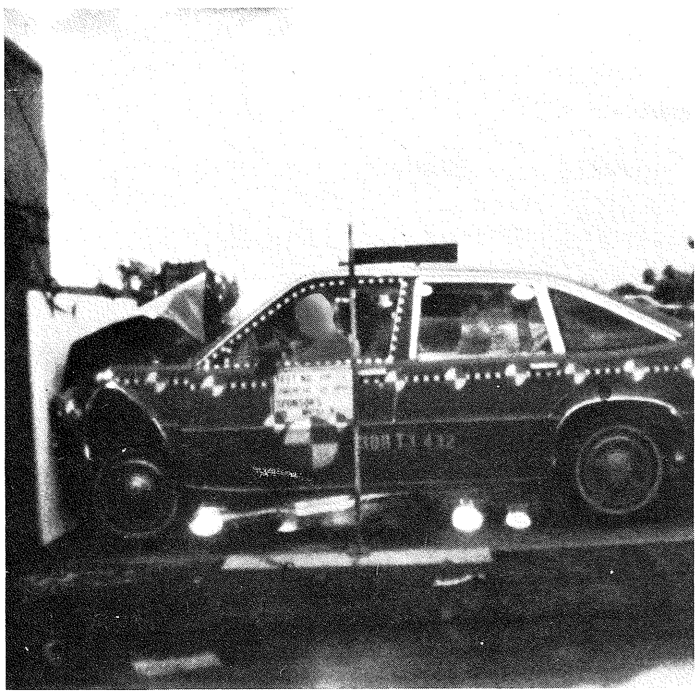
U.S. Department of Transportation

National Highway Traffic Safety Administration

July 1980

Automobile Occupant Crash Protection

Progress Report No. 3



Cover photographs:

1980 Chevrolet Citation being crash tested into a barrier at 35 miles per hour. Instrumented belted dummies were used to measure simulated crash forces on front seat occupants. The test results indicated the occupants would have survived such a crash.

Two modified production Volvo sedans being successfully crash tested in a head-on collision at a closing speed of 90 miles per hour. The right car was equipped with advanced air bags and the left car equipped with advanced safety belt systems. The test results indicated the occupants would have survived such a crash.

Interior view of a 1978 Volkswagen Rabbit after a severe head-on collision with another vehicle of similar size. The occupants, both wearing automatic belts, survived.

Interior view of a 1975 Cadillac equipped with air bags which deployed after the car ran off the road into a 14 inch diameter tree. The occupants survived.

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AUTOMOBILE OCCUPANT CRASH PROTECTION
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I. INTRODUCTION AND SUMMARY

- Human Loss in Motor Vehicle Crashes

Casualties in motor vehicle crashes continue to be a major public health problem of epidemic proportions. Today's motor vehicle death rate is comparable to the typhoid and diphtheria death rates of the early 1900's.

The current toll is now over 50,000 deaths and 4 million injuries each year. The monetary cost to society is now estimated at $50 billion dollars each year.*

In the U.S., from January 1975 through December 1979, the number of people killed in motor vehicle crashes totaled 238,992. For comparison, this is more than the entire population of any one of the following cities: Baton Rouge, Louisiana; Columbia, South Carolina; Independence, Missouri; Kansas City, Kansas; Lansing, Michigan; Las Vegas, Nevada; Lexington, Kentucky; Lincoln, Nebraska; Mobile, Alabama; or Richmond, Virginia.

A recent report** by the U.S. Congress' Office of Technology Assessment found:

> "In this century, approximately 2 million persons have died and nearly 100 million have been injured through the use of motor vehicles -- a total that is more than 3 times the combat losses suffered by the United States in all wars. The Nation's vehicles and highways claim more American lives each year than were lost in either the Korean or Southeast Asia Wars. On the average, a highway fatality occurs every 11 minutes and an injury every 9 seconds.... Despite existing Federal policies, regulations, and programs dealing with automobile and highway safety, and despite the introduction of new safety features, such as passive restraints, the annual toll is expected to keep rising. By 2000, there could be as many as 64,000 deaths and over 5 million injuries annually....
>
> Measured in terms of working life lost, traffic deaths represent a social problem comparable to heart disease and cancer."

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* National Highway Traffic Safety Administration, The Contributions of Automobile Regulation, December 1979, p.2.

** Congress of the United States, Office of Technology Assessment, Changes in the Future Use and Characteristics of the Automobile Transportation System, Vol. II, Technical Report, February 1979, p. 185.

TABLE I-1. TRAFFIC FATALITIES BY AGE GROUP-1975-1979*
(Includes Pedestrian and Occupant Deaths)

AGE GROUP	1975	1976	1977	1978	1979*	TOTAL 1975-79*
0 - 4	1,313	1,243	1,194	1,245	1,159	6,149
5 - 14	3,182	3,041	3,012	2,960	2,793	14,988
15 - 24	15,466	16,121	17,615	18,285	18,681	86,168
25 - 34	7,504	7,663	8,445	9,435	10,129	43,176
35 - 44	4,192	4,093	4,292	4,740	5,047	22,364
45 - 54	3,939	4,002	3,996	4,130	3,980	20,047
55 - 64	3,398	3,473	3,657	3,670	3,627	17,825
65 & Over	5,326	5,349	5,373	5,405	5,342	26,795
Unknown	205	196	292	462	325	1,480
All Ages	44,525	45,181	47,876	50,327	51,083	238,992

One tragic note shown by the figures in Table I-1 is the steady increase in the number of 15 to 24 year old people killed each year. In this age group fall the youth of America on whom the Nation's future depends.

Revealing as these statistics are, they do not show the hidden personal costs, the trauma and heartbreak suffered by individuals, their families, their friends and co-workers as a result of death or crippling injury.

Two anthropologists recently reported on their initial investigation into the effects of motor vehicle crashes on the American family. They asked how accidents change traditional family relationships and how they harm family members who were not involved in the crash.** They found that "victims and their families can suffer enormous emotional, physical, financial, and social disruptions from accidents."

But this study has only scratched the surface of describing the effects of crashes on the family. What are the effects on the child who loses a mother or father or both in a crash? What are the effects on the parents of the one thousand children under age 5 killed each year? What is the effect on the family of a once productive member now confined to a wheel chair for life?

A news story from the March 9, 1980, Peoria Journal-Star illustrates the human dimension of automobile crashes. The headline was: "Accident Victim, 38, Blinded for Life - But Still Alive," and the story read, "a 38-year old mother of three children.... Her stopped car was rammed by another car.... Some of the stitches have been removed from her face. But there's still a lot of work to do - perhaps years of cosmetic surgery, and the shattered bones in her face will be a long time in healing. Her jaws are wired together to keep her from disturbing that process."

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* Preliminary figures based on incomplete State data.

** Auto Crashes: The Repercussions for the American Family DOT/HS 805 218.

• The Technology of Occupant Protection

> "...in the 14 years between 1942 and 1956 a new engineering field has been created, namely, that of crash survival design engineering."*

Companies frequently design packaging to transport without damage, a wide variety of fragile goods they offer for sale. For example, eggs, china, clocks, cameras, televisions, and computers are routinely packaged carefully to be shipped by sea, air, and land, and are handled in the roughest manner with little breakage. Crashworthiness is the science of packaging people in automobiles so that when crashes inevitably occur (millions each year) the occupants are not unduly damaged.

> "On the basis of reasonable estimates, during their lifetimes every 1,000 new vehicles will be involved in somewhere between 2,000 and 3,000 crashes; they will kill more than 3 people; and they will injure more than 300."**

The science of crashworthiness now has progressed to the point where engineers can design crashworthiness, not only into safety glass and padding, but into the car body structure as well. For instance, vehicles can be designed such that in a collision, the passenger compartment is more resistant to collapse. Engineers can design occupant restraints -- air bags and safety belts -- that can protect occupants from death and injury in increasingly higher speed crashes.

Safety belts first appeared as a production option in Ford Motor Company automobiles in 1955. Just as the technology to build cars to be more comfortable and reliable has developed since then, so has the technology of occupant protection improved. Safety belts now can be made more comfortable and easier to use, while providing greater protection in a crash. Restraint technology has now developed to the point where during a crash, in a fraction of a second, a life-saving cushion emerges automatically to soften the occupant's collision with the interior of the vehicle. Some of the cars of the 1980's will be equipped with this advanced and humane technology. Other cars of the 80's will have safety belts which go into place automatically without the need for occupants to manually "buckle up."

National Highway Traffic Safety Administration (NHTSA) regulations set minimum requirements for occupant protection at 30 mph in frontal crashes. Systems that meet these requirements reduce a person's risk of death and serious injury in a severe crash by nearly 50 percent.

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* Haddon, Suchman, and Klein, Accident Research, Harper and Row (New York, 1964), p. 553.

** William Haddon, Jr., M.D., "Cars That Don't Protect You in a Crash," Business and Society Review, Winter 1978-79, Warren, Gorham and Lamont Inc., (New York, NY), p. 28.

Even higher levels of crashworthiness can be achieved when the structure of the vehicle and the restraint systems are specially designed to complement each other for increased occupant safety. For example, some of the 1980 models have demonstrated frontal crash protection at speeds close to 40 miles per hour, and research vehicles have demonstrated 50 mile per hour frontal and side crash protection.

Fortunately, these advanced technologies of occupant protection are available at a crucial time in the nation's motor vehicle history. As vehicles become smaller and lighter in the 1980's to meet the growing demands for fuel efficiency, the occupants of smaller vehicles will be at greater risk without the benefits of advanced crash protection technology. In 1979, for example, in crashes between large and subcompact cars, occupants of the small cars were killed at a rate eight times greater than occupants of the large cars.

The shift to small cars and the growth in the use of automobiles would result in an estimated 15,000 more people being killed each year by 1990 if the automatic crash protection standard is not implemented.

- <u>Federal Motor Vehicle Safety Standard 208</u>

On June 30, 1977, the U.S. Secretary of Transportation announced that beginning with model year 1982 (September 1981), all full-sized passenger cars manufactured for sale or use in the United States must be equipped with automatic restraint systems to protect front-seat occupants from serious injury in frontal crashes. Beginning with model year 1983, all new intermediate and compact cars also would have to be so equipped, and by model year 1984, all new passenger cars would be required to be manufactured with automatic crash protection systems under Federal Motor Vehicle Safety Standard 208 (FMVSS 208).

On the road experience in thousands of vehicles equipped with air bags and automatic safety belts has confirmed agency estimates of the life-saving and injury-preventing benefits of such systems. When all cars are equipped with automatic crash protection systems, each year an estimated 9,000 more lives will be saved, and tens of thousands of serious injuries will be prevented.

The standard was set in large part because of the low rate of use of manual safety belts. In 1979 only about 11 percent of all car drivers used the available belts. Statistics from the agency's National Crash Severity Study (NCSS) in 1977-1978, show that while drivers involved in crashes used their belts about 11 percent of the time, all occupants involved in accidents used their safety belts only 8.2 percent of the time (4.4 percent lap and shoulder belts together, plus 3.8 percent lap belts only).

New analyses by the National Highway Traffic Safety Administration, based on extensive accident statistics, continue to show that the use of occupant restraints (manual or automatic safety belts, or air bags) is effective in reducing the number of fatalities and serious injuries in motor vehicle crashes by up to 50 percent.

- Recent Reviews of Safety Standard 208

The U.S. Congress extensively reviewed the automatic crash protection standard in 1977, and fully supported the standard.

Shortly thereafter, the U.S. Court of Appeals also reviewed the standard in response to challenges from the Pacific Legal Foundation which argued for relaxation of the standard and from Ralph Nader and Public Citizen advocating stricter application of the standard. In February 1979, the court upheld the Department's standard in every respect.

Aspects of the standard also have been reviewed by the National Transportation Safety Board (NTSB) and the General Accounting Office (GAO). The NTSB looked specifically at the adequacy of the agency's plans for evaluation of the standard after it goes into effect. Last year, the NHTSA issued a proposed comprehensive evaluation program for public comment. The plan is described in detail in Chapter VI. The Chairman of the NTSB, James B. King, in a December 5, 1979 letter, commended NHTSA for organizing and publishing the proposed evaluation plan.

The NTSB also has published a series of reports* which discussed the procedures by which NHTSA carries out its rulemaking and used FMVSS 208 and other agency rules as case studies. The reports, however made no recommendations regarding the standard.

The General Accounting Office's report,** prepared by its Detroit office, concluded that "passive restraints offer life-saving and injury prevention potential."

The GAO also stated, "our concern for motor vehicle safety is evidenced by our suggestions directed toward improving implementation of the passive restraint standard."

The recommendations of the GAO, and the NHTSA's responses were:

-- The GAO endorsed the NTSB recommendation for an evaluation of standard 208 when cars with automatic crash protection were produced in sufficient numbers in the early 1980's, and further recommended that the evaluation plan be prepared by a task force representing various interest groups.

