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Injuries Associated with Specific Motor Vehicle Hazards: Radiators, Batteries, Power Windows, and Power Roofs

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16. Abstract

This report provides estimates of the numbers of persons injured as a result of hazards involving four specific motor vehicle components: radiators, batteries, power windows, and power roofs. The injury estimates are based upon data from the Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS). NEISS collects data on a nationally representative sample of consumer product-related injuries treated in hospital emergency rooms. NHTSA has used NEISS to obtain data on injuries associated with specific motor vehicle hazards that are non-crash related. During the period 10/1/93 through 9/30/94, data from 591 (409 involving radiators; 171 involving batteries; 10 involving power windows; and 1 involving a power roof) cases of persons injured and treated in hospital emergency rooms were collected in NEISS. Based upon these cases, it is estimated that in a twelve-month period: 19,638 persons are injured due to radiators; 8,134 are injured due to batteries (7,051 due to motor vehicle batteries); and 499 are injured due to power windows. The one case involving a power roof was a result of the injured person being ejected due to a traffic crash, and therefore, not related to a hazard associated with the power roof itself. The report provides breakdowns of the injury estimates for radiators, batteries, and power windows by activity producing the injury, injury diagnosis and severity, injured body region, and age/sex of the injured.

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Introduction

In recent years, the National Highway Traffic Safety Administration (NHTSA) has had a continuing and growing need for reliable national estimates of the number of injuries associated with specific motor vehicle non-crash type occurrences, which generally involve stationary vehicles. In this connection, there is a current need to monitor incidents associated injuries to persons involving four specific motor vehicle related hazards, i.e., radiator scalding; battery explosion; power window and power roof operation and/or malfunction.

NHTSA has a particular interest in injuries associated with motor vehicle radiators, as these appear to be the most common of the four hazards examined in this study. This is most certainly related to the conditions under which motor vehicle radiators operate, i.e., motor vehicle engine cooling fluid (coolant) may operate at temperatures as high as 245-265 degrees F. and at 16-17 lbs. of pressure. Under these temperature and pressure conditions, a hasty removal of the standard radiator cap usually results in scalding fluid exploding out of the neck of the radiator, with sometimes severe burn injury to the person opening the radiator. Because incidents of this type are not an uncommon occurrence, over the years NHTSA has received letters from the public and from medical personnel at hospital facilities in support of action to establish standards for safety locks for radiator caps.

In April 1992, NHTSA was petitioned to establish a new safety standard regarding motor vehicle radiator caps. The petitioner wanted the new standard to require any new vehicle sold in the U.S. with a water-cooled engine to be equipped with a radiator cap that automatically locks in a closed position when the temperature of the engine coolant is 125 degrees F. or greater. The cap would automatically unlock, allowing for a safe opening of the radiator, when the temperature of the coolant falls below 125 degrees F. This type of radiator cap is generally referred to as a "thermal-locking radiator cap." The purpose of this type of cap is to prevent the chance scalding of motorists, gas station attendants and others who hastily open hot radiators of motor vehicles.

In support of a new radiator cap safety standard, this petition stated that:

1. Radiator cap scalding incidents are increasing, and will continue to increase as motor vehicle use rises despite safety education and manufacturer warning labels.

2. Over 100,000 radiator cap scalding incidents occur annually in the U.S., and over 20,000 victims of such occurrences every year require treatment in hospital emergency rooms and other medical burn care facilities.

3. Enactment of a safety standard for thermal-locking radiator caps would result, not only in a number of economic and overall benefits to society as a whole, but in an overall improvement in motor vehicle safety, especially for senior citizens, handicapped and otherwise frail persons. There would be a reduction in the pain, suffering and scarring sustained by radiator cap burn victims, especially in view of the fact that chemicals currently used in coolant mixtures compound the severity of scald injuries by increasing any resulting infections. Finally, enactment of the new safety standard for thermal-locking radiator caps would have no adverse impact on the environment.

To support the contention that radiator cap scalding incidents are increasing and that over 100,000 such incidents occur annually in the U.S., the petitioner submitted four (4) medical journal articles as supporting data. A subsequent NHTSA review of these articles found:

1. Two of the articles discussed radiator-related scalding that actually occurred outside of the U.S. The first of these articles states that over a 6-year period from 1982-1987, 72 cases of car radiator burns (average of 12 per year) were treated at a hospital burn unit in Doha, Qatar. The second article states that during a 13-year period from 1975-1987, 80 patients (average of approx. 6 per year) were treated at a hospital burn unit in Beersheva, Israel.

2. The third medical article notes that during the summer of 1989, 11 patients were treated in the emergency room of the hospital in Nassau County, N.Y. for second and third degree burns resulting from overheated car radiator fluid.

3. The fourth and final article states that during a 3-year period from January, 1979 through December 1981, 86 patients (average of 29 per year) with radiator-related burn injuries were hospitalized at the University of Miami/Jackson Memorial Burn Center. This article further states that, during the same 3-year period at that hospital, twice that number of patients (average of 58 per year) were treated for radiator-associated injuries and released without being hospitalized.

None of the articles included extrapolation of these data to national estimates of the number of injuries associated with the last two medical articles described above to extrapolate the data to U.S. national totals. No similar attempt was made by the petitioner in support of the contention that radiator cap scalding incidents are increasing, that more than 100,000 such incidents occur annually in the U.S., and that 20,000 victims of these incidents are treated every year in hospital emergency rooms or at burn care facilities.

Of particular concern to NHTSA in this matter was that no data base was currently available within the Agency to validate and estimate the magnitude of the injury problem associated with non-crash related motor vehicle hazards. Recalling that the U.S. Consumer Product Safety Commission (CPSC) had at one time tracked several automobile product-related injuries, such as those from radiator caps in the late seventies and from exploding batteries in the early eighties, it was concluded that CPSC was still the only existing and reliable source of these much needed data, especially in view of the fact that CPSC data are sampled hospital emergency room data that can be projected to the U.S. national level. Thus, the decision was made to provide funding to CPSC to add to its existing data collection effort some specific areas related to NHTSA's crash avoidance mission. In addition to obtaining data on injuries involving radiator caps, NHTSA decided to gather information on injuries involving batteries, power windows, and power roofs.

Data Collection

As a result of NHTSA's need for injury data on certain non-crash type occurrences involving motor vehicles, data from CPSC was obtained from twelve (12) consecutive months of

incidents of injuries to persons involving injuries associated with four (4) specific types of motor vehicle equipment: radiators, batteries, power windows and power roofs. These data were gathered for the twelve month period beginning October 1, 1993 through September 30, 1994 under an Interagency Agreement between NHTSA and CPSC, using CPSC's National Electronic Injury Surveillance System (NEISS) to obtain data.

NEISS is a three level system which collects data on injuries related to consumer products from a sample of 91 of the 6,127 hospitals nationwide with at least six beds that provide emergency care on a continuing twenty four hour basis. The three levels of the NEISS system are the initial surveillance of emergency room injuries; follow-back telephone interviews with injured persons or witnesses; and more comprehensive on-site investigations with injured persons and/or witnesses. Additional details regarding the NEISS data collection system can be found in Appendix A.

For this particular study, core surveillance and special study data to meet NHTSA's needs were obtained on a selected sample of 591 NEISS cases collected during the subject twelve month period. For 148 of the 591 cases, telephone interviews were conducted to obtain additional in-depth information on the circumstances of the incident involving the specific motor vehicle hazard. An interview was unsuccessfully attempted on 128 of the remaining 443 cases. The breakdown of total sample cases obtained, by hazard type and interview completion status, is given in Table 1.

