



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



National Accident Sampling System Crashworthiness Data System 1988-1990

**National Accident
Sampling System
Crashworthiness
Data System
1988-1990**

Contents

	Page
Executive Summary	vii
1. Introduction	1
Background	1
Objective	1
Vehicles Under Consideration	1
CDS Estimates	2
2. Perspective	3
3. Vehicle Crash Data	5
Car Size	5
Car Crash Modes and Areas of Damage	5
Car Crash Severity	8
Seating Position of Car Occupants	10
Functional Class and Size of Light Trucks and Vans	11
Light Truck and Van Crash Modes and Areas of Damage	12
Light Truck, Van, and Multipurpose Vehicle Crash Severity	14
Seating Position of Light Truck, Van, and MPV Occupants	15
4. Occupant Injury Data	17
Crash-Involved Occupants by Injury Severity	17
Use of Manual Restraints	20
Effect of Belt Use on Injury Risk	22
Injury Severity and Outcome	23
Body Regions Injured in Highway Crashes	26
Injury Contacts	31
5. Vehicle Damage Data	37
Loss of Passenger Compartment Integrity in Towed Cars	37
Intrusion of the Passenger Compartment of Crash-Involved Cars	39
Door Failure in Crash-Involved Towed Cars	43
Causes of Door Opening in Crash-Involved Cars	46
Occupant Ejection and Entrapment in Crash-Involved Towed Cars	47
Glazing Damage in Crash-Involved Towed Cars	51
Appendixes	
A. Glossary	55
B. NASS/CDS Sample Design	59
C. NASS/CDS Zone Centers and Primary Sampling Units	61
D. NASS/CDS Data Elements	63
E. Harm Definition	105
F. Statistical Methods	107

Tables	Page
1. Crash-Involved Towed Cars by Weight Class, 1988-1990	5
2. Distribution of Towed Car Crash Modes and Areas of Damage, 1988-1990	6
3. Distribution of Towed Car Crashes by Crash Severity (delta-v) and Area of Damage: Weighted Average per Year, 1988-1990	8
4. Occupant Seating Positions in Towed Cars, 1988-1990	10
5. Distribution of Towed Light Trucks, Vans, and Multipurpose Vehicles by Vehicle Class and Size, 1988-1990	11
6. Distribution of Towed Light Truck, Van, and MPV Crash Modes and Areas of Damage, 1988-1990	12
7. Distribution of Towed Light Trucks, Vans, and MPVs by Crash Severity (delta-v) and Area of Damage: Weighted Average per Year, 1988-1990	14
8. Occupant Seating Positions in Towed Light Trucks, Vans, and MPVs, 1988-1990	15
9. Distribution of Crash-Involved Car Occupants by Maximum Injury Severity: Weighted Average per Year, 1988-1990	18
10. Distribution of Crash-Involved Light Truck, Van, and MPV Occupants by Maximum Injury Severity: Weighted Average per Year, 1988-1990	18
11. Distribution of Crash-Involved Car Occupants by Safety Belt Use and Maximum Injury Severity: Weighted Average per Year, 1988-1990	20
12. Distribution of Crash-Involved Light Truck, Van, and MPV Occupants by Safety Belt Use and Maximum Injury Severity: Weighted Average per Year, 1988-1990	21
13. Distribution of Crash-Involved Car Occupants by Treatment and Maximum Injury Severity: Weighted Average per Year, 1988-1990	23
14. Distribution of Crash-Involved Light Truck, Van, and MPV Occupants by Treatment and Maximum Injury Severity: Weighted Average per Year, 1988-1990	24
15. Distribution of All Injuries to Crash-Involved Car Occupants by Body Region and Severity: Weighted Average per Year, 1988-1990	26
16. Distribution of All Injuries to Crash-Involved Light Truck, Van, and MPV Occupants by Body Region and Severity: Weighted Average per Year, 1988-1990	28
17. Distribution of All Injuries to Crash-Involved Car Occupants by Injury Contact and Severity: Weighted Average per Year, 1988-1990	31
18. Distribution of All Injuries to Crash-Involved Light Truck, Van, and MPV Occupants by Injury Contact and Severity: Weighted Average per Year, 1988-1990	33
19. Loss of Passenger Compartment Integrity in Crash-Involved Cars: Weighted Average of Nationally Weighted Counts, 1988-1990	38
20. Number of Towed Cars With at Least One Intrusion of 6 inches or More by Intruding Component, Crash Type, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1988-1990	41
21. Number of Crash-Involved Cars With Doors That Opened or Jammed by Crash Mode and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1988-1990	43
22. Number of Crash-Involved Light Trucks, Vans, and MPVs With Doors That Opened or Jammed by Crash Mode and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1988-1990	44

	Page
23. Number of Crash-Involved Towed Cars With Doors That Opened by Mode of Door Failure, Crash Mode, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1988-1990	46
24. 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, 1988-1990	47
25. 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, 1988-1990	49
26. Glazing Damage of Any Degree Resulting from Vehicle Impact in Crash-Involved Towed Cars, by Glazing Component and Crash Type: Weighted Average of Nationally Weighted Counts per Year, 1988-1990	51
27. Maximum Glazing Damage Resulting from Vehicle Impact in Crash-Involved Towed Cars, by Glazing Component and Crash Type: Weighted Average of Nationally Weighted Counts per Year, 1988-1990	52
E1. 1990 Economic Harm	106
E2. 1990 Comprehensive Harm	106
F1. Crash-Involved Vehicle Characteristics Estimates and Standard Errors	111
F2. Crash-Involved Occupant Characteristics Estimates and Standard Errors	112

Figures

1. Crash-Involved Vehicles in the United States, Average per Year, 1988-1990	3
2. Distribution of Towed Car Crash Modes and Areas of Damage, 1988-1990	7
3. Distribution of Towed Car Crashes by Crash Severity and Area of Damage	9
4. Distribution of Crash Modes and Areas of Damage: Comparison of Cars vs. Light Trucks, Vans, and MPVs, 1988-1990	13
5. Distribution of Crash-Involved Occupant Injuries by Maximum Injury Severity: Cars vs. Light Trucks, Vans, and MPVs, 1988-1990	19
6. Injury Rates for Crash-Involved Car Occupants by Maximum Injury Severity as a Function of Restraint Use	22
7. Annual Incidence of Injured Crash-Involved Car Occupants by Maximum Injury Severity and Treatment	25
8. Distribution of Injuries to Crash-Involved Car Occupants by Affected Body Region and Severity of Injury	30
9. Distribution of Injuries to Crash-Involved Car Occupants by Injury Contact and Severity of Injury	35
10. Percentage of Towed Cars With at Least One Passenger Compartment Intrusion by Crash Mode and Area of Damage	39
11. Percentage of Towed Cars With at Least One Intrusion of More Than 6 Inches by Intruding Component	40
12. Door Failures in Towed Car Crashes	45
13. Towed Car Occupant Ejection Rates by Crash Mode and Degree of Ejection	48
14. Ejection-Induced Occupant Injury Rates for Crash-Involved Towed Cars by Degree of Ejection and Crash Mode	50

Executive Summary

During the period 1988 through 1990, an estimated 11.6 million vehicles each year were involved in police-reported traffic crashes. Approximately 88 percent of these were automobiles, pickup trucks, vans, and sport/utility vehicles, collectively referred to as *passenger vehicles*. Most of these vehicles were not seriously damaged: less than 30 percent of them were towed from the crash scene due to damage sustained. Approximately 51,000 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 (81 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 percent of the time, with passengers in the second and further seats about 12 percent of the time.
- One of the health-care consequences of motor vehicle crashes is the burden on emergency services. About 200,000 occupants of passenger vehicles were hospitalized each year as a result of police-reported traffic crashes. Another 935,000 occupants were transported to a medical facility and released, and 240,000 occupants were treated at the scene of the crash.
- Contact with the steering assembly accounted for about 10 percent of the minor injuries but about 19 percent of the severe (AIS 4+) injuries. A similar pattern was observed for contact with the interior side surface, comprising 6 percent of 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.

Executive Summary

- Approximately 13,000 injuries to occupants (mostly drivers) resulted from contacting an airbag. Over 90 percent of these were minor injuries, and there were no documented cases of injury beyond AIS 2 (moderate).
- About 76 percent of vehicles that rolled over experienced loss of passenger compartment integrity, while 8 percent of the frontally damaged cars in multiple-vehicle crashes experienced such an event. For cars that experienced damage to their side, passenger compartment integrity was compromised in 44 percent of the single-vehicle and 39 percent of the multiple-vehicle involvements.
- Approximately 6 percent of the towed cars in crashes rolled over, compared with 17 percent of the towed light trucks.
- About 10 percent of car occupants in rollover crashes were ejected; the remaining crash types exhibited ejection rates in the range of 1 to 2 percent.
- When the data are weighted by the "harm," or severity of the injury, ejected car occupants received 64 percent of the harm experienced in rollover crashes and about 30 percent of the harm in other crash modes. This demonstrates the severity of injury associated with occupant ejection, both complete and partial.

1. Introduction

Background

When the National Accident Sampling System (NASS) was first designed and implemented in 1979, it was anticipated that data from the NASS would be used to support highway and motor vehicle safety programs across the board.

After several years of data collection, it was determined that NASS data was best suited for in-depth analyses of light vehicle crash protection performance. It was also determined that analyses could be enhanced.

In order to enhance NASS applicability in addressing crashworthiness issues, the National Center for Statistics and Analysis (NCSA) of the National Highway Traffic Safety Administration (NHTSA) redesigned the NASS by dividing it into two parts: a Crashworthiness Data System (CDS), and a General Estimates System (GES). These new systems began operation in January 1988.

The NASS/CDS collects detailed information on approximately 7,000 crashes per year, involving light vehicles (passenger cars, light trucks, and vans) under 10,000 pounds gross vehicle weight rating (GVWR) that had to be towed due to damage as a result of the crash ("towed vehicles").

The NASS/GES collects less detailed information, based on a sample of about 45,000 police-reported traffic crashes of all types. Unlike the CDS, the GES does not investigate crashes and 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 1988 through 1990, 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 pickup trucks, vans, and multipurpose vehicles (MPVs), all under 10,000 pounds GVWR. MPVs 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.

Introduction

CDS Estimates

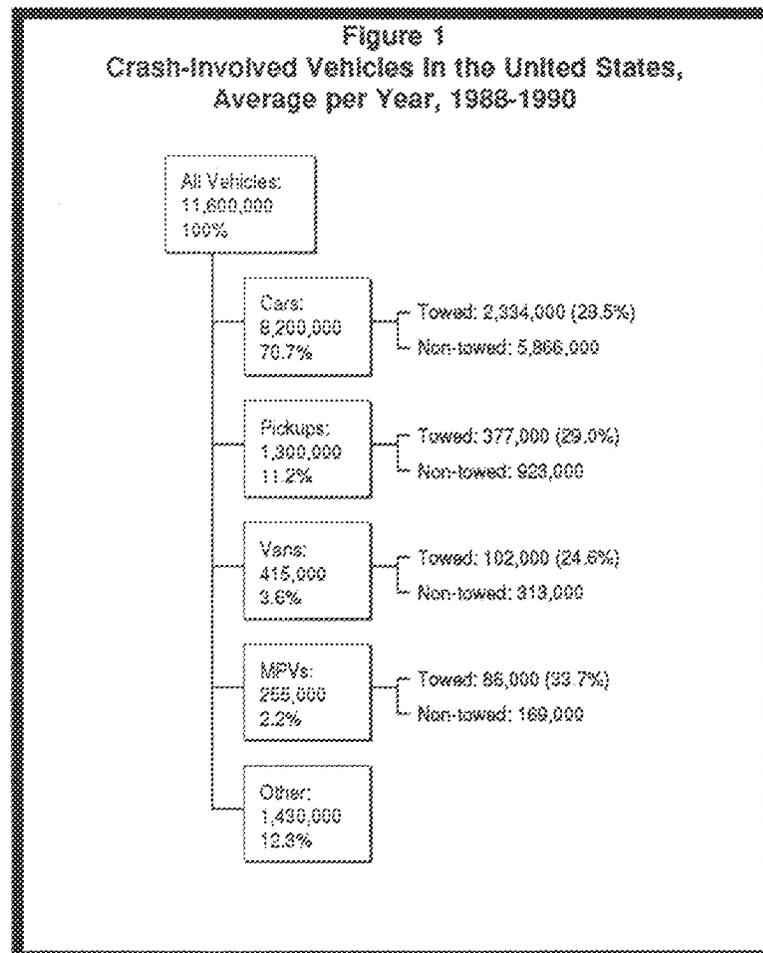
Unless otherwise noted, all the CDS statistics presented in this report are estimates—not exact counts—generated from a sample of crashes that occurred in the 3-year period from 1988 through 1990. Descriptions of the CDS sample design and the procedure used to obtain the data shown in the tables are 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 1988-1990 period are provided in Appendix F.

2. Perspective

A perspective on crash-involved vehicles is illustrated in Figure 1, which shows annual incidence averaged over the years 1988-1990.

The number of all vehicle body types involved in crashes each year in the United States is about 11,600,000; about 87.7 percent of these are passenger cars and light trucks (pickups, vans, and MPVs). Each of these body types is subdivided into (a) towed vehicles, involved in the most severe crashes, and (b) other.

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 1988-1990, the average number of registered passenger vehicles was 169,731,454, of which 122,514,739 (72.2 percent) were passenger cars and 47,216,715 (27.8 percent) were light trucks.



Note: While all vehicles are addressed by NASS/GES, only towed cars, pickups, vans, and MPVs are addressed by NASS/CDS.

Source: NASS/CDS and NASS/GES, 1988-1990.

3. Vehicle Crash Data

Car Size

About 2,334,000 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 81 percent of all NASS/CDS towed vehicles; the remaining 19 percent were light trucks and vans (see Table 5).

Table 1
Crash-Involved Towed Cars by Weight Class, 1988-1990

Weight Class	Total Sample	Total Crash-Involved		Annual Weighted Average	
		Percent	Count	Percent	Count
Small (<2,500 lbs)	6,400	33.5	2,269,363	33.5	781,510
Mid-Size (2,500-3,000 lbs)	5,357	27.7	1,874,241	27.6	643,238
Large (>3000 lbs)	6,403	36.0	2,432,342	36.2	843,998
Unknown Size	512	2.8	189,607	2.8	65,576
Total	18,672	100.0	6,765,553	100.0	2,334,422

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 58 percent of all towed car crashes. Side damage and all other nonrollover crash types account for 28 percent and 8 percent, respectively. Rollover car crashes account for the remaining 6 percent.

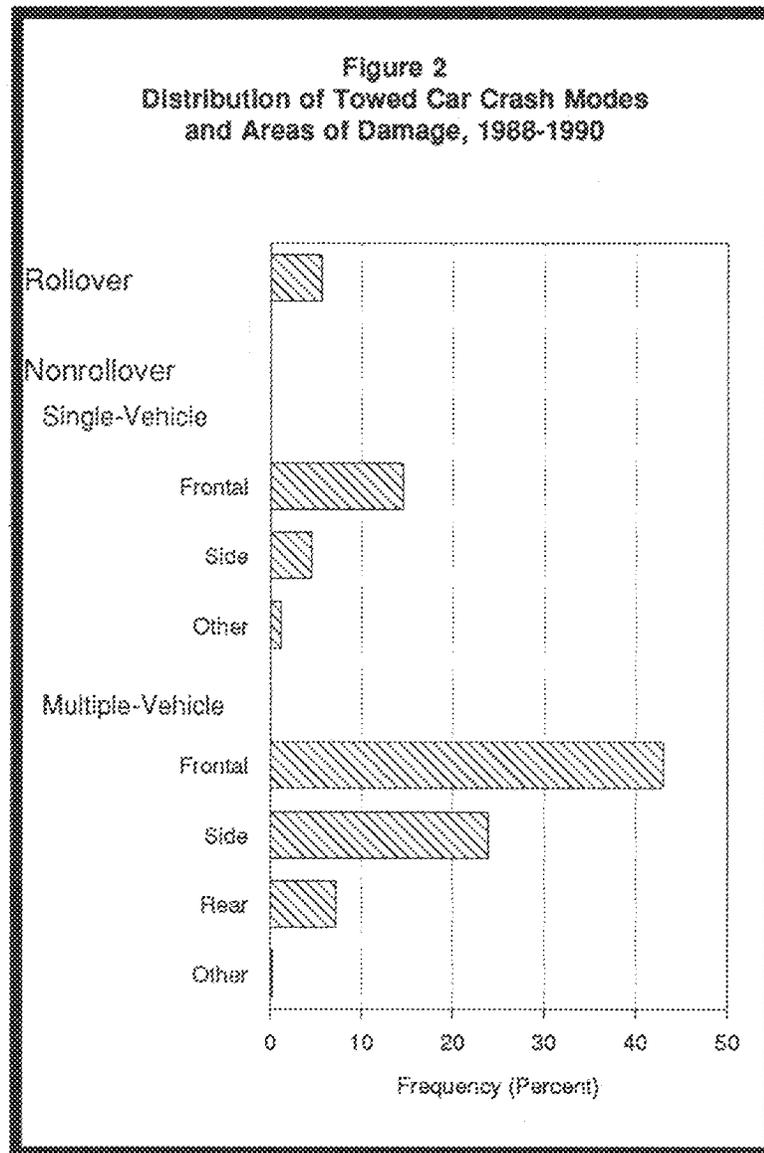
These crash frequencies do not reflect the distribution of harmful outcomes to the car occupants. Because of higher severities of outcome, certain crash types are associated with higher proportions of injury. For example, although rollover occurs in about 6 percent of towed car crashes, it is responsible for about 18 percent of the injuries to car occupants in towed crashes. On the other hand, car crashes with rear damage account for about 8 percent of the cases but are responsible for less than 4 percent of the injuries to occupants.

Vehicle Crash Data

Table 2
Distribution of Towed Car Crash Modes and Areas of Damage, 1988-1990

Crash Mode and Area of Damage	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Rollover					
1-3 Quarter Turns	770	3.7	248,824	3.4	79,895
4+ Quarter Turns	515	1.9	130,442	1.8	42,274
End Over End	62	0.3	17,699	0.4	8,492
<i>Total Rollover</i>	<i>1,347</i>	<i>5.9</i>	<i>396,965</i>	<i>5.6</i>	<i>130,660</i>
Nonrollover					
Single-Vehicle					
Frontal Damage	2,425	14.6	985,110	14.5	339,225
Side Damage	757	4.4	297,086	4.6	104,485
Rear, Top, or Under Damage	153	1.1	75,291	1.1	26,825
<i>Total Single-Vehicle</i>	<i>3,335</i>	<i>20.1</i>	<i>1,357,487</i>	<i>20.2</i>	<i>470,535</i>
Multiple-Vehicle					
Frontal Damage	7,871	42.6	2,884,778	43.0	1,003,701
Side Damage	4,664	24.1	1,632,033	23.9	557,127
Rear Damage	1,434	7.2	486,572	7.2	168,674
Top or Under Damage	21	0.1	7,718	0.2	3,525
<i>Total Multiple-Vehicle</i>	<i>13,990</i>	<i>74.1</i>	<i>5,011,101</i>	<i>74.2</i>	<i>1,733,227</i>
<i>Total Nonrollover</i>	<i>17,325</i>	<i>94.1</i>	<i>6,368,588</i>	<i>94.4</i>	<i>2,203,762</i>
Total Towed Car Crashes	18,672	100.0	6,765,553	100.0	2,334,422

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



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, 1988-1990.

Vehicle Crash Data

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.

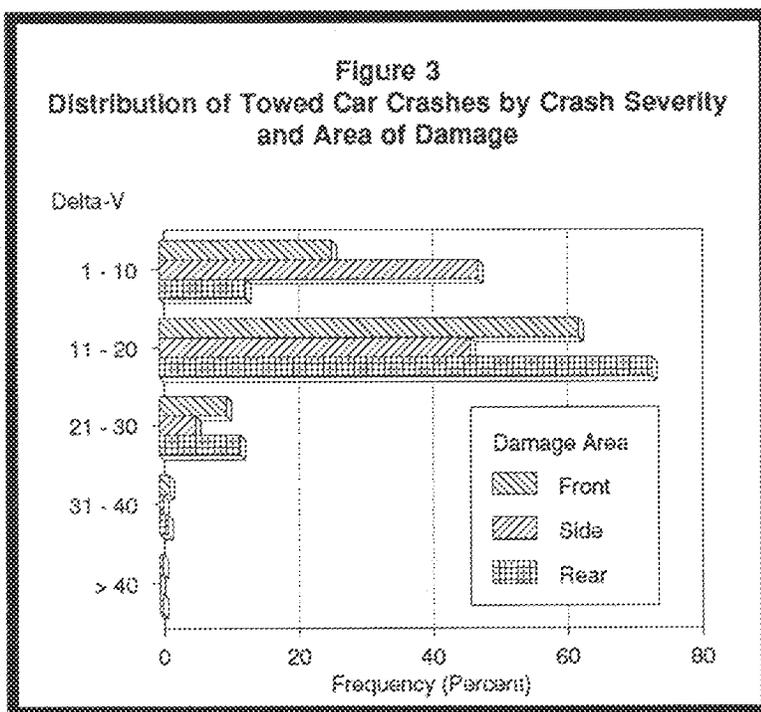
Crash frequency rises sharply to a peak located between 11 and 20 mph, as shown in Figure 3. This frequency drops sharply following the peak; cumulative frequency beyond 40 mph is much less than 1 percent. The same general pattern holds for all areas of damage in nonrollover crashes: front, side, and rear.

The location of the frequency peak for side impacts precedes that for frontal impacts. The peak for rear impacts occurs at a higher severity.

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.

Area of Damage	Crash Frequency by Crash Severity*						Total
	1-10 mph	11-20 mph	21-30 mph	31-40 mph	>40 mph	Unknown	
Front	106,636 25.7%	259,225 62.4%	41,458 10.0%	6,199 1.5%	1,917 0.5%	413,416 49.9%	829,851 35.5%
Side	119,219 47.5%	115,416 46.4%	13,513 5.4%	1,471 0.6%	337 0.1%	247,775 49.9%	496,731 21.3%
Rear	10,771 12.9%	61,282 73.3%	10,081 12.1%	1,074 1.3%	440 0.5%	62,186 42.6%	145,835 6.3%
Other	308 60.7%	199 39.3%	0 --	0 --	0 --	66,402 99.4%	66,909 3.7%
Unknown	14,813 31.9%	26,461 57.0%	4,409 9.5%	677 1.5%	77 0.2%	729,657 94.0%	776,095 33.3%
Total	250,747 31.5%	462,584 58.2%	69,460 8.7%	9,421 1.2%	2,771 0.3%	1,539,437 65.9%	2,334,420 100%

*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, 37 percent, 30 percent, 16 percent, and 12 percent for frontal impacts, compared with the corresponding crash proportions of 26 percent, 62 percent, 10 percent, 2 percent, and almost 0 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 72 percent of the injuries to occupants occur at severities under 30 mph; the cumulative injury proportion under 30 mph is 86 percent and 81 percent for side and rear impacts, respectively.

Vehicle Crash Data

Seating Position of Car Occupants

Every year, approximately 3.5 million people are involved in crashes as occupants of towed cars. Table 4 shows the distribution of occupant seating positions for towed cars from 1988 through 1990.

The distribution pattern—about 66 percent drivers, 21 percent right front passengers, and 13 percent all other—is roughly the same as for all cars regardless of crash involvement.

Car Occupants	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Drivers	18,640	66.0	6,754,197	65.9	2,274,005
Right Front Passengers	6,915	21.1	2,162,464	21.1	729,654
Second Seat Passengers	3,937	11.8	1,203,545	11.7	404,502
Other Passengers	376	1.1	113,492	1.2	42,122
Total	29,868	100.0	10,233,699	100.0	3,450,283

Functional Class and Size of Light Trucks and Vans

About 565,000 light trucks, vans, and multipurpose vehicles (MPVs) under 10,000 pounds gross vehicle weight rating are towed away from the scene of highway crashes every year. Table 5 shows the distribution of these vehicles by functional class and size. The annual weighted average for these vehicles is 19.5 percent of all NASS/CDS towed vehicles. The remaining 80.5 percent are cars.