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* NTSB, Safety Effectiveness Evaluation of the National Highway Traffic Safety Administration's Rulemaking Process, Vol. 2, "Case History of Federal Motor Vehicle Safety Standard 208: Occupant Crash Protection", NTSB-SEE-79-5, and Vol. 4, "Analysis, Conclusions, and Recommendations," NTSB-SEE-80-3.

** GAO, Passive Restraints For Automobile Occupants - A Closer Look, July, 1979, pp. i, 26.

The NHTSA's proposed plan for evaluation of the standard has been reviewed by interested persons in response to the agency's request in the Federal Register and by the National Accident Sampling System Advisory Committee, which is made up of representatives with substantial technical expertise from a broad spectrum of organizations.

-- The GAO also recommended additional testing of automatic restraints considering the effects on occupants not seated in the usual position.

This GAO recommendation was in response to concerns about out-of-position children expressed by GM. GM has since successfully addressed its concerns about air bag performance with out-of-position children and adults with its air bag design, and indicated in December 1979 that it would make full front air bag systems available on its full sized 1982 model year cars (see Chapter IV).

-- The GAO recommended additional research on the use of sodium azide in automobile air bags, and on the disposal of cars with air bags.

A. D. Little has since completed a study for the Motor Vehicle Manufacturer's Association (MVMA), and another one for NHTSA, on the handling of sodium azide in the disposal and recycling of air bag equipped cars, when the vehicles are scrapped. A cost effective method has been identified and is described in Chapter IV. NHTSA is now working with the automobile recycling industry to develop a standardized dismantling process. NHTSA also has been working with EPA, OSHA and air bag manufacturers to assure proper precautions are taken.

- Industry Plans for Implementation of FMVSS 208

Mercedes-Benz has taken the lead in deciding to build all of its 1982 U.S. models with air bags as standard equipment for the protection of front seat occupants. This voluntary action is being taken by Mercedes-Benz one year ahead of the requirement for automatic crash protection for most of its cars.

Ford Motor Company currently plans to make air bags available as an option in limited numbers beginning in the middle of the 1981 model year.

By contrast, General Motors, the world's largest manufacturer of automobiles and the company with the most experience in the production of cars with air bags, has changed its plans and announced it will not offer the public the choice of air bags for automatic crash protection in its 1982 models. This decision was made strictly on economic grounds and according to GM chairman Thomas A. Murphy will save the company about 20 million dollars in capital investments. It was a significant reversal of GM policy.

Earlier this year GM had stated in its 1980 General Motors Public Interest Report that the company would offer "an inflatable restraint (IR) extra-cost option on most full size 1982 model cars." The reversal of this policy will mean that 1982 GM full size cars will not be available with front 3 passenger bench seating, only the 2 passenger configuration with automatic belts.

GM's decision is the latest in a long line of actions by automobile companies, based on parochial concerns, resulting in consumers not being able to buy air bag restraints. Briefly, in August 1970, GM in a letter to Federal officials pledged to provide air bags on all its cars by the 1975 model year. In August 1973 GM cut its later 1974-75 planned production from 1,000,000 to "no more than 150,000 units." By November 1976 GM had stopped production after making only 10,000 cars equipped with air bags.

In December 1976, GM agreed to produce 30,000 to 300,000 cars equipped with air bags over a two year period beginning September 1979. This was later changed to introducing air bags as an option in 1981, but in October 1979, GM postponed production one more year.

In March 1980, GM informed NHTSA that GM "does not plan to offer inflatable restraints on medium or small cars" in 1982-86 model years. In June 1980, GM announced cancellation of plans to provide air bags as options in its full-size 1982 models.

The consequences of GM's decisions will be felt by motorists, air bag component manufacturers and their employees, and GM itself. Hundreds of motorists will needlessly be killed and injured in GM cars without air bags because they cannot or will not wear belts.

Two major companies, Eaton Corporation and Allied Chemical Corporation, already have gone out of the business of manufacturing air bag components as a result of the delays in the introduction of air bags and the diminishing production volumes planned by auto makers. As many as one hundred other companies and their employers also are affected by GM's decisions.

Because of GM's dominance of the U.S. automobile market, GM's decision will have a much larger adverse impact on suppliers and the public than would similar decisions by a smaller company. GM has also lost the opportunity to resuscitate domestic automobile sales and to gain a competitive edge over foreign car makers by re-introducing this major life saving technology. As the situation is now, Cadillac may be at a competitive disadvantage with Mercedes-Benz and Lincoln which will offer air bags.

GM must now face the prospect of a loss of world leadership in inflatable restraint crash protection, a field in which it has played a major, developmental role. Air bags will now be introduced for sale to the public by Ford, Mercedes-Benz, and other foreign car makers. In addition, GM will not be able to recover past investment in these systems, and may suffer a loss of public confidence in its willingness to provide the safest cars to the public.

Volvo and BMW have major air bag development programs that are also expected to lead to their offering air bags under the standard.

All of the domestic manufacturers are making plans to comply with the automatic crash protection standard, and two are currently manufacturing cars for sale with an automatic belt system (the Volkswagen Rabbit, and the General Motors Chevette).

Most foreign car manufacturers exporting cars to the U.S., are also planning to produce cars with automatic restraints. However, most are not required to comply with the standard until September 1982 or later because their cars are compact or subcompact.

Four U.S. parts manufacturers are presently in the final tooling stage in preparation for production of the major components of air bag systems for both domestic and foreign car manufacturers. They are Talley Industries of Mesa, Arizona; Thiokol Chemical Corp. of Brigham City, Utah; and a cooperative venture between Rocket Research Company of Redmond, Washington and Hamill Manufacturing Co. of Washington, Michigan. Other suppliers such as Essex Division of United Technologies, Corp. of Detroit, Michigan, Uniroyal of Mishawaka, Indiana and Toshiba America, Inc. of Southfield, Michigan, are preparing to produce such components as crash sensors, bags, and electronics. Manufacture of air bag systems for production cars will begin during 1981. Tens of millions of dollars have been invested by the industry to develop and produce these systems.

In addition to capital investments of millions of dollars, hundreds of new employees will be added in the manufacture and assembly of equipment to provide all new car occupants with automatic crash protection.

All of the major seat belt manufacturers are planning for production of automatic belt systems by the early 1980's. The Department has been shown at least seven different belt configurations that are being designed to meet the standard. These range from the relatively simple Volkswagen system (a single diagonal shoulder belt connected to the door with a knee bar for lower body restraint) to various three point systems (such as the 1980 Chevette system) and motorized systems (the Toyota system now being introduced). Some of these systems show a good deal of ingenuity and concern for comfort and convenience and for the attachment of child restraint systems. Chevrolet provides special mounting points and a special belt for attachment of child safety seats in its 1980 Chevette models equipped with automatic belts.

While the standard was controversial in the past, the restraint industry now is generally strongly behind the automatic protection concept as is shown by the following quote from the American Seat Belt Council (ASBC):

> The ASBC endorses and supports the provisions of FMVSS 208 -- Occupant Crash Protection requiring automatic protection for car occupants, and has developed and actively demonstrated automatic belt systems throughout the country.*

During 1979, General Motors postponed the introduction date for its air bag system because of difficulties it was having with its air bag design in properly protecting otherwise unrestrained small children. GM undertook a major redesign of the system it initially was developing, and in December 1979, announced that it had been successful in meeting its criteria for providing such protection. GM has acknowledged that all technical issues with air bags have been resolved. As a result of the added development and test work carried out by the company and the NHTSA in response to this challenge, a substantial amount has been learned about what happens to children in automobile crashes.

Industry progress continues in the development of the technologies of automatic crash protection. Implementation of the automatic crash protection standard by some manufacturers, however, is somewhat disappointing, particularly GM's most recent decision to not offer air bags in its 1982 models.

The agency continues to monitor the costs of the various automatic crash protection systems. The agency has not found any substantial evidence for significantly modifying previous price estimates. Previous cost estimates indicated prices to the consumer of approximately $200 for air bags and $50 for automatic belts (in 1978 dollars). The prices could be higher depending on the extra features chosen to be incorporated by the manufacturers.

- <u>Public Acceptance of Automatic Crash Protection</u>

In 1978, the NHTSA carried out a major scientific survey of public attitudes toward automatic restraint systems. This poll indicated that there is a good deal of general concern about safety in the cars the public buys, and strong support for the Department's automatic crash protection policy and standard. Approximately one third of the public expressed a strong preference for air bags; one third for automatic belts; and the remainder indicated that they would make their decision on the basis of factors such as the specific design of the system, its availability, or its price.

In December 1979, information was released on marketing studies conducted by General Motors in 1971, 1975, 1978, and 1979 on automatic restraint systems that confirms the strong market potential of automatic restraints,

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* Letter from Charles Pulley, President, American Seat Belt Council to Joan Claybrook, Administrator, NHTSA, dated November 30, 1979.

particularly air bags. As Congressman John L. Burton pointed out, GM's 1979 study found:

- -- "70 percent of the total principal driver sample selected the Air Cushion Restraint System (air bag) as their final first choice preference" over manual or automatic belts - even with the air bags adding $360 to the price of the car.

- -- The February 1979 GM report states: "The uncluttered, roomy interior of the Air Cushion Restraint System car and its ability to sit three passengers in the front seat were the major reasons for its selection."

- -- The 1978 GM study found that air bags "received the highest ratings on all operation, comfort and appearance items evaluated" compared to manual belts and automatic belts.

Volkswagen has been offering automatic belts in its Rabbit model since 1975. Approximately 250,000 Volkswagen Rabbits have been sold to date and have traveled over 5 billion miles. Sales of the automatic belts have been limited in part by the fact that they are currently available only on the higher priced models of the Rabbit. Nevertheless, approximately one-quarter of the Rabbits sold have automatic belts. Usage of these belts has been observed to be above 70 percent on the road.

The agency also is concerned with the deteriorating rate of safety belt usage, and the generally low rate of child restraint use. The agency plans to continue to give these areas high priority in its programs.

CHAPTER II

Trends in U.S. Motor Vehicle Death Rates

Figure II-A

Deaths per 100,000 registered vehicles

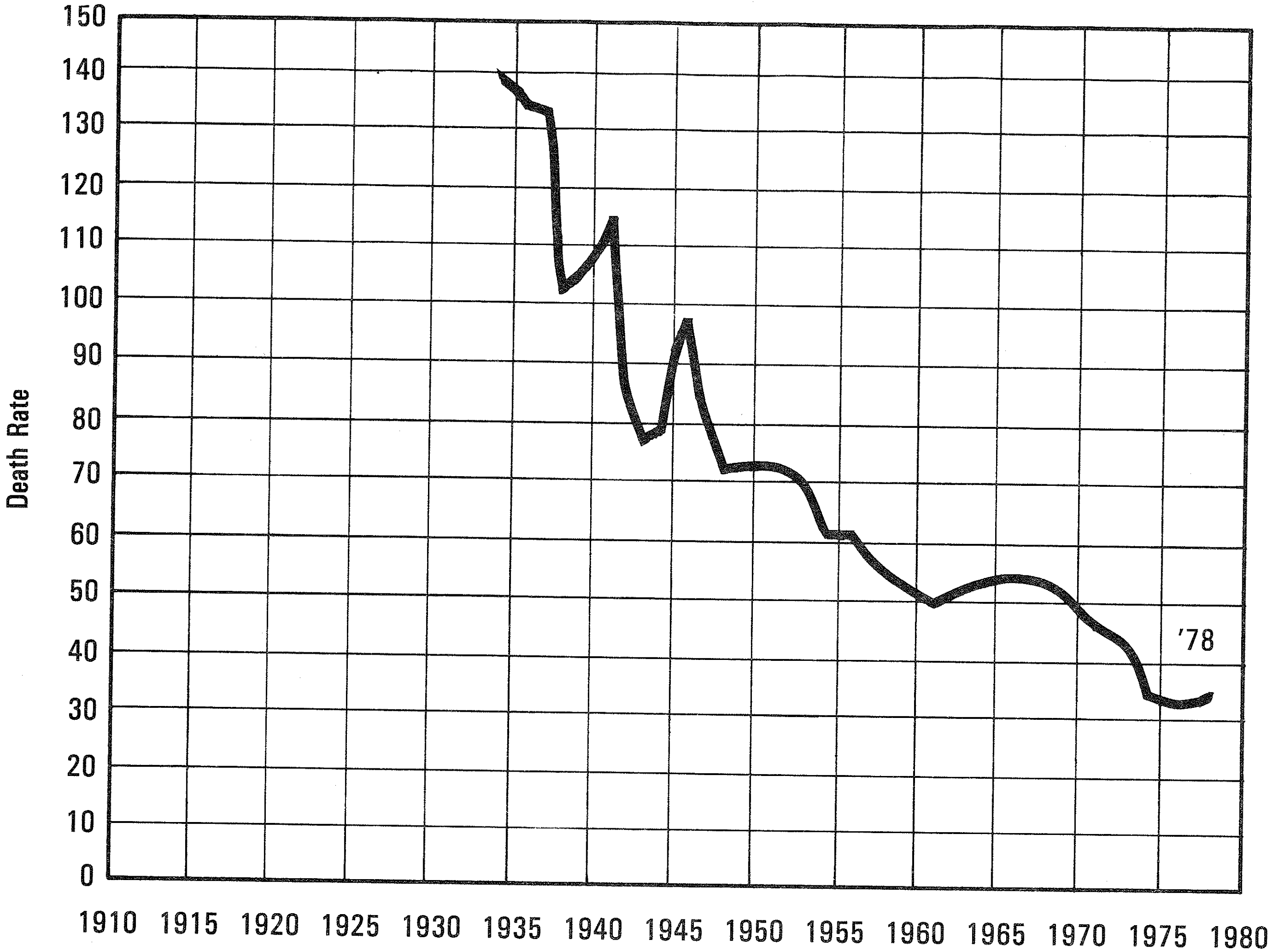
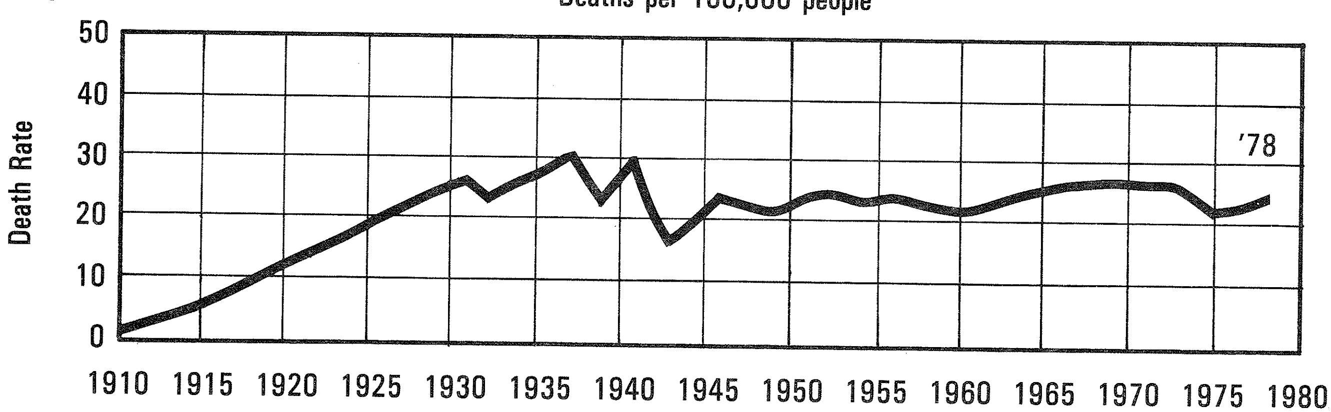