Table 1
Interview Completion Status for NEISS Cases in
NHTSA Motor Vehicle Hazard Study
October 1993 - September 1994

Motor Vehicle Product Involved	Interview Status			
	Completed	Attempted and Not Completed	No Interview	Total
Radiator	105	97	207	409
Battery	34	31	106	171
Power Window	9	0	1	10
Power Roof	0	0	1	1
Total	148	128	315	591

Details regarding the surveillance, special study and telephone interview data gathered in NEISS for this study are provided in Appendices A, B and C, respectively. All NEISS data gathered for the study were used in the analysis for this report.

Possible Limitations of NEISS Data

This study provides national estimates of the number of persons injured each year as a result of hazards associated with four (4) specific types of motor vehicle equipment, i.e., radiators, batteries, power windows, and power roofs. The injured were all treated in hospitals equipped with emergency rooms. Because these injury estimates are based on NEISS data collection, they are necessarily conservative for the following reasons. First, an indeterminate number of injury cases are not captured in the NEISS sample. NEISS does not collect injury data from other medical care facilities (walk-in clinics, etc.) or from physicians in private practice. Secondly, an undeterminable number of injured persons that were treated at NEISS hospital emergency rooms during the study period may not have been included by the NEISS data collectors. This is mostly due to missing or incomplete information in the emergency room report regarding details of the incident. These latter cases are the so-called "missed" NEISS cases, generally a very small number compared to the far larger first category of fully identifiable, relevant cases excluded altogether from the NEISS sample. Additional and more complete details regarding NEISS data limitations can be found in Appendix A.

Findings

The data shown in Tables 2 through 12 provide national estimates of the number of persons injured in non-crash incidents involving three of the four specific motor vehicle hazards annually based upon the NEISS data. As discussed earlier, these estimates may be considered conservative due to the possible limitations of NEISS data. Tables 2 through 12 present national estimates for the number of persons injured due to hazards associated with motor vehicle radiators. Tables 13 through 16 and Tables 17 through 21 provide estimates of the number of persons injured due to hazards associated with motor vehicle batteries and motor vehicle power windows, respectively. (Percentages may not add to 100% in every table due to rounding.) A brief discussion regarding the findings for injuries associated with motor vehicle power roofs is presented at the end of the report.

Injuries Associated with Motor Vehicle Radiators

During the 12-month study period October 1, 1993 through September 30, 1994, an estimated 19,638 persons were injured nationwide as a result of involvement in various ways with motor vehicle radiators. Of these 19,638 injured persons, the majority, approximately 77 percent, were injured as a result of activities associated with the radiator cap. Almost 73 percent of the radiator cap injuries were resulted from removing (or attempting to remove) the cap from the radiator. A surprising 25 percent of the radiator cap injuries were described as due to the radiator cap "exploding", i.e., the cap being ejected or dislodged from the neck of the radiator in some way. These situations involved mostly stationary vehicles, however, in situations in which the vehicle was moving, vehicle movement, coupled with excessive radiator pressure may have been contributors to the radiator cap ejection. The remaining 2 percent of the radiator cap injuries were associated with attempts to place the cap on the radiator, or because a loose, untightened, or badly fitting cap allowed the radiator to boil over.

Not surprisingly, radiator hoses accounted for the second highest number of injured persons, about 12 percent (2,370/19,638). Most were injured while replacing or attempting to replace a radiator hose, however, some were injured while doing something else such as checking or working on the vehicle's engine and accidentally brushing against or opening a hole in one of these hoses in the process.

Noteworthy in these data is that the radiator reservoir accounted for the third highest number of injured persons. Seven (7) percent (1,403/19,638) were injured as a direct result of handling the radiator reservoir (rather than the radiator cap), usually while attempting to add coolant to the radiator.

The remaining 747 injured persons, approximately 4 percent of the estimated 19,638 injured persons, occurred as follows: burn injury while working on some other part of the vehicle's cooling system such as a heater, heater hose, water pump, or thermostat (316 persons); burn or non-burn injury directly or indirectly due to the radiator in some way (e.g., cut by, fell on radiator, etc.; 243 persons); and non-burn injury caused by the radiator fan, fan belt or grill, by fumes from overheating, or by accidental ingestion of radiator fluid (188 persons).

Tables 2-11 present descriptive details on the injuries to persons by the body type of involved vehicle, vehicle model year, vehicle manufacturer, age, gender, injury diagnosis, the most injured body region, injury severity category, medical disposition, injury severity and medical disposition combined, and by season of the year. Percentages may not add to 100% due to rounding.

Automobiles were involved in nearly 91 percent of the radiator cap injuries; pickups in approximately 7 percent; vans in about 3 percent and trucks in the remainder [Table 2]. For injuries involving the radiator reservoir, automobiles were involved 100 percent of the time. Injuries associated with the radiator hose appeared to follow a different pattern, i.e., vans were associated with 22 percent of the injuries, while automobiles were associated with 70 percent.

For the radiator cap injuries, almost two-thirds (65 percent) of the motor vehicles involved were 1980-89 models, with slightly more than one-half of these (52 percent) being model-year 1980-84 [Table 3]. About 26 percent of these incidents involved 1975-79 models; about 2 percent involved models older than 1975, and less than 1 percent involved later model years, i.e., 1990-94. For the radiator reservoir, almost one-half (49 percent) of the injuries involved 1985-89 model year vehicles and no vehicles of model year older than 1975 were involved. A large portion of the incidents associated with the injuries related to the radiator hose (41 percent) involved 1985-89 vehicles. For all of the radiator cases combined, two-thirds (67 percent) of the vehicles involved were 1980-89 models.

The manufacturer of the vehicles were involved in injuries associated with radiator cap incidents were: General Motors - 62 percent; Chrysler - 17 percent; Ford - 12 percent; Other Domestic and Foreign - 3 and 6 percent, respectively. The radiator reservoir injuries differed somewhat in that 46 percent of the vehicles involved were manufactured by General Motors, and foreign vehicles were involved in 34 percent of the injuries [Table 4].

As might be expected, about 2 percent of the persons injured involving the radiator cap were less than 15 years of age [Table 5]. About 40 percent were 15-29 years of age, 37 percent were 30-44, 17 percent were 45-59, and the remaining 4 percent were 60 years of age or older. Compared to the radiator cap cases, the frequency of those injured by hot fluid/steam from the radiator reservoir differed markedly for age groups 15-29 and 45-59. In the cases of injuries to children involving radiator hose incidents, the children appeared to be present as bystanders or passed by while an adult was working with the vehicle. In these situations, children were sprayed with hot radiator fluid from hoses that either broke open during repair (by adults) or burst open on their own, some even while the vehicle was moving. It is currently not known if these noted differences in proportions of injured persons, by type of radiator involvement for certain victim age groups, reflect actual differences in injury patterns for the type of activity associated with radiators or occurred due to chance.

More than 86 percent of the persons injured involving radiator caps were males. All persons injured involving the radiator reservoirs were male. Males represented 89 percent of all persons injured in all types of incidents involving radiators [Table 6].