Vehicle Category and Size	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Compact Pickup	1,420	33.4	534,531	32.7	164,912
Standard Pickup	1,459	31.2	500,131	30.6	173,029
Unknown Size Pickup	108	2.9	46,297	3.4	19,079
Minivan	370	7.0	112,408	7.0	39,329
Standard Van	555	9.8	156,416	10.2	57,558
Unknown Size Van	33	0.6	9,744	0.8	4,700
MPV, Short Utility	223	4.4	70,667	4.8	27,285
MPV, Truck Based	564	10.7	170,574	10.5	59,116
Total	4,732	100.0	1,600,768	100.0	565,008

Vehicle Crash Data

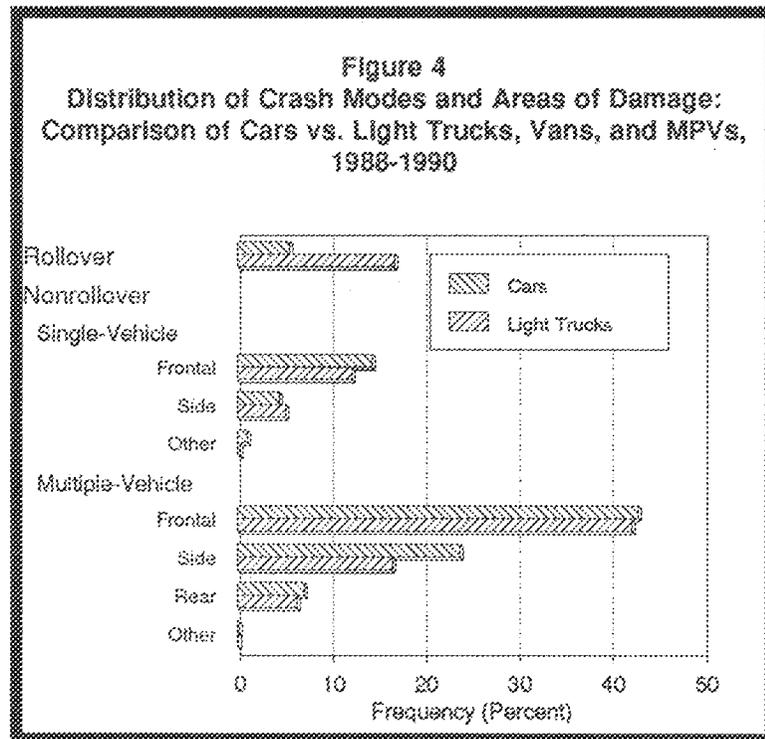
Light Truck and Van Crash Modes and Areas of Damage

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

Crash Mode and Area of Damage	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Rollover					
1-3 Quarter Turns	596	13.5	215,761	12.0	68,066
4+ Quarter Turns	384	5.1	80,860	4.6	25,822
End Over End	27	0.3	4,511	0.3	1,666
<i>Total Rollover</i>	<i>1,007</i>	<i>18.8</i>	<i>301,132</i>	<i>16.9</i>	<i>95,554</i>
Nonrollover					
Single-Vehicle					
Frontal Damage	610	13.7	219,664	12.3	69,455
Side Damage	128	3.5	55,384	5.2	29,267
Rear, Top, or Under Damage	16	0.2	3,849	0.3	1,496
Total Single-Vehicle	754	17.4	278,997	17.7	100,217
Multiple-Vehicle					
Frontal Damage	2,021	43.8	701,446	42.3	238,732
Side Damage	714	14.8	237,427	16.7	94,247
Rear Damage	233	5.1	81,404	6.4	36,005
Top or Under Damage	3	0.0	461	0.0	253
Total Multiple-Vehicle	2,971	63.8	1,020,738	65.4	369,237
<i>Total Nonrollover</i>	<i>3,725</i>	<i>81.2</i>	<i>1,299,635</i>	<i>83.1</i>	<i>469,454</i>
Total Crashes	4,732	100.0	1,600,768	100.0	565,008

Figure 4 shows the distribution of crash modes and areas of damage for towed light trucks, vans, and MPVs, compared with the distribution for towed cars for the years 1988 through 1990.

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, vans, and MPVs are both more frequent than car rollover crashes (18 percent and 6 percent, respectively) and result in a greater proportion of harmful outcomes to the vehicle occupants (38 percent and 18 percent, respectively). The proportion of injuries (38 percent) associated with rollover crashes is the average for three vehicle classes—pickups, vans, and MPVs. For these three classes the proportion of harmful outcomes varies significantly: approximately 34 percent for pickups, 23 percent for vans, and 53 percent for MPVs.



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

Vehicle Crash Data

Light Truck, Van, and Multipurpose Vehicle Crash Severity

Table 7 shows the distribution of towed light truck, van, and MPV 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, 35 percent, 32 percent, 13 percent, and 15 percent for frontal impacts, and the corresponding crash proportions are 28 percent, 58 percent, 10 percent, 3 percent, and about 1 percent.

A large majority of the injuries to occupants in towed light truck, van, and MPV crashes occur at crash severities under 30 mph. For example, in frontal impacts 72 percent of the injuries occur at severities under 30 mph. The cumulative injury proportion under 30 mph is 81 percent and 98 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, Vans, and MPVs by Crash Severity (delta-v)
and Area of Damage: Weighted Average per Year, 1988-1990

Area of Damage	Crash Frequency by Crash Severity*						Total
	1-10 mph	11-20 mph	21-30 mph	31-40 mph	>40 mph	Unknown	
Front	25,788	54,007	9,362	2,432	988	104,869	197,446
	27.9%	58.3%	10.1%	2.6%	1.1%	53.1%	35.0%
Side	12,153	14,899	1,467	155	172	63,219	92,060
	42.1%	51.6%	5.1%	0.5%	0.6%	68.7%	16.3%
Rear	2,895	10,220	807	141	0	8,124	22,176
	20.5%	72.7%	5.7%	1.0%	--	36.6%	3.9%
Other	0	160	0	0	0	42,714	42,873
	--	100.0%	--	--	--	99.6%	7.6%
Unknown	9,626	9,165	550	612	6	190,494	210,453
	48.2%	45.9%	2.8%	3.1%	--	90.5%	37.3%
Total	50,452	88,445	12,186	3,340	1,165	409,420	565,008
	32.4%	56.8%	7.8%	2.1%	0.7%	72.5%	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, Van, and MPV Occupants

Approximately 816,000 people are involved in crashes as occupants of towed light trucks, vans, and MPVs every year. Table 8 shows the distribution of occupant seating positions for these vehicles from 1988 through 1990.

The distribution pattern—about 66 percent drivers, 23 percent right front passengers, and 11 percent all other—is roughly the same as for all light trucks, vans, and MPVs 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, Vans, and MPVs, 1988-1990

Vehicle Occupants	Total Sample Size	Total		Annual Weighted Average	
		Percent	Count	Percent	Count
Drivers	4,706	66.2	1,591,586	65.9	537,384
Right Front Passengers	1,839	29.3	559,080	23.2	189,330
Second Seat Passengers	531	5.5	132,890	5.6	45,706
Other Passengers	479	5.0	119,721	5.3	43,339
Total	7,557	100.0	2,403,077	100.0	815,759

4. Occupant Injury Data

Crash-Involved Occupants by Injury Severity

Approximately 3,450,000 occupants are involved in towed car crashes every year. About 55 percent of them are uninjured, and 45 percent are injured at various severity levels. Similarly, about 816,000 occupants are involved in towed light truck, van, and MPV crashes per year, with about 41 percent injured and 59 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 100 percent for AIS=6; about 50 percent for AIS=5; about 10 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, vans, and MPVs. 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.

Occupant Injury Data

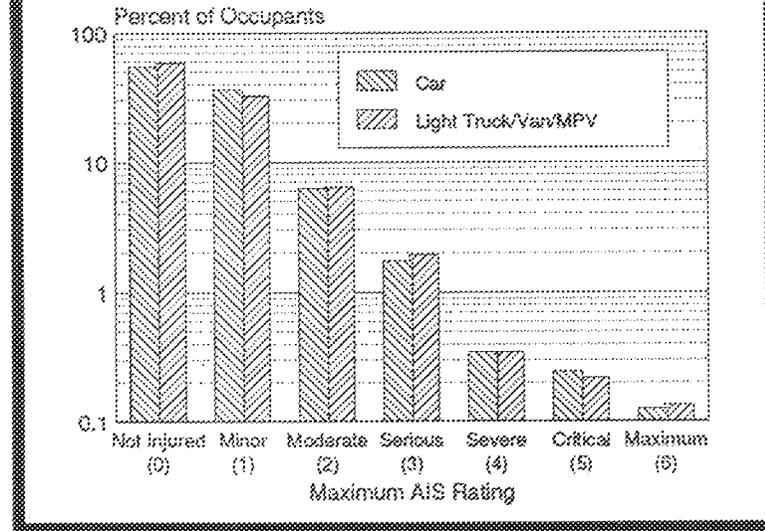
Table 9
Distribution of Crash-Involved
Car Occupants by Maximum Injury Severity:
Weighted Average per Year, 1988-1990

Maximum AIS Rating	Count	Percent
Not Injured (0)	1,746,586	54.8
Minor (1)	1,161,385	36.4
Moderate (2)	200,654	6.3
Serious (3)	54,932	1.7
Severe (4)	11,060	0.3
Critical (5)	7,819	0.2
Maximum (6)	3,985	0.1
<i>Total, Known Severity</i>	<i>3,186,420</i>	<i>92.4</i>
Injured, Severity Unknown (7) or Unknown if Injured	263,862	7.6
Total	3,450,283	100.0

Table 10
Distribution of Crash-Involved
Light Truck, Van, and MPV Occupants
by Maximum Injury Severity:
Weighted Average per Year, 1988-1990

Maximum AIS Rating	Count	Percent
Not Injured (0)	449,187	58.5
Minor (1)	249,343	32.5
Moderate (2)	49,485	6.4
Serious (3)	14,889	1.9
Severe (4)	2,681	0.3
Critical (5)	1,692	0.2
Maximum (6)	1,032	0.1
<i>Total, Known Severity</i>	<i>768,308</i>	<i>94.2</i>
Injured, Severity Unknown (7) or Unknown if Injured	47,451	5.8
Total	815,759	100.0

Figure 5
Distribution of Crash-Involved Occupant Injuries
by Maximum Injury Severity:
Cars vs. Light Trucks, Vans, and MPVs, 1988-1990



Occupant Injury Data

Use of Manual Restraints

Despite the recent implementation of automatic occupant restraints, the crash experience for 1988 through 1990, 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, van, and MPV occupants.

Table 11
Distribution of Crash-Involved Car Occupants by Safety Belt Use
and Maximum Injury Severity: Weighted Average per Year, 1988-1990

Manual Belt Use	Frequency of Injury by Maximum AIS Rating*								Total
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7), or Unknown If Injured	
None	504,732 32.3%	485,885 43.3%	110,768 55.6%	33,452 63.0%	7,368 67.0%	5,565 71.1%	3,006 75.4%	98,872 49.6%	1,249,669 39.6%
Shoulder Belt	2,410 0.2%	1,719 0.2%	147 0.1%	0 --	0 --	0 --	20 0.5%	69 --	4,400 0.1%
Lap Belt	132,151 8.5%	62,140 5.5%	10,143 5.2%	1,665 3.1%	572 5.2%	589 7.5%	190 4.8%	7,403 3.7%	214,858 6.8%
Shoulder and Lap Belt	842,800 54.0%	542,622 48.4%	70,185 35.9%	17,563 33.1%	2,831 25.7%	1,591 20.3%	641 16.1%	71,076 35.7%	1,549,311 49.1%
Belt Used, Type Unknown	44,994 2.9%	7,690 0.7%	4,207 2.1%	409 0.8%	76 0.7%	49 0.6%	129 3.2%	19,802 9.9%	77,055 2.5%
Belt With Child Seat	33,816 2.2%	21,347 1.9%	220 0.1%	31 0.1%	162 1.4%	30 0.4%	0 --	1,960 1.0%	57,556 1.8%
Total Belt Used	1,056,171 67.7%	635,617 56.7%	84,907 43.4%	19,667 37.0%	3,631 33.0%	2,259 28.9%	979 24.6%	100,313 50.4%	1,903,480 60.4%
Total Known	1,560,902 96.0%	1,121,403 97.1%	165,675 87.6%	63,119 96.3%	11,020 94.7%	7,834 97.3%	3,986 95.8%	199,185 70.7%	3,153,150 91.4%
Unknown	172,525 10.0%	34,078 2.9%	4,883 2.4%	2,040 3.7%	616 5.3%	218 2.7%	177 4.2%	82,633 29.3%	297,169 9.6%
Total	1,733,427 50.2%	1,155,481 33.5%	200,558 5.8%	55,159 1.6%	11,635 0.3%	8,042 0.2%	4,163 0.1%	281,818 8.2%	3,450,282 100.0%

*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.

It is evident in both tables that belt use in one form or another is approximately 60 percent. However, this figure is considered to be an overestimate by comparison with belt use rates observed by NHTSA in independent surveys of the motoring public. In 1990, driver shoulder belt use was found to be 49.0 percent and right front passenger shoulder belt use was 43.9 percent in the 19-Cities Study.

Table 12
Distribution of Crash-Involved Light Truck, Van, and MPV Occupants
by Safety Belt Use and Maximum Injury Severity:
Weighted Average per Year, 1988-1990

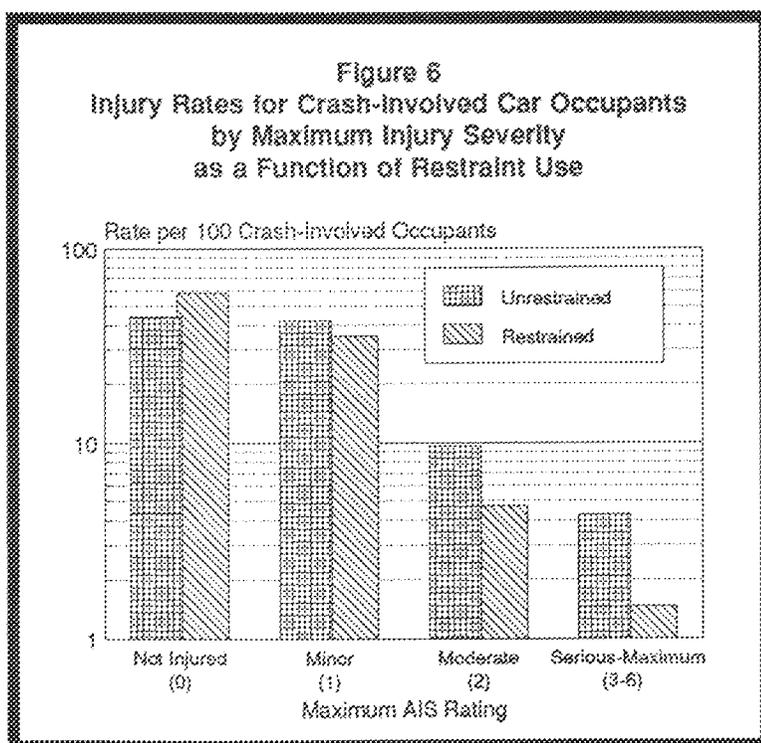
Manual Belt Use	Frequency of Injury by Maximum AIS Rating*							Injured, Severity Unknown (?), or Unknown If Injured	Total
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)		
None	131,329 34.0%	119,376 50.0%	27,488 59.7%	10,512 71.5%	2,159 76.9%	1,412 82.4%	793 82.2%	18,092 51.8%	311,163 42.8%
Shoulder Belt	1,390 0.4%	153 0.1%	0 --	31 0.2%	0 --	0 --	0 --	0 --	1,574 0.2%
Lap Belt	31,483 8.1%	20,679 8.7%	2,900 6.4%	1,220 8.4%	334 11.9%	0 --	91 9.4%	731 2.1%	57,679 7.9%
Shoulder and Lap Belt	204,678 52.9%	92,646 38.8%	15,302 33.3%	2,724 18.5%	313 11.2%	160 9.3%	55 5.7%	11,969 34.2%	327,677 45.1%
Belt Used, Type Unknown	7,531 1.9%	1,496 0.6%	162 0.4%	95 0.6%	0 --	57 3.3%	26 2.7%	3,961 11.3%	13,328 1.8%
Belt With Child Seat	10,337 2.7%	4,361 1.8%	112 0.2%	104 0.7%	0 --	85 5.0%	0 --	202 0.6%	15,202 2.1%
Total, Belt Used	255,420 66.0%	119,935 50.0%	18,539 40.3%	4,167 28.5%	648 23.1%	302 17.6%	171 17.8%	16,663 48.2%	415,660 57.2%
Total Known	386,749 86.0%	238,912 96.7%	46,927 98.3%	14,693 93.8%	2,807 95.1%	1,715 96.6%	964 83.9%	34,955 71.2%	726,823 89.1%
Unknown	63,117 14.0%	8,035 3.3%	2,249 4.7%	975 6.2%	146 4.9%	60 3.4%	186 16.1%	14,169 28.8%	88,936 10.9%
Total	449,867 55.1%	246,947 30.3%	49,276 5.9%	15,668 1.9%	2,953 0.4%	1,774 0.2%	1,150 0.1%	49,124 6.0%	815,759 100.0%

*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.

Effect of Belt 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.



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. Fatales with AIS=1 are the result of incomplete medical information by which to code the data and therefore have been excluded from the tables. A similar distribution is shown in Table 14 for crash-involved light truck, van, and MPV occupants.

Table 13
Distribution of Crash-Involved Car Occupants by Treatment
and Maximum Injury Severity: Weighted Average per Year, 1988-1990

Treatment	Frequency of Injury by Maximum AIS Rating*								Total
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7), or Unknown If Injured	
None	1,627,871	360,416	12,411	0	0	0	0	51,743	2,072,442
	76.5%	18.4%	0.6%	--	--	--	--	2.5%	60.1%
Treated at Scene	26,833	136,692	11,563	1,673	0	0	0	7,859	166,840
	14.4%	74.2%	6.2%	1.0%	--	--	--	4.2%	6.4%
Transported and Released	46,347	591,472	110,398	7,000	0	0	0	21,980	777,197
	6.0%	76.1%	14.2%	0.9%	--	--	--	2.6%	20.5%
Hospitalized	2,582	33,477	63,311	43,870	7,287	4,705	0	3,501	158,734
	1.6%	21.1%	39.9%	27.6%	4.6%	3.0%	--	2.2%	4.6%
Fatal	0	0	1,995	2,922	3,603	3,829	3,910	2,088	18,326
	--	--	10.0%	15.9%	19.7%	20.9%	21.3%	11.3%	0.5%
Unknown	35,816	14,889	2,661	570	23	15	0	182,770	236,744
	15.1%	6.3%	1.1%	0.2%	--	--	--	77.2%	6.9%
Total	1,739,450	1,156,945	202,359	56,236	10,912	6,548	3,910	259,822	3,450,282
	50.4%	33.6%	5.9%	1.6%	0.3%	0.2%	0.1%	7.8%	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. For the "Total" column, the second data row shows the percentage of the grand total.

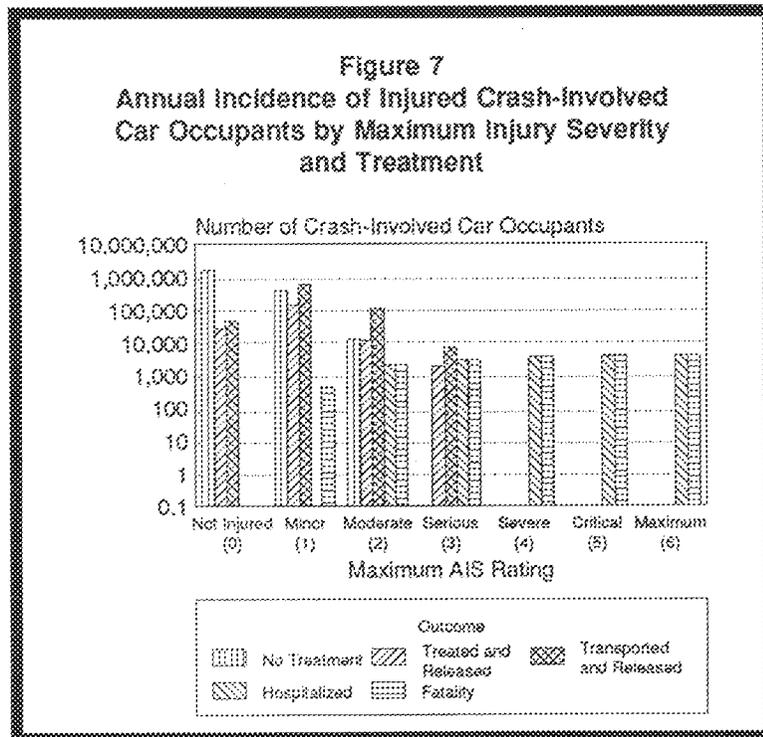
Occupant Injury Data

Table 14
Distribution of Crash-Involved Light Truck, Van, and MPV Occupants
by Treatment and Maximum Injury Severity:
Weighted Average per Year, 1988-1990

Treatment	Frequency of Injury by Maximum AIS Rating*								Total
	Not Injured (0)	Minor (1)	Moderate (2)	Serious (3)	Severe (4)	Critical (5)	Maximum (6)	Injured, Severity Unknown (7), or Unknown if Injured	
None	423,853 81.0%	84,012 16.1%	5,198 1.0%	0 --	0 --	0 --	0 --	9,941 1.9%	523,003 64.1%
Treated at Scene	11,479 22.4%	35,733 69.6%	2,092 4.1%	0 --	0 --	0 --	0 --	2,005 3.9%	51,309 6.3%
Transported and Released	6,940 4.4%	118,097 74.5%	25,048 15.8%	3,008 1.9%	0 --	0 --	0 --	5,398 3.4%	158,491 19.4%
Hospitalized	323 0.8%	8,813 20.9%	16,758 39.8%	11,933 28.3%	1,630 3.9%	1,037 2.5%	0 --	1,629 3.9%	42,123 5.2%
Fatal	0 --	0 --	609 12.2%	928 16.6%	967 19.4%	680 13.7%	996 20.0%	895 16.0%	4,976 0.6%
Unknown	3,993 11.1%	1,342 3.7%	1,281 3.6%	155 0.4%	29 0.1%	0 --	0 --	29,057 81.0%	35,857 4.4%
Total:	446,589 54.7%	247,999 30.4%	50,983 6.2%	15,923 2.0%	2,626 0.3%	1,717 0.2%	998 0.1%	48,925 6.0%	815,759 100.0%

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



Occupant Injury Data

Body Regions Injured in Highway Crashes

There are about 1,750,000 cars towed away from highway crashes every year. The incidence of crash-involved occupants in these cars is about 3,450,000 per year. Of these, about 1,700,000 car occupants per year are injured, incurring about 4,300,000 injuries of various severities, in various body regions, and by various injuring 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 15 shows the same distribution for injured occupants of light trucks, vans, and MPVs.

Body Region	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Head (Brain)	67,990 35.9% 1.8%	93,620 49.6% 24.6%	15,864 8.4% 13.6%	5,769 3.0% 25.0%	4,238 2.2% 37.6%	892 0.5% 17.6%	712 0.4% 1.1%	189,283
Head (Skull)	671 5.3% --	5,115 40.3% 1.3%	4,966 39.2% 4.3%	1,213 9.6% 5.3%	0 -- --	566 4.5% 11.2%	148 1.2% 0.2%	12,679
Head (Other)	18,887 49.3% 0.5%	1,832 4.3% 0.4%	30 0.1% --	42 0.1% 0.2%	0 -- --	0 -- --	17,747 46.3% 26.7%	38,338
Face	151,019 84.9% 4.1%	20,543 11.5% 5.4%	2,583 1.5% 2.2%	685 0.4% 3.0%	0 -- --	0 -- --	3,075 1.7% 4.6%	177,904
Neck	321,195 94.8% 8.7%	9,163 2.7% 2.4%	3,030 0.9% 2.6%	202 0.1% 0.9%	347 0.1% 3.1%	330 0.1% 6.5%	5,764 1.7% 8.7%	340,051
Chest	43,358 34.7% 1.2%	27,451 22.0% 7.2%	31,706 25.4% 27.2%	11,609 9.3% 50.3%	3,239 2.6% 28.7%	2,169 1.7% 42.8%	5,291 4.2% 8.0%	124,822
Shoulder and Back	151,705 77.3% 4.1%	36,768 19.7% 9.7%	1,956 1.0% 1.7%	0 -- --	50 -- 0.4%	0 -- --	5,781 2.9% 8.7%	196,259

*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, 1988-1990

Body Region	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Abdomen	6,413 11.5% 0.2%	23,526 42.4% 6.2%	7,048 12.6% 6.1%	2,484 4.5% 10.6%	2,366 4.2% 21.0%	77 0.1% 1.5%	13,722 24.6% 20.7%	55,736
Spine	10 0.4% --	0 -- --	694 26.2% 0.6%	698 26.3% 3.0%	670 32.8% 7.7%	228 8.6% 4.5%	153 5.7% 0.2%	2,653
Upper Extremities	46,630 48.0% 1.3%	35,005 36.0% 9.2%	10,586 10.9% 9.1%	0 -- --	0 -- --	0 -- --	5,012 5.2% 7.6%	97,233
Pelvis	3,396 9.4% 0.1%	21,299 59.9% 5.6%	10,374 28.7% 8.9%	162 0.4% 0.7%	0 -- --	0 -- --	953 2.6% 1.4%	36,175
Lower Extremities	35,137 31.9% 0.9%	43,919 39.8% 11.5%	26,188 23.8% 22.5%	188 0.2% 0.8%	0 -- --	0 -- --	4,826 4.4% 7.3%	110,156
Skin	2,851,411 97.8% 76.9%	62,386 2.1% 16.4%	1,331 -- 1.1%	8 -- --	166 -- 1.5%	602 -- 15.8%	682 -- 1.0%	2,916,785
All Other	11,167 81.8% 0.3%	0 -- --	0 -- --	0 -- --	0 -- --	0 -- --	2,486 18.2% 3.7%	13,655
Total	3,708,989	380,618	116,354	23,060	11,275	5,063	66,371	4,011,730

*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.