Figure II-B

Deaths per 100,000 people



Source: National Safety Council, Accident Facts, 1979

II. OCCUPANT CRASH PROTECTION: THE NEED AND NHTSA'S PROGRAM

- The Need

More people die in automobile crashes than in all other transportation accidents combined. Nationally in 1979, the number of people killed in motor vehicle crashes was thirteen times greater than the number of people who died in all air, rail, waterborne transportation, and recreational boating accidents combined. Motor vehicle accidents are the largest single killer of Americans under the age of 34. At present rates, one out of every 60 infants born today will die in a traffic accident, and most of them will die young.

Out of every three people born today in the U.S., two will suffer injuries in a crash. Motor vehicle crashes are a leading cause of paraplegia and epilepsy. Each year, crashes cost the country about $50 billion in medical and rehabilitation costs, lost wages, welfare, and property damage. In 1978 alone, 50,327 people died and over 4 million were injured.

Statistics, not yet final, count 51,083 people killed in motor vehicle accidents in 1979. This was an increase of 756 over the number of people killed in 1978.

Figure II-A shows that since the early 1900's, a sharp decline has occurred in the motor vehicle death rate as measured in deaths per 100,000 vehicles. This decline reflects the growth in the number of vehicles and improvements in safety including improved roads, vehicles and traffic safety programs such as compliance with 55 mph speed limits. NHTSA estimates its safety standards since 1968 have saved over 60,000 lives. These improvements have enabled people, on average, to drive farther without suffering a fatal crash.

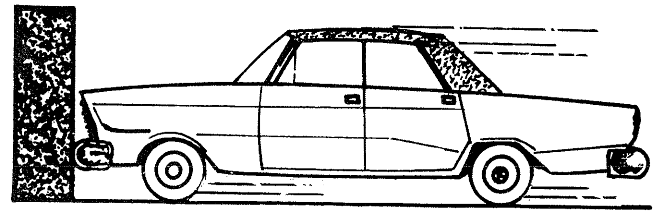
Figure II-B, however, shows that since the early 1900's the motor vehicle death rate as measured in deaths per 100,000 people has remained relatively constant. This almost constant rate since the 1940's indicates that while a citizen, on average, now can expect to drive farther without a fatal crash, the probability of being killed in a motor vehicle crash is about the same today as it was in 1947, or even the same as it was in the late 1920's.

Approximately 70 percent of the 50,000 fatalities that occur each year in motor vehicle crashes are occupants of automobiles, light trucks, and vans. The remaining 30 percent are primarily pedestrians, motorcyclists and heavy truck occupants. Table II-1 provides a State-by-State count of fatalities of occupants of passenger cars, light trucks, and vans for the four years, 1975-1979. Examination of these figures provides an insight into the problem of automotive occupant protection. The figures show a regularity, year after year, which suggests that with safer designs, many could be saved in the future.

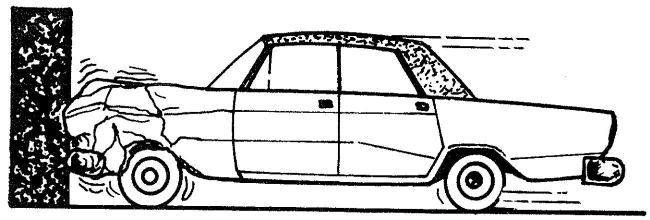
Figure II-C

What Happens in a Collision

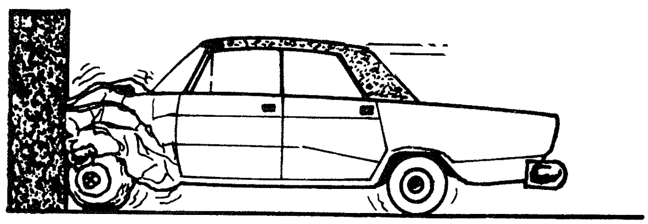
1st, The Car Collision



When a car hits a solid barrier, it doesn't stop all at once. The bumper stops immediately, but the rest of the car continues to move forward.

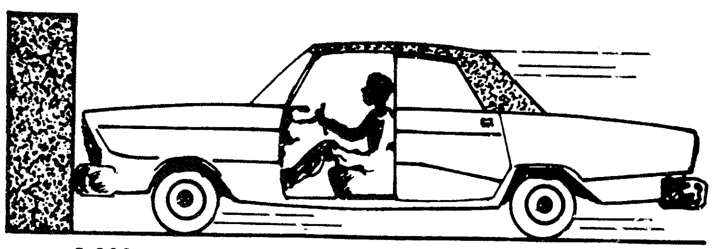


The car slows down as the crushing of the front end absorbs some of the force of the collision.



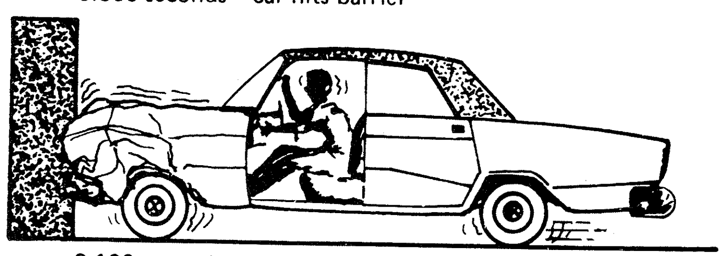
At 30 mph, the car takes about 1/10 of a second to come to a complete stop. The front end is crushed, but the passenger compartment usually remains undamaged.

2nd, The Human Collision



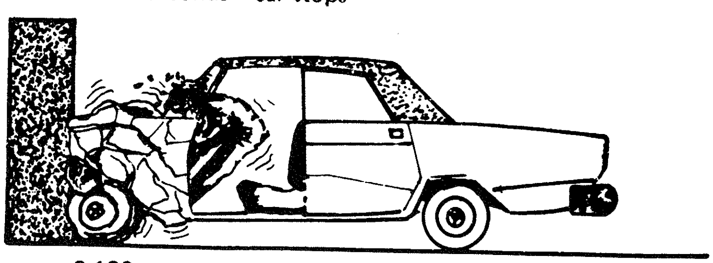
0.000 seconds - car hits barrier

On impact, the car begins to crush and to slow down. The person inside the car has nothing to slow him down, so he continues to move forward inside the car at 30 mph.



0.100 seconds - car stops

Within 1/10 of a second, the car has come to a complete stop, but the person is still moving forward at 30 mph.



0.120 seconds - person hits car interior

One-fiftieth of a second after the car has stopped, the person slams into the dashboard and windshield. This is the human collision. The car takes 1/10 of a second to stop; the human takes only 1/100 of a second.

TABLE II-1
OCCUPANT FATALITIES IN PASSENGER CARS, LIGHT TRUCKS AND VANS
BY STATE FOR 1975, 1976, 1977, 1978, 1979

	1975	1976	1977	1978	1979*	Total 1975-1978
TOTAL	30,601	31,532	32,790	34,757	34,907	164,587
STATE:						
Alabama	686	758	835	882	768	3,929
Alaska	76	95	79	79	50	379
Arizona	419	453	578	683	653	2,786
Arkansas	418	390	415	453	405	2,081
California	2,665	2,760	3,038	3,361	3,490	15,314
Colorado	430	458	506	489	482	2,365
Connecticut	266	256	289	263	372	1,446
Delaware	89	77	93	81	80	420
District of Columbia	20	18	23	20	18	99
Florida	1,237	1,198	1,224	1,348	1,546	6,553
Georgia	980	897	870	1,089	1,107	4,943
Hawaii	99	107	100	146	137	589
Idaho	180	157	245	252	234	1,068
Illinois	1,376	1,394	1,470	1,474	1,387	7,101
Indiana	757	821	885	875	903	4,241
Iowa	514	594	454	454	475	2,491
Kansas	390	439	392	415	364	2,000
Kentucky	628	640	720	666	647	3,301
Louisiana	658	652	657	726	826	2,519
Maine	108	139	145	165	172	729
Maryland	439	350	426	414	409	2,038
Massachusetts	565	547	426	564	605	2,707
Michigan	1,153	1,336	1,323	1,383	1,256	6,451
Minnesota	518	565	537	662	592	2,874
Mississippi	391	417	535	643	519	2,505
Missouri	805	914	844	860	890	4,313
Montana	232	232	256	200	271	1,191
Nebraska	266	301	260	255	249	1,331
Nevada	161	155	185	229	264	994
New Hampshire	103	116	92	122	123	556
New Jersey	694	657	691	720	692	3,454
New Mexico	414	394	483	475	441	2,207
New York	1,482	1,398	1,344	1,487	1,450	7,161
North Carolina	1,062	1,008	967	1,063	1,110	5,210
North Dakota	120	151	139	143	76	629
Ohio	1,216	1,332	1,281	1,438	1,569	6,836
Oklahoma	563	634	641	675	634	3,147
Oregon	408	474	461	517	475	2,335
Pennsylvania	1,383	1,420	1,394	1,373	1,427	6,997
Rhode Island	66	64	66	50	74	320
South Carolina	546	569	658	645	654	3,072
South Dakota	156	173	145	152	154	780
Tennessee	733	898	911	935	939	4,416
Texas	2,433	2,337	2,624	2,785	2,931	13,110
Utah	180	152	231	286	188	1,037
Vermont	106	85	91	82	120	484
Virginia	694	712	807	744	717	3,674
Washington	575	618	692	721	733	3,339
West Virginia	354	373	413	349	376	1,865
Wisconsin	617	640	657	692	683	3,289
Wyoming	170	207	192	172	170	911

*Preliminary figures based on incomplete State data.

In a search for remedies, examination of individual accidents to determine their causes, and the causes of the resulting human injuries remedies, reveals a wide array of contributing factors such as:

-- defects in vehicle design, construction, or maintenance that impair a driver's control of the vehicle, or that cause or increase injuries in a crash;

-- driver impairments such as alcohol and/or drug use or abuse, driver fatigue, misjudgments, momentary inattention or distraction, inexperience, and physical problems ranging from dizziness, hearing, vision or reflex imperfections, to heart attacks; and

-- road hazards resulting from poor design or maintenance of roads, and roadside hazards which arise naturally as a result of heavy usage and weather conditions.