As expected, scalding burns from hot radiator fluid released from the radiator were the predominant form of injury involving radiator caps. Almost 91 percent were injured in this manner [Table 7]. More than 7 percent of the persons injured in these incidents sustained chemical or thermal burns, while almost 2 percent sustained contusions, abrasions, lacerations or fractures, mostly caused by striking against some part of the vehicle as a reaction to hot radiator fluid. The remaining persons injured in incidents involving the radiator cap (less than one-half percent) were poisoned due to having accidentally ingested radiator antifreeze. In incidents involving the radiator reservoir nearly 94 percent sustained scalding burn injuries, 4 percent received chemical or thermal burns, while more than 2 percent sustained other injury. For those injured while removing or replacing a radiator hose, or by hose breakage in some manner, the distribution of injuries is generally similar to that of the reservoir cases.

The face, including eye area and nose, was the most severely injured body region for nearly 38 percent of the persons injured involving radiator caps [Table 8]. The lower arm was injured for about 26 percent of those injured and the upper trunk in 18 percent. For those injured involving the radiator reservoir, the face and lower arm were almost equally likely to be the body regions most affected, 38 percent and 39 percent respectively, for each. A sizeable portion, 15 percent, sustained overall injury to 25 percent or more of the body. For persons injured in incidents involving the radiator hose, the face was the most severely injured body region for about 34 percent of the cases. Fewer than 2 percent of all radiator hose injured persons sustained overall injury to 25 percent or more of the body.

Approximately 88 percent of the persons injured in incidents involving radiator caps received injuries of moderate severity, primarily first and/or second degree burns that, in general, did not require hospitalization (see Table 10). Nearly 10 percent of these persons injured were seriously injured, many of whom were hospitalized. The remaining persons injured involving radiator caps, approximately 3 percent, received minor injuries. For incidents involving radiator reservoirs, about 75 percent received injuries of moderate severity while almost 22 percent were seriously injured [Table 9].

Approximately 93 percent of the persons injured in incidents involving radiator caps were treated and released without hospitalization; the remaining 7 percent were hospitalized due to more serious injuries [Table 10]. For those injured by the radiator reservoir, all 1,403 persons estimated to have been injured in this manner were treated and released. For persons injured involving radiator hoses, 97 percent were treated and released. In general, hospitalized cases involved second and third degree burns requiring special and immediate treatment. These data, however, may be misleading. A sizeable number of persons injured, some with only moderate injuries, though treated at hospital emergency facilities and released because they did not require hospitalization, had second and third degree burns that could be expected to require further medical treatment, either at a hospital or with a private physician

Persons injured who required hospitalization tended to be those with the more serious injuries, i.e., for persons injured involving radiator caps, approximately 64 percent (929/1,456) of the seriously injured were hospitalized, compared with only slightly more than 1 percent (184/13,266) of the moderately injured and none of those persons with minor injuries. For persons injured involving radiator reservoirs, none were hospitalized [Table 11]. For persons injured involving radiator hoses, 67 percent (70/105) of the seriously injured were hospitalized, while none of those with moderate or minor injuries were hospitalized.

For persons injured in incidents involving radiator caps, about 44 percent occurred during the summer months of June, July and August [Table 12]. Approximately 25% were injured in incidents involving radiator caps in winter, while roughly similar proportions of persons were injured in the fall and spring. For persons injured involving radiator reservoirs, the majority, 62 percent, occurred during the summer. Nearly three-quarters of the persons injured involving radiator hoses occurred during the spring and summer.

Table 2
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Body Type of Motor Vehicle
October 1993 - September 1994*

Type of Radiator Involvement	Body Type of Motor Vehicle				
	Auto	Van	Pickup	Truck	Total
Radiator Cap	13,711	373	955	79	15,118
%	91%	2%	6%	**	100%
Removal	9,824	373	748	79	11,024
Ejection(1)	3,704	0	60	0	3,764
Closure	119	0	147	0	266
Other(2)	64	0	0	0	64
Radiator Reservoir	1,403	0	0	0	1,403
%	100%	0	0	0	100%
Radiator Hose	1,655	524	75	116	2,370
%	70%	22%	3%	5%	100%
Other Radiator (3)	141	6	7	34	188
Unspecified Radiator (4)	217	12	14	0	243
Other Cooling System (5)	316	0	0	0	316
Total	17,443	915	1,051	229	19,638
%	89%	5%	5%	1%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
* Percentages may not add to 100% due to rounding.
** Less than 1%.

Table 3
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Model Year of Involved Vehicle
October 1993 - September 1994*

Type of Radiator Involvement	Vehicle Model Year					
	Pre 1975	1975-1979	1980-1984	1985-1989	1990-1994	Total
Radiator Cap	1,228	3,893	5,143	4,728	126	15,118
%	8%	26%	34%	31%	1%	100%
Removal	1,168	3,311	3,325	3,094	126	11,024
Ejection(1)	60	582	1,607	1,515	0	3,764
Closure	0	0	147	119	0	266
Other (2)	0	0	64	0	0	64
Radiator Reservoir	0	279	377	689	59	1,403
%	0	20%	27%	49%	4%	100%
Radiator Hose	229	618	525	979	19	2,370
%	10%	26%	22%	41%	1%	100%
Other Radiator(3)	0	39	58	91	0	188
Unspecified Radiator(4)	0	61	91	91	0	243
Other Cooling System (5)	0	0	316	0	0	316
Total	1,457	4,890	6,510	6,578	203	19,638
%	7%	25%	33%	34%	1%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
* Percentages may not add to 100% due to rounding.

Table 4
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Vehicle Manufacturer
October 1993 - September 1994*

Type of Radiator Involvement	Vehicle Manufacturer					
	General Motors	Chrysler	Ford	Other Domestic	Foreign	Total
Radiator Cap	9,419	2,609	1,859	386	845	15,118
%	62%	17%	12%	3%	6%	100%
Removal	6,085	2,243	1,465	386	845	11,024
Ejection (1)	3,123	366	275	0	0	3,764
Closure	147	0	119	0	0	266
Other (2)	64	0	0	0	0	64
Radiator Reservoir	646	145	132	0	480	1,403
%	46%	10%	9%	0	34%	100%
Radiator Hose	1,140	315	781	25	108	2,370
%	48%	13%	33%	1%	5%	100%
Other Radiator (3)	139	23	26	0	0	188
Unspecified Radiator (4)	152	34	38	0	19	243
Other Cooling System (5)	316	0	0	0	0	316
Total	11,813	3,126	2,836	411	1,452	19,638
%	60%	16%	14%	2%	7%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
* Percentages may not add to 100% due to rounding.

Table 5
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Age
October 1993 - September 1994*

Radiator Involvement	Age of Person					
	0-14	15-29	30-44	45-59	60+	Total
Radiator Cap	320	5,973	5,609	2,561	655	15,118
%	2%	40%	37%	17%	4%	100%
Removal	294	2,960	4,911	2,266	593	11,024
Ejection (1)	26	2,747	698	231	62	3,764
Closure	0	266	0	0	0	266
Other (2)	0	0	0	64	0	64
Radiator Reservoir	22	748	471	141	21	1,403
%	2%	53%	34%	10%	2%	100%
Radiator Hose	149	854	1,104	131	132	2,370
%	6%	36%	47%	6%	6%	100%
Other Radiator (3)	0	52	102	0	34	188
Unspecified Radiator (4)	17	49	66	111	0	243
Other Cooling System (5)	0	0	316	0	0	316
Total	508	7,676	7,668	2,944	842	19,638
%	3%	39%	39%	15%	4%	100%

(1)Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2)Cap on radiator, but loose, not tightened or bad fit.
(3)Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4)Cut by/fell on, etc. or injury indirectly due to radiator.
(5)Heater, heater hose, water pump, thermostat, etc.
* Percentages may not add to 100% due to rounding.