Occupant Injury Data

Table 16
Distribution of All Injuries to Crash-Involved Light Truck,
Van, and MPV Occupants by Body Region and Severity:
Weighted Average per Year, 1988-1990

Body Region	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Head (Brain)	22,078 44.9% 2.5%	20,105 40.9% 21.3%	3,595 7.3% 11.7%	1,693 3.4% 32.8%	1,439 2.9% 53.4%	214 0.4% 15.2%	79 0.2% 0.7%	49,202
Head (Skull)	0 -- --	1,866 41.2% 2.0%	2,056 45.4% 6.7%	230 5.1% 4.4%	0 -- --	322 7.1% 22.9%	58 1.3% 0.5%	4,532
Head (Other)	7,069 69.6% 0.8%	244 2.4% 0.3%	13 0.1% --	43 0.4% 0.8%	0 -- --	0 -- --	2,802 27.5% 25.3%	10,191
Face	35,293 80.6% 4.0%	5,791 13.2% 6.1%	1,555 3.6% 5.1%	32 0.1% 0.6%	0 -- --	0 -- --	1,098 2.5% 9.9%	43,768
Neck	55,637 91.0% 6.3%	2,603 4.6% 3.0%	1,280 2.1% 4.2%	57 0.1% 1.1%	314 0.5% 11.7%	70 0.1% 5.0%	960 1.6% 8.7%	61,122
Chest	11,539 40.7% 1.3%	5,335 18.8% 5.7%	7,264 25.6% 23.7%	2,007 7.1% 38.7%	554 2.0% 20.5%	530 1.9% 37.6%	1,103 3.9% 10.0%	28,332
Shoulder and Back	45,668 80.6% 5.2%	9,806 17.3% 10.4%	335 0.6% 1.1%	0 -- --	0 -- --	0 -- --	880 1.6% 8.0%	56,690

*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, Van,
and MPV Occupants by Body Region and Severity:
Weighted Average per Year, 1988-1990

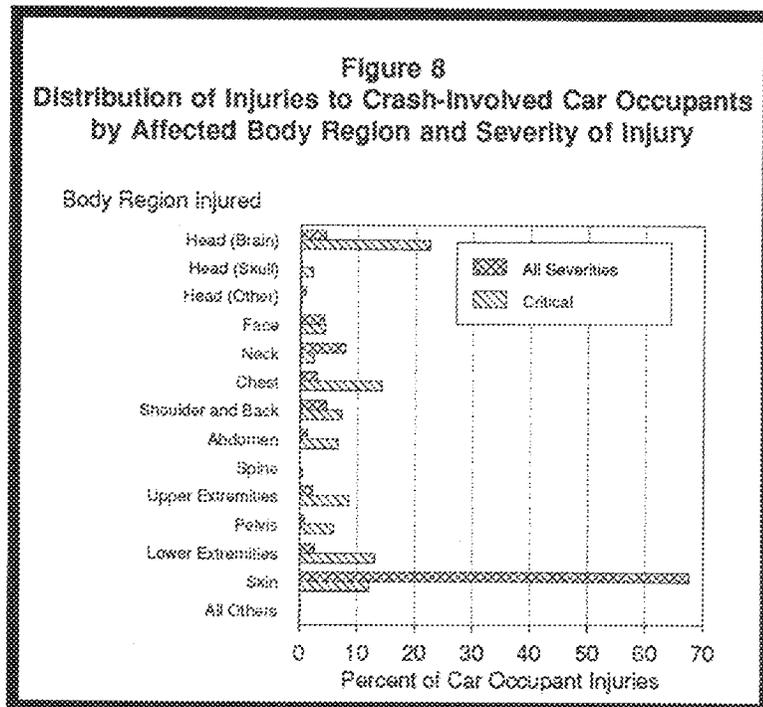
Body Region	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Abdomen	1,674 19.4% 0.2%	4,524 52.5% 4.8%	813 9.4% 2.6%	789 9.2% 15.2%	275 3.2% 10.2%	23 0.3% 1.7%	518 6.0% 4.7%	8,616
Spine	0 -- --	0 -- --	388 53.9% 1.3%	128 17.8% 2.5%	95 13.2% 3.5%	56 7.6% 4.0%	52 7.3% 0.5%	721
Upper Extremities	10,667 46.7% 1.2%	9,042 39.6% 9.6%	2,638 11.6% 8.6%	0 -- --	0 -- --	0 -- --	491 2.1% 4.4%	22,837
Pelvis	1,296 20.3% 0.1%	2,928 46.0% 3.1%	1,982 31.1% 6.5%	12 0.2% 0.2%	0 -- --	0 -- --	151 2.4% 1.4%	6,369
Lower Extremities	8,387 27.9% 1.0%	11,821 39.3% 12.6%	8,429 29.0% 27.5%	195 0.6% 3.8%	0 -- --	0 -- --	1,240 4.1% 11.2%	30,072
Skin	679,340 97.0% 77.2%	19,917 2.6% 21.1%	346 -- 1.1%	0 -- --	19 -- 0.7%	192 -- 13.6%	236 -- 2.1%	700,050
All Other	1,054 42.6% 0.1%	11 0.4% --	0 -- --	0 -- --	0 -- --	0 -- --	1,407 56.9% 12.7%	2,473
Total	879,720	94,191	30,692	5,185	2,697	1,408	11,081	1,024,974

*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.

Occupant Injury Data

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 (e.g., critical (AIS=5)). This is illustrated in Figure 8, where two distributions are shown: one for all severities and one for critical severities, each adding up to 100 percent.

It is evident in this figure that body regions such as lower extremities, face, upper extremities, and neck are injured with a high frequency in general, but do not occur at all at critical severities. Conversely, other body regions, such as the brain, chest, and abdomen are injured frequently at high severities, but do not occur significantly when all severities are considered.



Injury Contacts

In addition to data on injured body regions, crash protection practitioners need data concerning the various sources of injury (injuring 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, vans, and MPVs. Table 17 shows the distribution of all crash-involved car occupant injuries as a function of injury severity and injuring contact. Table 18 shows the same distribution for light truck occupants.

Injury Contact	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Steering Assembly	408,800 84.2% 11.1%	52,337 10.8% 13.6%	14,797 3.0% 12.3%	4,447 0.9% 18.9%	2,008 0.4% 16.7%	1,040 0.2% 20.1%	2,073 0.4% 3.0%	485,502
Instrument Panel	579,849 90.1% 16.5%	41,381 6.5% 10.7%	18,785 2.6% 14.0%	1,485 0.2% 6.3%	1,025 0.2% 8.5%	187 --- 3.6%	2,367 0.4% 3.5%	537,097
Windshield	389,179 86.3% 10.5%	42,278 9.6% 11.0%	3,914 0.9% 3.3%	862 0.2% 3.7%	295 0.1% 1.9%	34 --- 0.6%	4,356 1.0% 6.3%	440,857
Interior Side Surface	222,136 74.7% 6.0%	44,322 14.9% 11.5%	22,774 7.7% 19.1%	4,680 1.6% 19.8%	1,325 0.4% 11.0%	865 0.2% 12.8%	1,524 0.5% 2.2%	297,427
Pillars	45,702 67.8% 1.2%	12,172 18.0% 3.2%	5,610 8.3% 4.7%	1,834 2.7% 7.8%	1,130 1.7% 9.4%	356 0.5% 6.9%	633 0.9% 0.9%	67,436
Restraint (Belt) System	255,284 88.6% 6.9%	15,874 5.5% 4.1%	3,402 1.2% 2.8%	739 0.3% 3.1%	400 0.1% 3.3%	36 --- 0.7%	12,533 4.9% 18.2%	288,239
Child Seat	22,168 97.8% 0.6%	75 0.3% ---	91 0.4% 0.1%	53 0.2% 0.2%	0 --- ---	0 --- ---	286 1.3% 0.4%	22,673
Airbag	11,605 91.2% 0.3%	619 4.8% 0.2%	0 --- ---	0 --- ---	0 --- ---	0 --- ---	504 4.0% 0.7%	12,728
Head Restraints	39,286 95.4% 1.1%	1,292 3.1% 0.3%	364 0.9% 0.3%	75 0.2% 0.3%	0 --- ---	27 0.1% 0.5%	138 0.3% 0.2%	41,183
Seat Back	139,085 88.5% 3.8%	12,929 6.2% 3.4%	2,771 1.6% 2.3%	418 0.3% 1.8%	56 --- 0.5%	39 --- 0.8%	1,947 1.2% 2.7%	157,148
Roof	54,413 75.3% 1.5%	11,960 16.6% 3.1%	2,901 4.0% 2.4%	1,228 1.7% 5.2%	832 1.2% 6.9%	186 0.3% 3.6%	700 1.0% 1.0%	72,222

*For each injuring 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.

Occupant Injury Data

Table 17 (Continued)
Distribution of All Injuries to Crash-Involved Car Occupants
by Injury Contact and Severity: Weighted Average per Year, 1988-1990

Injury Contact	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Floor	75,423	15,127	5,384	0	0	0	56	95,990
	78.6%	15.8%	5.6%	--	--	--	0.1%	
	2.0%	3.9%	4.5%	--	--	--	0.1%	
Non-Contact Injuries	358,265	7,503	904	14	74	148	158	367,065
	97.6%	2.0%	0.2%	--	--	--	--	
	9.7%	1.9%	0.8%	0.1%	0.6%	2.9%	0.2%	
Fire in Vehicle	3,193	0	57	0	162	703	0	4,115
	77.6%	--	1.4%	--	3.9%	17.1%	--	
	0.1%	--	--	--	1.3%	13.6%	--	
Ground	35,777	11,087	2,637	745	685	242	420	51,794
	69.1%	21.4%	5.5%	1.4%	1.3%	0.5%	0.8%	
	1.0%	2.9%	2.4%	3.2%	5.7%	4.7%	0.6%	
Exterior (Occupant's Vehicle)	3,313	793	589	121	129	157	141	5,242
	63.2%	15.1%	11.2%	2.3%	2.5%	3.0%	2.7%	
	0.1%	0.2%	0.5%	0.5%	1.1%	3.0%	0.2%	
Exterior (Other Vehicle or Exterior Object)	13,934	4,393	3,446	1,083	514	315	452	24,137
	57.7%	18.2%	14.3%	4.5%	2.1%	1.3%	1.9%	
	0.4%	1.1%	2.9%	4.6%	4.3%	5.1%	0.7%	
Side and Rear Glazing	136,289	10,891	1,533	302	395	129	352	149,891
	90.9%	7.3%	1.0%	0.2%	0.3%	0.1%	0.2%	
	3.7%	2.8%	1.3%	1.3%	3.3%	2.5%	0.5%	
All Others	166,354	15,105	4,121	253	91	36	3,224	211,194
	89.2%	7.2%	1.9%	0.1%	--	--	1.5%	
	5.1%	3.9%	3.4%	1.1%	0.8%	0.7%	4.7%	
Unknown	721,716	84,805	27,221	5,241	2,993	878	36,935	879,789
	82.0%	9.6%	3.1%	0.6%	0.3%	0.1%	4.2%	
	19.5%	22.0%	22.8%	22.2%	24.8%	16.9%	53.8%	
Total	3,697,770	384,941	119,499	23,590	12,056	5,182	66,691	4,311,730

*For each injuring 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, Van,
and MPV Occupants by Injury Contact and Severity:
Weighted Average per Year, 1988-1990

Injury Contact	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Steering Assembly	98,281 85.2% 11.2%	9,990 8.7% 10.4%	4,448 3.9% 13.7%	1,324 1.1% 23.7%	410 0.4% 14.1%	438 0.4% 26.6%	426 0.4% 4.1%	115,316
Instrument Panel	133,254 87.8% 15.2%	11,456 7.5% 11.9%	6,901 4.0% 18.5%	321 0.2% 5.7%	207 0.1% 7.1%	0 -- --	496 0.3% 4.8%	151,734
Windshield	90,970 88.9% 10.4%	8,976 8.6% 9.3%	871 0.9% 2.7%	257 0.3% 4.6%	372 0.4% 12.8%	89 0.1% 5.4%	806 0.8% 7.6%	102,342
Interior Side Surface	46,370 86.6% 5.3%	5,502 10.3% 5.7%	1,354 2.5% 4.2%	192 0.4% 3.4%	47 0.1% 1.6%	0 -- --	63 0.2% 0.8%	53,548
Pillars	9,528 77.1% 1.1%	1,607 14.6% 1.9%	490 4.0% 1.5%	209 1.7% 3.7%	145 1.2% 5.0%	0 -- --	179 1.5% 1.7%	12,359
Restraint (Belt) System	37,280 90.7% 4.3%	2,836 6.9% 3.0%	603 1.5% 1.9%	73 0.2% 1.3%	9 -- 0.3%	0 -- --	280 0.7% 2.7%	41,081
Child Seat	1,518 87.8% 0.2%	106 6.1% 0.1%	106 6.1% 0.3%	0 -- --	0 -- --	0 -- --	0 -- --	1,729
Head Restraints	1,059 77.9% 0.1%	294 15.0% 0.2%	96 7.1% 0.3%	0 -- --	0 -- --	0 -- --	0 -- --	1,359
Seat Back	23,530 88.4% 2.7%	1,981 7.4% 2.1%	669 2.6% 2.1%	419 1.6% 7.5%	0 -- --	0 -- --	0 -- --	26,618
Roof	21,067 77.9% 2.4%	4,148 15.3% 4.3%	1,298 4.8% 4.0%	192 0.7% 3.4%	61 0.2% 2.1%	82 0.3% 5.0%	194 0.7% 1.9%	27,042

*For each injuring 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.

Occupant Injury Data

Table 18 (Continued)
Distribution of All Injuries to Crash-Involved Light Truck, Van,
and MPV Occupants by Injury Contact and Severity:
Weighted Average per Year, 1988-1990

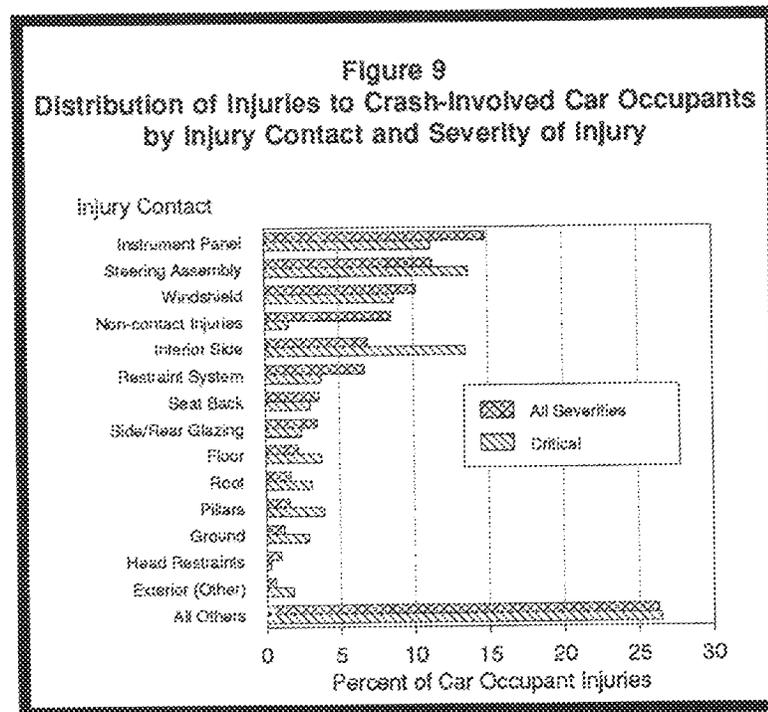
Injury Contact	Frequency of Injury by AIS Rating*							Total
	1	2	3	4	5	6	Unknown	
Floor	14,230 63.7% 1.6%	5,859 26.3% 6.1%	2,161 9.7% 6.7%	97 0.4% 1.7%	0 -- --	0 -- --	0 -- --	22,356
Non-Contact Injuries	79,408 98.1% 9.1%	1,496 1.8% 1.6%	48 0.1% 0.1%	0 -- --	0 -- --	0 -- --	0 -- --	80,952
Fire in Vehicle	26 8.1% --	14 4.0% --	68 19.9% 0.2%	0 -- --	44 12.8% 1.5%	188 55.1% 11.4%	0 -- --	341
Ground	28,604 75.3% 3.3%	6,228 15.3% 6.5%	2,193 5.7% 6.7%	436 1.1% 7.8%	245 0.6% 8.5%	197 0.5% 12.0%	165 0.4% 1.6%	38,268
Exterior (Occupant's Vehicle)	2,881 57.6% 0.3%	744 14.9% 0.8%	448 8.9% 1.4%	170 3.4% 3.1%	241 4.8% 8.3%	47 0.9% 2.9%	473 9.5% 4.6%	5,004
Exterior (Other Vehicle or Exterior Object)	2,936 58.6% 0.3%	658 13.9% 0.7%	922 18.4% 2.8%	135 2.7% 2.4%	76 1.5% 2.5%	104 2.1% 6.4%	138 2.7% 1.3%	5,010
Side and Rear Glazing	36,658 88.6% 4.2%	3,509 8.5% 3.7%	436 1.1% 1.3%	158 0.4% 2.8%	212 0.5% 7.3%	19 -- 1.1%	345 0.8% 3.4%	41,357
All Others	30,658 85.3% 3.5%	4,376 12.2% 4.6%	577 1.5% 1.8%	58 0.2% 1.0%	100 0.3% 3.5%	20 0.1% 1.2%	168 0.5% 1.6%	35,997
Unknown	217,490 92.8% 24.8%	26,134 10.0% 27.2%	9,686 3.7% 29.8%	1,536 0.5% 27.5%	730 0.3% 25.2%	458 0.2% 27.9%	6,528 2.5% 63.5%	262,561
Total	675,989	96,093	32,494	5,577	2,900	1,643	10,279	1,024,974

*For each injuring 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 critical injuries. This is illustrated in Figure 9, where two distributions are shown: one for all severities and one for critical severities, each adding up to 100 percent.

As can be seen in this figure, the windshield as an injury contact has a high frequency in general but a low frequency for critical injuries. The converse is observed for the pillars, and roof.

A large disparity between all severities and critical severities is also observed for other injuring contacts. Included in Figure 9 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.



5. Vehicle Damage Data

Loss of Passenger Compartment Integrity in Towed Cars

Loss of passenger compartment integrity means that a crash-induced opening (that was previously closed) has occurred in the passenger compartment of sufficient size to allow an occupant to have been ejected completely or partially during the crash sequence. Integrity may be lost through components such as the windshield, doors, windows, roof hatch, and combinations thereof.

Table 19 gives estimates of the number of towed cars per year (nationwide average for the years 1988 through 1990) that experienced a loss of passenger compartment integrity, as a function of opening and crash type. Loss of integrity through at least one of the openings shown amounts to 25 percent of crash-involved cars, irrespective of crash type (i.e., for all crash types).

The frequency of occurrence of loss of integrity in crash-involved cars by crash type is as follows:

- 76 percent for rollovers
- 17 percent for nonrollover single-vehicle frontal crashes
- 44 percent for nonrollover single-vehicle side crashes
- 8 percent for nonrollover multiple-vehicle frontal crashes
- 39 percent for nonrollover multiple-vehicle side crashes
- 28 percent for nonrollover multiple-vehicle rear crashes.

Note that the entire 1988-1990 sample of cases available for this analysis is about 5,400 crash-involved cars.

Vehicle Damage Data

Table 19
Loss of Passenger Compartment Integrity in Crash-Involved Cars:
Weighted Average of Nationally Weighted Counts, 1988-1990

Crash Type	Loss of Integrity*						Total
	None	Windshield	Doors	Roof Hatch	Windows	Combination	
Rollover	28,229 24.0%	6,779 5.8%	1,247 1.1%	751 0.6%	32,752 27.9%	47,656 40.6%	117,417
Nonrollover							
Single-Vehicle							
Frontal Damage	178,942 83.4%	5,184 2.9%	2,624 1.2%	646 0.3%	13,564 6.3%	12,704 5.9%	214,653
Side Damage	42,227 56.3%	32 --	1,573 2.1%	2,274 3.0%	14,598 19.6%	14,174 18.9%	74,979
Rear Damage	4,576 46.4%	0 --	0 --	0 --	3,276 33.2%	2,013 20.4%	9,865
Other and Unknown	46,253 61.0%	2,100 3.7%	100 0.2%	95 0.2%	4,053 7.1%	4,521 7.9%	57,124
Multiple-Vehicle							
Frontal Damage	559,380 91.9%	4,498 0.7%	3,317 0.5%	304 --	29,032 4.8%	11,951 2.0%	606,482
Side Damage	242,774 60.6%	3,212 0.8%	7,156 1.8%	1,942 0.5%	104,390 26.2%	39,518 9.9%	398,990
Rear Damage	96,721 72.2%	0 --	1,750 1.3%	725 0.5%	23,210 17.3%	11,513 8.6%	133,920
Other and Unknown	118,552 68.2%	311 0.2%	260 0.2%	0 --	13,434 10.0%	1,849 1.4%	134,405
Total	1,317,654 75.3%	23,116 1.3%	18,027 1.0%	6,737 0.4%	236,411 13.5%	145,998 8.3%	1,749,844

*For each crash type, the first data row shows the number of crash-involved cars and the second row shows the percentage of the row total.

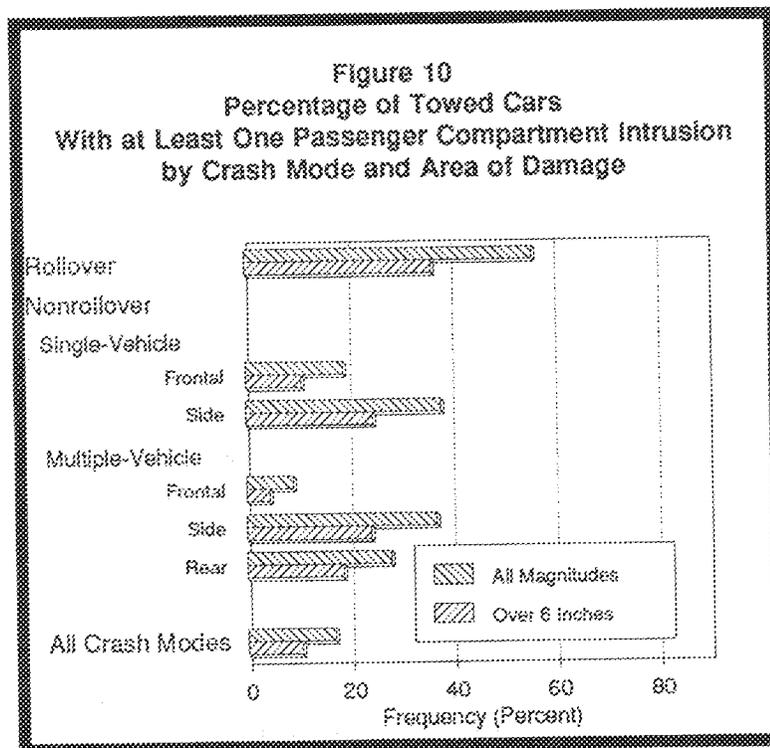
Intrusion into the Passenger Compartment of Crash-Involved Cars

Passenger compartment intrusion in crash-involved motor vehicles results when the internal boundary surface of the passenger compartment is moved inward as the result of direct or indirect crash forces applied to the vehicle exterior. The characterization of intrusion is highly complex, as it requires descriptions of several attributes on a per-vehicle basis, including:

- number and type of intruding component(s)
- location(s) of intrusion(s)
- magnitude(s) of intrusion(s)
- direction(s) of intrusion(s).