Only one of these factors need occur to set off a chain of events ending in tragedy. People rarely think when they start their car, they may be heading for a crash. People generally assume they are in control and often do not foresee hazards in their own or another driver's vehicle, in themselves or other drivers, or on the road ahead -- thus, the need for automatic crash protection.

The penalty (injury and death) is simply too high a price to pay for the failings, mechanical or human, which result in crashes on our roads millions of times each year, particularly when cars can readily be designed to mitigate or eliminate such harm.

- NHTSA's Program

Although many traffic and motor vehicle safety programs are aimed at preventing accidents, it is not realistic to expect that all crashes, or even a majority, can be prevented. Thus, the NHTSA program to improve motor vehicle crashworthiness is an effort to reduce injuries and fatalities through the design of vehicles to better protect the occupants if the vehicle is involved in an accident.

> "It cannot be argued that injurious motor vehicle crashes are such rare events that it is unreasonable to anticipate them by safely packaging the passenger, since between one-fourth and two-thirds of all vehicles manufactured are at some time during their subsequent use involved in the tragedy of human injury and death. Because of this high probability, vehicle designers should seek as their logical goal the production of vehicles that are safe to have accidents in, if those accidents occur under the types of use for which the vehicles are designed."*

* A.L. Haynes, "Statement Before A Subcommittee On Investigation of Highway Traffic Accidents," Accident Research, Haddon, Suchman and Klein, Harper and Row (New York, 1964), p. 681.

Improvements in three areas of vehicle design can increase the likelihood of surviving a crash without serious injury:

1. Structural integrity -- to prevent occupants from being ejected, trapped, burned, or crushed by collapse of the occupant compartment.

2. Crash energy management -- to absorb, control, and reduce crash forces on the occupants with improved structural design; and

3. Occupant restraints -- to prevent or soften the second collision of the occupant with the vehicle's interior.

Improvements in these three areas are being examined by NHTSA with renewed vigor and concern for public safety. The concern in part stems from the fact that as a result of the trend to smaller and lighter cars to conserve energy, the number of people killed each year in crashes is very likely to increase.

As the new smaller and lighter cars join the older heavier cars already on the roads, more collisions between large and small vehicles will occur. Of the passenger car occupants killed in two-car collisions, deaths in subcompact cars accounted for 25 percent of the total in 1977, rose to 27 percent in 1978, and climbed to 30 percent in 1979. In two-car crashes where a subcompact collided with a larger car, 85 percent of the persons killed were occupants of the subcompact vehicles.

An examination of statistics of crashes in which subcompacts collided with full sized cars found that the occupants of the subcompact vehicles were eight times more likely to be killed than the occupants of the full sized vehicle (see Figures II-D and II-E).

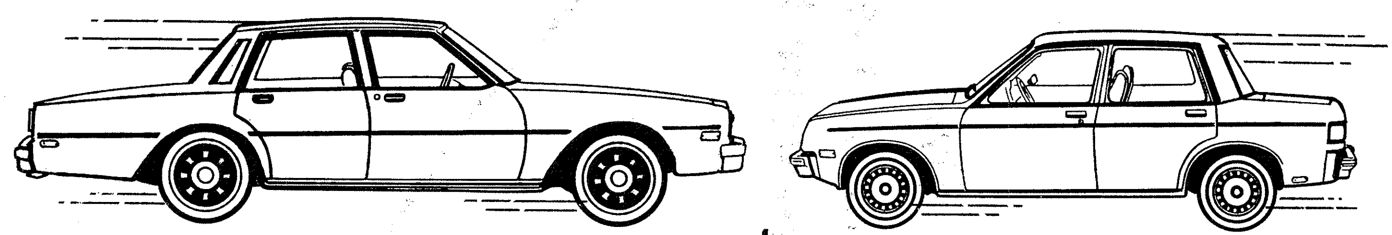
Occupants of the smaller cars generally are at greater risk because:

1. in collisions between vehicles of different weight, the forces imposed on occupants of lighter cars tend to be proportionately greater than the forces felt by occupants of heavier vehicles;

2. the occupant's survival space is generally less in small cars (survival space, in simple terms, means enough room for the occupant to be held by the vehicle's restraint system without being smashed into injurious surfaces, and enough room to prevent being crushed or hit by a collapsing surface); and

3. smaller and lighter vehicles generally have less physical structure available to absorb and manage crash energy and forces.

Figure II-D Effects in a Large Car/Small Car Collision



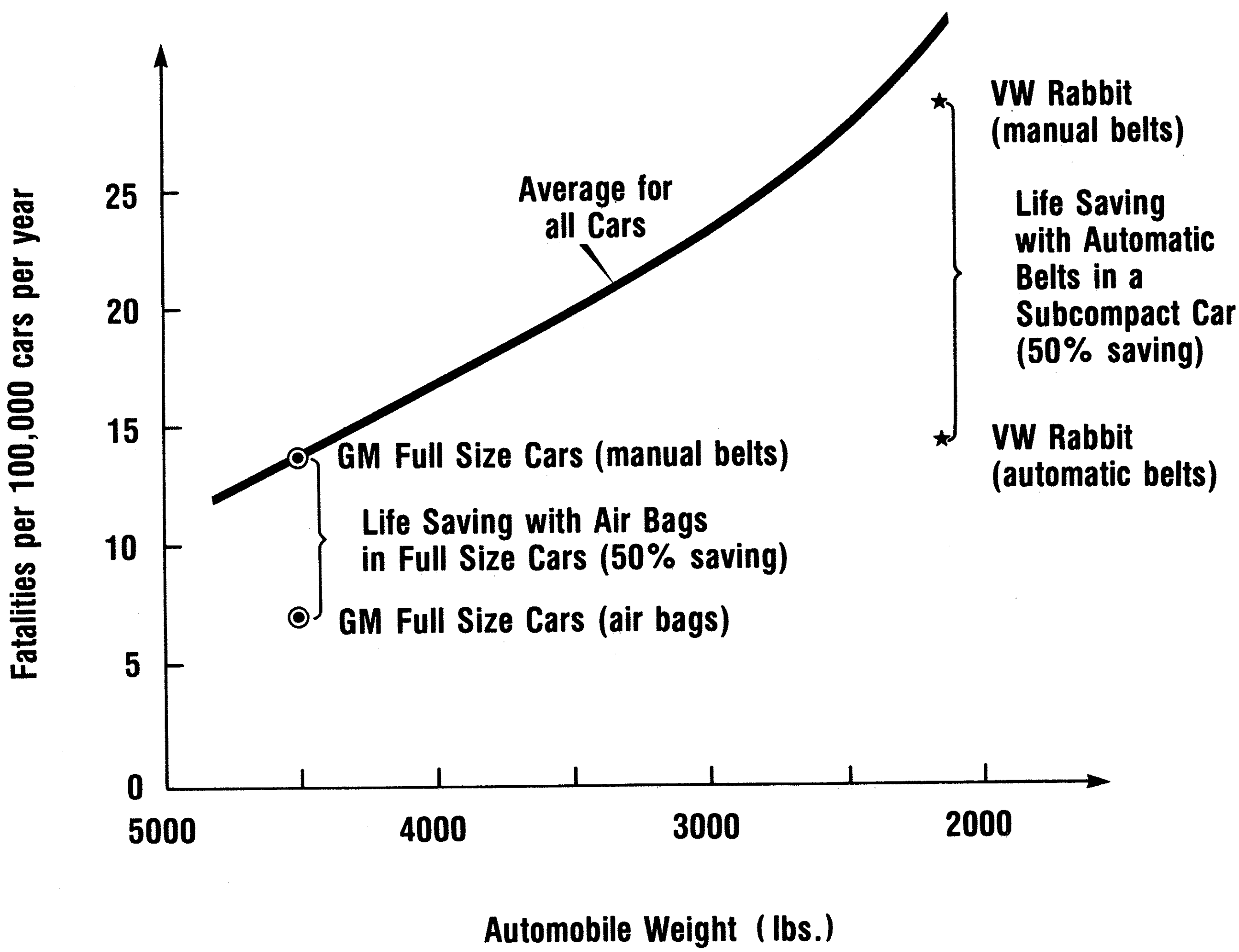
Weight (pounds)	4,000	2,000
Velocity—miles per hour (mph)	30	30
Change in Velocity (mph)	Slowed from 30 mph to 10 mph	Changed from 30 mph in one direction to −10 mph in the opposite direction.
Total Velocity Change (mph)	20	40
Occupant's Relative Chance of Death*	1	8

Occupant's Relative Chance of Death in All Types of Collisions**	1	2

*Based on 1979 FARS accident data in two car collisions
**Nearly half of all fatal collisions involve only one vehicle, e.g. car into a telephone pole.

Figure II-E

Fatalities by Car Size with an Indication of the Lives Saved in Cars with Automatic Restraints



In another area of occupant crash protection, larger vehicles also are experiencing an increase in fatalities. Since 1975, there has been a 30 percent increase in the number and use of pickup trucks and vans. But, deaths of occupants of pickup trucks and vans have increased over this same period by 52 percent.

In the search for improved crashworthiness, investigation of the direction of forces in fatal accidents has indicated ways to design vehicles to reduce injuries when crashes occur. Figure II-F provides statistics on the direction of crash forces in fatal accidents. Summing up the frontal and side statistics shows about 60 percent of these fatalities occurred in frontal collisions and about 30 percent in side collisions. These data support the agency's policy of placing priority on frontal and side impact protection.

Figure II-G shows the distribution of fatalities in frontal crashes as recorded for various crash speeds. The data are expressed in terms of velocity change experienced by the vehicle during the crash. The data, collected in the National Crash Severity Study, indicate that about 50 percent of fatal frontal crashes occur in vehicles experiencing a change in velocity at impact of less than 35 miles per hour. Thus, many occupants can be saved with appropriate restraints.

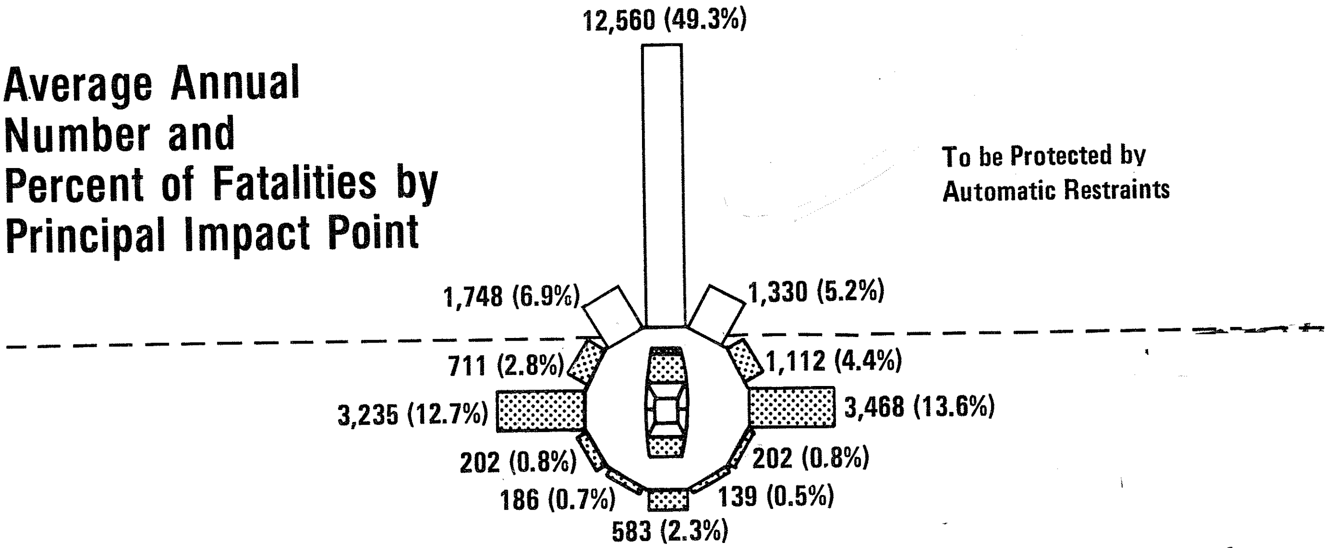
Occupant restraint has traditionally been provided by manual seat belts that have been standard equipment in new cars for more than a decade. However, usage rates have been so low that the safety potential of seat belts has not even been approached. Figure II-H shows that in 1979 about 9 out of every 10 motorists did not wear safety belts. This fact, combined with the development of practical and effective automatic restraints, has led to the government policy of requiring manufacturers to provide automatic crash protection in all new cars in the near future (Federal Motor Vehicle Safety Standard No. 208).

Two forms of automatic occupant crash protection have been commercially developed, and will most likely be used to meet Federal requirements: air bags and automatic safety belts. Both of these systems have proven effective, reliable, and acceptable to the public.