Table 6
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Gender
October 1993 - September 1994

Radiator Involvement	Gender		
	Male	Female	Total
Radiator Cap	13,074	2,044	15,118
%	86%	14%	100%
Removal	9,153	1,871	11,024
Ejection (1)	3,626	138	3,764
Closure	231	35	266
Closure (2)	64	0	64
Radiator Reservoir	1,403	0	1,403
%	100	0	100
Radiator Hose	2,328	42	2,370
%	98%	2%	100%
Other Radiator (3)	154	34	188
Unspecified Radiator (4)	226	17	243
Other Cooling System (5)	316	0	316
Total	17,501	2,137	19,638
%	89%	11%	100%

(1)Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.

Table 7
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Injury Diagnosis
October 1993 - September 1994*

Type of Radiator Involvement	Injury Diagnosis				
	Burns, Scalding	Other Burns (6)	Poisoning (7)	Other Injury (8)	Total
Radiator Cap	13,704	1,083	35	296	15,118
%	91%	7%	**	2%	100%
Removal	9,973	776	35	240	11,024
Ejection (1)	3,524	184	0	56	3,764
Closure	207	59	0	0	266
Other (2)	0	64	0	0	64
Radiator Reservoir	1,313	56	0	34	1,403
%	94%	4%	0	2%	100%
Radiator Hose	2,217	106	0	47	2,370
%	94%	4%	0	2%	100%
Other Radiator (3)	0	0	34	154	188
Unspecified Radiator (4)	0	0	0	243	243
Other Cooling System (5)	316	0	0	0	316
Total	17,550	1,245	69	774	19,638
%	89%	6%	**	4%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
(6) Chemical or thermal burns.
(7) Due to ingesting radiator antifreeze.
(8) Contusions, abrasions, lacerations or fractures.
* Percentages may not add to 100% due to rounding.
** Less than 1%.

Table 8
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Most Injured Body Region
October 1993 - September 1994*

Type of Radiator Involvement	Most Injured Body Region					
	Face	Lower Arm	Upper Trunk	Hand/ Wrist	All Other (6)	Total
Radiator Cap	5,677	3,874	2,782	2,032	753	15,118
%	38%	26%	18%	13%	5%	100%
Removal	3,715	2,910	2,162	1,685	552	11,024
Ejection (1)	1,929	841	561	237	196	3,764
Closure	33	123	0	110	0	266
Other (2)	0	0	59	0	5	64
Radiator Reservoir	532	541	0	15	315	1,403
%	38%	39%	0	1%	22%	100%
Radiator Hose	800	456	769	184	161	2,370
%	34%	19%	32%	8%	7%	100%
Other Radiator (3)	34	34	0	86	34	188
Unspecified Radiator (4)	80	0	0	163	0	243
Other Cooling System (5)	116	0	182	18	0	316
Total	7,239	4,905	3,733	2,498	1,263	19,638
%	37%	25%	19%	13%	6%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
(6) Face includes eyeball, eyelid, eye area, and nose; Hand/Wrist includes finger; Upper arm includes shoulder and elbow.
* Percentages may not add to 100% due to rounding.

Table 8 (continued):
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Most Injured Body Region
October 1993 - September 1994*

Type of Radiator Involvement	Most Injured Body Region (6)			
	Lower Trunk	25%+ of Body	All Other	Total
Radiator Cap	461	646	659	15,118
%	3%	4%	4%	100%
Removal	405	470	568	11,024
Ejection (1)	56	176	91	3,764
Closure	0	0	0	266
Other (2)	0	0	0	64
Radiator Reservoir	0	210	0	1,403
%	0	15%	0	100%
Radiator Hose	106	35	129	2,370
%	5%	2%	5%	100%
Other Radiator (3)	0	34	0	188
Unspecified Radiator (4)	0	0	48	243
Other Cooling System (5)	153	0	0	316
Total	720	925	836	19,638
%	4%	5%	4%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
(6) 25%+ of Body includes 2 categories of overall injury to the body: 25-50% and more than 50%; All Other includes head, ear, upper and lower leg, knee, foot, and toe.

Table 9
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Injury Severity
October 1993 - September 1994*

Type of Radiator Involvement	Injury Severity			
	Minor	Moderate	Serious	Total
Radiator Cap	396	13,266	1,456	15,118
%	3%	88%	10%	100%
Removal	313	9,559	1,152	11,024
Ejection(1)	83	3,377	304	3,764
Closure	0	266	0	266
Other (2)	0	64	0	64
Radiator Reservoir	48	1,050	305	1,403
%	3%	75%	22%	100%
Radiator Hose	87	2,178	105	2,370
%	4%	92%	4%	100%
Other Radiator (3)	120	68	0	188
Unspecified Radiator (4)	163	80	0	243
Other Cooling System (5)	0	316	0	316
Total	814	16,958	1,866	19,638
%	4%	86%	10%	100%

(1) Exploded, popped of, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
* Percentages may not add to 100% due to rounding.

Table 10
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Medical Disposition
October 1993 - September 1994

Type of Radiator Involvement	Medical Disposition		
	Treated & Released	Hospitalized	Total
Radiator Cap	14,005	1,113	15,118
%	93%	7%	100%
Removal	10,069	955	11,024
Ejection (1)	3,606	158	3,764
Closure	266	0	266
Other (2)	64	0	64
Radiator Reservoir	1,403	0	1,403
%	100%	0	100%
Radiator Hose	2,300	70	2,370
%	97%	3%	100%
Other Radiator (3)	188	0	188
Unspecified Radiator (4)	243	0	243
Other Cooling System (5)	316	0	316
Total	18,455	1,183	19,638
%	94%	6%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into yes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.

Table 11
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement, Injury Severity
and Medical Disposition
October 1993 - September 1994

Type of Radiator Involvement & Injury Severity	Medical Disposition		
	Treated & Released	Hospitalized	Total
Radiator Cap (1)	14,005	1,113	15,118
Minor	396	0	396
Moderate	13,082	184	13,266
Serious	527	929	1,456
Radiator Reservoir	1,403	0	1,403
Minor	48	0	48
Moderate	1,050	0	1,050
Serious	305	0	305
Radiator Hose	2,300	70	2,370
Minor	87	0	87
Moderate	2,178	0	2,178
Serious	35	70	105
All Other Radiator	747	0	747
Minor	283	0	283
Moderate	464	0	464
Serious	0	0	0
Total	18,455	1,183	19,638
Minor	814	0	814
Moderate	16,774	184	16,958
Serious	867	999	1,866

(1) Cap removal, ejection, closure; loose or badly fitting cap.
(2) Other and unspecified radiator; other cooling system.