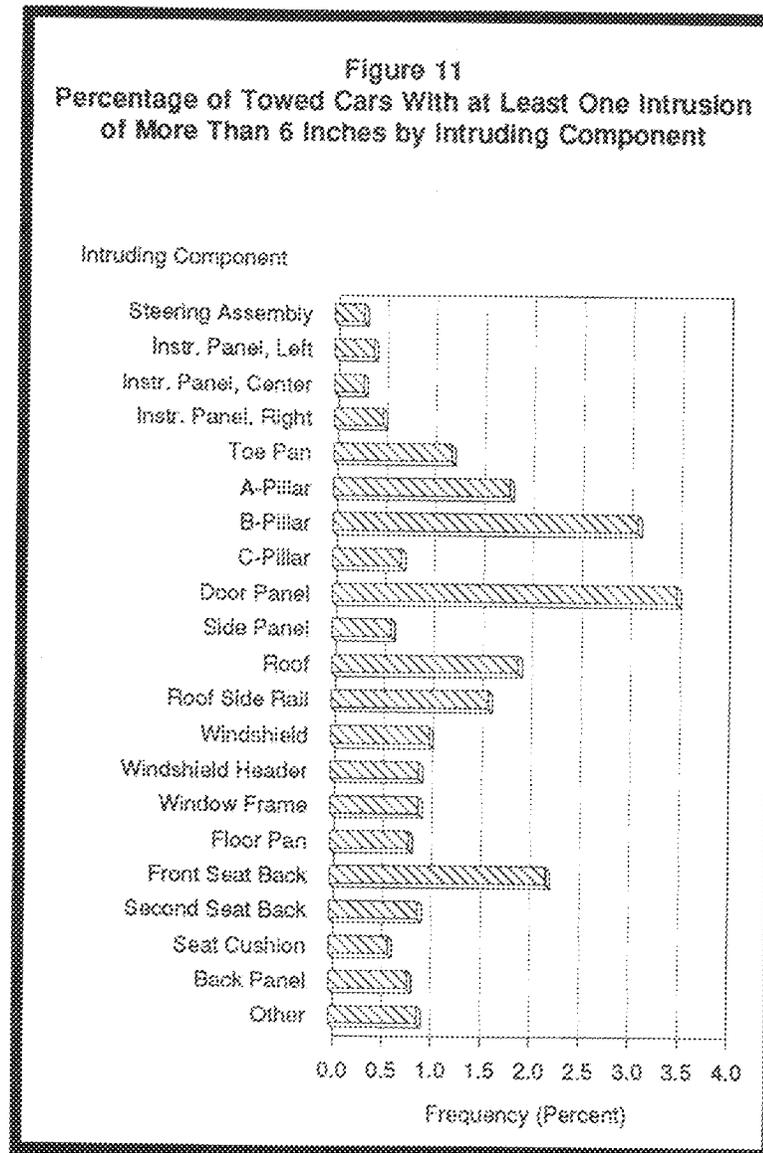
The portion of crash-involved towed cars experiencing at least one intrusion of any component, location, magnitude, or direction and in any crash mode and any area of damage is about 17 percent. However, this portion is sensitive to the crash mode, area of damage, and intrusion magnitude, as shown in Figure 10. It is also sensitive to the intruding component, as shown in Figure 11.

It is evident from Figure 10 that car rollover and side impacts are associated with a high frequency of intrusion, whereas the fewest intrusions occur in frontal collisions, especially in multiple-vehicle car crashes.



Vehicle Damage Data

As shown in Figure 11, the number of potential intruding components is large. It becomes even larger when the location of intrusion is specified for large components. For example, the roof is a large surface subject to distinct and localized intrusions of different magnitudes and directions. The NASS/CDS records specify six locations for roof intrusion: driver, middle, and passenger side in the front or rear of the roof; each of these six locations is subject to intrusion of various magnitudes in the following ranges: up to 3 inches, 3 to 6 inches, 6 to 12 inches, 12 to 18 inches, 18 to 24 inches, and over 24 inches. In addition to location and magnitude, the direction of intrusion—vertical, lateral, or longitudinal—can be distinguished for most components.



Vehicle Damage Data

Table 20 shows detailed data for intruding components in towed cars. The data shown in the table are estimates of the number of towed cars per year (nationwide average for the year 1988 through 1990) that experienced passenger compartment intrusions of at least 6 inches, by intruding component, crash type, and area of damage.

Table 20 Number of Towed Cars With at Least One Intrusion of 6 Inches or More by Intruding Component, Crash Type, and Area of Damage: Weighted Average of Nationally Weighted Counts per Year, 1988-1990										
Intruding Component	Crash Type and Area of Damage*									
	Rollover	Nonrollover, Single-Vehicle				Nonrollover, Multiple-Vehicle				All Crash Modes
		Front	Side	Rear	Other/ Unknown	Front	Side	Rear	Other/ Unknown	
Steering Assembly	333 5.8%	1,055 18.3%	785 13.5	0 --	13 0.2%	2,838 49.1%	666 11.5%	18 0.3%	69 1.2%	5,777 1.0%
Instrument Panel, Left	1,057 9.8%	1,987 18.2%	853 8.0%	0 --	66 0.8%	4,592 42.4%	2,451 19.9%	18 0.2%	84 0.8%	10,839 1.8%
Instrument Panel, Center	361 5.0%	1,816 24.9%	797 11.0%	0 --	19 0.3%	2,803 38.5%	1,415 19.4%	18 0.2%	59 0.8%	7,287 1.2%
Instrument Panel, Right	674 5.5%	2,966 24.3%	1,092 9.0%	0 --	127 1.0%	3,369 27.6%	3,736 30.8%	26 0.2%	213 1.7%	12,203 2.1%
Toe Pan	1,768 8.8%	5,995 29.7%	1,207 6.0%	0 --	31 0.2%	9,173 45.5%	1,906 9.4%	0 --	101 0.5%	20,181 3.4%
A-Pillar	16,374 37.8%	3,427 7.9%	5,501 12.7%	0 --	1,618 3.8%	6,624 15.3%	9,156 21.1%	29 0.1%	594 1.4%	43,325 7.3%
B-Pillar	10,037 14.2%	698 1.0%	5,112 7.2%	104 0.2%	514 0.7%	1,085 1.5%	52,862 74.2%	130 0.2%	590 0.8%	70,931 12.0%
C-Pillar	5,160 31.0%	6 --	3,397 20.4%	0 --	40 0.2%	171 1.0%	6,657 40.0%	1,085 6.5%	143 0.9%	16,658 2.8%
D-Pillar	121 9.3%	6 0.4%	63 4.8%	0 --	0 --	53 4.0%	64 4.9%	1,002 76.6%	0 --	1,308 0.2%
Door Panel	3,997 5.1%	430 .6%	9,926 12.6%	0 --	411 0.5%	2,074 2.8%	61,166 77.8%	172 0.2%	462 0.6%	78,638 13.3%
Side Panel/ Kick Panel	645 7.8%	493 4.6%	1,023 9.5%	0 --	0 --	440 4.1%	7,645 70.9%	121 1.1%	212 2.0%	10,779 1.8%
Roof	34,447 76.1%	1,039 2.4%	1,937 4.2%	0 --	1,514 3.4%	1,508 3.4%	2,606 5.9%	504 1.1%	653 1.5%	44,107 7.5%
Roof Side Rail	19,663 53.3%	956 2.6%	4,444 12.1%	12 --	979 2.7%	1,122 3.0%	8,928 24.2%	203 0.8%	566 1.5%	36,876 6.2%
Windshield	12,596 51.6%	4,822 19.8%	1,134 4.7%	0 --	1,004 4.1%	3,723 15.3%	626 3.4%	109 0.5%	200 0.8%	24,414 4.1%

*For each intruding component, the first data row shows the number of towed cars with at least one intrusion of 6 inches or more and the second row shows the percentage of the row total. For the row total ("All Crash Modes" column), the second row shows the percentage of the grand total.

Vehicle Damage Data

Table 20 (Continued)
Number of Towed Cars With at Least One Intrusion of 6 Inches or More
by Intruding Component, Crash Type, and Area of Damage:
Weighted Average of Nationally Weighted Counts per Year, 1988-1990

Intruding Component	Crash Type and Area of Damage*									
	Rollover	Nonrollover, Single-Vehicle				Nonrollover, Multiple-Vehicle				All Crash Modes
		Front	Side	Rear	Other/ Unknown	Front	Side	Rear	Other/ Unknown	
Windshield	14,425	1,397	713	0	1,063	2,321	558	9	469	20,973
Header	58.6%	6.7%	3.4%	--	5.2%	11.1%	2.7%	--	2.2%	3.6%
Window	5,301	27	1,287	0	645	205	10,619	460	164	18,707
Frame	26.3%	0.1%	6.9%	--	3.5%	1.1%	56.8%	2.5%	0.9%	3.2%
Floor Pan	1,140	1,800	2,641	0	328	2,304	6,346	998	127	17,683
	6.4%	10.2%	14.9%	--	1.9%	13.0%	47.2%	5.7%	0.7%	3.0%
Backlight	2,623	37	172	104	254	39	864	961	53	5,107
Header	51.4%	0.7%	3.4%	2.0%	5.0%	0.8%	16.9%	18.8%	1.0%	0.9%
Front	4,261	1,960	3,056	1,422	476	3,031	15,283	10,813	177	40,498
Seat Back	10.5%	4.9%	7.6%	3.5%	1.2%	7.5%	37.7%	26.7%	0.4%	6.9%
Second	2,062	460	2,619	513	88	1,225	5,016	5,704	181	17,889
Seat Back	11.6%	2.6%	14.6%	2.9%	0.5%	6.9%	28.0%	31.9%	1.0%	3.0%
Seat	1,129	276	1,374	13	2	570	7,011	1,161	90	11,725
Cushion	9.6%	2.4%	11.7%	0.1%	--	5.7%	59.8%	9.9%	0.8%	2.0%
Back Panel/ Door Surface	793	0	1,603	210	7	199	9,224	4,948	9	16,993
	4.7%	--	9.4%	1.2%	--	1.2%	54.3%	29.1%	0.1%	2.9%
Other Interior Components	1,129	377	1,899	259	9	532	6,118	1,470	4	11,766
	9.6%	3.2%	15.9%	2.2%	0.1%	4.5%	52.0%	12.5%	--	2.0%
Side Panel	3,036	2,249	6,222	0	9	2,057	25,577	1,014	57	40,221
	7.6%	5.6%	15.5%	--	--	5.1%	63.6%	2.5%	0.1%	6.8%
Hood	101	366	49	0	0	548	0	0	0	1,064
	0.5%	34.4%	4.6%	--	--	51.5%	--	--	--	0.2%
Outside Vehicle Components	301	126	502	0	75	112	1,150	253	0	2,519
	12.0%	5.0%	19.9%	--	3.0%	4.5%	45.7%	10.1%	--	0.4%
Exterior Object	121	369	273	0	6	241	33	0	0	1,044
	11.6%	35.3%	26.2%	--	0.6%	23.1%	3.1%	--	--	0.2%
Components Not Listed	63	12	280	0	0	22	520	30	26	958
	6.6%	1.3%	29.3%	--	--	2.3%	54.5%	3.1%	2.5%	0.2%
Total	143,935	9,336	59,639	2,635	9,336	53,079	249,905	131,256	5,307	590,465

*For each intruding component, the first data row shows the number of towed cars with at least one intrusion of 6 inches or more and the second row shows the percentage of the row total. For the row total ("All Crash Modes" column), the second row shows the percentage of the grand total.

Door Failure in Crash-Involved Towed Cars

Occupant protection during and after a crash is enhanced when the vehicle doors remain closed and operational during the crash sequence. There are two distinct threats to this desirable outcome: door opening and jammed door. These events may involve at least one of the following: left or right front door, left or right rear door, and tailgate or hatch door.

Table 21 gives estimates of the number of towed cars per year that experienced no door failure, at least one door opened, at least one door jammed, at least one door opened and at least one door jammed, or unknown. Similar estimates of door failures for light trucks, vans, and MPVs are shown in Table 22.

Table 21
Number of Crash-Involved Cars With Doors That Opened or Jammed
by Crash Mode and Area of Damage:
Weighted Average of Nationally Weighted Counts per Year, 1988-1990

Crash Mode and Area of Damage	Door Failure*					Total
	Door Operational or No Door	At Least One Door Opened	At Least One Door Jammed	At Least One Door Opened and One Door Jammed	Unknown or Uncoded	
Rollover	50,507 36.4%	7,302 5.3%	48,577 35.0%	7,956 5.7%	24,538 17.7%	138,779
Nonrollover						
Single-Vehicle						
Front	155,844 75.0%	2,822 1.4%	46,979 22.6%	890 0.4%	1,286 0.6%	207,821
Side	38,256 52.2%	1,998 2.7%	28,238 38.6%	2,768 3.8%	1,980 2.7%	73,232
Rear	3,764 35.6%	1,042 9.9%	3,674 34.7%	196 1.9%	1,901 18.0%	10,578
Other/Unknown	40,115 64.5%	2,165 3.5%	6,321 13.4%	290 0.5%	11,316 18.2%	62,208
Multiple-Vehicle						
Front	479,644 80.6%	3,784 0.6%	100,987 17.0%	3,155 0.5%	7,308 1.2%	594,889
Side	184,888 47.9%	8,729 2.3%	180,223 46.7%	7,075 1.8%	4,687 1.2%	385,603
Rear	71,114 55.0%	1,811 1.4%	48,651 36.1%	6,242 4.8%	3,577 2.8%	129,394
Other/Unknown	106,830 72.5%	160 0.1%	19,928 13.5%	1,319 0.9%	19,042 12.9%	147,279
Total	1,130,963 64.6%	29,813 1.7%	493,830 27.6%	29,802 1.7%	75,635 4.3%	1,749,844

*For each crash mode, the first data row shows the number of crash-involved cars with doors that opened or jammed and the second row shows the percentage of the row total.

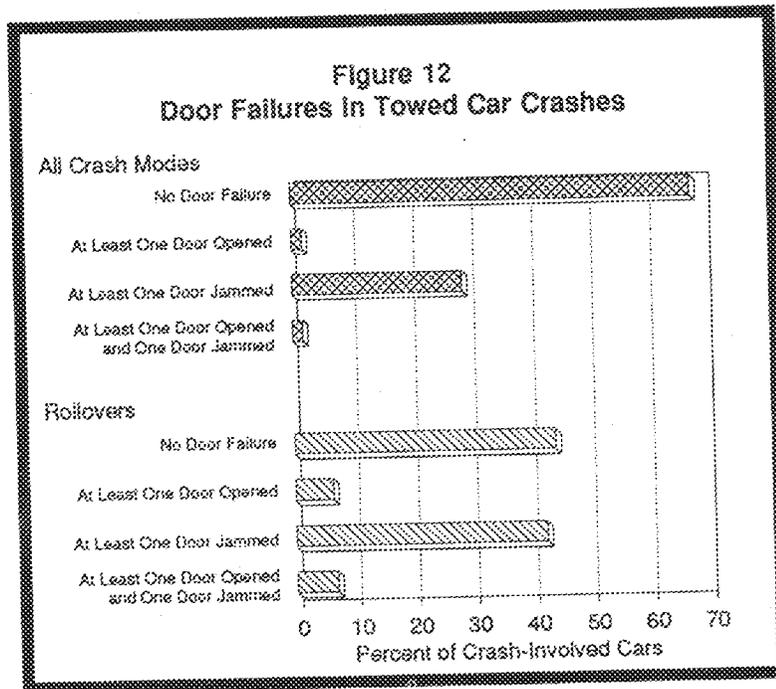
Vehicle Damage Data

Table 22
Number of Crash-Involved Light Trucks, Vans, and MPVs
With Doors That Opened or Jammed by Crash Mode and Area of Damage:
Weighted Average of Nationally Weighted Counts per Year, 1988-1990

Crash Mode and Area of Damage	Door Failure*					Total
	Door Operational or No Door	At Least One Door Opened	At Least One Door Jammed	At Least One Door Opened and One Door Jammed	Unknown or Uncoded	
Rollover	33,867 31.8%	4,736 4.5%	42,020 39.5%	4,112 3.9%	21,651 20.4%	106,385
Nonrollover						
Single-Vehicle						
Front	34,297 76.6%	1,341 3.0%	6,385 18.7%	511 1.1%	238 0.5%	44,771
Side	8,097 46.9%	2,935 17.0%	5,764 33.4%	66 0.4%	386 2.2%	17,248
Rear	0 --	0 --	181 100.0%	0 --	0 --	181
Other/Unknown	15,166 75.6%	129 0.6%	1,588 8.4%	326 1.6%	2,744 13.7%	20,053
Multiple-Vehicle						
Front	107,588 77.4%	1,842 1.3%	19,609 14.1%	452 0.3%	9,451 6.8%	138,943
Side	33,262 56.6%	2,173 3.7%	19,851 33.9%	949 1.6%	2,372 4.1%	58,608
Rear	11,885 50.7%	685 2.9%	10,541 45.4%	172 0.7%	72 0.3%	23,455
Other/Unknown	36,611 69.0%	2,739 5.2%	5,980 11.1%	516 1.0%	7,334 13.8%	53,060
Total	280,773 60.7%	16,579 3.6%	114,020 24.6%	7,105 1.5%	44,247 9.6%	462,724

*For each crash mode, the first data row shows the number of crash-involved vehicles with doors that opened or jammed and the second row shows the percentage of the row total.

The results in Tables 21 and 22 are shown as a function of crash mode. It is evident that the frequency of door failure is sensitive to the crash mode. This is also illustrated in Figure 12, where unknowns have been redistributed among the known categories of door failure for crash-involved towed cars.



Vehicle Damage Data

Causes of Door Opening in Crash-Involved Cars

Doors that come open during a crash do so on account of one or more door component failures. The door components that may fail include door latches, hinges, door structure, door support (pillars, sills, roof rails), and combinations thereof.

Table 23 gives estimates of towed cars per year (nationwide average for the years 1988 through 1990) that experienced crash-induced door opening, as a function of mode of door failure and crash type.

It is evident that the most frequent cause of door opening is the failure of door latches (52 percent), followed by door support (13 percent), door structure (11 percent), and hinges (9 percent). All other combinations account for 9 percent of door openings.

Note that the entire 1988-1990 NASS/CDS sample of cases available for this analysis is about 1,000.

Table 23
Number of Crash-Involved Towed Cars With Doors That Opened
by Mode of Door Failure, Crash Mode, and Area of Damage:
Weighted Average of Nationally Weighted Counts per Year, 1988-1990

Crash Mode and Area of Damage	Mode of Door Failure						Total
	Latches	Hinges	Door Structure	Door Support	Combination	None	
Rollover	8,048 46.8%	3,760 21.9%	2,629 15.3%	1,815 9.4%	912 5.3%	244 1.4%	17,206
Nonrollover							
Single-Vehicle							
Front	2,369 59.6%	86 2.2%	343 8.6%	517 13.0%	323 8.1%	333 8.4%	3,971
Side	3,004 59.4%	112 2.2%	402 7.9%	602 11.9%	378 7.5%	563 11.1%	5,060
Rear	1,010 82.0%	0 --	0 --	221 18.0%	0 --	0 --	1,232
Other/Unknown	968 50.7%	19 1.0%	513 26.9%	256 13.4%	152 8.0%	0 --	1,908
Multiple-Vehicle							
Front	3,322 44.0%	392 5.2%	1,408 18.6%	426 5.6%	550 7.3%	1,456 19.3%	7,553
Side	9,463 51.2%	1,259 6.8%	1,487 8.1%	3,832 20.8%	1,388 7.5%	1,040 5.6%	18,470
Rear	5,404 70.1%	20 0.3%	287 3.7%	187 2.4%	1,148 14.9%	663 8.6%	7,710
Other/Unknown	215 12.5%	333 19.3%	124 7.2%	806 46.6%	251 14.5%	0 --	1,729
Total	33,801 52.1%	5,981 9.2%	7,191 11.1%	8,464 13.1%	5,102 7.9%	4,300 6.6%	64,838

*For each crash mode, the first data row shows the number of crash-involved cars with doors that opened and the second row shows the percentage of the row total.

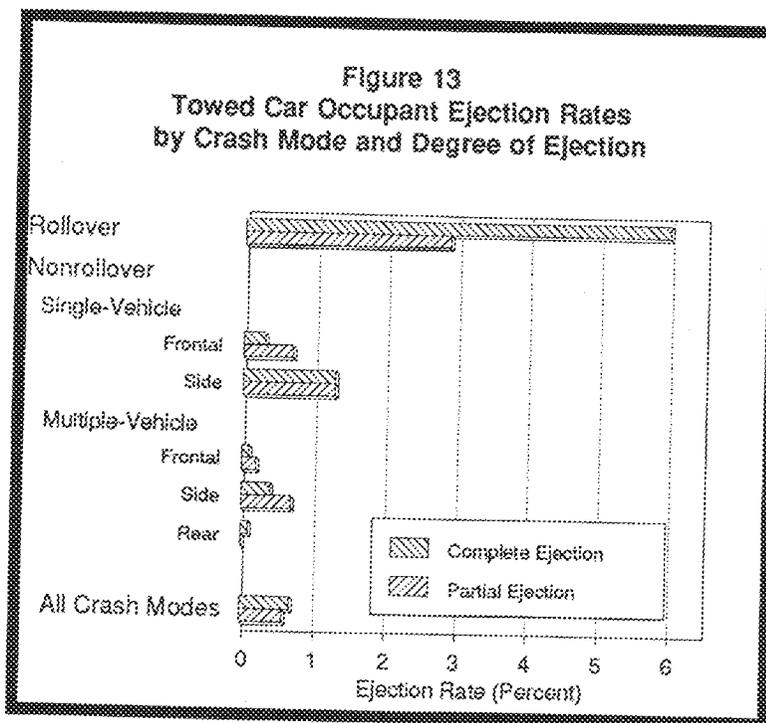
Occupant Ejection and Entrapment in Crash-Involved Towed Cars

Table 24 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 24 are shown by primary crash modes and areas of damage. Ejection rates by degree of ejection are also shown in Figure 13. Ejection occurs most frequently in rollover crashes, followed by side impacts.

Table 24
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, 1988-1990

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	12,350 6.5%	5,571 3.0%	791 0.4%	188,737
Nonrollover				
Single-Vehicle				
Front	1,374 0.5%	3,009 1.0%	1,612 0.5%	295,123
Side	1,438 1.3%	1,777 1.5%	1,111 1.0%	114,900
Rear	69 0.4%	0 --	0 --	16,021
Other/Unknown	722 0.9%	581 0.6%	273 0.4%	77,020
Multiple-Vehicle				
Front	972 0.1%	1,821 0.2%	2,960 0.3%	898,821
Side	2,304 0.4%	9,898 1.7%	2,110 0.4%	583,787
Rear	435 0.2%	31 --	87 --	202,019
Other/Unknown	893 0.5%	25 --	198 0.1%	193,422
Total	20,556 0.8%	22,504 0.9%	9,141 0.4%	2,569,847

*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.

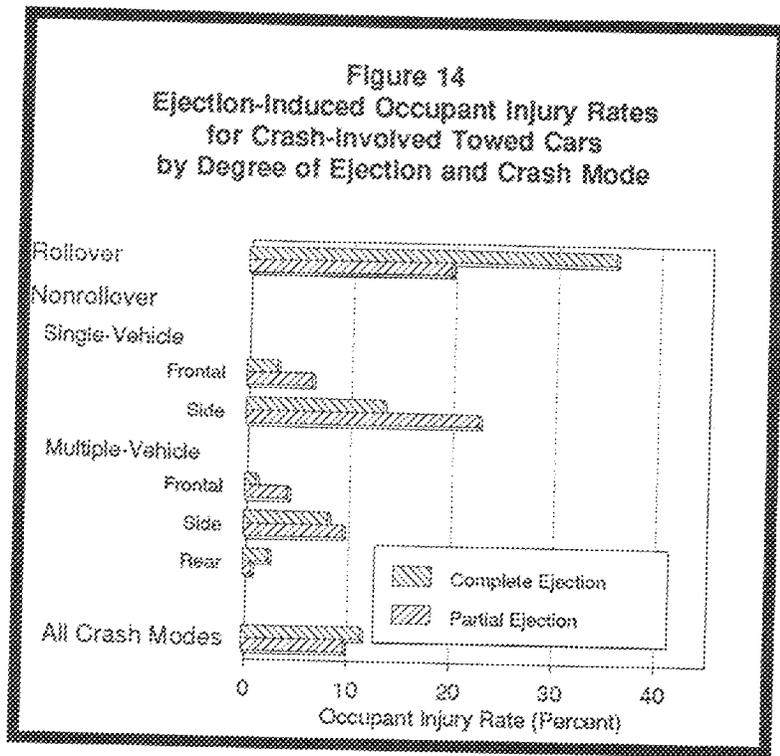


The ejection rates shown in Table 24 are generally small, except in car rollovers. However, due to the very harmful outcomes of occupant ejections, the rate of injuries associated with occupant ejections is significantly higher, as shown in Table 25, which shows injury-weighted (using Harm—see Appendix E) ejection and entrapment data for crash-involved towed cars, and Figure 14, which shows ejection-induced injury rates for towed cars. 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 25
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, 1988-1990

Crash Mode and Area of Damage	Complete Ejection	Partial Ejection	Entrapment	Total
Rollover	1,834,019 41.9%	967,279 22.1%	296,557 6.8%	4,379,818
Nonrollover				
Single-Vehicle				
Front	195,981 6.3%	349,103 11.3%	510,949 16.5%	3,095,592
Side	223,990 15.5%	565,351 41.8%	169,760 12.5%	1,353,911
Rear	6,991 8.9%	0 --	0 --	78,532
Other/Unknown	93,185 15.8%	58,781 10.5%	27,549 5.0%	553,574
Multiple-Vehicle				
Front	47,005 0.8%	351,420 6.0%	607,929 10.3%	5,874,787
Side	526,794 9.1%	1,291,155 22.4%	445,307 7.7%	5,761,529
Rear	19,155 2.2%	21,625 2.6%	30,683 3.7%	826,539
Other/Unknown	200,185 23.7%	2,860 0.3%	5,841 0.7%	845,579
Total	3,146,294 13.9%	3,607,574 15.8%	2,094,576 9.2%	22,770,000

*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.