When all cars on the road have some form of automatic crash protection, the Department of Transportation estimates that an additional 9,000 lives, tens of thousands of serious injuries, and billions of dollars now lost in automobile crashes will be saved each year. These estimates are supported by years of on-the-road experience with 10,000 air bag equipped GM cars and nearly 250,000 Volkswagen Rabbits equipped with automatic safety belts which respectively have traveled an estimated 800 million miles and 5 billion miles. In addition to these benefits, there will be the incalculable benefits from the reduction in pain and suffering of the people involved in accidents and those close to them.

Figure II-F

Distribution of Occupant Fatalities in Cars, Light Trucks, and Vans by Direction of Impact



Note: Top (rollover), undercarriage, non-collisions and unknown impact points not included (Data from FARS for 1975 through 1978)

Figure II-G

Distribution of Automobile Occupant Fatalities in Frontal Collisions by Velocity Change at Impact

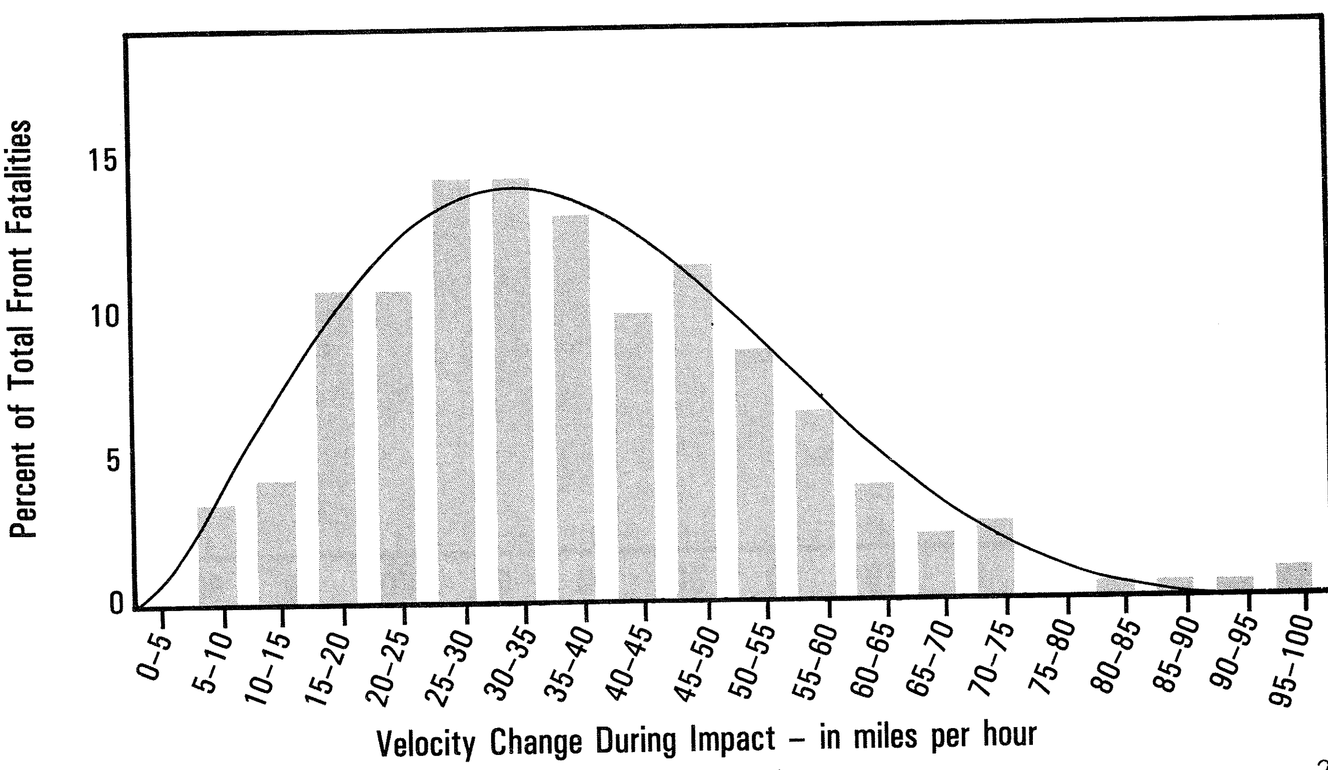
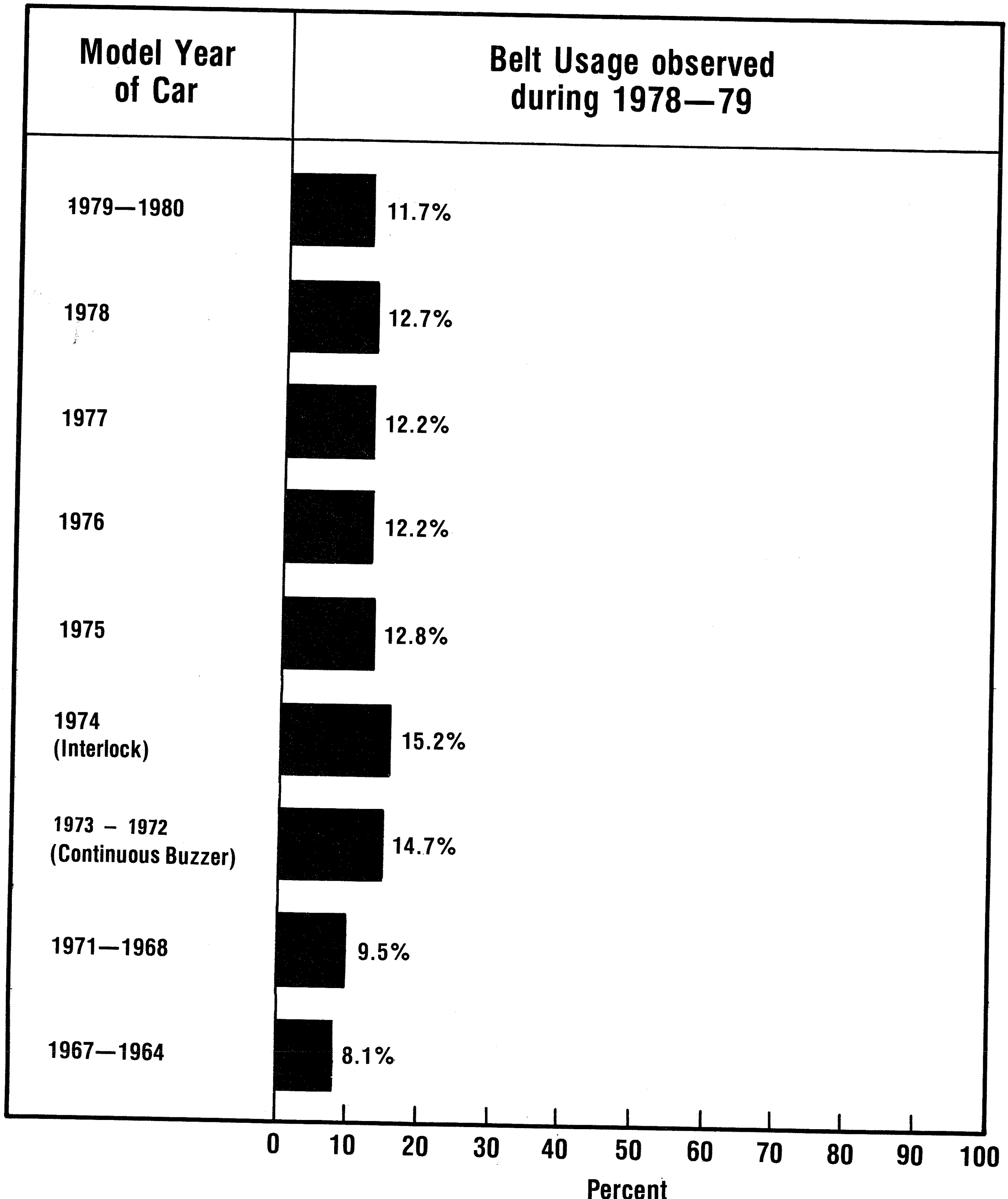


Figure II-H **Safety Belt Usage by Model Year**



The automatic occupant protection standard is part of a program of new crash protection standards that have been or will be issued over the next 5 years. This program is described in the Five Year Plan for Motor Vehicle Rulemaking that was revised and published in the Federal Register, April 26, 1979 (44 FR 24591).

The agency's long range goal is to simplify occupant protection regulations down to four basic, dynamic crash test, standards covering frontal, side, rollover, and rear-end collisions. These four crash modes account for the following approximate numbers of occupant fatalities each year: 20,000 frontal; 10,000 side; 5,000 rollover; and 1,000 rear. Accordingly, the agency has placed its first priority on frontal collisions, and is now placing its second major occupant protection priority on side impacts.

For the near term, the rulemaking program will include the following new or amended standards as steps toward the comprehensive occupant protection standards:

1. Side Impact Protection. Side impacts account for nearly one-third of the occupant fatalities each year. The agency is considering upgrading FMVSS 214 and extending it to light trucks in an effort to reduce the nearly 10,000 fatalities and over 100,000 disabling injuries which occur each year in side collisions. Occupant compartment integrity criteria would be defined, and interior padding performance would be specified in terms of injury criteria for test dummies, under dynamic crash test conditions. Potential solutions include the following:

   (a) strengthened doors, door frames, door hinges and latches to prevent intrusion into the occupant compartment;

   (b) improved padding on the doors and door frames to cushion impacts;

   (c) design of glazing retention to soften the impact of the occupant's head and to prevent ejection of the occupant; and

   (d) improved seat structure design to cushion side impact forces.

   The agency's intentions are given in more detail in an advanced notice published in the December 6, 1979 Federal Register (44 FR 70204).

2. Collapsible Steering Columns, Column Displacement and Interior Impact Requirements. FMVSS 201 requiring padding on instrument panels and other surfaces, and FMVSS 203 and 204 requiring steering columns that are not driven into the occupant by crash forces and that cushion the driver's chest in a crash, have been extended to light trucks and vans.

The amendment was published in the Federal Register on November 29, 1979 (44 FR 68470) and will become effective September 1, 1981.

3. Child Protection. A revised child restraint standard has been promulgated to help reduce the nearly 700 deaths of children under 5 years of age which occur each year in motor vehicles. The standard calls for dynamic testing of child seating systems, and extends the standard to infant seating systems and car beds. This standard was published in the Federal Register on December 13, 1979 (44 FR 72030) and takes effect January 1, 1981.

4. Seat Belt Assemblies. To increase use of safety belts, the agency has proposed requiring improved comfort and convenience of manual and automatic belts for passenger cars, light trucks and vans. The proposed amendment was published in the Federal Register on December 31, 1979 (44 FR 77210).

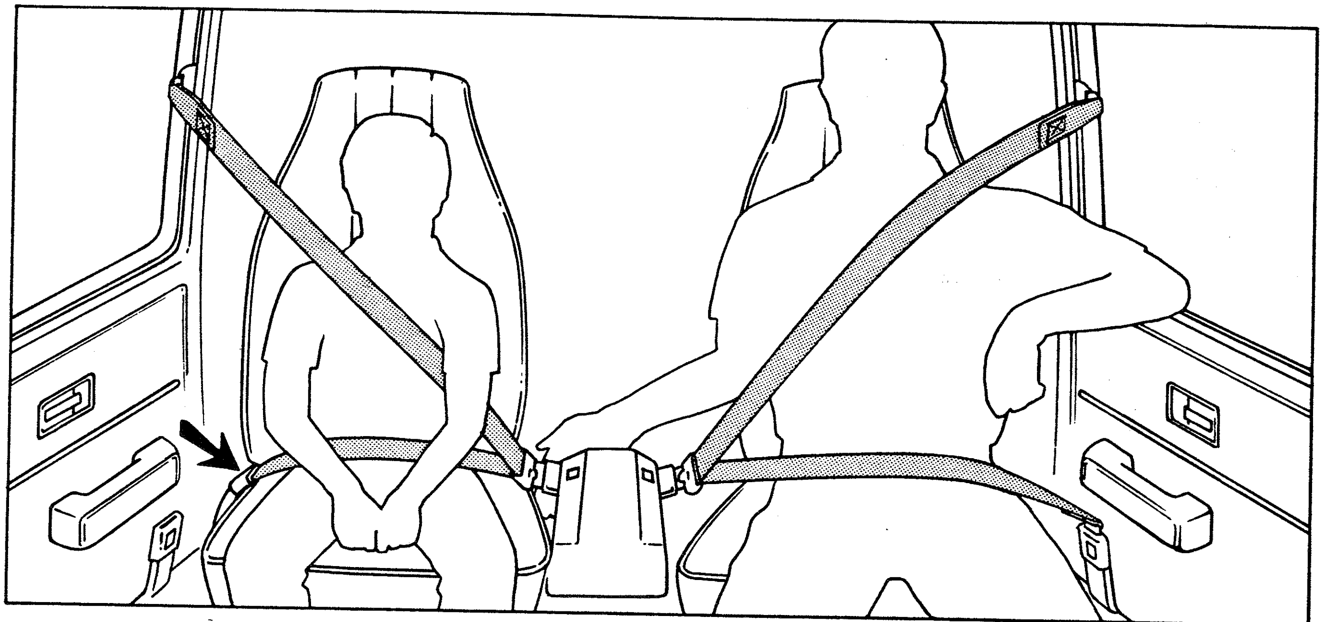
5. Door Locks and Retention Components. The agency will propose amending FMVSS 206, which specifies strength requirements for door latches and hinges to reduce the probability of occupants being thrown from the vehicle in a crash, to extend coverage to transverse rear doors such as those on hatchback and station wagon models.

