicated by official sources (or from PAR or other unofficial sources if medical records and interviewee data are unavailable.)



OFFICIAL INJURY DATA — INTERNAL INJURIES

Indicate the Location, Specific Anatomic Structure, Detail (size, depth, fracture type, head injury clinical signs and neurological deficits), and Source of all injuries indicated by official sources (or from PAR or other unofficial sources if medical records and interviewee data are unavailable.)



Appendix E. CRASHPC and OLDMISSPC Summary

CRASHPC is an acronym for Calspan Reconstruction of Accident Speeds on the Highway. As its name implies, the CRASHPC program is a general-purpose personal computer program that can be used to estimate vehicle speeds in real-world accidents, based on physical evidence obtained by an accident investigator. The objective of the CRASHPC program is to provide a standardized and objective means of interpreting the physical evidence from the scene of an automobile collision.

Two separate and independent methods can be used to estimate the change in vehicle speeds experienced by the vehicles. The first method makes use of trajectory data and is based on work-energy relationships and the principle of conservation of linear momentum. The other method makes use of detailed measurements of the structural deformation of each vehicle to arrive at an estimate of the energy required to produce the observed vehicle damage. These two methods can be used to check each other, since they should yield similar results if the user possesses sufficient information to use both methods fully.

The CRASHPC program is a simplified mathematical analysis of automobile accident events. As is the case with any such analytical procedure, certain assumptions have been made to reduce the complexity and the operating cost of the program. In some particular cases, CRASHPC is not, nor was it intended to be, a high-fidelity collision simulation program. In most accidents, only a minimum of data are available, and even these data are only available second hand.

Beyond its use by Federal Government sponsored researchers, CRASHPC has become a popular tool among reconstructionists involved in litigation, and much of the criticism of the CRASHPC program regards its accuracy in such applications. CRASHPC was intended as a statistical tool to identify and isolate problems in motor vehicle safety, not as a simulation program, and it should be used accordingly. Often, accuracy problems are the result of applying the CRASHPC program in situations which violate, to some degree, its fundamental assumptions:

- It is a two-dimensional program.
- It simplifies the characteristics of vehicles.
- It assumes that at some instant during the impact both vehicles have a common velocity.
- It assumes that the vehicles spin out to rest with constant rolling resistances, no active steering, and over a single friction surface (a secondary friction surface may be specified in the trajectory simulation).

The above assumptions mean that the program cannot be used for: rollovers; sideswipes; severe override/underride crashes; nonhorizontal collision forces; or collisions with large trucks or trains in motion, yielding objects, or pedestrians, bicyclists, or motorcyclists.

The missing vehicle algorithm (OLDMISSPC) methodology is based on CRASHPC.

Appendix F. Harm Definition

"Harm" is a concept developed by Malliaris [1] for quantifying, or normalizing, the relative consequences of the total estimated number of crash deaths and injured people. Harm is commonly used for prioritization in crashworthiness program planning.

Harm attributes to each surviving injured person and each death a quantity based on the costs (excluding property damage and travel delay costs) associated with each death or injured person. The cost quantities are obtained from National average cost estimates for injured people. National Harm estimates are developed by multiplying the frequency estimates of the incidence of injured people at each severity level by the unit cost estimates of the average losses for that severity of injury. These figures are then summed to arrive at annual National Harm estimates.

Injury costs are estimated in accordance with the Abbreviated Injury Scale (AIS) of six grades of increasing threat-to-life ranging from AIS 1 (Minor) to AIS 6 (Maximum). Table F1 provides the latest "Economic Harm" figures associated with the maximum AIS for a given crash victim using the latest NHTSA estimates of economic costs and injury incidence. Table F2 provides Comprehensive Harm figures that include quantities representing values for pain and suffering costs that are excluded in the "economic" cost schedule.

Table F1. 1990 Economic Harm

Survivor's Maximum AIS		Unit Costs [2]	Incidence [3]	Harm [4] (Billion Dollars)
Minor	1	$3,094	4,617,228	$14
Moderate	2	$23,674	566,850	$13
Serious	3	$78,926	180,110	$14
Severe	4	$150,991	21,756	$3
Critical	5	$581,811	11,386	$7
Fatalities		$693,836	*44,531	$31
1990 National Estimate of Total Economic Harm				**$82**

*This number was obtained from the 1990 Fatality Accident Reporting System.