Table 12
Estimates of Persons Injured by Motor Vehicle Radiators
By Type of Radiator Involvement and Season of the Year
October 1993 - September 1994*

Type of Radiator Involvement	Season of the Year				
	Fall	Winter	Spring	Summer	Total
Radiator Cap	3,742	1,702	2,981	6,693	15,118
%	25%	11%	20%	44%	100%
Removal	2,937	1,254	2,151	4,682	11,024
Ejection (1)	679	342	824	1,919	3,764
Closure	128	106	0	32	266
Other (2)	0	0	0	64	64
Radiator Reservoir	196	159	185	863	1,403
%	14%	11%	13%	62%	100%
Radiator Hose	436	181	968	785	2,370
%	18%	8%	41%	33%	100%
Other Radiator	85	0	35	68	188
Unspecified Radiator (4)	65	17	113	48	243
Other Cooling System (5)	0	0	136	180	316
Total	4,524	2,059	4,749	8,637	19,638
%	23%	11%	23%	44%	100%

(1) Exploded, popped off, dislodged by vehicle motion, etc. without being touched.
(2) Cap on radiator, but loose, not tightened or bad fit.
(3) Fan, fan belt, grill, fumes from overheating, radiator fluid got into eyes, unintentional ingestion of radiator fluid, etc.
(4) Cut by/fell on, etc. or injury indirectly due to radiator.
(5) Heater, heater hose, water pump, thermostat, etc.
* Percentages may not add to 100% due to rounding.

Injuries Associated with Motor Vehicle Battery Explosions

During the 12-month period October 1993 through September 1994, data from 134 cases of injuries associated with motor vehicle batteries were obtained from NEISS. Based upon these 134 cases, an estimated 7,051 persons were treated in hospital emergency rooms for injuries resulting from an activity involving motor vehicle batteries nationwide during the 12-month study period. The types of injuries sustained can be described by five general categories: battery explosions, chemical burns and/or contamination resulting from contact with battery acid, muscle strains and/or crush-type injuries associated with lifting or dropping the battery, and electrical shock from contacting battery cables and/or posts. Persons injured as a result of battery explosions, the type of injury of particular interest to NHTSA, comprised the largest of these five general categories. An estimated 2,280 persons (32% of 7,051 motor vehicle battery injuries) were injured as a direct result of a motor vehicle battery explosion. Tables 1 through 5 provide additional details on the persons injured as a result of motor vehicle battery explosion during the period October 1, 1993 - September 30, 1994 by the action which produced the injury, the region of the body most severely injured, the injury diagnosis, the injury severity, and the age of the injured person, respectively. (The percentages may not add to 100% in every table due to rounding.)

Thirty-one percent (31%) of the persons injured by battery explosions were charging the battery (702 persons injured), as shown in Table 13. More than one-fourth (26%) of the injuries were associated with an activity involving the battery cables (replacing, securing, or tightening). An almost equal number of persons were injured as a result of "jump starting" the battery (19%) or checking/adding fluid (19%). Unfortunately, it is not known what activity led to the injury for about 5% of the persons injured.

Table 13
Estimated Number of Persons Injured by Motor Vehicle Battery Explosions by Injury Producing Action
October 1993-September 1994

Injury Producing Action	Estimated No. Of Persons Injured	% Total
Charging Battery	702	31%
Replacing, Securing, or Tightening Cables	581	26%
Jump Starting Battery	444	19%
Checking Fluid Level and/or Adding Water	442	19%
Unknown	111	5%
Total	2,280	100%

Table 14
Estimated Number of Persons Injured by Motor Vehicle Battery Explosions by Injury Diagnosis
October 1993-September 1994

Diagnosis	Estimated No. Of Persons Injured	% Total
Chemical Burns	1,421	62%
Contusion or Abrasion	185	8%
Laceration	475	21%
Conjunctivitis	199	9%
Total	2,280	100%

The majority (62%) of the 2,280 persons estimated to have been injured by motor vehicle battery explosions were diagnosed as having chemical burns [Table 14]. Twenty-one percent (21%) of the persons injured were diagnosed with lacerations. Almost three-fourths (72%) of those injured suffered an eye injury [Table 15]. Unfortunately, a sizeable portion (43%) of the persons injured were diagnosed as having a serious injury [Table 16]. None of the 2,280 persons injured, however, were hospitalized. This may be misleading, as 80% of the persons injured (43% + 37%) were diagnosed as having a serious or moderate injury [Table 16], indicating that while hospitalization may not have been warranted, further medical treatment would probably be necessary.

Table 15
Estimated Number of Persons Injured by Motor Vehicle Battery Explosions by Most Injured Body Region
October 1993-September 1994

Body Region Injured	Estimated No. Of Persons Injured	%Total
Eye	1,648	72%
Face	501	22%
All Other (Including Head, Hands, Fingers)	131	6%
Total	2,280	100%

Table 16
Estimated Number of Persons Injured by Motor Vehicle Battery Explosions by Injury Severity
October 1993-September 1994

Injury Severity	Estimated No. Of Persons Injured	%Total
Minor	464	20%
Moderate	844	37%
Serious	972	43%
Total	2,280	100%

Injuries Associated with Motor Vehicle Power Windows

During the 12-month study period October 1993 through September 1994, data on 10 cases of injuries associated with motor vehicle power windows were obtained from CPSC's NEISS. Based upon these 10 cases, an estimated 499 persons were treated in hospital emergency rooms for injuries associated with motor vehicle power windows nationwide during the twelve month study period. Ninety-three percent (465/499) of the injured persons were injured in connection with passenger car power windows. Ninety-one percent (456/499) of those injured were treated and released from the emergency room without hospitalization. Tables 17 through 21 provide additional details on the estimated number of persons injured during the period October 1993 - September 1994 by the action which produced the injury, the region of the body most severely injured, the injury diagnosis, the injury severity, and the age of the injured person, respectively. (Percentages may not add to 100% in every table due to rounding.)

As shown in Table 17, 88% of the estimated 499 persons injured were injured as a result of [unintentionally] closing the power window on a finger, wrist, or hand (either one's own or another person's). Another 4% were injured as a result of attempting to work on or repair the window and/or was cut by broken glass. Just under 9% attributed the cause of the injury to a "faulty" power window. Table 18 presents data on the diagnosis of the injury sustained by the estimated 499 persons injured. A large proportion were diagnosed as having a fracture (38%) or had a body part considered as crushed (30%).

Table 17
Estimated Number of Persons Injured by Motor Vehicle Power Windows by Injury Producing Action
October 1993-September 1994*

Injury Producing Action	Estimated No. Of Persons Injured	% Total
Closing Window on a Hand, Wrist, or Finger	437	88%
Faulty Power Window	43	9%
Working on Power Window and/or Cut by Broken Glass	19	4%
Total	499	100%

* Percentages may not add to 100% due to rounding.

Table 18
Estimated Number of Persons Injured by Motor Vehicle Power Windows by Injury Diagnosis
October 1993-September 1994

Diagnosis	Estimated No. Of Persons Injured	% Total
Fracture	192	38%
Crushing	150	30%
Contusion or Abrasion	77	15%
Dislocation	43	9%
Laceration	19	4%
Strain or Sprain	18	4%
Total	499	100%

For the majority of the 499 persons estimated to have been injured by power windows, the body region most severely injured was a finger (77%). In fact, all of the injuries sustained were confined to a portion of an upper extremity (finger, wrist, or hand). These data are presented in Table 19. As seen in Table 20, more than half (53%) of the injuries sustained were considered "minor." The majority (64%) of the persons injured were children under the age of fifteen, with half of these being less than six years of age. Table 21 presents data on the age of the injured person.