Later, after further supporting research and development is completed (in such areas as compliance test dummy design for other than frontal crash modes, additional human injury criteria, moving barrier crash test devices, crash energy management, and occupant ejection), NHTSA intends to consolidate the present crashworthiness standards on vehicle components into four system performance standards for frontal, side, rear and rollover crashes. Static tests that are used in some of the present standards, such as for side door strength, roof strength, and door latches, would be replaced with more comprehensive, dynamic crash test requirements at various speeds.

Reduced aggressiveness of certain larger vehicles--that is, a reduction in their ability to inflict damage to the occupants of smaller vehicles in a collision--would be one of the goals of these standards. It has already been shown to be highly feasible and desirable in the NHTSA Minicars Inc. experimental safety vehicle which provides protection for its own occupants in crashes up to 50 miles per hour.

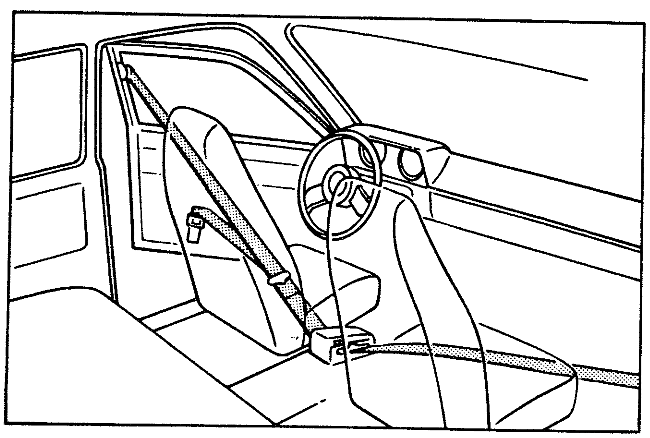
CHAPTER III

1980 Chevette Automatic Safety Belt System



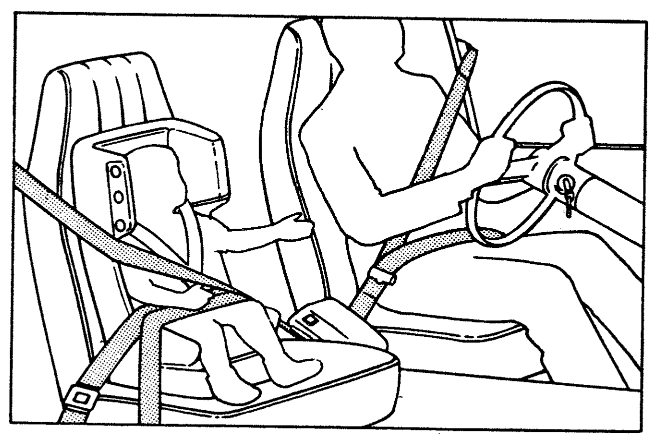
DESIGNED FOR BOTH TALL AND SMALL. This new protection system has a special provision for a child in the passenger seat who is less than 4'-11" tall. Detach the lap belt from its regular anchor-socket on the door and re-attach it to a special anchor-socket on the floor next to the seat. It takes only seconds and the small child is held in place much the same as an adult passenger using the lap belt connection. When the seat is again to be used by a full-size passenger, the belt is detached from the floor anchor-socket and reconnected to its regular position on the door.

Figure III-A



HANDY "COMFORT-SET" CONTROL BETWEEN SEATS. When front seat occupants are in and seated and doors have been closed, they can relieve excess belt pressure by simply pressing a "comfort-set" button on the belt system control box, located between the front seats. This permits the belts to be pulled out slightly and allows easy upper body movement.

Figure III-B



SPECIAL PROVISION FOR GM INFANT AND CHILD "LOVE SEATS." When a GM infant or child Love Seat occupies the front passenger seat, the Automatic Belt system lap belt for this seat is disconnected completely and replaced with a special Love Seat lap belt, ordinarily stowed in the glove compartment. This belt attaches to the belt reel control between the seats, passes through the belt recesses in the Love Seat and is connected to the floor anchor socket beside the seat.

Figure III-C

III. NEW DEVELOPMENTS IN AUTOMATIC AND MANUAL SAFETY BELTS

- New Belt Designs

A considerable amount of innovation is now being seen as the day approaches when new cars will be required to be equipped with automatic crash protection systems. Automakers and prospective suppliers to the auto industry are displaying new and imaginatively improved automatic safety belt designs. New features designed for improved comfort, convenience, and use by children, as well as adults of all sizes, are being shown.

In previous years, manufacturers were able to tuck safety belts out of sight on new car models. As a result they made only minimal efforts to design really comfortable and convenient belt systems. With the advent of the automatic crash protection standard and new comfort and convenience requirements, manufacturers are devoting greater attention to belt design features which now are more likely to affect the consumer acceptance of their vehicles.

General Motors has introduced a revised design automatic belt system as an option on its 1980 model Chevette. The new system is an automatic, 3 point, lap and shoulder belt combination, as shown in Figures III-A, B, and C. A particularly noteworthy "first" is GM's special provision for infant and small child restraint in the automatic belt equipped Chevette. GM has designed, built and marketed a feature which improves the safety of children riding in the front seats of Chevettes. It permits easy securing of the child restraint as shown in Figure III-C.

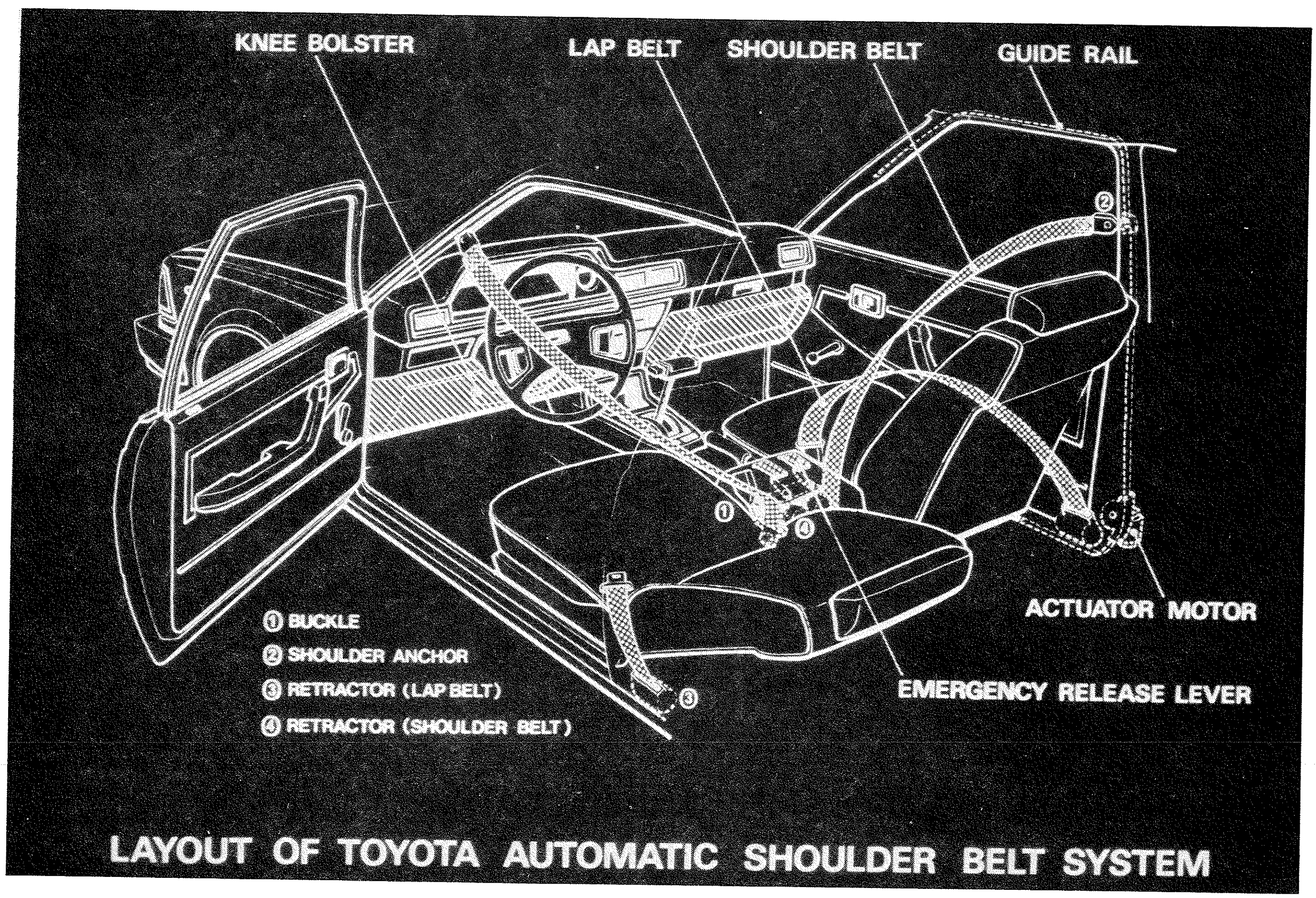
Toyota began selling motorized automatic belts as an option in a small number of its Corona models in the spring of 1980, and will make the system standard equipment on another model beginning in 1981. (See Figure III-D.)

Mercedes-Benz, is scheduled to introduce, for world wide sale, a manual belt system with adjustable anchorage points (low, medium and high) on the door pillar for improved comfort. The system has a device which, in a crash, automatically snugs or tightens the driver's safety belt to restrain the forward motion of the occupant. Another feature is that the passenger belt will limit the belt forces on the occupant to acceptable levels by allowing some controlled forward motion of the occupant. The system also has a small air bag mounted in the steering wheel to protect the driver's head from forces which might cause death or disfiguring injuries. This system will be found on the 1981 model S series cars, and all 1982 models to be sold outside the U.S. (Mercedes-Benz will make air bags standard equipment on all U.S. models in 1982.)

Figure III-D Toyota Automatic Safety Belt

Entering

Seated



Irvin Industries, Inc. of Madison Heights, Michigan has developed door mounted retractor systems for improved automatic belt comfort and convenience. Figures III-E and F show demonstration models of their system. Irvin Industries has developed a new and useful device which they call a "snubber." It is similar to the buckles on belts used with military uniforms which tighten when the belts are pulled taut. It catches the belt above the occupant's shoulder during the severe forces which occur in a crash. The snubber is designed to provide greater protection in a crash by reducing the forward movement of the occupant. The snubber also has a "tell-tale" shear tab designed to indicate whether the belt was being worn at the time of a crash--important information in evaluating the effectiveness of the system.

Another encouraging design feature used in the Irvin Industries demonstration model (shown in Figures III-E and F) is that the belt retractor is in the door rather than at the inboard side on the seat. The advantage of this design is that when the door opens, the belt does not drag across the occupant. This system holds promise of being even more acceptable than the already popular VW type automatic belt which has the inboard retractor.

An automatic belt designed by Hamill Manufacturing Co., of Washington, Michigan, is shown in Figure III-G. This design features a mechanical "lifter" which raises the lap portion of the belt off the occupant as the door is opened and lowers it when the door is closed.

Another motorized automatic safety belt has been developed by American Safety Equipment Corporation. This system is shown in Figure III-H.

- <u>Comfort and Convenience of Safety Belts</u>

Lap safety belts have been available for retrofit in automobiles since 1956 and have been standard equipment since 1964. Since 1968, lap and shoulder belts have been required in the front outboard seating positions of all cars sold in the U.S.

Studies have shown the ability of safety belts to prevent injuries and deaths in real world crashes. Lap and shoulder belts, when worn, reduce a person's chance of being killed or seriously injured by at least 60 percent. For crashes above 40 miles per hour, however, average belt usage was observed in the National Crash Severity Study to be only about 3 percent.