Glazing Damage in Crash-Involved Towed Cars

Tables 26 and 27 address glazing damage due to car impact forces; they show estimates of the numbers of towed cars (nationwide average for the years 1988 through 1990) that experienced glazing damage to the specific components shown, as a function of crash mode and area of damage.

Glazing in motor vehicles is defined as the transparent covering of openings in the vehicle structure. Glazing is usually glass. Glazing retention and integrity are major objectives in ejection avoidance during a crash sequence. Under consideration here are the windshield; front and rear side windows; backlight, tailgate, or hatchback; and the roof hatch.

A good deal of glazing is permanently in place (windshield, backlight, many rear windows, and sunroofs). In addition, field experience indicates that operable glazing (e.g., front side windows) is closed most of the time.

Table 26
Glazing Damage of Any Degree Resulting from Vehicle Impact
in Crash-Involved Towed Cars, by Glazing Component and Crash Type:
Weighted Average of Nationally Weighted Counts per Year, 1988-1990

Crash Mode and Area of Damage	Glazing Component Damaged*								
	Windshield	Left Front Window	Right Front Window	Left Rear Window	Right Rear Window	Backlight	Roof	Other	Total
Rollover	30,931 25.4%	9,874 7.3%	17,159 14.1%	13,787 11.3%	8,420 6.9%	23,340 19.1%	9,923 8.1%	9,524 7.8%	121,957
Nonrollover									
Single-Vehicle									
Frontal Damage	83,925 68.7%	7,968 6.5%	11,237 9.2%	5,149 4.2%	1,812 1.5%	7,139 5.8%	1,063 0.9%	3,960 3.2%	122,152
Side Damage	9,241 18.5%	6,259 12.5%	6,662 13.3%	3,687 7.4%	7,441 14.9%	9,777 19.6%	3,434 6.9%	3,500 7.0%	48,999
Rear Damage	0 --	4,845 51.0%	0 --	0 --	976 10.3%	3,194 33.6%	249 2.6%	236 2.5%	9,500
Other and Unknown	12,216 39.6%	2,923 9.5%	1,363 4.4%	930 3.0%	1,340 4.3%	7,311 23.7%	2,001 6.5%	2,767 8.9%	30,843
Multiple-Vehicle									
Frontal Damage	217,641 79.9%	16,951 6.1%	12,643 4.6%	8,211 3.0%	2,509 0.9%	3,907 1.4%	1,451 0.5%	9,469 3.5%	272,392
Side Damage	73,542 28.2%	46,416 17.8%	37,416 14.3%	31,063 12.0%	32,762 12.5%	13,812 5.3%	1,592 0.6%	24,399 9.3%	261,202
Rear Damage	7,968 12.1%	1,267 2.0%	308 0.5%	2,382 3.5%	4,396 6.7%	37,839 57.6%	452 0.7%	11,129 16.9%	65,661
Other and Unknown	15,759 27.8%	2,638 4.7%	2,007 3.6%	6,543 15.1%	659 1.2%	19,427 34.3%	104 0.2%	7,451 13.2%	55,817
Total	451,225 45.6%	97,861 9.9%	88,848 9.0%	73,852 7.5%	60,313 6.1%	125,647 12.7%	20,277 2.0%	72,324 7.3%	990,344

*For each crash mode, the first data row shows the number of cars with glazing damage and the second row shows the percentage of the row total. See page 54 for definition of glazing components.

Vehicle Damage Data

In crashes, glazing may be compromised to various degrees: it may still be in place but cracked or holed; it may come out of place irrespective of cracks or holes; and it may disintegrate completely.

Table 26 addresses glazing damage of any degree, while Table 27 addresses maximum damage only (i.e., disintegration).

Cars with glazing damage of any degree to any component are about 42 percent of all crash-involved towed cars. This proportion varies as a function of crash type: for nonrollover crashes, the proportions of glazing damage are 36 percent for single-vehicle frontal crashes, 48 percent for single-vehicle side crashes, 35 percent for single-vehicle rear crashes, 27 percent for multiple-vehicle frontal crashes, 47 percent for multiple-vehicle side crashes, and 39 percent for multiple-vehicle rear crashes (Tables 2 and 26).

Crash Mode and Area of Damage	Glazing Component Damaged*									Total
	Wind-shield	Left Front Window	Right Front Window	Left Rear Window	Right Rear Window	Back-light	Roof	Other		
Rollover	21,085 55.1%	5,427 14.2%	3,636 9.5%	6,460 16.9%	302 0.8%	570 1.5%	398 1.0%	418 1.1%		38,295
Nonrollover										
Single-Vehicle										
Frontal Damage	98,104 93.7%	1,919 1.8%	3,233 3.1%	0 --	0 --	168 0.2%	1,210 1.2%	117 0.1%		104,791
Side Damage	6,787 42.5%	3,909 20.7%	5,587 35.0%	0 --	65 0.4%	0 --	0 --	224 1.4%		15,972
Rear Damage	241 25.2%	0 --	716 74.8%	0 --	0 --	0 --	0 --	0 --		958
Other and Unknown	5,490 19.7%	138 0.5%	13,455 49.3%	88 0.3%	8,672 31.1%	0 --	0 --	0 --		27,843
Multiple-Vehicle										
Frontal Damage	232,019 87.3%	15,609 5.9%	9,942 3.7%	3,609 1.4%	3,279 1.2%	292 0.1%	481 0.2%	443 0.2%		265,673
Side Damage	34,007 47.8%	22,735 31.9%	7,439 10.5%	1,492 2.1%	2,484 3.5%	80 0.1%	2,111 3.0%	822 1.2%		71,171
Rear Damage	11,518 62.2%	5,962 32.2%	0 --	290 1.5%	609 3.3%	29 0.2%	119 0.6%	0 --		18,518
Other and Unknown	13,385 89.7%	707 4.7%	137 0.9%	0 --	652 4.4%	0 --	0 --	49 0.3%		14,930
Total	422,636 75.7%	55,806 10.0%	44,144 7.9%	11,929 2.1%	16,063 2.9%	1,139 0.2%	4,319 0.8%	2,074 0.4%		558,110

*For each crash mode, the first data row shows the number of cars with glazing damage and the second row shows the percentage of the row total. See page 54 for definition of glazing components.

Vehicle Damage Data

The proportion of cars with glazing damage also varies significantly as a function of the damaged component. Glazing damage of any degree, regardless of crash type, occurs as follows: 29 percent for the windshield, 7 percent for each of the front windows, 4 percent for each of the rear windows, and 5 percent for the rear glazing.

Except for the windshield, these proportions do not change much when maximum damage (disintegration) is considered instead of any degree, indicating that disintegration is the most common glazing damage in towed car crashes. By contrast, windshield damage drops from 29 percent for damage of any degree to 0.1 percent for disintegration.

In addition to car impact forces, addressed in Tables 26 and 27, occupant loading is a second cause of glazing damage.

A comparison of the frequencies of glazing damage resulting from car impact forces versus damage resulting from occupant loading shows that the latter is a much weaker cause, especially when maximum damage (disintegration) is considered.

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.

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 damage crash severity)

Two vehicles approach each other at an impact velocity, strike, reach a common velocity, and then separate. Delta-v is equal to the impact velocity minus the common speed. Other factors being equal, the greater the velocity change 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.

Fatally Injured Occupant

A death caused by injuries sustained by an occupant in a CDS applicable motor vehicle crash and occurring within 30 days of the 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 (GVW)

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 GVW.

Glossary

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.

Intrusion

Elements of the vehicle structure or exterior objects in the environment which intrude into the passenger compartment space as a result of impact forces.

Light Trucks and Vans

Includes utility vehicles, pickups, vans, and truck-based station wagons, with 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.

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 Systems

Manually operated restraint systems include shoulder belts, lap belts, lap and should 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 truck, and vans.

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 to six PSUs were selected from each category with probability proportional to its 1983 population. These 36 PSUs are the first stage in the selection of CDS sample crashes.

If every crash in each of the 36 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.

The procedure used to obtain the desired sample by type and severity of crashes is an unequal probability selection. This required listing police crash reports in categories defined by most severe police-reported injury. Each category was assigned a selection ratio that would produce the desired sample size. A systematic sample was selected within each category. Within each PSU, all crashes (sampled and nonsampled) within the same category have equal weight (probability of selection).

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

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.

NASS/CDS Data Elements



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

ACCIDENT FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

<p>1. Primary Sampling Unit Number</p> <p>2. Case Number - Stratum</p>	<p style="text-align: center;">SPECIAL STUDIES INDICATORS</p> <p>Check (✓) each special study (SS12-SS16 below) that has been completed; code 1 for the checked special studies and 0 for the special studies not checked.</p> <p>6.SS12 Not Active <u>0</u></p> <p>7.SS13 ADPS</p> <p>8.SS14</p> <p>9.SS15</p> <p>10.SS16</p>																																										
IDENTIFICATION																																											
<p>3. Number of General Vehicle Forms Submitted</p> <p>4. Date of Accident (Month, Day, Year) / / <u>9</u> <u>0</u></p> <p>5. Time of Accident</p> <p>Code reported military time of accident.</p> <p>NOTE: Midnight = 2400 Unknown = 9999</p>	<p style="text-align: center;">NUMBER OF EVENTS</p> <p>11. Number of Recorded Events in This Accident</p> <p>Code the number of events which occurred in this accident.</p>																																										
ACCIDENT EVENTS																																											
<p>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.</p>																																											
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Accident Event Sequence Number</th> <th style="width: 10%;">Vehicle Number</th> <th style="width: 10%;">Class of Vehicle</th> <th style="width: 10%;">General Area of Damage</th> <th style="width: 10%;">Vehicle Number or Object Contacted</th> <th style="width: 10%;">Class of Vehicle</th> <th style="width: 10%;">General Area of Damage</th> </tr> </thead> <tbody> <tr> <td>12. <u>0</u> <u>1</u></td> <td>13.</td> <td>14.</td> <td>15.</td> <td>16.</td> <td>17.</td> <td>18.</td> </tr> <tr> <td>19. <u>0</u> <u>2</u></td> <td>20.</td> <td>21.</td> <td>22.</td> <td>23.</td> <td>24.</td> <td>25.</td> </tr> <tr> <td>26. <u>0</u> <u>3</u></td> <td>27.</td> <td>28.</td> <td>29.</td> <td>30.</td> <td>31.</td> <td>32.</td> </tr> <tr> <td>33. <u>0</u> <u>4</u></td> <td>34.</td> <td>35.</td> <td>36.</td> <td>37.</td> <td>38.</td> <td>39.</td> </tr> <tr> <td>40. <u>0</u> <u>5</u></td> <td>41.</td> <td>42.</td> <td>43.</td> <td>44.</td> <td>45.</td> <td>46.</td> </tr> </tbody> </table>	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. <u>0</u> <u>1</u>	13.	14.	15.	16.	17.	18.	19. <u>0</u> <u>2</u>	20.	21.	22.	23.	24.	25.	26. <u>0</u> <u>3</u>	27.	28.	29.	30.	31.	32.	33. <u>0</u> <u>4</u>	34.	35.	36.	37.	38.	39.	40. <u>0</u> <u>5</u>	41.	42.	43.	44.	45.	46.	
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. <u>0</u> <u>1</u>	13.	14.	15.	16.	17.	18.																																					
19. <u>0</u> <u>2</u>	20.	21.	22.	23.	24.	25.																																					
26. <u>0</u> <u>3</u>	27.	28.	29.	30.	31.	32.																																					
33. <u>0</u> <u>4</u>	34.	35.	36.	37.	38.	39.																																					
40. <u>0</u> <u>5</u>	41.	42.	43.	44.	45.	46.																																					
<p>IF GREATER THAN FIVE EVENTS, CONTINUE CODING ON THE ACCIDENT EVENTS SUPPLEMENT</p>																																											

HS Form 434 (1/90)

CODES FOR CLASS OF VEHICLE	CODES FOR GENERAL AREA OF DAMAGE (GAD)	
<p>(00) Not a motor vehicle (01) Subcompact/mini (wheelbase = 100") (02) Compact (wheelbase = 100" - 104") (03) Intermediate (wheelbase = 105" - 109") (04) Full size (wheelbase = 110" - 114") (05) Largest (wheelbase = 115") (09) Unknown passenger car size (11) Short utility vehicle (12) Truck based utility (> 10,000 lbs GVWR) (13) Passenger van (> 10,000 lbs GVWR) (14) Other van (> 10,000 lbs GVWR) (15) Pickup truck (> 10,000 lbs GVWR) (18) Other truck (> 10,000 lbs GVWR) (19) Unknown light truck type (20) School bus (21) Other bus (22) Truck (> 10,000 lbs GVWR) (23) Tractor without trailer (24) Tractor trailer(s) (25) Motored cycle (28) Other vehicle (99) Unknown</p>	<p>CDC APPLICABLE AND OTHER VEHICLES</p>	<p>TDC APPLICABLE VEHICLES</p>
	<p>(0) Not a motor vehicle (N) Noncollision (F) Front (R) Right side (L) Left side (B) Back (T) Top (U) Undercarriage (9) Unknown</p>	<p>(0) Not a motor vehicle (N) Noncollision (F) Front (R) Right side (L) Left side (B) Back (rear of cargo area (rear of trailer or straight truck) (D) Back (rear of tractor) (C) Rear of cab (V) Front of cargo area (T) Top (U) Undercarriage (9) Unknown</p>
CODES FOR VEHICLE NUMBER OR OBJECT CONTACTED		
<p>(01-30) -- Vehicle number</p>		
<p>Noncollision (31) Overtake -- rollover (32) Fire or explosion (33) Jackknife (34) Other intraunit damage (specify): _____</p>	<p>(57) Fence (58) Wall (59) Building (60) Ditch or culvert (61) Ground (62) Fire hydrant (63) Curb (64) Bridge (66) Other fixed object (specify): _____</p>	
<p>(35) Noncollision injury (36) Other noncollision (specify): _____</p>	<p>(69) Unknown fixed object</p>	
<p>(39) Noncollision -- details unknown</p>	<p>Collision with Nonfixed Object</p>	
<p>Collision with Fixed Object (41) Tree (< 4 inches in diameter) (42) Tree (> 4 inches in diameter) (43) Shrubby or bush (44) Embankment</p>	<p>(71) Motor vehicle not in-transport (72) Pedestrian (73) Cyclist or cycle (74) Other nonmotorist or conveyance (specify): _____</p>	
<p>(45) Breakaway pole or post (any diameter)</p>	<p>(75) Vehicle occupant (76) Animal (77) Train (78) Trailer, disconnected in transport (88) Other nonfixed object (specify): _____</p>	
<p>Nonbreakaway Pole or Post (50) Pole or post (< 4 inches in diameter) (51) Pole or post (> 4 but < 12 inches in diameter) (52) Pole or post (> 12 inches in diameter) (53) Pole or post (diameter unknown)</p>	<p>(89) Unknown nonfixed object</p>	
<p>(54) Concrete traffic barrier (55) Impact attenuator (56) Other traffic barrier (specify): _____</p>	<p>(96) Other event (specify): _____</p>	
<p>_____</p>	<p>(99) Unknown event or object</p>	

National Accident Sampling System - Crashworthiness Data System: Accident Form

ACCIDENT EVENTS SUPPLEMENT						
1. Primary Sampling Unit Number _____				2. Case Number - Stratum _____		
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
47. 0 8	48. _____	49. _____	50. _____	51. _____	52. _____	53. _____
54. 0 7	55. _____	56. _____	57. _____	58. _____	59. _____	60. _____
61. 0 6	62. _____	63. _____	64. _____	65. _____	66. _____	67. _____
68. 0 9	69. _____	70. _____	71. _____	72. _____	73. _____	74. _____
75. 1 0	76. _____	77. _____	78. _____	79. _____	80. _____	81. _____
82. 1 1	83. _____	84. _____	85. _____	86. _____	87. _____	88. _____
89. 1 2	90. _____	91. _____	92. _____	93. _____	94. _____	95. _____
96. 1 3	97. _____	98. _____	99. _____	100. _____	101. _____	102. _____
103. 1 4	104. _____	105. _____	106. _____	107. _____	108. _____	109. _____
110. 1 5	111. _____	112. _____	113. _____	114. _____	115. _____	116. _____
117. 1 6	118. _____	119. _____	120. _____	121. _____	122. _____	123. _____
124. 1 7	125. _____	126. _____	127. _____	128. _____	129. _____	130. _____
131. 1 8	132. _____	133. _____	134. _____	135. _____	136. _____	137. _____
138. 1 9	139. _____	140. _____	141. _____	142. _____	143. _____	144. _____
145. 2 0	146. _____	147. _____	148. _____	149. _____	150. _____	151. _____

HS Form 434C (1/90)

NASS/CDS Data Elements



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

GENERAL VEHICLE FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

<p>1. Primary Sampling Unit Number _____</p> <p>2. Case Number--Stratum _____</p> <p>3. Vehicle Number _____</p> <p style="text-align: center;">VEHICLE IDENTIFICATION</p> <p>4. Vehicle Model Year _____ Code the last two digits of the model year (99) Unknown</p> <p>5. Vehicle Make (specify): _____ _____ Applicable codes are found in your NASS CDS Data Collection, Coding, and Editing Manual. (99) Unknown</p> <p>6. Vehicle Model (specify): _____ _____ Applicable codes are found in your NASS CDS Data Collection, Coding, and Editing Manual. (999) Unknown</p> <p>7. Body Type _____ Note: Applicable codes are found on the back of this page.</p> <p>8. Vehicle Identification Number _____ _____ Left justify: Slash zeros and letter Z (0 and Z) No VIN--Code all zeros Unknown--Code all nine's</p> <p style="text-align: center;">OFFICIAL RECORDS</p> <p>9. Police Reported Vehicle Disposition _____ (0) Not towed due to vehicle damage (1) Towed due to vehicle damage (9) Unknown</p> <p>10. Police Reported Travel Speed _____ _____ Code to the nearest mph (NOTE: 00 means less than 0.5 mph) (97) 96.5 mph and above (99) Unknown</p>	<p>11. Police Reported Alcohol or Drug Presence _____ (0) Neither alcohol nor drugs present (1) Yes (alcohol present) (2) Yes (drugs present) (3) Yes (alcohol and drugs present) (4) Yes (alcohol or drugs present--specifics unknown) (7) Not reported (8) No driver present (9) Unknown</p> <p>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 _____</p> <p style="text-align: center;">ACCIDENT RELATED</p> <p>13. Speed Limit _____ (00) No statutory limit Code posted or statutory speed limit (99) Unknown</p> <p>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</p> <p>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</p>
<p>**** STOP HERE IF GV07 DOES NOT EQUAL 01-49 ****</p>	

HS Form 435 (Rev. 1/90)

CODES FOR BODY TYPE

CDS APPLICABLE VEHICLES	OTHER VEHICLES
<p>Automobiles</p> <ul style="list-style-type: none"> (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) (08) Other automobile type (specify): <hr/> <p>(09) Unknown automobile type</p>	<p>Other Light Trucks (- 10,000 lbs GVWR)</p> <ul style="list-style-type: none"> (40) Cab chassis based (includes rescue vehicle, light stake, dump, and tow truck) (41) Truck based panel (42) Light truck based motorhome (chassis mounted) (47) Other light conventional truck type (not a pickup) (specify): <hr/> <p>(48) Unknown other light truck type (not a pickup)</p> <p>(49) Unknown light vehicle type (automobile, van, or light truck)</p>
<p>Automobile Derivatives</p> <ul style="list-style-type: none"> (10) Auto based pickup (includes El Camino, Caballero, Ranchero, and Brat) (11) Auto based panel (cargo station wagon, includes auto based ambulance/hearse) (12) Large limousine—more than four side doors or stretched chassis 	<p>Buses (Excludes Van Based)</p> <ul style="list-style-type: none"> (50) School bus (designed to carry students, not cross country or transit) (58) Other bus type (e.g., transit, intercity, bus based motorhome) (specify): <hr/> <p>(59) Unknown bus type</p>
<p>Utility Vehicles</p> <ul style="list-style-type: none"> (13) Short utility—not truck based (includes Jeep CJ-5, Jeep CJ-7, Renegade, Landrover, Pre-78 Bronco, Landcruiser, Thing) (14) Truck based utility (2-door; includes Blazer, Bronco—79 on, Bronco II, Jimmy, Ranchanger, Cherokee, Trailduster, Scout) 	<p>Medium/Heavy Trucks (-10,000 lbs GVWR)</p> <ul style="list-style-type: none"> (60) Step van (61) Single unit straight truck (10,000 lbs - GVWR - 26,000 lbs) (62) Single unit straight truck (-26,000 lbs GVWR) (63) Medium/heavy truck based motorhome (64) Truck-tractor with no cargo trailer (65) Truck-tractor pulling one trailer (66) Truck-tractor pulling two or more trailers (67) Truck-tractor (unknown if pulling trailer) (68) Unknown medium/heavy truck type (69) Unknown truck type (light/medium/heavy)
<p>Van Based Light Trucks (- 10,000 lbs GVWR)</p> <ul style="list-style-type: none"> (20) Minivan (Lumina APV, Astro, Caravan, Plymouth Vista, Aerostar, Safari, Voyager [84 and after], Dodge Vista, Mini Ram Van, Toyota Cargo Van, Toyota Van, Vanagon, VW Bus, Kombi) (21) Standard van (Sportvan, Chevy Van, Club Wagon, Ford Econoline, Ram Van, Chateau, Ram Wagon, Vandura, Rally, Voyager [83 and before], Beauville, Sportsman) (28) Other van type (specify): (29) Unknown van type 	<p>Motored Cycles (Does Not Include All-Terrain Vehicles/Cycles)</p> <ul style="list-style-type: none"> (70) Motorcycle (71) Moped (motorized bicycle) (78) Other motored cycle type (minibike, motorscooter) (specify): <hr/> <p>(79) Unknown motored cycle type</p>
<p>Light Conventional Trucks (Pickup Style Cab, 10,000 lbs GVWR)</p> <ul style="list-style-type: none"> (30) Compact pickup (- 4,500 lbs. GVWR, S-10, LUV, Ram 50, Rampage, Courier, Ranger, S-16 Pup, Mazda Pickup, Mitsubishi Truck, Nissan Pickup, Arrow Pickup, Scamp, Toyota Pickup, VW Pickup) (31) Standard pickup (4,500 to 10,000 lbs. GVWR, C10 - C30, K10 - K30, T10, D100 - D350, W150 - W350, F100 - F350, Comanche, J10 - J30, Dakota) (32) Pickup with slide-in camper (33) Truck based station wagon (4-door; includes Suburban, Travelall, Wagoner) (34) Light truck based suburban limousine (35) Convertible pickup (39) Unknown (pickup style) light conventional truck type 	<p>Other Vehicles</p> <ul style="list-style-type: none"> (80) ATV (All-Terrain Vehicle) and ATC (All-Terrain Cycle) (88) Other vehicle type (specify): <hr/> <p>(89) Unknown body type</p>