Table 19
Estimated Number of Persons Injured by Motor Vehicle Power Windows by Injured Body Region
October 1993-September 1994

Body Region Injured	Estimated No. Of Persons Injured	%Total
Finger	384	77%
Wrist	61	12%
Hand	54	11%
Total	499	100%

Table 20
Estimated Number of Persons Injured by Motor Vehicle Power Windows by Injury Severity
October 1993-September 1994

Severity of Injury	Estimated No. Of Persons Injured	%Total
Minor	264	53%
Moderate	235	47%
Total	499	100%

Table 21
Estimated Number of Persons Injured by Motor Vehicle Power Windows by Age
October 1993-September 1994*

Age of Person	Estimated No. Of Persons Injured	% Total
0 - 5 Years	158	32%
6 - 14 Years	158	32%
15 - 29 Years	68	14%
30 - 44 Years	38	8%
45 - 59 Years	43	9%
Over 60 Years	34	7%
Total	499	100%

*Percentages may not add to 100% due to rounding.

Injuries Associated with Motor Vehicle Power Roofs

One case of an injury associated with a motor vehicle power roof was obtained from CPSC's NEISS during the 12-month study period of October 1993 - September 1994. As this case involved ejection through a power roof due to a motor vehicle crash, it may not be related to a hazard or malfunction associated with the power roof use and/or operation. When projected to the national level, this case represents 34 similar injury cases treated in hospital emergency rooms in the U.S. during this 12-month study period.

References

1. U.S. Consumer Product Safety Commission, Division of Hazard and Injury Data Systems: "NEISS - The National Electronic Injury Surveillance System. A Description of Its Role in the U.S. Consumer Product Safety Commission," March 1990, pp. 1-10.

2. U.S. Consumer Product Safety Commission, Division of Hazard and Injury Data Systems: "The NEISS Sample (Design and Implementation)," March 1986 (Revised February, 1994), pp. 22-23.

3. Annest JL, Mercy JA, Gibson DR, Ryan GW. "National Estimates of Nonfatal Firearm-Related Injuries. Beyond the Tip of the Iceberg," Journal of the American Medical Association, June 14, 1995, Vol 273, No.22, pp. 1749-1754.

APPENDIX A

The National Electronic Injury Surveillance System

Overview

The U.S. Consumer Product Safety Commission (CPSC) currently operates a national probability survey of hospital emergency departments, designated the National Electronic Injury Surveillance System (NEISS), in order to monitor consumer products involved in injury-producing incidents. This system enables CPSC to make national estimates of the number, type and severity of injuries associated with specific consumer products. The current NEISS provides for three (3) levels of data collection: surveillance of hospital emergency room injuries; follow-back telephone interviews with injured persons or informed respondents regarding the incident; and more comprehensive on-site investigations with injured persons and/or witnesses to the incident. One, two or all three levels are used by the CPSC as primary data collection tools. Each level is described below:

1. Injury Surveillance - The NEISS is a surveillance-type reporting system in that it continuously monitors product-related injuries treated in NEISS hospital emergency rooms. These injuries are reported daily, 365 days a year. Data collection begins when the patient tells a clerk, nurse or physician how the injury occurred, and this information is then placed in the patient's medical record. At the end of the day, a NEISS data coder reviews the medical records and extracts the following routine or core data from each in-scope study case:

    - o treatment date
    - o hospital identifier
    - o case record number
    - o age and sex of victim
    - o injury diagnosis and body region injured
    - o medical disposition of case (treated & released, etc.)
    - o incident locale (home, street, farm, etc.)
    - o fire and/or motor vehicle involvement
    - o identification of up to 2 specific products involved
    - o indication of whether a third product was involved
    - o two lines of free-text comments describing how the injury occurred as stated in the medical record

    Except for the free-text comments which are entered as-is, these data are entered in coded form into a personal computer at the hospital, computer-edited for coding accuracy, checked for completeness and timeliness of reporting, then transmitted via modem hookup to the NEISS data base at CPSC headquarters in Washington, DC. Data are transmitted nightly and thus become immediately available to CPSC staff for review and analysis.

    NEISS is also available for special studies involving product-related cases of particular interest, or injury cases that are actually non product-related. For these studies, the additional information needed is gathered by the hospital emergency room staff, coded as required by the NEISS data

coders, computer-edited, etc., and entered into the NEISS system as "special study" data along with the routine surveillance data noted above.

2. Telephone Follow-Back Interviews - In general, less than one percent of product-related surveillance cases are selected for follow-back investigation. This percentage, however, may be much greater for a NEISS special study. These investigations are based on telephone interviews with victims, witnesses to, or knowledgeable respondents regarding, the incident. The purpose is to gather additional information about the sequence of events, human behavior and role of consumer product(s) in the incident. These investigations also describe the environment, the victim (including injury and medical treatment), and the consumer product(s) involved. The interview is conducted using either a structured questionnaire containing a series of questions, or a guideline designed to gather more extensive information pertinent to the specific product and its involvement in the incident.

3. On-Site Follow-Back Investigations - For selected cases requiring further detail, an on-site investigation is conducted. This is to obtain very specific and fully reliable information about the consumer product and its role in the incident, the sequence of events involved, human behavior, the victim, and the environment in which the injury occurred. Photographs may be taken of the victim, the product and where the injury occurred. The product may be examined or collected for laboratory study. Reconstruction of the incident is frequently performed by talking to the victim, victim's family, witnesses, attending medical personnel or anyone else having knowledge of the factors involved. Police, fire and coroner's reports may be examined and included in the investigator's report.

The NEISS Hospital Sample

NEISS currently comprises a stratified probability sample of 91 of the 6,127 hospitals in the U.S. and its territories that have at least six (6) beds and provide emergency service on a continuing 24-hour basis. This 91-hospital sample includes large inner-city hospitals with trauma centers as well as other urban, suburban and rural hospitals. The sample is stratified by hospital size reflecting total emergency room visits per year, and there are four (4) such hospital-size strata: small, medium, large and very large. The following table shows the basic characteristics of the current NEISS hospital sample:

NEISS Sample Characteristics, 1991 - 1994

Stratum	Annual # of Emergency Room Visits	# and % of Hospitals in Universe		# and % of Hospitals in Sample		Sample Case Weight
1	1 - 15,730	4,262	69.5%	37	40.6%	115.189
2	15,731 - 25,895	943	15.4%	20	22.0%	47.150
3	25,896 - 42,298	685	11.2%	20	22.0%	34.250
4	≥ 42,299	237	3.9%	14	15.4%	16.929
Total		6,127	100%	91	100%	

The sample weights shown above reflect the inverse of the probability of selection of a hospital for the NEISS sample, within each of the four hospital-size strata involved. Thus, for stratum 1, the hospital sample weight of 115.189 is 4262 divided by 37. Because the probability of selection for the NEISS sample becomes progressively greater from the smallest (37/4262) to the largest (14/237) stratum, the corresponding hospital sample weights are just the reverse, that is, largest for the small hospitals and smallest for the very large hospitals.

For each monthly reporting period, all hospitals within each stratum have the sample weight shown, except for 3 of the 91 hospitals. These 3 hospitals have unique sample weights due to mergers with other hospitals after the current sample design was implemented. Also, if for any reason a hospital with data to report during a given period does not report during that period, the sample weights of other hospitals within that stratum are adjusted to account for the nonresponse.

Data from these 91 hospitals can be used to estimate the number of persons nonfatally injured and treated in hospital emergency rooms nationwide, during any time period desired. To obtain national estimates, each injury study case treated in one of the 91 hospitals is assigned that hospital's sample weight and the weights are then summed across all hospitals involved.