Studies of accident victims, however, show that few occupants were wearing their belts when they needed them. One of the most frequently given reasons for such low usage rates are complaints of belt discomfort and inconvenience. To help alleviate this problem, NHTSA has proposed a

Irvin Industries Automatic Safety Belt System

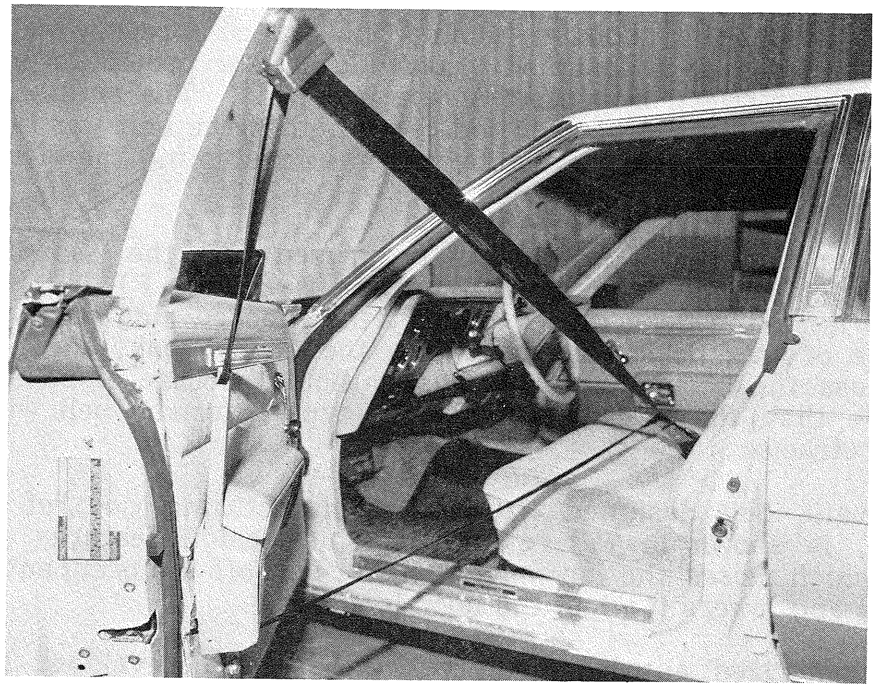
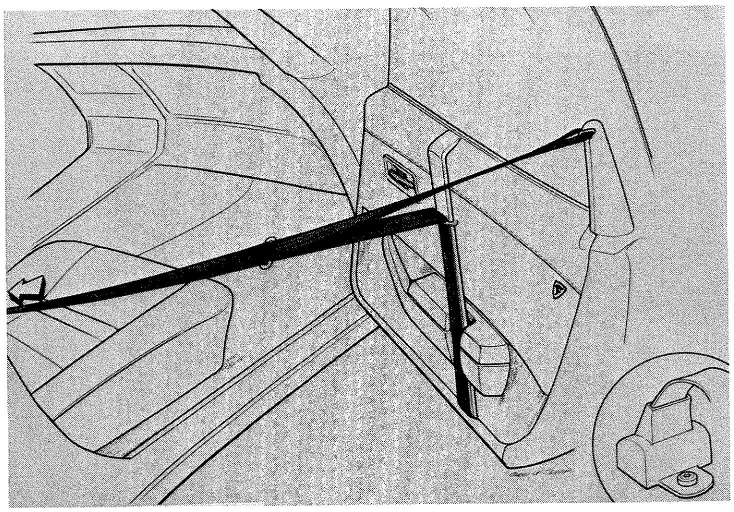


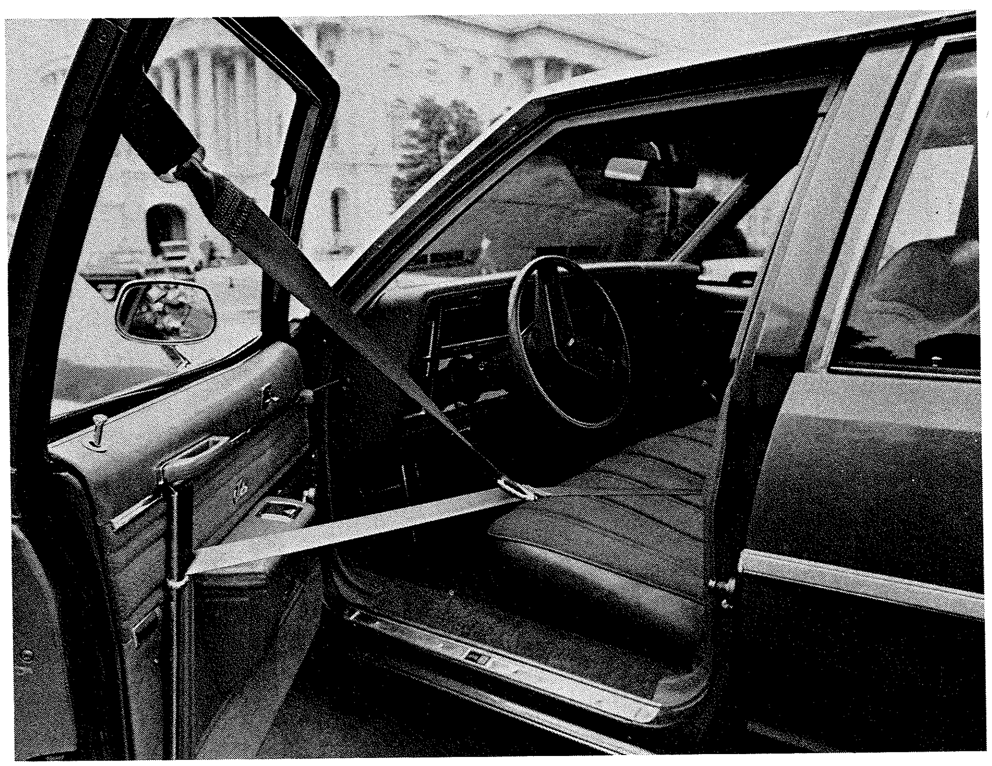
Figure III-E

Figure III-F

Figure III-G **Hamill Automatic Safety Belt Systems with Mechanical Lifter**



Frameless door model

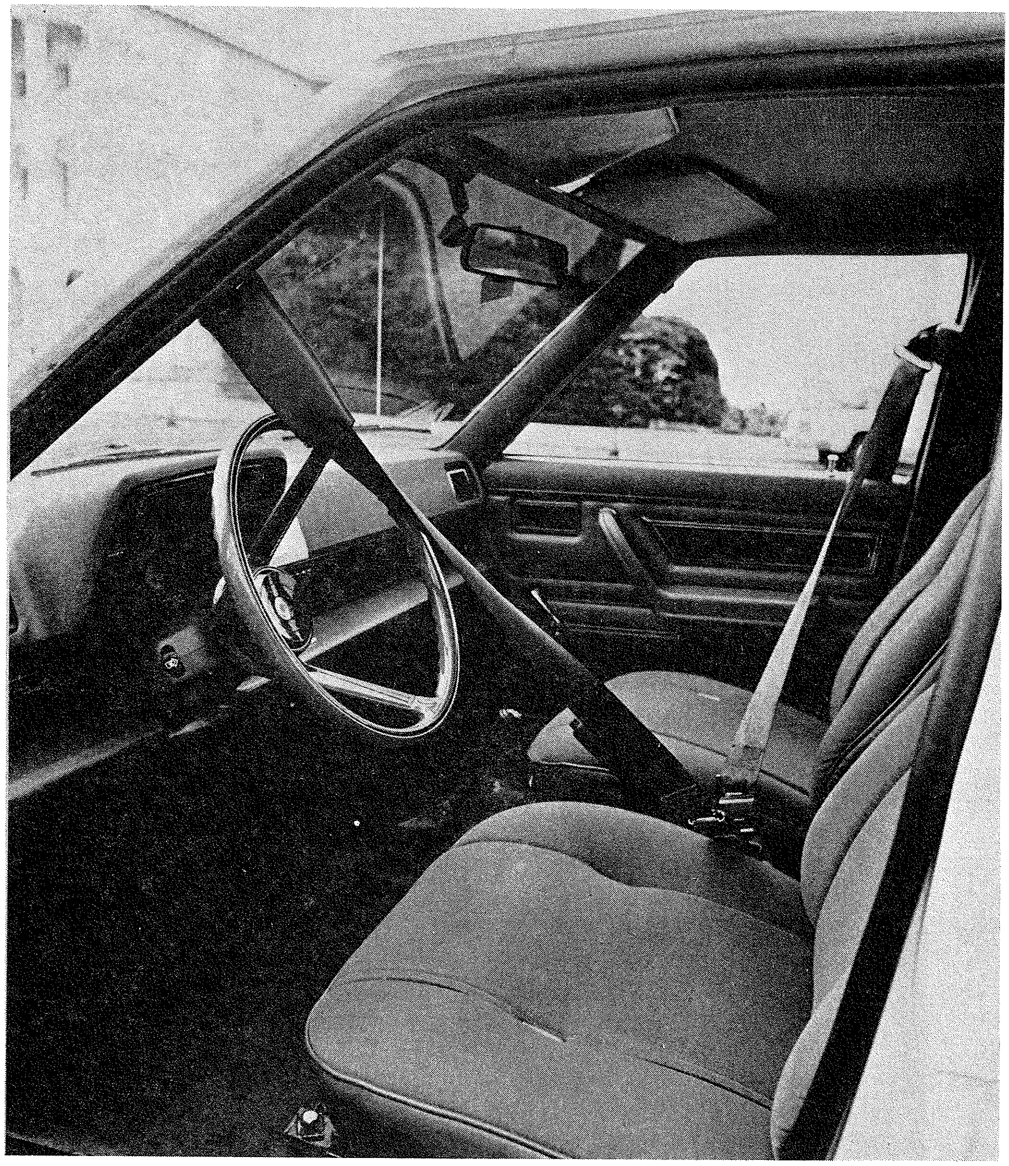


Frame door model

Note: These combination lap-shoulder automatic safety belts were designed by Hamill Manufacturing Co. and shown by courtesy of American Seat Belt Council.

Figure III-H

Automatic Safety Belt Systems by American Safety Equipment Corporation



Note:American Safety Equipment Corporation has demonstrated on one vehicle two different types of automatic safety belt systems. On the driver's side, is an electric shoulder harness, which runs along the track above the door frame when the car door opens or closes. On the passenger side, the shoulder harness is mechanical. It automatically moves around the passenger as the door closes. Padded knee bolsters take the place of lap belts.

standard for the improvement of future safety belts. The proposed rule, published in the December 31, 1979 Federal Register (44 FR 77210), contains specifications which will result in more comfortable and easier to use safety belts. The proposed amendment would apply to automatic belts in passenger cars and manual belts in light trucks and vans beginning with 1982 models. The proposed requirements would improve safety belt fit and ease of use, and reduce belt pressure on the occupant.

1. Occupant Fit - Improper fit of the torso or shoulder belt is identified as a major factor affecting usage of a particular safety belt system. The two chief complaints about torso belt fit are that the belt webbing rubs against the occupant's neck and face, or that it rubs across the tip of the person's shoulder. The proposed requirements for torso belt fit are designed to reduce these problems.

2. Safety Belt Body Contact Pressure - NHTSA research indicates that occupants are likely to complain about shoulder belt pressure if the belt contact force is greater than .7 pounds. The sensitivity to belt pressure is even greater when there is not a proper fit; i.e., when the webbing contacts the wearer's neck, face, shoulder or breast. To minimize discomfort, the proposed requirements specify that the shoulder portion of any belt system shall not create a body contact pressure exceeding .7 pounds.

3. Comfort and Convenience (Automatic Locking Retractors) - Safety belts incorporating automatic locking retractors in the lap belt portion of the system often have been found inconvenient because they tighten excessively under normal driving conditions, making it necessary to unbuckle and refasten the lap belt to relieve pressure on the pelvis and abdomen.

   Also, when putting the belt on, the occupant must extend the belt in a single continuous movement to a length sufficient to allow buckling. Otherwise, if the movement is interrupted, the retractor locks before sufficient webbing has been withdrawn to accomplish buckling. The belt then has to be fully retracted before the occupant can complete the donning process.

   In addition, automatic locking retractors inhibit the driver's normal movement such as to pay tolls or reach the glove compartment. Consequently, many persons have avoided use of the belt. A belt system that incorporates an emergency locking retractor however, permits the occupant to move freely and only locks when a sudden lurching occurs, as in an accident. With emergency locking retractors, the problems described would be alleviated.

The proposed standard specifies use of emergency locking retractors in front seats, along with a manual lock feature on the passenger side for use with child safety restraints. In the rear seats, either emergency or automatic locking retractors can be used to meet the proposed requirements.

4. Seat Belt Guides (Manual Belts) - Several years ago, the agency granted a petition by the Center for Auto Safety to amend Standard No. 208 to require rear seat belts in taxi cabs to be easily accessible. The Center noted that belt webbing and buckles in taxi cabs are often pushed down behind the seat or are otherwise difficult to locate and grasp, thereby diminishing use of the belts. The petition also pointed out that belts that have been pushed behind the seat cushions often become dirty, which also discourages their use.

   The agency agreed with the recommendations of the Center for Auto Safety. Therefore, the proposal would require belt webbing at any designated seating position to pass through flexible stiffeners or other guides in the seat cushion to ensure that the belts are easily accessible to occupants.