OCCUPANT RELATED		
<p>16. Driver Presence in Vehicle _____ (0) Driver not present (1) Driver present (9) Unknown</p> <p>17. Number of Occupants This Vehicle _____ (00-96) Code actual number of occupants for this vehicle (97) 97 or more (99) Unknown</p> <p>18. Number of Occupant Forms Submitted _____</p>	<p>24. Rollover _____ (0) No rollover (no overturning)</p> <p>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): _____</p> <p>(5) Rollover -- end-over-end (i.e., primarily about the lateral axis) (9) Rollover (overturn), details unknown</p>	
VEHICLE WEIGHT ITEMS		
<p>19. Vehicle Curb Weight _____ 00 _____Code weight to nearest 100 pounds (010) Less than 1050 pounds (135) 13,500 lbs or more (999) Unknown</p> <p>Source: _____</p> <p>20. Vehicle Cargo Weight _____ 00 _____Code weight to nearest 100 pounds. (00) Less than 50 pounds (97) 9,650 lbs or more (99) Unknown</p>	<th style="background-color: #cccccc;">OVERRIDE/UNDERRIDE (THIS VEHICLE)</th> <p>25. Front Override/Underride (this vehicle) _____</p> <p>26. Rear Override/Underride (this vehicle) _____</p> <p>(0) No override/underride, or not an end-to-end impact</p> <p>Override (see specific CDC) (1) 1st CDC (2) 2nd CDC (3) Other not automated CDC (specify): _____</p> <p>Underride (see specific CDC) (4) 1st CDC (5) 2nd CDC (6) Other not automated CDC (specify): _____</p> <p>(7) Medium-heavy truck override (9) Unknown</p>	OVERRIDE/UNDERRIDE (THIS VEHICLE)
RECONSTRUCTION DATA		
<p>21. Towed Trailing Unit _____ (0) No towed unit (1) Yes -- towed trailing unit (9) Unknown</p> <p>22. Documentation of Trajectory Data for This Vehicle _____ (0) No (1) Yes</p> <p>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</p>	<th style="background-color: #cccccc;">HEADING ANGLE AT IMPACT FOR HIGHEST DELTA V</th> <p>Values: (000)-1359) Code actual value (997) Noncollision (998) Impact with object (999) Unknown</p> <p>27. Heading Angle for This Vehicle _____</p> <p>28. Heading Angle for Other Vehicle _____</p>	HEADING ANGLE AT IMPACT FOR HIGHEST DELTA V

NASS/CDS Data Elements

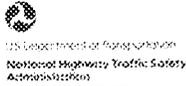
Category	Configuration	ACCIDENT TYPES (Includes Intent)					
I Single Driver	A Right Roadside Departure	01 DRIVE OFF ROAD	02 CONTROL/ TRACTION LOSS	03 AVOID COLLISION WITH VEH., PED., ANIM	04 SPECIFICS OTHER	05 SPECIFICS UNKNOWN	
	B Left Roadside Departure	06 DRIVE OFF ROAD	07 CONTROL/ TRACTION LOSS	08 AVOID COLLISION WITH VEH., PED., ANIM	09 SPECIFICS OTHER	10 SPECIFICS UNKNOWN	
	C Forward Impact	11 PARKED VEH	12 STA OBJECT	13 PEDESTRIAN/ ANIMAL	14 END DEPARTURE	15 SPECIFICS OTHER	16 SPECIFICS UNKNOWN
II Same Trafficway Same Direction	D Rear End	20 STOPPED 21, 22, 23	24 SLOWER 25, 26, 27	28 DECEL. 29, 30, 31	30 SPECIFICS OTHER	31 SPECIFICS UNKNOWN	
	E Forward Impact	34 CONTROL/ TRACTION LOSS	36 CONTROL/ TRACTION LOSS	38 AVOID COLLISION WITH VEH.	40 AVOID COLLISION WITH OBJECT	(EACH + 32) SPECIFICS OTHER	(EACH + 33) SPECIFICS UNKNOWN
	F Sideswipe Angle	44 45 46 47	(EACH + 48) SPECIFICS OTHER	(EACH + 49) SPECIFICS UNKNOWN			
III Same Trafficway Opposite Direction	G Head On	50 LATERAL MOVE	(EACH + 52) SPECIFICS OTHER	(EACH + 53) SPECIFICS UNKNOWN			
	H Forward Impact	54 CONTROL/ TRACTION LOSS	56 CONTROL/ TRACTION LOSS	58 AVOID COLLISION WITH VEH.	60 AVOID COLLISION WITH OBJECT	(EACH + 62) SPECIFICS OTHER	(EACH + 63) SPECIFICS UNKNOWN
	I Sideswipe Angle	64 LATERAL MOVE	(EACH + 66) SPECIFICS OTHER	(EACH + 67) SPECIFICS UNKNOWN			
IV Change Trafficway Vehicle Turning	J Turn Across Path	68 INITIAL OPPOSITE DIRECTIONS	71 INITIAL SAME DIRECTIONS	73 72	(EACH + 74) SPECIFICS OTHER	(EACH + 75) SPECIFICS UNKNOWN	
	K Turn Into Path	77 78 TURN INTO SAME DIRECTION	79 80 TURN INTO OPPOSITE DIRECTIONS	81 82	(EACH + 84) SPECIFICS OTHER	(EACH + 85) SPECIFICS UNKNOWN	
V Intersecting Paths (Vehicle Damage)	L Straight Paths	86 87	88 89	(EACH + 90) SPECIFICS OTHER	(EACH + 91) SPECIFICS UNKNOWN		
VI Miscellaneuous	M Backing Etc.	92 BACKING VEH.	93 OTHER VEH OR OBJECT	98 Other Accident Type 99 Unknown Accident Type 00 No Impact			

NASS/CDS Data Elements

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

Page 3

<p>29. Basis for Total Delta V (Highest) -----</p> <p>Delta V Calculated</p> <p>(1) CRASH program-- damage only routine</p> <p>(2) CRASH program-- damage and trajectory routine</p> <p>(3) Missing vehicle algorithm</p> <p>Delta V Not Calculated</p> <p>(4) At least one vehicle (which may be this vehicle) is beyond the scope of an acceptable reconstruction program, regardless of collision conditions.</p> <p>(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 techniques, regardless of adequacy of damage data.</p> <p>(6) All vehicles and collision conditions are within scope of one of the acceptable reconstruction programs, but there is insufficient data available.</p>	<p style="text-align: right;">Secondary Highest</p> <p style="text-align: right;">+ +</p> <p>32. Lateral Component of Delta V -----</p> <p>..... Nearest mph -----</p> <p>(NOTE: .....00 means greater than -0.5 and less than +0.5 mph) (= 97) ± 96.5 mph and above (= 99) Unknown</p> <p>33. Energy Absorption ----- 00</p> <p>..... Nearest 100 foot-lbs -----</p> <p>(NOTE: 0000 means less than 50 Foot-Lbs) (9997) 999,850 foot-lbs or more (9999) Unknown</p> <p>34. Confidence in Reconstruction Program Results (for Highest Delta V) -----</p> <p>(0) No reconstruction</p> <p>(1) Collision fits model--results appear reasonable</p> <p>(2) Collision fits model--results appear high</p> <p>(3) Collision fits model--results appear low</p> <p>(4) Borderline reconstruction--results appear reasonable</p> <p>35. Type of Vehicle Inspection -----</p> <p>(0) No inspection</p> <p>(1) Complete inspection</p> <p>(2) Partial inspection (specify):</p> <p>.....</p> <p>36. Is this an ADPS Vehicle? -----</p> <p>(0) No</p> <p>(1) Yes</p>
<p>COMPUTER GENERATED DELTA V</p>	
<p style="text-align: right;">Secondary Highest</p> <p style="text-align: right;">+ +</p> <p>30. Total Delta V -----</p> <p>..... Nearest mph -----</p> <p>(NOTE: 00 means less than 0.5 mph) (97) 96.5 mph and above (99) Unknown</p> <p>31. Longitudinal Component of Delta V -----</p> <p>..... Nearest mph -----</p> <p>(NOTE: .....00 means greater than -0.5 and less than +0.5 mph) (= 97) ± 96.5 mph and above (= 99) Unknown</p>	
<p>*** STOP: IF THE CDS APPLICABLE VEHICLE WAS NOT INSPECTED (I.E., GV35 = 0), *** DO NOT COMPLETE THE EXTERIOR AND INTERIOR VEHICLE FORMS.</p>	



GENERAL VEHICLE LOG
Performance Assessment

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

TO BE COMPLETED BY TEAM	TO BE COMPLETED BY THE ZONE CENTER
<p>1. PSU Number _____</p> <p>2. Case Number--Stratum _____</p> <p>3. Researcher Completing Form _____</p> <p>4. Vehicle Number _____</p> <p>5. Vehicle Disposition / Type _____ (1) Towed, CDS applicable (2) Non-towed, CDS applicable (3) Non-CDS applicable</p> <p>6. Reason Vehicle Inspection Not Completed _____ (00) Non-CDS applicable vehicle (01) Inspection completed (02) Vehicle cannot be located (03) Vehicle destroyed (04) Vehicle outside of study area (05) Vehicle impounded (06) Vehicle sold (07) Hit and run vehicle (08) Owner could not be located (09) Owner refusal (10) Insurance company refusal (11) Attorney refusal or litigation (12) Repair or tow facility refusal (13) Stolen (14) Wrong name and address on PAR (15) Caseload / staff turnover (16) Other (specify): _____</p>	<p>10. Reconstruction Program (Most Severe Impact) _____ (0) Not present (1) Added (2) Dropped (3) Changed (4) Correct</p> <p>11. Reason(s) Program Results Dropped or Changed _____ a. Algorithm choice b. Collision type c. Vehicle type d. Size / stiffness / weight e. Improved PDOF f. CDC g. Trajectory data h. Damage data i. Heading angle for Oldmiss</p> <p>a b c d e f g h i <input type="checkbox"/> <input type="checkbox"/></p> <p>(Blank) Correct or no reconstruction (1) Incorrect</p>
<p>7. Knowledge of Highest Delta V Results _____ <i>Known</i> (01) CRASH-PC damage only (02) CRASH-PC damage and trajectory (03) OLDMISS</p> <p><i>Unknown</i> (04) Rollover (05) Other non horizontal force (06) Sideswipe type damage / severe override (07) Vehicle out of scope / pedestrian (08) Yielding object (09) Overlapping damage (10) insufficient data (11) Other (specify): _____</p> <p>8. Presence of Non-coded Reconstruction Program? _____ (0) No (1) Yes</p> <p>9. Data Obtained for This Vehicle's Most Severe Impact _____ (Regardless of Usage) (0) No data obtained (1) CDC data only (2) Trajectory data only (3) CDC and crush profile only (4) CDC and trajectory data only (5) CDC, crush profile, and trajectory data</p>	<p>DATA STATUS OF VARIABLE NUMBERS 3-35</p> <p>3 4 5 6 7 8 9 10 11 12 13 <input type="checkbox"/> <input type="checkbox"/></p> <p>14 15 16 17 18 19 20 21 22 23 24 <input type="checkbox"/> <input type="checkbox"/></p> <p>25 26 27 28 29 30 31 32 33 34 35 <input type="checkbox"/> <input type="checkbox"/></p> <p>Data Status Codes: (Blank) Correct (1) Derived error (2) Non-correctable error (3) Correctable error (4) Change--no error (5) MDE error (6) Unknown coded</p>
<p>IF THIS CDS VEHICLE WAS NOT INSPECTED OR IF THIS WAS NOT A CDS VEHICLE, DO NOT COMPLETE AN EXTERIOR OR INTERIOR VEHICLE LOG</p>	

COLLISION DEFORMATION CLASSIFICATION							
HIGHEST DELTA "V"							
Accident Event Sequence Number	Object Contacted	(1) (2) Direction of Force	(3) Deformation Location	(4) Specific Longitudinal or Lateral Location	(5) Specific 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							
(The crush profile for the damage described in the CDC(s) above should be documented in the appropriate space below. ALL MEASUREMENTS ARE IN INCHES.)							
HIGHEST DELTA "V"							
20. L	21. C1	C2	C3	C4	C5	C6	22. + - D
.....	+ -
Second Highest Delta "V"							
23. L	24. C1	C2	C3	C4	C5	C6	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 (9) Unknown			28. Original Wheelbase.....Code to the nearest tenth of an inch (9999) Unknown			
*** STOP: IF THE CDS APPLICABLE VEHICLE WAS NOT TOWED *** (I.E., GV09 = 0 OR 9), DO NOT COMPLETE THE INTERIOR VEHICLE FORM.							

NASS/CDS Data Elements



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

EXTERIOR VEHICLE LOG

Performance Assessment

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

TO BE COMPLETED BY TEAM																	
1. PSU Number																
2. Case Number—Stratum																
3. Researcher Completing Form																
4. Vehicle Number																
5. Date Vehicle Inspected / /																
TO BE COMPLETED BY ZONE CENTER																	
6. Assessment of Complexity of Inspection (1) Level 1—No measurements required (e.g., vehicle repaired or measurements not obtainable) Level 2 (2) Routine (3) Difficult (4) Extremely complex																
7. Applicable Precrash Measurements (0) Not applicable (1) Unacceptable (2) Poor (3) Adequate (4) Good (5) Very good																
8. Impact Damage Documentation (0) Not applicable (1) Unacceptable (2) Poor (3) Adequate (4) Good (5) Very good																
9. Quality of Vehicle Damage Sketch (0) Level 1 (e.g., repaired vehicle) Level 2 (1) Unacceptable (2) Poor (3) Adequate (4) Good (5) Very good																
10. Exterior Slides Subject Quality (0) Not applicable (1) Unacceptable (2) Poor (3) Adequate (4) Good (5) Very good																
11. Exterior Slides Quality (0) Not applicable (1) Unacceptable (2) Poor (3) Adequate (4) Good (5) Very good																
12. Primary Error Source (Vehicle Frame) (0) No error (1) Front (2) Side (left or right) (3) Back (rear) (4) Top (5) Undermarriage (9) Other (specify)																
13. Number of Coded CDCs (0,1,2)																
14. Number of Coded Crush Profiles (0,1,2)																
DATA STATUS OF VARIABLE NUMBERS 4-28																	
Highest CDC																	
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>		4	5	6	7	8	9	10	11								
4	5	6	7	8	9	10	11										
Secondary CDC																	
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>		12	13	14	15	16	17	18	19								
12	13	14	15	16	17	18	19										
Highest Crush Profile																	
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>20</td><td>21</td><td>22</td> </tr> <tr> <td> </td><td> </td><td> </td> </tr> </table>		20	21	22													
20	21	22															
Secondary Crush Profile																	
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>23</td><td>24</td><td>25</td> </tr> <tr> <td> </td><td> </td><td> </td> </tr> </table>		23	24	25													
23	24	25															
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>26</td><td>27</td><td>28</td> </tr> <tr> <td> </td><td> </td><td> </td> </tr> </table>		26	27	28													
26	27	28															
Data Status Codes: (Blank) Correct (1) Derived error (2) Non-correctable error (3) Correctable error (4) Change—no error (5) Sequencing error (9) MDE error (9) Unknown coded																	
IF THIS VEHICLE WAS NOT TOWED (E.G., GV09 ≠ 1), DO NOT COMPLETE THE INTERIOR VEHICLE LOG																	



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

INTERIOR VEHICLE FORM

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

<p>1. Primary Sampling Unit Number _____</p> <p>2. Case Number - Stratum _____</p> <p>3. Vehicle Number _____</p> <p style="text-align: center;">INTEGRITY</p> <p>4. Passenger Compartment Integrity _____</p> <p>(0) No integrity loss</p> <p>Yes, integrity Was Lost Through</p> <p>(01) Windshield</p> <p>(02) Door (side)</p> <p>(03) Door/hatch (rear)</p> <p>(04) Roof</p> <p>(05) Roof glass</p> <p>(06) Side window</p> <p>(07) Rear window</p> <p>(08) Roof and roof glass</p> <p>(09) Windshield and door (side)</p> <p>(10) Windshield and roof</p> <p>(11) Side and rear window</p> <p>(12) Windshield and side window</p> <p>(13) Door and side window</p> <p>(98) Other combination of above (specify): _____</p> <p>(99) Unknown</p> <p>Door, Tailgate Or Hatch Opening</p> <p>5. LF _____ 6. RF _____ 7. LR _____ 8. RR _____ 9. TG/H _____</p> <p>(0) No door/gate/hatch</p> <p>(1) Door/gate/hatch remained closed and operational</p> <p>(2) Door/gate/hatch came open during collision</p> <p>(3) Door/gate/hatch jammed shut</p> <p>(8) Other (specify): _____</p> <p>(9) Unknown</p> <p>Damage/Failure Associated with Door, Tailgate or Hatch Opening in Collision. If IV05-IV09 = 2, Then Code 8.</p> <p>10. LF _____ 11. RF _____ 12. LR _____ 13. RR _____ 14. TG/H _____</p> <p>(0) No door/gate/hatch or door not opened</p> <p>Door, Tailgate, or Hatch Came Open During Collision</p> <p>(1) Door operational (no damage)</p> <p>(2) Latch/striker failure due to damage</p> <p>(3) Hinge failure due to damage</p> <p>(4) Door structure failure due to damage</p> <p>(5) Door support (i.e., pillar, sill, roof side rail, etc.) failure due to damage</p> <p>(6) Latch/striker and hinge failure due to damage</p> <p>(8) Other failure (specify): _____</p> <p>(9) Unknown</p>	<p style="text-align: center;">GLAZING</p> <p>Glazing Damage from Impact Forces</p> <p>15. WS _____ 16. LF _____ 17. RF _____ 18. LR _____ 19. RR _____</p> <p>20. BL _____ 21. Roof _____ 22. Other _____</p> <p>(0) No glazing damage from impact forces</p> <p>(2) Glazing in place and cracked from impact forces</p> <p>(3) Glazing in place and holed from impact forces</p> <p>(4) Glazing out-of-place (cracked or not) and not holed from impact forces</p> <p>(5) Glazing out-of-place and holed from impact forces</p> <p>(6) Glazing disintegrated from impact forces</p> <p>(7) Glazing removed prior to accident</p> <p>(8) No glazing</p> <p>(9) Unknown if damaged</p> <p>Glazing Damage from Occupant Contact</p> <p>23. WS _____ 24. LF _____ 25. RF _____ 26. LR _____ 27. RR _____</p> <p>28. BL _____ 29. Roof _____ 30. Other _____</p> <p>(0) No occupant contact to glazing or no glazing</p> <p>(1) Glazing contacted by occupant but no glazing damage</p> <p>(2) Glazing in place and cracked by occupant contact</p> <p>(3) Glazing in place and holed by occupant contact</p> <p>(4) Glazing out-of-place (cracked or not) by occupant contact and not holed by occupant contact</p> <p>(5) Glazing out-of-place by occupant contact and holed by occupant contact</p> <p>(6) Glazing disintegrated by occupant contact</p> <p>(8) Unknown if contacted by occupant</p> <p>If No Glazing Damage And No Occupant Contact or No Glazing, Then Code IV 31 Through IV 46 As 0</p> <p>Type of Window/Windshield Glazing</p> <p>31. WS _____ 32. LF _____ 33. RF _____ 34. LR _____ 35. RR _____</p> <p>36. BL _____ 37. Roof _____ 38. Other _____</p> <p>(0) No glazing contact and no damage, or no glazing</p> <p>(1) AS-1 --- Laminated</p> <p>(2) AS-2 --- Tempered</p> <p>(3) AS-3 --- Tempered-tinted</p> <p>(4) AS-14 --- Glass/Plastic</p> <p>(8) Other (specify): _____</p> <p>(9) Unknown</p> <p>Window Pre-crash Glazing Status</p> <p>39. WS _____ 40. LF _____ 41. RF _____ 42. LR _____ 43. RR _____</p> <p>44. BL _____ 45. Roof _____ 46. Other _____</p> <p>(0) No glazing contact and no damage, or no glazing</p> <p>(1) Fixed</p> <p>(2) Closed</p> <p>(3) Partially opened</p> <p>(4) Fully opened</p> <p>(9) Unknown</p>
---	---

HS Form 435C (Rev. 1/90)

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

OCCUPANT AREA INTRUSION

Note: If no intrusions, leave variables IV 47-IV 86 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 | Fourth Seat |
| (11) Left | (41) Left |
| (12) Middle | (42) Middle |
| (13) Right | (43) Right |
| Second Seat | (97) Catastrophic |
| (21) Left | (98) Other enclosed area (specify): |
| (22) Middle | _____ |
| (23) Right | (99) Unknown |
| Third Seat | |
| (31) Left | |
| (32) Middle | |
| (33) Right | |

INTRUDING COMPONENT

- Interior Components
- (01) Steering assembly
 - (02) Instrument panel left
 - (03) Instrument panel center
 - (04) Instrument panel right
 - (05) Toe pan
 - (06) A-pillar
 - (07) B-pillar
 - (08) C-pillar
 - (09) D-pillar
 - (10) Door panel
 - (12) Roof (or convertible top)
 - (13) Roof side rail
 - (14) Windshield
 - (15) Windshield header
 - (16) Window frame
 - (17) Floor pan
 - (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 panel or door surface
 - (26) Other interior component (specify):
 - _____
 - (27) Side panel - forward of the A-pillar
 - (28) Side panel - rear of the A-pillar
- Exterior Components
- (30) Hood
 - (31) Outside surface of 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) ≥ 1 inch but < 3 inches
- (2) ≥ 3 inches but < 6 inches
- (3) ≥ 6 inches but < 12 inches
- (4) ≥ 12 inches but < 18 inches
- (5) ≥ 18 inches but < 24 inches
- (6) ≥ 24 inches
- (7) Catastrophic
- (9) Unknown

DOMINANT CRUSH DIRECTION

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

STEERING COLUMN WORKING DIAGRAMS

STEERING COLUMN COLLAPSE

Steering Column Shear Module Movement



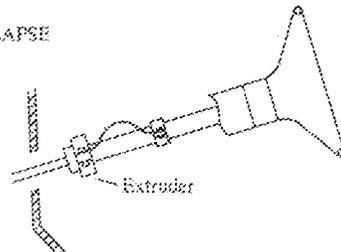
SHEAR CAPSULE

Left 

Right 

V =

Direction and Magnitude of Steering Column Movement



Extruder

After Compression



Flare Tube

Extruder

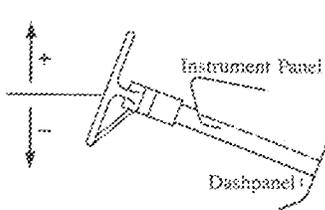
Possible Remaining Starter Grooves At 6 and 12 o'clock

A =

Compression = Measurement A

STEERING COLUMN MOVEMENT

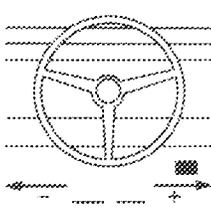
Vertical Movement



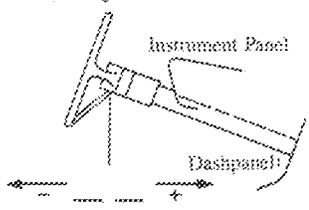
Instrument Panel

Dashpanel

Lateral Movement



Longitudinal Movement



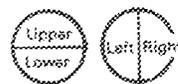
Instrument Panel

Dashpanel

	COMPARISON VALUE	...	DAMAGED VALUE	=	MOVEMENT
VERTICAL		...		=	
LATERAL		...		=	
LONGITUDINAL		...		=	

STEERING RIM/SPOKE DEFORMATION

COMPARISON VALUE	...	DAMAGED VALUE	=	DEFORMATION
	...		=	
	...		=	

STEERING COLUMN	
<p>87. Steering Column Type _____</p> <p>(1) Fixed column (2) Tilt column (3) Telescoping column (4) Tilt and telescoping column (5) Other column type (specify): _____</p> <p>(9) Unknown</p> <p>If PDOF ≠ 11, 12 or 1, Then Code IV88-IV91 As 96</p>	<p>82. Steering Rim/Spoke Deformation _____</p> <p>Code actual measured deformation to the nearest inch.</p> <p>(0) No steering rim deformation (1-5) Actual measured value (6) 6 inches or more (8) Observed deformation cannot be measured (9) Unknown</p>
<p>88. Steering Column Collapse Due to Occupant Loading _____</p> <p>Code actual measured movement to the nearest inch. See coding manual for measurement technique(s).</p> <p>(00) No movement, compression, or collapse (01-19) Actual measured value (20) 20 inches or greater</p> <p>Estimated movement from observation</p> <p>(81) Less than 1 inch (82) ≥ 1 inch but < 2 inches (83) ≥ 2 inches but < 4 inches (84) ≥ 4 inches but < 6 inches (85) ≥ 6 inches but < 8 inches (86) Greater than or equal to 8 inches (96) Not assessed (PDOF ≠ 11, 12, 1) (97) Apparent movement, value undetermined or cannot be measured or estimated (98) Nonspecified type column (99) Unknown</p>	<p>93. Location of Steering Rim/Spoke Deformation _____</p> <p>(00) No steering rim deformation</p> <p>Quarter Sections (01) Section A (02) Section B (03) Section C (04) Section D</p>  <p>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</p>  <p>(09) Complete steering wheel collapse (10) Undetermined location (99) Unknown</p>
INSTRUMENT PANEL	
<p>Direction And Magnitude of Steering Column Movement</p> <p>89. Vertical Movement _____ +</p> <p>90. Lateral Movement _____ +</p> <p>91. Longitudinal Movement _____ +</p> <p>Code the actual measured movement to the nearest inch. See Coding Manual for measurement technique(s)</p> <p>(00) No steering column movement (±01 - ±49) Actual measured value (±50) 50 inches or greater</p> <p>Estimated movement from observation</p> <p>(±81) ≥ 1 inch but < 3 inches (±82) ≥ 3 inches but < 6 inches (±83) ≥ 6 inches but < 12 inches (±84) ≥ 12 inches (...96) Not assessed (PDOF ≠ 11, 12, 1) (...97) Apparent movement > 1 inch but cannot be measured or estimated (...99) Unknown</p>	<p>94. Odometer Reading _____ 000</p> <p>_____ miles - Code mileage to the nearest 1,000 miles</p> <p>(000) No odometer (001) Less than 1,500 miles (300) 299,500 miles or more (999) Unknown</p> <p>Source: _____</p> <p>95. Instrument Panel Damage from Occupant Contact? _____</p> <p>(0) No (1) Yes (9) Unknown</p> <p>96. Knee Bolsters Deformed from Occupant Contact? _____</p> <p>(0) No (1) Yes (9) Not present (9) Unknown</p> <p>97. Did Glove Compartment Door Open During Collision(s)? _____</p> <p>(0) No (1) Yes (8) Not present (9) Unknown</p>

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.