Table F2. 1990 Comprehensive Harm

Survivor's Maximum AIS		Unit Costs [2]	Incidence [3]	Harm [4] (Billion Dollars)
Minor	1	$6,180	4,617,228	$28
Moderate	2	$107,638	566,850	$61
Serious	3	$400,310	180,110	$72
Severe	4	$1,017,331	21,756	$22
Critical	5	$2,122,648	11,386	$24
Fatalities		$2,620,516	*44,531	$117
1990 National Estimate of Total Comprehensive Harm				**$324**

*This number was obtained from the 1990 Fatality Accident Reporting System.

References

[1] Malliaris, A., A Search for Priorities in Crash Protection, SAE, 820242, 1982.

[2] NHTSA, *The Economic Cost of Motor Vehicle Crashes, 1990*, DOT HS 807-876, 9/92, Table II-15.

[3] NHTSA, *The Economic Cost of Motor Vehicle Crashes, 1990*, DOT HS 807-876, 9/92, Table I-3 (1990 incidence figures).

[4] NHTSA, *The Economic Cost of Motor Vehicle Crashes, 1990*, DOT HS 807-876, 9/92, Table I-1.

Appendix G. Statistical Methods

Three aspects of the NASS/CDS statistics presented in this report are discussed in this appendix. These aspects are:

- The univariate imputations of missing data
- The annual weighted average counts for the 1991-1993 period
- The sampling errors for the weighted average counts over the 1991-1993 period.

The method for producing estimates from the 1991-1993 CDS data is to use national ratio-adjusted weights. These sampling weights are appended to the CDS data on the electronic data file. By summing the sampling weights that have a certain characteristic, an estimate of the national total for that characteristic can be produced.

Imputations of Missing Data

A univariate imputation procedure was used to impute the missing (unknown or uncoded) data for crash mode (Tables 2, 6, 19-22, 32, and 33 of this report) and seating position (Tables 4, 8, and 25). The use of the univariate imputation procedure is illustrated here, using the data for occupant seating positions in towed cars (Table 4). The procedure distributes the missing values of seating position according to the proportion of all the known values (except drivers) of the seating position. The imputation of missing values for the seating position of car occupants in the 1991-1993 period is performed as follows.

The distribution of the occupant seating positions in towed cars in the 1991-1993 period before imputations is:

Car Occupant	Percent	Count
Drivers	65.4	6,069,682
Right Front Passengers	21.6	2,008,132
Second Seat Passengers	11.2	1,036,506
Other Passengers	1.1	986,932
Unknown Seating	0.1	4,750
Uncoded Seating	0.7	64,413
Total	**100.0**	**9,282,178**

It was decided to impute the missing (unknown and uncoded) values of seating positions to seating positions other than drivers (right front, second seat, and others). The distribution of occupants seated in these three seating positions is:

Car Occupant	Percent	Count
Right Front Passengers	49.8	2,008,132
Second Seat Passengers	25.7	1,036,508
Other Passengers	24.5	986,932
Total	**100.0**	**4,031,572**

After imputing the missing seating positions to these three known seating positions, the distribution of all occupants is:

Car Occupant	Percent	Count
Drivers	65.4	6,069,682
Right Front Passengers	22.0	2,037,597
Second Seat Passengers	11.6	1,074,801
Other Passengers	1.1	100,098
Total	**100.0**	**9,282,178**

The seating position of the car occupants is presented in Table 4 of the report. The missing data for the seating positions of light truck occupants were similarly imputed. The seating positions of the light truck occupants are presented in Table 8 of the report.

Annual Weighted Average Counts

The data presented in the CDS report are for years 1991, 1992, and 1993. To compute an annual summary of the 3 years' data, the weighted average procedure was used instead of a simple annual average. The weighted average procedure was chosen to account for the differences between the distribution of the CDS attributes in each year. The use of the weighted average procedure is illustrated using the data for crash-involved towed cars by weight class (Table 1 of the report).

The distribution of crash-involved cars by weight class in each year is given below.

Weight Class	1991		1992		1993	
	Count	Percent	Count	Percent	Count	Percent
Small (<2,500 lbs)	742,808	32.7	658,944	35.2	642,415	32.9
Mid-size (2,500-3,000 lbs)	693,873	30.6	645,663	34.5	702,000	36.0
Large (>3,000 lbs)	795,947	35.1	545,502	29.2	573,635	29.4
Unknown Size	37,778	1.7	21,040	1.1	32,367	1.7
Total	**2,270,406**	**100.0**	**1,871,149**	**100.0**	**1,950,417**	**100.0**

The ratio of each year's count to the total of the 3 years' count is given below.