Limitations of NEISS Data

1. Injury estimates based on NEISS data collection are necessarily conservative for the following reasons:

   a) NEISS is limited to data on injuries treated in hospital emergency departments and, for this reason, an undeterminable number of injury cases are continually excluded from the NEISS sample. Patients with injuries that are untreated or treated in other types of medical care systems will be missed through NEISS. NEISS excludes not only smaller hospitals, those without emergency departments or with less than six beds, but all walk-in clinics such as urgent/emergency/family care centers, most managed health care providers such as HMOs (though the NEISS sample does include a few HMO hospitals), and physicians in private practice.

   b) An undeterminable number of injury cases treated at NEISS hospital emergency rooms that properly belong to a study based on NEISS data may not be included in that study (by the NEISS data coders). This is generally due to missing or incomplete information in the emergency room medical record regarding details of the accident. These are the so-called "missed" NEISS cases, usually a very small number compared to the far larger category of fully identifiable, relevant injury cases excluded from the NEISS sample, as noted in item a) above.

2. Even though an injury case has been fully identified as a NEISS study case, there may be limitations to the information obtained about that case from the hospital emergency room medical record. Study protocols involving NEISS data collection generally require orientation of emergency room staff regarding documentation of appropriate case study data. Complete documentation, however, may not be done, may be done improperly, or may not even be possible. Note that a patient in need of resuscitation or immediate surgery may not be able to provide all (or even any) details of the accident (reference 3).

3. CPSC normally does not automate any of the information obtained from telephone or on-site follow-back investigations. The completed investigation reports are generally delivered to the user, as-is, in hard-copy format. There are two problems in this regard:

   a) Because this additional case information is routinely not included in the NEISS data base, the user must then perform the task of incorporating, if necessary, these hard-copy data with the automated files of NEISS injury surveillance/special study data obtained from CPSC at the conclusion of data collection.

   b) Data obtained from the follow-back investigation(s) may not always agree with corresponding surveillance or special study data obtained from the emergency room medical record. This disagreement in corresponding data items may require the usage of, say, the follow-back data as basic "control" data for the analysis of <u>all</u> NEISS data. This procedure is equivalent, statistically, to usage of a subsample within the NEISS data sample.

4. The NEISS core data (surveillance + special study) may have discrepancies. This is especially true

for the special study data which should be in agreement with corresponding data items reflected in the free-text comments of surveillance data that describe the injury incident.

5. Some of the patients treated in NEISS hospital emergency rooms with injuries severe enough to require hospitalization may die in the hospital. These medical outcomes, however, may not be fully updated in the NEISS data base. At the time of admittance to the emergency room, patients are categorized as nonfatally injured at some level of severity. Thus, based on NEISS data, estimates of persons nonfatally vs. fatally injured (and treated in hospital emergency rooms) may be inflated to some extent on the one hand, and deflated on the other, depending on the nature and severity of injuries involved (reference 3).

6. NEISS cannot provide data for estimates of injuries treated in hospital emergency rooms on a state or local regional basis. NEISS currently can provide these data only for nationwide estimates.

APPENDIX B

NHTSA Special Study Data Variables

Hazard Type - classifies the injury by the specific motor vehicle hazard involved in the incident

	Code
radiator/radiator cap	1
battery, motor vehicle	2
battery, type not reported	3
battery, other type (non-motor vehicle)	4
power window	5
power roof	6
other motor vehicle hazard	7
not reported in emergency room record	0

Incident Type - specifies whether stationary or moving motor vehicle was involved

moving motor vehicle	1
stationary motor vehicle	2
no motor vehicle involved	3
not reported in emergency room record	0

Patient/Motor Vehicle Relationship - specifies location of patient with respect to motor vehicle when incident occurred

no motor vehicle involved	1
inside motor vehicle	2
outside motor vehicle	3
motor vehicle involved, but relationship not reported	4
not reported in emergency room record	0

Motor Vehicle Body Type - classifies the injury by the body style of the involved vehicle

automobile....1
motorcycle....2
bus....3
van....4
pickup truck....5
other light truck (not pickup)....6
heavy truck....7
truck, type not reported....8
other motor vehicle (not specified above)....9
not reported in emergency room record....0

Injured Person - specifies the person type of the patient with respect to the involved motor vehicle

driver....1
passenger....2
occupant, type not reported in emergency room record....3
pedestrian....4
pedalcyclist....5
other nonoccupant of a motor vehicle....6
not reported in emergency room record....0

Patient at Work - identifies work-related motor vehicle incidents

yes....1
no....2
not reported in emergency room record....0

Patient's Usual Occupation

(Free-text response such as engineer, secretary, truck driver, retired, student, none, etc.)

APPENDIX C

Telephone Follow-Back Questionnaire

GENERAL QUESTIONS

1. I understand that (you were/the victim was) treated at _____ Hospital on _____ (date) for an injury that involved a motor vehicle _____ (radiator, battery, power window or power roof)? Is that correct?

   1 yes (continue)
   2 no (stop after obtaining correct product information)
   9 don't know (ask if anyone else in household knows more about the incident and can respond. If necessary, set up time to call back.)

   Respondent is:

   1 injured person (skip to question 2)
   2 parent of an injured child under 16
   3 other Specify:_____

   Respondent:

   1 witnessed the incident
   2 did not witness the incident

2. Please tell me how the incident happened. That is, what (were you/was the victim) doing before, during and after the incident happened?

   _____

   _____

   _____

3. Was the vehicle in the incident owned by (your/the victim's) household?

   1 yes
   2 no Who owns the vehicle?_____
   3 no vehicle was involved
   9 don't know

4. What is the year of the motor vehicle? 19__

   9 don't know
   Please estimate the age of the vehicle,
   specifying years or months. _____

5. Who is the manufacturer or what is the make of the vehicle?

_____ 9 don't know

6. What is the vehicle model name or number?

_____ 9 don't know

RADIATORS

1. Which part of the vehicle's cooling system was involved in the incident such as the radiator, radiator cap, radiator hoses, water pump, heater hoses or something else? (Multiple responses allowed.)

1 radiator
2 radiator cap
3 radiator hoses
4 water pump
5 heater hoses
6 something else Specify:_____
9 don't know

Note: If respondent's answer is 3-9, skip to question 7.

2. Did the incident involve opening or closing the radiator, or did it involve something else?

1 opening
2 closing
3 something else Specify:_____
9 don't know

3. Did the incident involve removing or putting on the radiator cap, or did it involve something else?

1 removing
2 putting on
3 something else Specify:_____
(skip to question 7)
9 don't know (skip to question 7)

4. Was this the radiator cap that came with the vehicle when the vehicle was new, or was this a radiator cap that had been replaced at some time?

1 radiator cap that came with vehicle when vehicle was new
2 replacement cap
9 don't know

5. Was there a pressure release valve on this radiator cap? The pressure release valve is a little red handle on the radiator cap.