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					

<p>FRONT</p> <p>(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-pillar, instrument panel, mirror, or steering assembly (driver side only) (15) Windshield including one or more of the following: front header, A-pillar, instrument panel, or mirror (passenger side only) (16) Other front object (specify): _____</p>		<p>CODES FOR INTERIOR COMPONENTS</p> <p>(26) Left side window glass including one or more of the following: frame, window sill, A-pillar, B-pillar, or roof side rail (27) Other left side object (specify): _____</p> <p>RIGHT SIDE</p> <p>(30) Right side interior surface, excluding hardware or armrests (31) Right side hardware or armrest (32) Right A pillar (33) Right B pillar (34) Other right pillar (specify): _____</p> <p>(35) Right side window glass or frame (36) Right side window glass including one or more of the following: frame, window sill, A-pillar, B-pillar, or roof side rail (37) Other right side object (specify): _____</p> <p>INTERIOR</p> <p>(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 (46) Other occupants (specify): _____ (47) Interior loose objects</p>		<p>(48) Child safety seat (specify): _____ (49) Other interior object (specify): _____</p> <p>ROOF</p> <p>(50) Front header (51) Rear header (52) Roof left side rail (53) Roof right side rail (54) Roof or convertible top</p> <p>FLOOR</p> <p>(56) Floor including toe pan (57) Floor or console mounted transmission lever, including console (58) Parking brake handle (59) Foot controls including parking brake</p> <p>REAR</p> <p>(60) Backlight (rear window) (61) Backlight storage rack, door, etc. (62) Other rear object (specify): _____</p>	
<p>LEFT SIDE</p> <p>(20) Left side interior surface, excluding hardware or armrests (21) Left side hardware or armrest (22) Left A pillar (23) Left B pillar (24) Other left pillar (specify): _____</p> <p>_____</p> <p>(25) Left side window glass or frame</p>		<p>CONFIDENCE LEVEL OF CONTACT POINT</p> <p>(1) Certain (2) Probable (3) Possible (4) Unknown</p>			

NASS/CDS Data Elements

AUTOMATIC RESTRAINTS								
<p>NOTES: Encode the data for each applicable front seat position. The attributes for the variables may be found below. Restraint systems should be assessed during the vehicle inspection then coded on the Occupant Assessment Form.</p>								
		Left	Center	Right				
F I R S T	Availability							
	Function							
	Failure							
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; padding: 5px;"> <p>Automatic (Passive) Restraint System Availability</p> <p>(0) Not equipped/not available (1) Airbag (2) Airbag disconnected (specify): _____ (3) Airbag not reinstalled (4) 2 point automatic belts (5) 3 point automatic belts (6) Automatic belts destroyed or rendered inoperative (9) Unknown</p> </td> <td style="width: 50%; vertical-align: top; padding: 5px;"> <p>Automatic (Passive) Restraint Function</p> <p>(0) Not equipped/not available</p> <p>Automatic Belt (1) Automatic belt in use (2) Automatic belt not in use (3) Automatic belt use unknown</p> <p>Air Bag (4) Airbag deployed during accident (5) Airbag deployed inadvertently just prior to accident (6) Deployed, accident sequence undetermined (7) Nondeployed (8) Unknown if deployed (9) Unknown</p> </td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 10px;"> <p>Did Automatic (Passive) Restraint Fail</p> <p>(0) Not equipped/not available (1) No (2) Yes (specify): _____ (9) Unknown</p> </td> </tr> </table>					<p>Automatic (Passive) Restraint System Availability</p> <p>(0) Not equipped/not available (1) Airbag (2) Airbag disconnected (specify): _____ (3) Airbag not reinstalled (4) 2 point automatic belts (5) 3 point automatic belts (6) Automatic belts destroyed or rendered inoperative (9) Unknown</p>	<p>Automatic (Passive) Restraint Function</p> <p>(0) Not equipped/not available</p> <p>Automatic Belt (1) Automatic belt in use (2) Automatic belt not in use (3) Automatic belt use unknown</p> <p>Air Bag (4) Airbag deployed during accident (5) Airbag deployed inadvertently just prior to accident (6) Deployed, accident sequence undetermined (7) Nondeployed (8) Unknown if deployed (9) Unknown</p>	<p>Did Automatic (Passive) Restraint Fail</p> <p>(0) Not equipped/not available (1) No (2) Yes (specify): _____ (9) Unknown</p>	
<p>Automatic (Passive) Restraint System Availability</p> <p>(0) Not equipped/not available (1) Airbag (2) Airbag disconnected (specify): _____ (3) Airbag not reinstalled (4) 2 point automatic belts (5) 3 point automatic belts (6) Automatic belts destroyed or rendered inoperative (9) Unknown</p>	<p>Automatic (Passive) Restraint Function</p> <p>(0) Not equipped/not available</p> <p>Automatic Belt (1) Automatic belt in use (2) Automatic belt not in use (3) Automatic belt use unknown</p> <p>Air Bag (4) Airbag deployed during accident (5) Airbag deployed inadvertently just prior to accident (6) Deployed, accident sequence undetermined (7) Nondeployed (8) Unknown if deployed (9) Unknown</p>							
<p>Did Automatic (Passive) Restraint Fail</p> <p>(0) Not equipped/not available (1) No (2) Yes (specify): _____ (9) Unknown</p>								

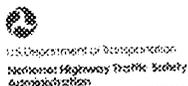
MANUAL RESTRAINTS						
<p>NOTES: Encode the applicable data for each seat position in the vehicle. The attributes for the variables may be found below. Restraint systems should be assessed during the vehicle inspection then coded on the Occupant Assessment Form.</p> <p>If a child safety seat is present, encode the data on the back of this page.</p> <p>If the vehicle has automatic restraints available, encode the appropriate data on the back of the previous page.</p>						
		Left	Center	Right		
F I R S T	Availability					
	Use					
	Failure Modes					
S E C O N D	Availability					
	Use					
	Failure Modes					
T H I R D	Availability					
	Use					
	Failure Modes					
O T H E R	Availability					
	Use					
	Failure Modes					
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; padding-right: 20px;"> <p>Manual (Active) Belt System Availability</p> <p>(0) Not available (1) Belt removed/destroyed (2) Shoulder belt (3) Lap belt (4) Lap and shoulder belt (5) Belt available -- type unknown (6) Other belt (specify): _____ (9) Unknown</p> <p>Manual (Active) Belt System Use</p> <p>(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 _____</p> </td> <td style="width: 50%; vertical-align: top;"> <p>(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): _____ (89) Unknown if belt used</p> <p>Manual (Active) Belt Failure Modes During Accident</p> <p>(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</p> </td> </tr> </table>					<p>Manual (Active) Belt System Availability</p> <p>(0) Not available (1) Belt removed/destroyed (2) Shoulder belt (3) Lap belt (4) Lap and shoulder belt (5) Belt available -- type unknown (6) Other belt (specify): _____ (9) Unknown</p> <p>Manual (Active) Belt System Use</p> <p>(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 _____</p>	<p>(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): _____ (89) Unknown if belt used</p> <p>Manual (Active) Belt Failure Modes During Accident</p> <p>(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</p>
<p>Manual (Active) Belt System Availability</p> <p>(0) Not available (1) Belt removed/destroyed (2) Shoulder belt (3) Lap belt (4) Lap and shoulder belt (5) Belt available -- type unknown (6) Other belt (specify): _____ (9) Unknown</p> <p>Manual (Active) Belt System Use</p> <p>(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 _____</p>	<p>(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): _____ (89) Unknown if belt used</p> <p>Manual (Active) Belt Failure Modes During Accident</p> <p>(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</p>					

NASS/CDS Data Elements

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					
<p>1. Type of Child Safety Seat</p> <p>(0) No child safety seat (1) Infant seat (2) Toddler seat (3) Convertible seat (4) Booster seat (7) Other type child safety seat (specify): _____</p> <p>(8) Unknown child safety seat type (9) Unknown if child safety seat used</p> <p>2. Child Safety Seat Orientation</p> <p>(00) No child safety seat</p> <p>Designed for Rear Facing for This Age/Weight (01) Rear facing (02) Forward facing (03) Other orientation (specify): _____</p> <p>(04) Unknown orientation</p> <p>Designed for Forward Facing for This Age/Weight (11) Rear facing (12) Forward facing (18) Other orientation (specify): _____</p> <p>(19) Unknown orientation</p> <p>Unknown Design or Orientation for This Age/Weight, or Unknown Age/Weight (21) Rear facing (22) Forward facing (28) Other orientation (specify): _____</p> <p>(29) Unknown orientation</p> <p>(99) Unknown if child safety seat used</p>			<p>3. Child Safety Seat Harness Usage</p> <p>4. Child Safety Seat Shield Usage</p> <p>5. Child Safety Seat Tether Usage</p> <p>Note: Options Below Are Used for Variables 3-5.</p> <p>(00) No child safety seat</p> <p>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 (08) Unknown if harness/shield/tether added or used</p> <p>Designed with Harness/Shield/Tether (11) Harness/shield/tether not used (12) Harness/shield/tether used (18) Unknown if harness/shield/tether used</p> <p>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</p> <p>(99) Unknown if child safety seat used</p> <p>6. Child Safety Seat Make/Model (Specify make/model and occupant number)</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>			

HEAD RESTRAINTS/SEAT EVALUATION				
NOTES: Encode the applicable data for each seat position in the vehicle. The attributes 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
F I R S T	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
S E C O N D	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
T H I R D	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
O T H E R	Head Restraint Type/Damage			
	Seat Type			
	Seat Performance			
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 Performance (This Occupant Position) (0) No seat (1) No seat performance failure(s) (2) Seat adjusters failed (3) Seat back folding locks failed (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 Type (This Occupant Position) (00) 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., van type) (09) Other seat type (specify): _____ (99) Unknown				
DESCRIBE ANY INDICATION OF ABNORMAL OCCUPANT POSTURE (I.E. UNUSUAL OCCUPANT CONTACT PATTERN): _____ _____ _____				

EJECTION/ENTRAPMENT DATA																																									
Complete the following if the researcher has any indications that an occupant was either ejected from or entrapped in the vehicle. Code the appropriate data on the Occupant Assessment Form.																																									
EJECTION No [<input type="checkbox"/>] Yes [<input type="checkbox"/>]																																									
Describe indications of ejection and body parts involved in partial ejection(s):																																									
_____ _____ _____																																									
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 25%; padding: 5px;">Occupant Number</td> <td style="width: 12.5%;"></td> </tr> <tr> <td style="padding: 5px;">Ejection</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding: 5px;">(Note on Vehicle Interior Sketch) Ejection Area</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding: 5px;">Ejection Medium</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding: 5px;">Medium Status</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>							Occupant Number							Ejection							(Note on Vehicle Interior Sketch) Ejection Area							Ejection Medium							Medium Status						
Occupant Number																																									
Ejection																																									
(Note on Vehicle Interior Sketch) Ejection Area																																									
Ejection Medium																																									
Medium Status																																									
Ejection (1) Complete ejection (2) Partial ejection (3) Ejection, unknown degree (9) Unknown	(7) Roof (8) Other area (e.g., back of pickup, etc.) (specify): _____ (9) Unknown	(5) Integral structure (6) Other medium (specify): _____ (9) Unknown																																							
Ejection Area (1) Windshield (2) Left front (3) Right front (4) Left rear (5) Right rear (6) Rear	Ejection Medium (1) Door/hatch/taillgate (2) Nonfixed roof structure (3) Fixed glazing (4) Nonfixed glazing (specify): _____	Medium Status (Immediately Prior to Impact) (1) Open (2) Closed (3) Integral structure (9) Unknown																																							
ENTRAPMENT No [<input type="checkbox"/>] Yes [<input type="checkbox"/>]																																									
Describe entrapment mechanism: _____ _____ _____																																									
Component(s): _____ _____																																									
(Note in vehicle interior diagram)																																									

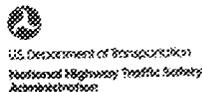


INTERIOR VEHICLE LOG

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

Performance Assessment

TO BE COMPLETED BY TEAM	DATA STATUS OF VARIABLE NUMBERS 4-87
1. PSU Number: _____	Integrity 4 5 6 7 8 9 10 11 12 13 14 [][][][][][][][][][][][]
2. Case Number--Stratum _____	
3. Researcher Completing Form _____	Glazing 15 16 17 18 19 20 21 22 23 24 25 [][][][][][][][][][][][]
4. Vehicle Number _____	
TO BE COMPLETED BY ZONE CENTER	
5. Assessment Of Complexity Of Interior Vehicle Inspection _____ (1) Level 1--Interior inaccessible or repaired Level 2 (2) Routine (3) Difficult (4) Extremely complex	26 27 28 29 30 31 32 33 34 35 36 [][][][][][][][][][][][]
6. Documentation of Integrity _____	37 38 39 40 41 42 43 44 45 46 [][][][][][][][][][][][]
7. Documentation of Glazing _____	Intrusion 47 48 49 50 51 52 53 54 55 56 57 [][][][][][][][][][][][]
8. Documentation of Intrusions _____	
9. Documentation of Steering Column _____	58 59 60 61 62 63 64 65 66 67 68 [][][][][][][][][][][][]
10. Documentation of Occupant Contacts _____	
11. Documentation of Restraint Systems _____	69 70 71 72 73 74 75 76 77 78 79 [][][][][][][][][][][][]
12. Documentation of Seats _____	
13. Interior Slides Subject Quality _____	80 81 82 83 84 85 86 [][][][][][][][]
14. Interior Slides Quality _____ Codes For Log Variables 6-14 (0) Not applicable (1) Unacceptable (2) Poor (3) Adequate (4) Good (5) Very good	Steering Column / Instrument Panel 87 88 89 90 91 92 93 94 95 96 97 [][][][][][][][][][][][]
15. Number of Coded Intrusions _____	Data Status Codes: (Blank) Correct (1) Derived error (2) Non-correctable error (3) Correctable error (4) Change--no error (5) Sequencing error (6) MDE error (9) Unknown coded



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

OCCUPANT ASSESSMENT FORM

<p>1. Primary Sampling Unit Number _____</p> <p>2. Case Number--Stratum _____</p> <p>3. Vehicle Number _____</p> <p>4. Occupant Number _____</p>	<p>11. Occupant's Posture _____</p> <p>(0) Normal posture</p> <p>(1) Abnormal posture (specify): _____</p> <p>(9) Unknown</p>
EJECTION/ENTRAPMENT	
OCCUPANT'S CHARACTERISTICS	<p>12. Ejection _____</p> <p>(0) No ejection</p> <p>(1) Complete ejection</p> <p>(2) Partial ejection</p> <p>(3) Ejection, unknown degree</p> <p>(9) Unknown</p>
<p>5. Occupant's Age _____</p> <p>Code actual age at time of accident.</p> <p>(00) Less than one year old (specify by month): _____</p> <p>(97) 97 years and older</p> <p>(99) Unknown</p>	<p>13. Ejection Area _____</p> <p>(0) No ejection</p> <p>(1) Windshield</p> <p>(2) Left front</p> <p>(3) Right front</p> <p>(4) Left rear</p> <p>(5) Right rear</p> <p>(6) Rear</p> <p>(7) Roof</p> <p>(8) Other area (e.g., back of pickup, etc.)</p> <p>(specify): _____</p> <p>(9) Unknown</p>
<p>6. Occupant's Sex _____</p> <p>(1) Male</p> <p>(2) Female</p> <p>(9) Unknown</p>	<p>14. Ejection Medium _____</p> <p>(0) No ejection</p> <p>(1) Door/hatch/taillgate</p> <p>(2) Nonfixed roof structure</p> <p>(3) Fixed glazing</p> <p>(4) Nonfixed glazing (specify): _____</p> <p>(5) Integral structure</p> <p>(6) Other medium (specify): _____</p> <p>(9) Unknown</p>
<p>7. Occupant's Height _____</p> <p>Code actual height to the nearest inch.</p> <p>(99) Unknown</p>	<p>15. Medium Status (Immediately Prior to Impact) _____</p> <p>(0) No ejection</p> <p>(1) Open</p> <p>(2) Closed</p> <p>(3) Integral structure</p> <p>(9) Unknown</p>
<p>8. Occupant's Weight _____</p> <p>Code actual weight to the nearest pound.</p> <p>(999) Unknown</p>	<p>16. Entrapment _____</p> <p>(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.)</p> <p>(0) Not entrapped</p> <p>(1) Entrapped</p> <p>(9) Unknown</p>
<p>9. Occupant's Role _____</p> <p>(1) Driver</p> <p>(2) Passenger</p> <p>(9) Unknown</p>	
<p>10. Occupant's Seat Position _____</p> <p>Front Seat</p> <p>(11) Left side</p> <p>(12) Middle</p> <p>(13) Right side</p> <p>(14) Other (specify): _____</p> <p>Second Seat</p> <p>(21) Left side</p> <p>(22) Middle</p> <p>(23) Right side</p> <p>(24) Other (specify): _____</p> <p>Third Seat</p> <p>(31) Left side</p> <p>(32) Middle</p> <p>(33) Right side</p> <p>(34) Other (specify): _____</p> <p>Fourth Seat</p> <p>(41) Left side</p> <p>(42) Middle</p> <p>(43) Right side</p> <p>(44) Other (specify): _____</p> <p>(97) In or on unenclosed area</p> <p>(98) Other seat (specify): _____</p> <p>(99) Unknown</p>	

HB Form 433A (Rev. 1/89)

This report is authorized by P.L. 89-562, 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.

RESTRAINT SYSTEM AND SEAT EVALUATION	
<p>17. Manual (Active) Belt System Availability -----</p> <p>(0) Not available (1) Belt removed/destroyed (2) Shoulder belt (3) Lap belt (4) Lap and shoulder belt (5) Belt available - type unknown (6) Other belt (specify): _____ (9) Unknown</p>	<p>21. Automatic (Passive) Restraint System Availability -----</p> <p>(0) Not equipped/not available (1) Airbag (2) Airbag disconnected (specify): _____ (3) Airbag not reinstalled (4) 2 point automatic belts (5) 3 point automatic belts (6) Automatic belts destroyed or rendered inoperative (9) Unknown</p>
<p>18. Manual (Active) Belt System Use -----</p> <p>(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 (09) 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</p>	<p>22. Automatic (Passive) Restraint Function -----</p> <p>(0) Not equipped/not available</p> <p>Automatic Belt (1) Automatic belt in use (2) Automatic belt not in use (3) Automatic belt use unknown</p> <p>Air Bag (4) Airbag deployed during accident (5) Airbag deployed inadvertently just prior to accident (6) Deployed, accident sequence undetermined (7) Nondeployed (9) Unknown if deployed (9) Unknown</p>
<p>19. Proper Use of Manual (Active) Belts -----</p> <p>(0) None used or not available (1) Belt used properly (2) Belt used properly with child safety seat</p> <p>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</p>	<p>23. Did Automatic (Passive) Restraint Fail? -----</p> <p>(0) Not equipped/not available (1) No (2) Yes (specify): _____ (9) Unknown</p>
<p>20. Manual (Active) Belt Failure Modes During Accident -----</p> <p>(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</p>	<p>24. Police Reported Restraint Use -----</p> <p>(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"</p>
<p>25. Head Restraint Type/Damage by Occupant at This Occupant Position -----</p> <p>(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</p>	

INJURY CONSEQUENCES	
<p>34. Injury Severity (Police Rating) _____</p> <p>(0) C -- 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</p>	<p>38. Working Days Lost _____</p> <p>_____ Code the number of days (up through 60) that the occupant lost from work due to the accident</p> <p>(00) No working days lost (61) 61 days or more (62) Fatally injured (97) Not working prior to accident (99) Unknown</p>
<p>35. Treatment -- Mortality _____</p> <p>(0) No treatment (1) Fatal (2) Fatal -- ruled disease</p> <p>Nonfatal (3) Hospitalized (4) Transported and released (5) Treatment at scene -- nontransported (6) Treatment later (8) Treatment -- other (specify): _____</p> <p>(9) Unknown</p>	<p>39. Time to Death _____</p> <p>_____ 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)</p> <p>(00) Not fatal (96) Fatal -- ruled disease (99) Unknown</p>
<p>36. Type of Medical Facility (for Initial Treatment) _____</p> <p>(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): _____</p> <p>(9) Unknown</p>	<p>40. 1st Medically Reported Cause of Death _____</p> <p>41. 2nd Medically Reported Cause of Death _____</p> <p>42. 3rd Medically Reported Cause of Death _____</p> <p>_____ Code the Occupant Injury from line number(s) for the medically reported injury(s) which reportedly contributed to this occupant's death</p> <p>(00) Not fatal or no additional causes (97) Other result (specify): _____</p> <p>(99) Unknown</p>
<p>37. Hospital stay _____</p> <p>_____ Code number of days (up through 60) that the occupant stayed in the hospital</p> <p>(00) Not hospitalized (61) 61 days or more (99) Unknown</p>	<p>43. Number of Recorded Injuries for This Occupant _____</p> <p>_____ Code the actual number of injuries recorded for this occupant.</p> <p>(00) No recorded injuries (97) Injured, details unknown (99) Unknown if injured</p>
<p>UPDATE CANDIDATE NO [] YES []</p>	
<p>*** STOP HERE *** IF THERE ARE NO RECORDED INJURIES (I.E., OA43=00, 97, 99)</p>	

NASS/CDS Data Elements



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

OCCUPANT ASSESSMENT LOG

Performance Assessment

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

TO BE COMPLETED BY TEAM		12. Injury Information	
1. PSU Number	.....	<i>Official</i>	
2. Case Number—Stratum	.....	a. Autopsy (invasive examination)	.....
3. Researcher Completing Form	.....	b. Post-ERI medical record which includes information about death based on non-invasive examination	.....
4. Vehicle Number	.....	c. Admission record/summary of admission/discharge face sheet	.....
5. Interviewer Number	.....	d. Discharge summary	.....
6. Occupant Number	.....	e. Radiographic record(s) post ERI visit	.....
7. Occupant's Role	.....	f. History and physical examination and/or consultation records	.....
(1) Driver	.....	g. Emergency room records	.....
(2) Passenger	.....	h. Radiographic record(s) associated with ERI visit	.....
(3) Unknown	.....	i. Private physician	.....
8. Interviewee For This Occupant	.....	<i>Unofficial</i>	
(0) No interview	.....	j. Lay coroner	.....
(1) Same person	.....	k. EMS record	.....
<i>Surrogate</i>		l. Interviewee	.....
(2) Other occupant	.....	m. Other source (specify): .....	.....
(3) Relative or friend	.....	n. Police report	.....
(4) Combination of above categories (specify):			
9. Manner Of Interview	.....	(Blank) Not medically treated/record not required	
(0) No attempt	.....	(01) No record of treatment at medical facility	
(1) Telephone	.....	(02) Medical release required— not obtained	
(2) In-person	.....	(03) Injury not related to accident	
(3) Questionnaire	.....	(04) Noncooperative hospital	
(4) Other (specify):		(05) Hospital out of study area	
10. Result Of Interview Attempt	.....	(06) Private physician would not release data	
(01) Unable to contact or locate	.....	(07) Unknown if medically treated	
(02) Hit and run	.....	(08) To be updated	
(03) Fatal—surrogate not available	.....	(09) Record not received before file closeout	
(04) In intensive care—surrogate not available	.....	(10) Record not obtained	
(05) Out-of-state resident	.....	(11) Record obtained	
(06) Refused interview	.....	(12) Partial record obtained—not to be updated	
(07) Insurance company refusal	.....	(13) Partial record obtained—to be updated	
(08) Attorney refusal or litigation	.....	
(09) No return of questionnaire	.....	
(10) Other (specify):			
(11) Return of completed questionnaire	.....	
(12) Partial interview	.....	
(13) Complete interview	.....	
11. Injury Treatment Status	.....	13. Medical Facility Code	.....
(0) No treatment	.....	
(1) Fatal—died before hospitalization	.....	
(2) Fatal—died after hospitalization	.....	
(3) Hospitalization	.....	
(4) Emergency room treatment only	.....	
(5) Treatment at physician's office	.....	
(6) Treatment at scene or self treatment	.....	
(9) Unknown	.....	