Weight Class	1991	1992	1993
Small (<2,500 lbs)	0.363	0.322	0.314
Mid-size (2,500-3,000 lbs)	0.340	0.316	0.344
Large (>3,000 lbs)	0.416	0.285	0.300
Unknown Size	0.414	0.231	0.355

These fractions were multiplied by the corresponding weighted counts in each year to adjust for differences between the 3 years' distributions. The annual weighted average obtained from summing the adjusted weighted total count for the 3 years is compared to the simple average in the following table:

Weight Class	Total Crash-Involved		Annual Simple Average		Annual Weighted Average	
	Count	Percent	Count	Percent	Count	Percent
Small (<2,500 lbs)	2,044,168	33.6	681,389	33.5	715,301	33.3
Mid-size (2,500-3,000 lbs)	2,041,535	33.5	680,512	33.5	712,370	33.1
Large (>3,000 lbs)	1,915,084	31.4	638,361	31.4	687,906	32.0
Unknown Size	91,185	1.5	30,395	1.6	33,448	1.6
Total	**6,091,972**	**100.0**	**2,030,657**	**100.0**	**2,149,025**	**100.0**

The annual weighted average of the crash-involved towed cars by weight class is given in Table 1 of the report.

Standard Errors of the CDS Estimates

The national estimates produced from the CDS data may differ from the true values, because they are based on a probability sample of towed cars and not a census of all crashes. The size of these differences may vary depending on which sample was selected. The standard error of an estimate is a measure of the precision or reliability with which an estimate from this particular CDS sample approximates the result of a census.

It is impractical to compute and provide a standard error for each estimate in this report. Instead, generalized standard errors for estimates of totals are presented in the following two tables for vehicle characteristics (Table G1) and for occupant characteristics (Table G2). The generalized standard error tables were produced separately for the vehicle and occupant tables, using three steps:

1. The standard errors for selected estimates in the report were calculated using a Taylor series approximation.

2. An equation that best fit the standard errors was found using regression techniques.

3. Approximate standard errors were generated from this equation, and the generalized standard error tables were produced.

Shown in each table are the values for the estimates and an estimate of one standard error for that value derived from the 1991-1993 CDS data. By adding and subtracting one standard error to the associated estimate, approximate 68 percent confidence intervals for an estimate can be created. The estimated annual average number of small, crash-involved, towed cars is given in Table 1 of the report as 715,301 cars. To calculate one standard error for this estimate, use Table G1 in this appendix. Since 715,301 does not appear in Table G1, use linear interpolation from the standard error values for the estimates 700,000 and 800,000. One approximate standard error would be 42,148 + 679 = 42,827. The confidence interval for this estimate would be 715,301 ± 42,827 or 672,474 to 758,128.

The formula used to compute the standard errors is presented below each table. More information on standard error estimates can be obtained from the National Center for Statistics and Analysis.

Table G1
Crash-Involved Vehicle Characteristics Estimates and Standard Errors

Estimate	Standard Error*	Estimate	Standard Error*
500	500	100,000	10,964
1,000	1,000	200,000	17,292
5,000	2,079	300,000	22,853
10,000	2,922	400,000	28,006
20,000	4,218	500,000	32,896
30,000	5,284	600,000	37,595
40,000	6,254	700,000	42,148
50,000	7,140	800,000	46,585
60,000	7,972	900,000	50,927
70,000	8,763	1,000,000	55,189
80,000	9,522	1,100,000	59,382
90,000	10,254	1,200,000	63,515

*$SE = e^{a+b(\ln(x))^2}$

where:
a = 5.62936
b = 0.02771
x = estimate
SE = standard error.

Table G2
Crash-Involved Occupant Characteristics Estimates and Standard Errors

Estimate	Standard Error*	Estimate	Standard Error*
500	360	100,000	7,183
1,000	481	200,000	12,130
5,000	1,061	300,000	16,715
10,000	1,570	400,000	21,119
20,000	2,395	500,000	25,412
30,000	3,110	600,000	29,629
40,000	3,767	700,000	33,792
50,000	4,386	800,000	37,914
60,000	4,979	900,000	42,006
70,000	5,552	1,000,000	46,072
80,000	6,108	1,100,000	50,120
90,000	6,651	1,200,000	54,153

*$SE = e^{a+b(\ln(x))^2}$

where:
a = 4.65576
b = 0.03186
x = estimate
SE = standard error.