1 yes
2 no (skip to question 7)
9 don't know (skip to question 7)

6. Did (you/the victim) open this release valve by lifting up on it just before removing/putting on the radiator cap?

1 yes
2 no
9 don't know

7. Was the motor running when the incident occurred, or had the motor been cut off before it occurred?

1 running
2 cut off
9 don't know

8. Was the motor (radiator) cool or just a little warm, hot from running, or was it actually overheated?

1 cool or just a little warm
2 hot from running
3 overheated
9 don't know

9. Did the radiator boil over?

1 yes
2 no (skip to question 11)
9 don't know (skip to question 11)

10. Did the radiator boil over with so much force that it seemed to explode or blow up?

1 yes
2 no
9 don't know

11. Was the injury caused by hot radiator fluid or steam that burned (you/the victim), or by something else that made contact with (you/the victim)?

1 hot radiator fluid or steam
2 something else Specify:_____
9 don't know

12. (Were you/was the victim) the driver, a passenger in the vehicle, or someone else?

1 driver
2 passenger
3 someone else Specify:_____
9 don't know

Battery Explosions

1. What part of the vehicle's electrical system was involved in the incident -- the battery, battery cables, starter, alternator or something else?

1 battery
2 battery cables
3 starter
4 alternator
5 other Specify:_____
9 don't know

2. Did the battery blow up/explode?

1 yes
2 no (skip to question 19)
9 don't know

3. When the incident occurred, was the battery in or out of the vehicle?

1 in
2 out (skip to question 9)
9 don't know

4. Were the keys in the ignition and was the ignition turned to the "on" or "start" position?

1 yes
2 no (skip to question 6)
9 don't know

5. Was the motor running when the incident occurred?

1 yes
2 no
9 don't know

6. Was the battery involved in jump-starting, that is, did this battery have cables that were attached to it and to the battery of another vehicle?

1 yes
2 no (skip to question 9)
9 don't know (skip to question 9)

7. How were the jumper cables hooked up? Were both connected to the battery, or was there only one cable to the battery while the other was attached to the vehicle itself or to the motor?

1 both cables were attached to the battery
2 one cable was attached to the battery and the other was attached to the vehicle or motor
9 don't know

8. Did the explosion occur before jumping (while the cables were being hooked up to the battery), during jumping, or after jumping (while the cables were being removed from the battery)?

1 before jumping while the cables were being hooked up
2 during jumping
3 after jumping while the cables were being removed
9 don't know

(Note: after respondent answers this question, skip to question 15)

9. Was the battery being charged, that is, were cables from a battery charger hooked up to the battery?

1 yes
2 no (skip to question 12)
9 don't know (skip to question 12)

10. Did the explosion occur before charging (while the cables were being hooked up to the battery), during charging, or after charging (while the cables were being removed from the battery)?

1 before charging while the cables were being attached
2 during charging (skip to question 15)
3 after charging while the cables were being removed
9 don't know

11. Was the battery charger turned on and working when the explosion happened?

1 yes
2 no
9 don't know

(Note: after respondent answers this question, skip to question 15)

12. Was some other work being done that involved the battery?

1 yes
2 no (skip to question 14)
9 don't know (skip to question 14)

13. What work was being done -- cleaning or replacing the battery or battery cables, using the battery to test some other electrical part, working on some other part of the electrical system such as the starter or alternator or something else?

1 cleaning the battery or battery cables
2 replacing the battery or battery cables
3 testing an electrical part of the vehicle
4 working on the starter
5 working on the alternator
6 something else Specify:_____
9 don't know

14. Was there a flame or electric spark close to the battery when it exploded, such as from an acetylene or electric welding torch, or from a stove or space heater?

1 yes, a flame/spark Specify:_____
2 no
9 don't know

15. Was there a lighted cigarette, cigar or pipe close to the battery when it exploded?

1 yes Specify:_____
2 no
9 don't know

16. Was the injury associated with the battery explosion, or with something else?

1 battery explosion
2 something else Specify:_____
9 don't know

17. What was the "make" of the battery?

_____ 9 don't know

18. What was the approximate age of the battery?

_____ months

_____ years
9 don't know

19. Was the injury caused by battery fluid (acid) that made contact with (you/the victim), by flames that burned (you/the victim), by both battery fluid and flames, or was the injury caused by something else?

1 battery fluid
2 flames
3 both battery fluid and flames
4 something else Specify:_____
9 don't know

20. (Were you/was the victim) the driver, a passenger in the vehicle, or someone else?

1 driver
2 passenger
3 someone else Specify:_____
9 don't know

POWER-OPERATED WINDOWS

1. Was the incident associated in any way with a power-operated or manually-operated window of the vehicle? (Note that power-operated windows are controlled by a push-button or electric switch, whereas manually-operated windows are controlled by hand, usually by turning a handle or moving a latch.)

1 power-operated window
2 manually-operated window
9 don't know

2. Was the incident associated with opening or closing the window, or doing something else with or to the window (such as working on it)?

1 opening
2 closing
3 something else Specify:_____
9 don't know

3. Did (you/the victim) or someone else open/close or do something else with or to the window?

1 you/the victim
2 someone else Specify:_____
9 don't know

4. Did the incident occur while (you were/the victim was) inside or outside the vehicle?

1 inside
2 outside
9 don't know

5. Were the keys in the ignition and was the ignition in the "on," "start" or "accessory" position when the incident occurred?

1 yes (keys in ignition and turned to "on," "start" or "accessory" position)
2 no
9 don't know

6. Was the vehicle moving when the incident occurred?

1 yes
2 no
9 don't know

7. Was the injury caused by opening or closing the window, or by doing something else with or to the window?

1 opening
2 closing
3 something else Specify:_____
9 don't know

8. (Were you/was the victim) the driver, a passenger in the vehicle or someone else?

1 driver (skip to END OF INTERVIEW)
2 passenger
3 someone else Specify:_____
9 don't know

9. Was the driver inside the vehicle when the incident happened?

1 yes
2 no
9 don't know

POWER-OPERATED ROOFS

1. Was the incident associated in any way with the power-operated or manually-operated movable roof of the vehicle? (Note that power-operated roofs are controlled by a push-button or electric switch, whereas manually-operated roofs are controlled by hand, usually by turning a handle or moving a latch.)

1 power-operated roof
2 manually-operated roof
9 don't know

2. Was the incident associated with opening or closing the roof, or doing something else with or to the roof (such as doing work on it)?

1 opening
2 closing
3 something else Specify:_____
9 don't know

3. Did (you/the victim) or someone else open/close or do something else with or to the roof?

1 you/the victim
2 someone else Specify:_____
9 don't know

4. Did the incident occur while (you were/the victim was) inside or outside the vehicle?

1 inside
2 outside
9 don't know

5. Were the keys in the ignition and was the ignition in the "on," "start" or "accessory" position when the incident occurred?

1 yes (keys in ignition and ignition in the "on," "start" or "accessory" position)
2 no
9 don't know

6. Was the vehicle moving when the incident occurred?

1 yes
2 no
9 don't know

7. Was the injury caused by opening or closing the roof, or by doing something else with or to the roof?

1 opening
2 closing
3 something else Specify:_____
9 don't know

8. (Were you/was the victim) the driver, a passenger in the vehicle or someone else?

1 driver (skip to END OF INTERVIEW)
2 passenger
3 someone else Specify:_____
9 don't know

9. Was the driver inside the vehicle when the incident occurred?

1 yes
2 no
9 don't know

END OF INTERVIEW

1. I have one more question. Just for statistical purposes, what is (your/the victim's) usual occupation?

_____

2. Thank you very much for your time. Your information may help us learn how to help other people avoid similar crashes. If I have missed anything important, would you mind if I called back?

1 OK to call back

2 don't call back