TO BE COMPLETED BY ZONE CENTER																																							
DATA STATUS OF VARIABLE NUMBERS 4-43																																							
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43

Data Status Codes:

(Blank) Correct	(4) Change—no error
(1) Derived error	(5) Sequencing error
(2) Non-correctable error	(6) MDE error
(3) Correctable error	(9) Unknown coded



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

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

OCCUPANT INJURY FORM

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

O.I.C.—A.I.S.										
	Source of Injury Data	Body Region	Aspect	Lesion	System Organ	A.I.S. Severity	Injury Source	Injury Source Confidence Level	Direct/Indirect Injury	Occupant Area Intrusion No.
1st	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
2nd	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
3rd	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.
4th	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.
5th	45.	46.	47.	48.	49.	50.	51.	52.	53.	54.
6th	55.	56.	57.	58.	59.	60.	61.	62.	63.	64.
7th	65.	66.	67.	68.	69.	70.	71.	72.	73.	74.
8th	75.	76.	77.	78.	79.	80.	81.	82.	83.	84.
9th	85.	86.	87.	88.	89.	90.	91.	92.	93.	94.
10th	95.	96.	97.	98.	99.	100.	101.	102.	103.	104.

HS Form 433B (Rev. 1/90)

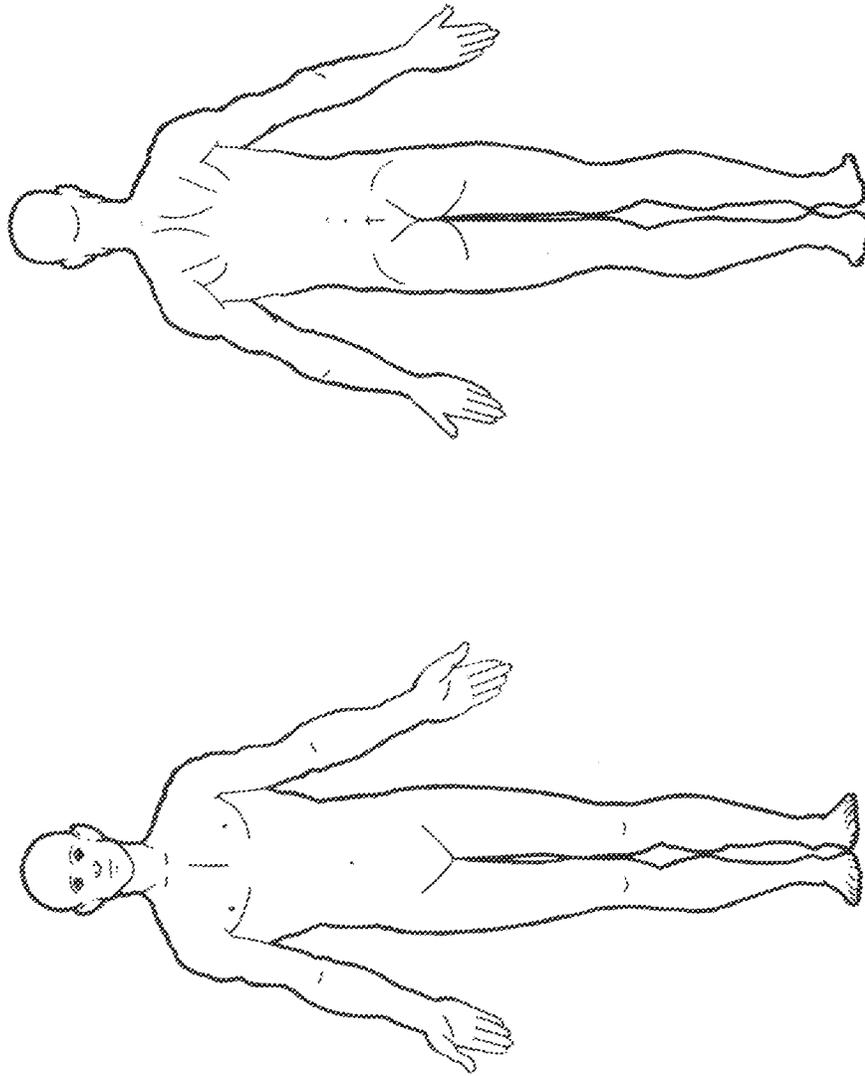
This report is authorized by P.L. 89-563, Title 1, Section 105, 106, and 112. While you are not required to respond, your cooperation is needed to make the results of this data collection effort comprehensive, accurate, and timely.

NASS/CDS Data Elements

OCCUPANT INJURY DATA										
Source of Injury Data	G.I.C.--A.I.S.					A.I.S. Severity	Injury Source	Injury Source Confidence Level	Direct/Indirect Injury	Occupant Area Intrusion No.
	Body Region	Aspect	Lesion	System	Organ					
11th	---	---	---	---	---	---	---	---	---	---
12th	---	---	---	---	---	---	---	---	---	---
13th	---	---	---	---	---	---	---	---	---	---
14th	---	---	---	---	---	---	---	---	---	---
15th	---	---	---	---	---	---	---	---	---	---
16th	---	---	---	---	---	---	---	---	---	---
17th	---	---	---	---	---	---	---	---	---	---
18th	---	---	---	---	---	---	---	---	---	---
19th	---	---	---	---	---	---	---	---	---	---
20th	---	---	---	---	---	---	---	---	---	---
21st	---	---	---	---	---	---	---	---	---	---
22nd	---	---	---	---	---	---	---	---	---	---
23rd	---	---	---	---	---	---	---	---	---	---

OFFICIAL INJURY DATA - SOFT TISSUE INJURIES

Indicate the Location, Lesion, Depth, Tissue 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 interview data are unavailable.)

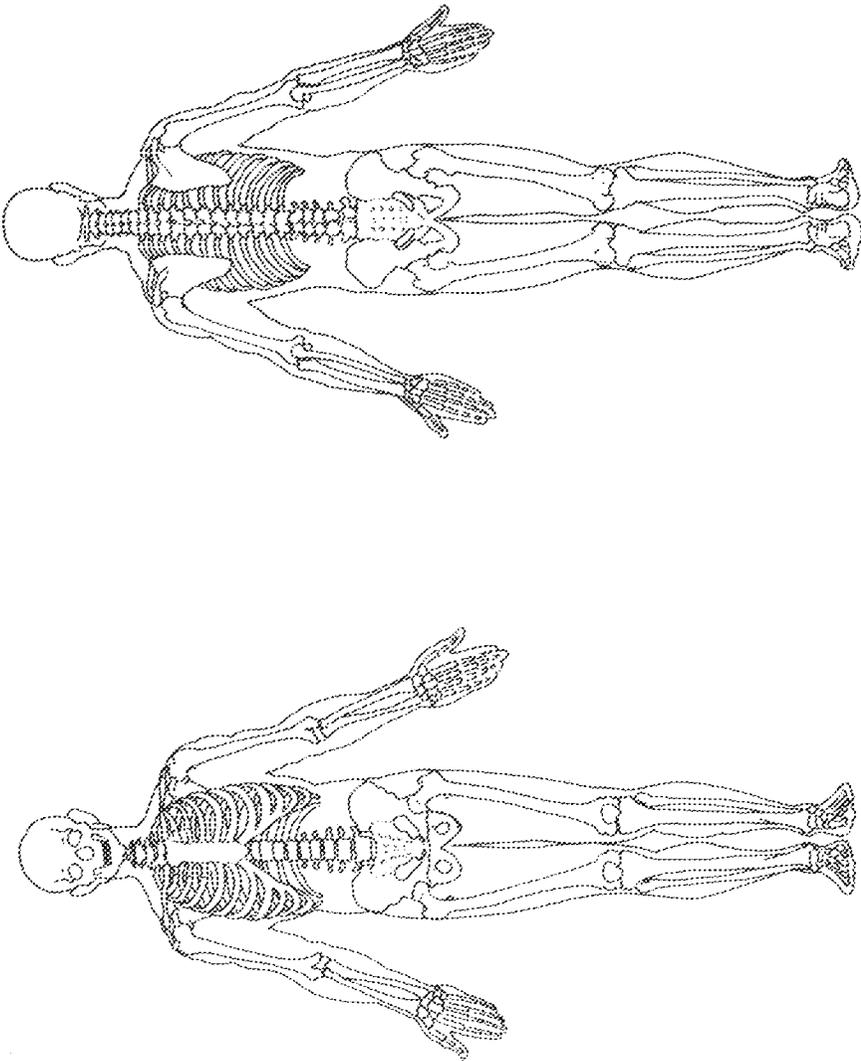


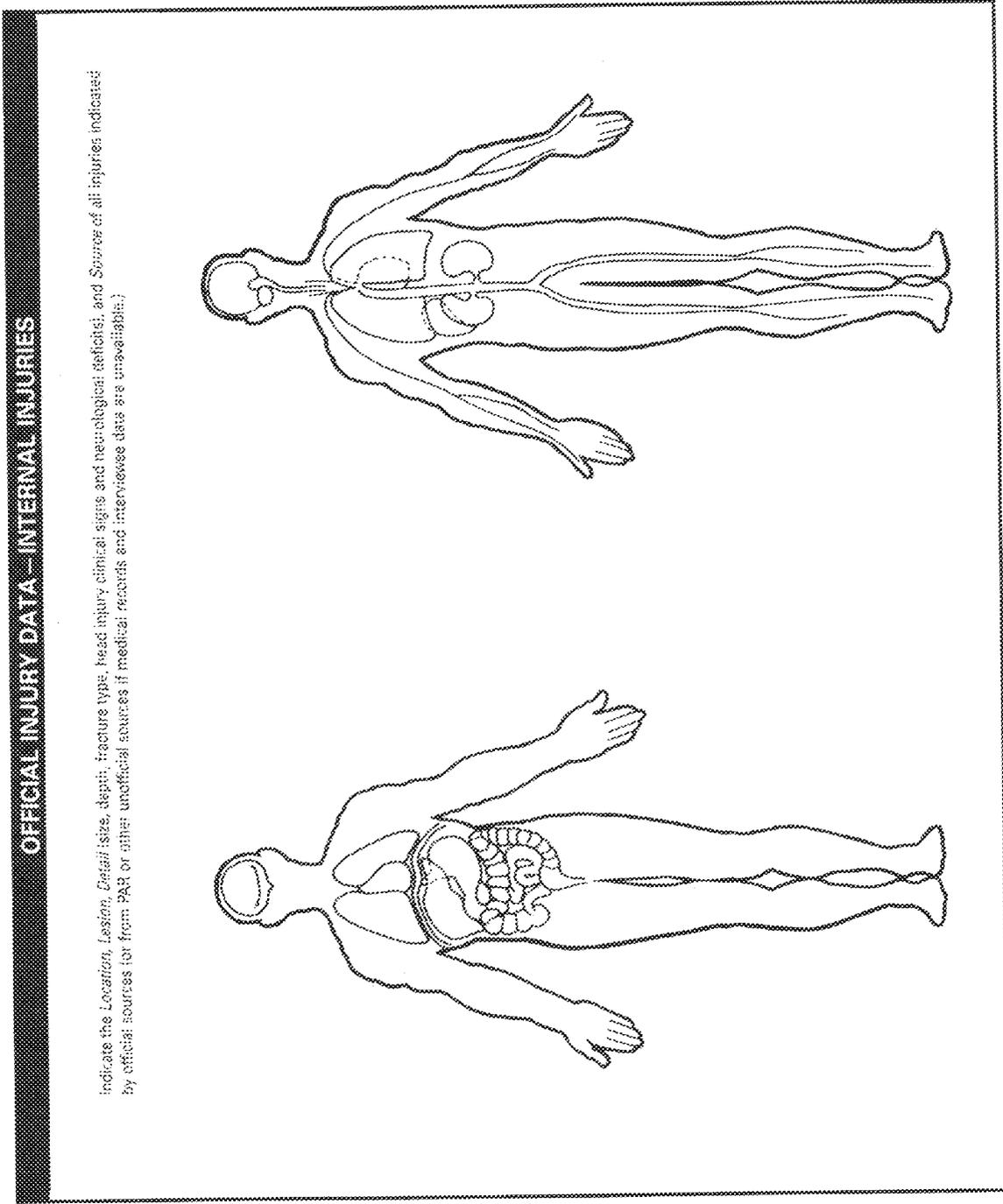
NASS/CDS Data Elements

SOURCE OF INJURY DATA OFFICIAL (1) Autopsy records with or without hospital medical records (2) Hospital medical records other than emergency room (eg. 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 person report (6) E.M.S. personnel (7) Interviewee (8) Other source (specify): _____ (9) Police		(26) Left side window glass including one or more of the following: frame, window sill, A-pillar, B-pillar, or roof side rail (27) Other left side object (specify): _____ RIGHT SIDE (28) Right side interior surface, excluding hardware or armrests (29) Right side hardware or armrest (30) Right A-pillar (31) Right B-pillar (32) Other right pillar (specify): _____ (33) Right side window glass or frame (34) Right side window glass including one or more of the following: frame, window sill, A-pillar, B-pillar, roof side rail (35) Other right side object (specify): _____ 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 (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 rack side rail (53) Roof rack side rail (54) Roof or convertible top FLOOR (55) Floor including toe pan (56) Floor or console mounted transmission lever, including console (57) Parking brake handle (58) Foot controls including parking brake REAR (59) Backlight (rear window) (60) Backlight storage rack, door, etc. (61) Other rear object (specify): _____	EXTERIOR OF OCCUPANT'S VEHICLE (62) Hood (63) Outside hardware (e.g., outside mirror, antenna) (64) Other exterior surface or tires (specify): _____ (65) Unknown exterior objects EXTERIOR OF OTHER MOTOR VEHICLE (70) Front bumper (71) Hood edge (72) Other front of vehicle (specify): _____ (73) Hood (74) Hood ornament (75) Windshield, roof rail, A-pillar (76) Side surface (77) Side mirrors (78) Other side protrusions (specify): _____ (79) Rear surface (80) 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 (90) Fire in vehicle (91) Flying glass (92) Other noncontact injury source (specify): _____ (93) Injured, unknown source
INJURY SOURCE FRONT (01) Windshield (02) Mirror (03) Sunvisor (04) Steering wheel hub (05) Steering wheel hub/spoke (06) Steering wheel tub/shaft/air of coxes (04 and 05) (07) Steering column, transmission selector lever, other attachment (08) Add-on equipment (e.g., C/S, 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-pillar, instrument panel, mirror, or steering assembly (driver side only) (15) Windshield including one or more of the following: front header, A-pillar, instrument panel, or mirror (passenger side only) (16) Other front object (specify): _____ LEFT SIDE (20) Left side interior surface, excluding hardware or armrests (21) Left side hardware or armrest (22) Left A-pillar (23) Left B-pillar (24) Other left pillar (specify): _____ (25) Left side window glass or frame		INJURY SOURCE CONFIDENCE LEVEL (1) Certain (2) Probable (3) Possible (4) Unknown DIRECT/INDIRECT INJURY (1) Direct contact injury (2) Indirect contact injury (3) Noncontact injury (4) Injured, unknown source	
OCCUPANT INJURY CLASSIFICATION			
O.I.C. Body Region (00) Abdomen (01) Ankle - foot (02) Arm (upper) (03) Back - thoracic/lumbar spine (04) Chest (05) Elbow (06) Face (07) Forearm (08) Head - skull (09) Injured - unknown region (10) Knee (11) Leg (lower) (12) Lower limb(s) (whole or unknown part) (13) Neck - cervical spine (14) Pelvis - hip (15) Shoulder (16) Thigh (17) Upper limb(s) (whole or unknown part) (18) Whole body	(00) Wrist - hand Aspect of Injury (01) Anterior - front (02) Superior (top) (fracture only) (03) Central (04) Inferior - lower (05) Internal, unknown aspect (06) Left (07) Posterior - back (08) Right (09) Superior - upper (10) Whole region Lesion (01) Abrasion (02) Amputation (03) Avulsion (04) Burn (05) Contusion (06) Concussion (07) Crush	(01) Detachment, separation (02) Dislocation (03) Fracture (04) Fracture and dislocation (05) Injured, unknown lesion (06) Laceration (07) Other (08) Puncture, contusion (09) Burn/trauma (10) Sprain (11) Strain (12) Tissue severance, transection System/Organ (00) All systems in region (01) Arteries - veins (02) Brain (03) Digestive (04) Ear (05) Eye (06) Heart (07) Injured, unknown system	(01) Integumentary (02) Joints (03) Kidneys (04) Liver (05) Muscles (06) Nerve system (07) Pulmonary - lungs (08) Reproductive (09) Skeleton (10) Spinal Cord (11) Spleen (12) Thyroid, other endocrine gland (13) Urinary (14) Vertebrate
Abbreviated Injury Scale (1) Minor injury (2) Moderate injury (3) Serious injury (4) Severe injury (5) Critical injury (6) Maximum nonfatal (7) Injured, unknown severity			

OFFICIAL INJURY DATA—SKELETAL INJURIES

Indicate the Location, Lesion, 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 interview data are unavailable.)







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

OCCUPANT INJURY LOG

Performance Assessment

NATIONAL ACCIDENT SAMPLING SYSTEM
CRASHWORTHINESS DATA SYSTEM

TO BE COMPLETED BY TEAM		AIS 1-7	AIS 3-8								
1. PSU Number	_____	12. Number of Researcher Coded Rows	_____								
2. Case Number--Stratum	_____	13. Number of Rows Added by Zone Center	_____								
3. Researcher Completing Form	_____	14. Number of Rows Deleted by Zone Center	_____								
4. Vehicle Number	_____	15. Number of Other Rows with Errors	_____								
5. Interviewer Number	_____										
6. Occupant Number	_____										
TO BE COMPLETED BY ZONE CENTER		DATA STATUS FOR INJURY VARIABLES									
7. Assessment of Complexity of Medical Data--Official Sources	_____	Errors (total number in each column)									
(1) No data obtained		5	6	7	8	9	10	11	12	13	14
(2) Routine											
(3) Difficult											
(4) Extremely complex											
8. Assessment of Complexity of Medical Data--Interview	_____	Unknowns (total number in each column)									
(1) No data obtained		5	6	7	8	9	10	11	12	13	14
(2) Routine											
(3) Difficult											
(4) Extremely complex											
9. Documentation of Unofficial Data on Manikin/Listing	_____	16. Date Update Received	_____	_____							
(0) Not applicable		17. Date Updated Reviewed	_____	_____							
(1) Unacceptable		18. Reviewed By (Initials)	_____	_____							
(2) Poor		19. Date MDE'd	_____	_____							
(3) Adequate		20. MDE'd By (Initials)	_____	_____							
(4) Good											
(5) Very good											
10. Documentation of Official Data on Manikin	_____										
(0) Not applicable											
(1) Unacceptable											
(2) Poor											
(3) Adequate											
(4) Good											
(5) Very good											
11. Primary Error Area	_____										
(0) Not injured/no errors											
(1) Head or neck											
(2) Face											
(3) Chest											
(4) Abdominal or pelvic contents											
(5) Extremities or pelvic girdle											
(6) General (external)											

Appendix E. 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 E1 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 E2 provides Comprehensive Harm figures that include quantities representing values for pain and suffering costs that are excluded in the "economic" cost schedule.

Harm Definition

Table E1. 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 E2. 1990 Comprehensive Harm

Survivor's Maximum AIS		Unit Costs [2]	Incidence [3]	Harm [4] (Billion Dollars)
Minor	1	\$6,160	4,617,228	\$29
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 F. 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 1988-1990 period
- The sampling errors for the weighted average counts over the period 1988-1990 period.

The method for producing estimates from the 1988-1990 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

Missing (unknown or uncoded) data for the seating position of car, light truck, van, and MPV occupants (Tables 4 and 8 of the report) are imputed using a univariate imputation procedure. The procedure distributes the missing values of seating position according to the proportion of all of the known values (except drivers) of the seating position. The imputation of missing values for the seating position of car occupants in the 1988-1990 period is performed as follows.

The distribution of the occupant seating positions in towed cars in the 1988-1990 period before imputations is:

Car Occupant	Percent	Count
Drivers	66.0	6,754,197
Right Front Passengers	20.6	2,103,092
Second Seat Passengers	11.5	1,174,366
Other Passengers	1.1	111,065
Unknown Seating	0.0	4,615
Uncoded Seating	0.8	86,344
Total	100.0	10,233,699

Statistical Methods

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	62.1	2,103,092
Second Seat Passengers	34.7	1,174,366
Other Passengers	3.3	111,085
Total	100.0	3,388,543

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

Car Occupant	Percent	Count
Drivers	66.0	6,754,197
Right Front Passengers	21.1	2,162,464
Second Seat Passengers	11.8	1,203,545
Other Passengers	1.1	113,492
Total	100.0	10,233,699

The seating position of the car occupants is presented in Table 4 of the report. The missing data of the seating position of light truck, van, and MPV occupants were similarly imputed. The seating position of the light truck, van and MPV occupants is presented in Table 8 of the report.

Annual Weighted Average Counts

The data presented in the CDS report are for years 1988, 1989, and 1990. 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).

Statistical Methods

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

Weight Class	1988		1989		1990	
	Count	Percent	Count	Percent	Count	Percent
Small (<2,500 lbs)	838,462	33.9	786,281	33.0	709,220	33.7
Mid-size (2,500-3,000 lbs)	631,425	25.5	672,343	28.2	623,826	29.7
Large (>3,000 lbs)	931,636	37.6	859,202	36.1	710,744	33.8
Unknown Size	73,245	3.0	63,127	2.7	58,632	2.8
Total	2,474,767	100.0	2,380,953	100.0	2,102,422	100.0

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

Weight Class	1988	1989	1990
Small (<2,500 lbs)	0.359	0.337	0.304
Mid-size (2,500-3,000 lbs)	0.326	0.349	0.324
Large (>3,000 lbs)	0.372	0.343	0.284
Unknown Size	0.378	0.324	0.301

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)	2,269,363	3.5	756,454	33.5	781,610	33.5
Mid-size (2,500-3,000 lbs)	1,874,241	27.7	624,747	27.7	643,238	27.6
Large (>3,000 lbs)	2,432,342	36.0	810,781	36.0	843,998	36.2
Unknown Size	159,607	2.8	63,202	2.8	65,576	2.8
Total	6,958,142	100.0	2,255,184	100.0	2,334,422	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 F1) and for occupant characteristics (Table F2). 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 1988-1990 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 781,610 cars. To calculate one standard error for this estimate, use Table F1 in this Appendix. Since 781,610 does not appear in Table F1, use linear interpolation from the standard error values for the estimates 700,000 and 800,000. One approximate standard error would be $45,415 + 4,682 = 50,097$. The confidence interval for this estimate would be $781,610 \pm 50,097$ or 731,513 to 831,707.

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 F1
Crash-Involved Vehicle Characteristics Estimates and Standard Errors

Estimate	Standard Error*	Estimate	Standard Error
500	415	100,000	9,164
1,000	561	200,000	15,750
5,000	1,270	300,000	21,939
10,000	1,903	400,000	27,998
20,000	2,945	500,000	33,827
30,000	3,857	600,000	39,644
40,000	4,702	700,000	45,415
50,000	5,504	800,000	51,152
60,000	6,275	900,000	56,868
70,000	7,022	1,000,000	62,568
80,000	7,750	1,100,000	68,258
90,000	8,464	1,200,000	73,941

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

where:

a = 4.75737

b = 0.03294

x = estimate

SE = standard error.

Table F2
Crash-Involved Occupant Characteristics Estimates and Standard Errors

Estimate	Standard Error*	Estimate	Standard Error
500	217	100,000	7,103
1,000	304	200,000	13,086
5,000	764	300,000	19,019
10,000	1,206	400,000	24,982
20,000	1,973	500,000	30,998
30,000	2,576	600,000	37,076
40,000	3,346	700,000	43,219
50,000	3,996	800,000	49,428
60,000	4,633	900,000	55,702
70,000	5,260	1,000,000	62,040
80,000	5,880	1,100,000	68,441
90,000	6,494	1,200,000	74,904

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

where:

a = 3.9428

b = 0.03716

x = estimate

SE = standard error.