Comfort and Convenience of 1980 Model Safety Belts - The NHTSA evaluates the comfort and convenience of safety belts in new vehicles as a part of a continuing program. Figure III-I provides examples of observations made in this program.* The evaluation of the 1980 model belt systems was conducted for NHTSA by Verve Research Corporation at the Renaissance Center in Detroit from December 16 through 21, 1979. One hundred fifteen people compared the belt systems in thirty-six passenger cars, vans, and light trucks (representing thirteen manufacturers).

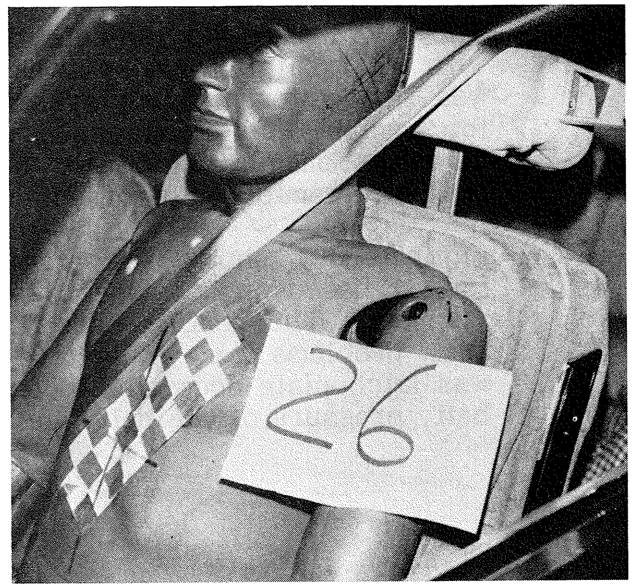
The participants were asked to rate the belt systems in each car in the following categories:

- Accessibility -- relating to reaching for and grasping the safety belt latch plate.
- Extending -- moving the latch plate over the buckle.
- Buckling -- inserting the latch plate into the buckle.
- Fit -- how the shoulder belt fits the wearer.
- Pressure -- belt pressure applied on the wearer's chest and shoulder.
- Releasing -- disengaging the latch plate from the buckle.
- Retracting -- how conveniently the system moves out of the way.

* Verve Research Corporation, The Comfort and Convenience of Safety Belt Systems in 1980 Model Vehicles, in print.

Figure III-I Example of Poor Fit Safety Belt

Poor Fit on 5th percentile female
(5ft., 101 lbs.)

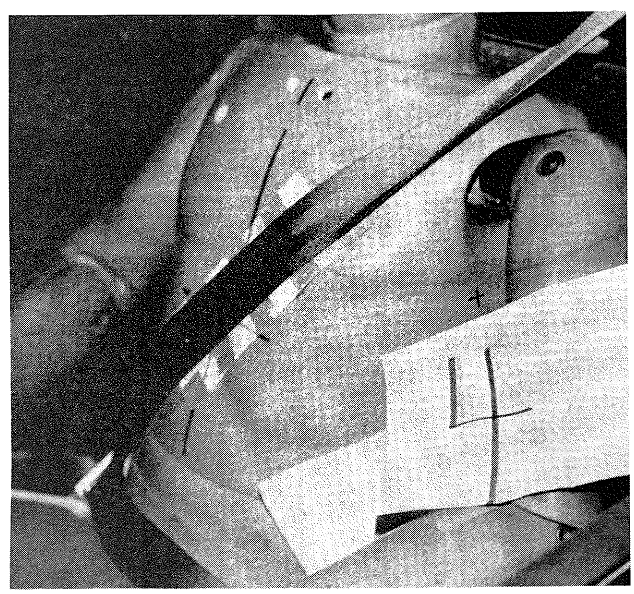


Poor Fit on 50th percentile male dummy
(5 ft., 8 in., 164 lbs)

1980 Buick Regal

Example of Good Fit Safety Belt

Good Fit on 5th percentile female
(5 ft., 101 lbs.)



Good Fit on 50th percentile male dummy
(5 ft., 8 in., 164 lbs.)

1980 Oldsmobile Delta 88

The safety belt systems in all 36 vehicles were evaluated to determine if they complied with new Federal requirements for comfort and convenience proposed by NHTSA.

The overall results indicate that a majority of people had some difficulty with most safety belt systems. However, an unexpected, positive finding was that automatic belt systems that complied with proposed requirements for comfort and convenience were more acceptable than any of the manual belt systems or automatic belt systems that did not comply with the proposed comfort and convenience requirements.

Figure III-J shows the frequency of comfort and convenience problems found, based on consumer evaluations of the safety belt systems in all the vehicles. The vertical bars represent the percentage of trials during which such problems were indicated. As seen in the chart, the greatest problem was latch plate accessibility followed by extending the latch plate, fit of the belt, pressure of the belt, and buckling.

Figure III-J **Comfort and Convenience Problems (Average for All Vehicles)**

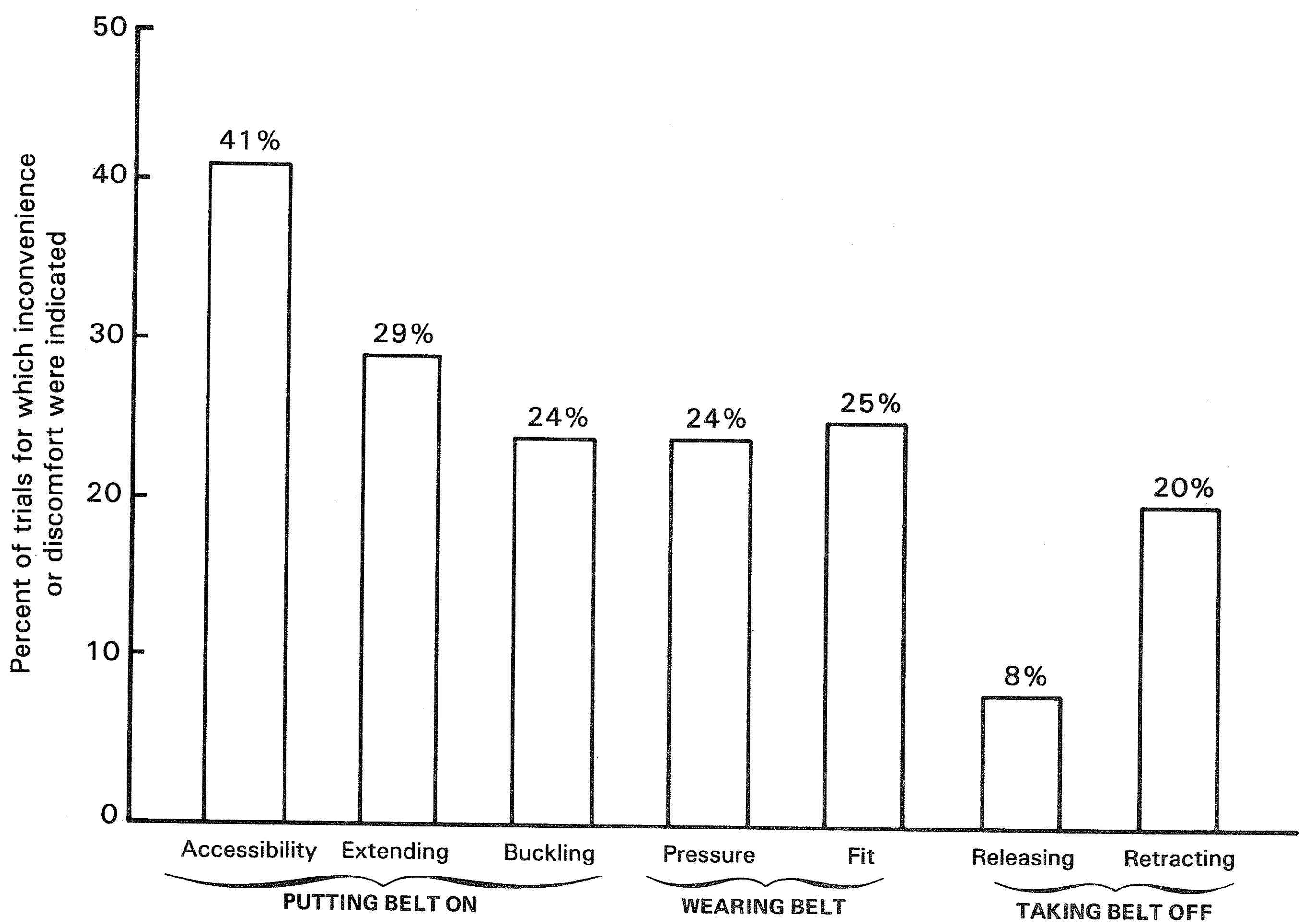


Figure III-K shows the ranking of all vehicle belt systems evaluated with respect to the percentage of participants reporting comfort and convenience problems. Thirty-two percent of the participants had comfort and convenience problems with the belt system which was ranked the most acceptable, while 88% had a problem with the least acceptable system. The automatic belt systems tended to have fewer problems than manual belt systems especially with regard to fit and pressure.

Figure III-K **Ranking of Vehicles**

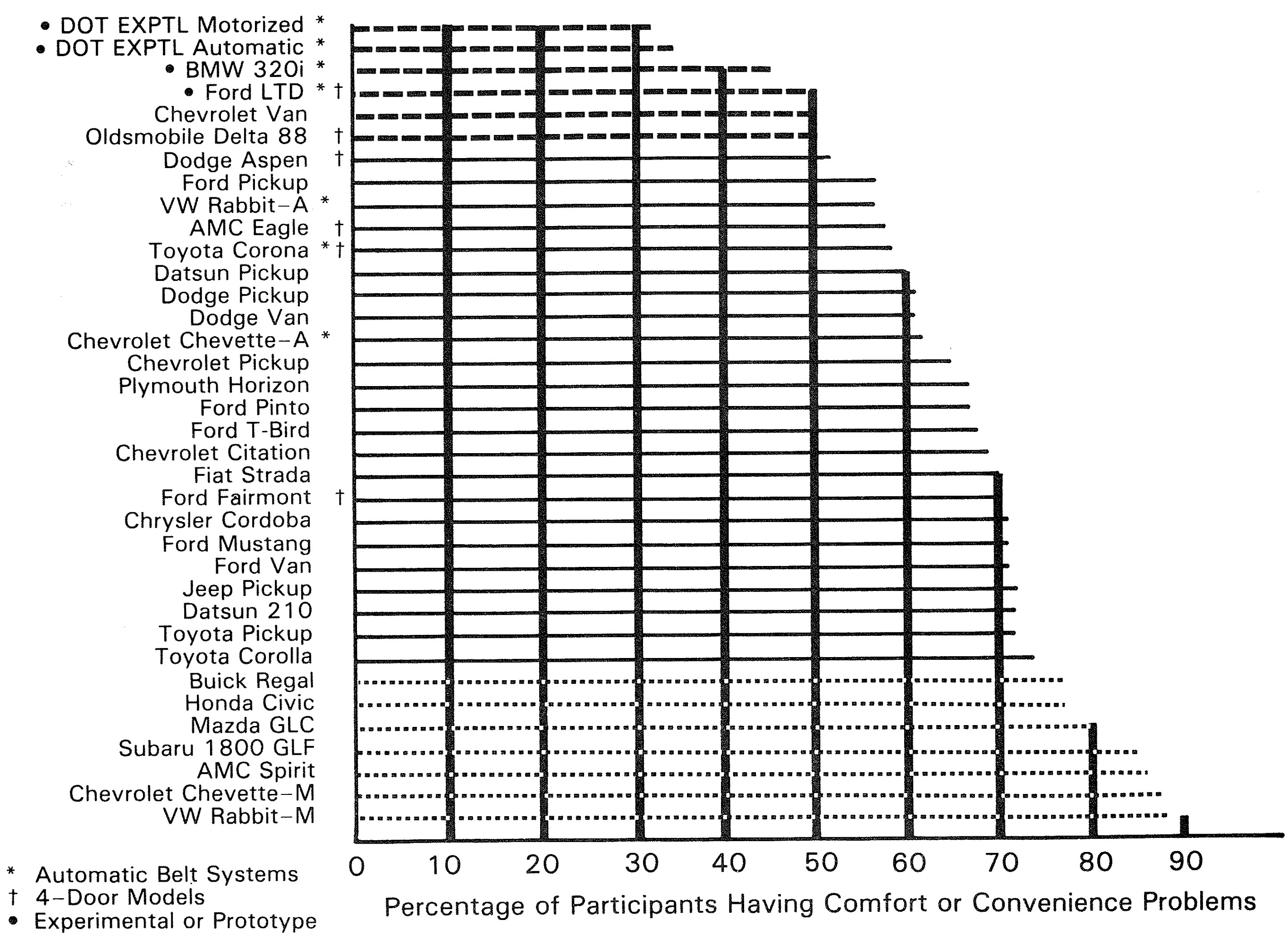
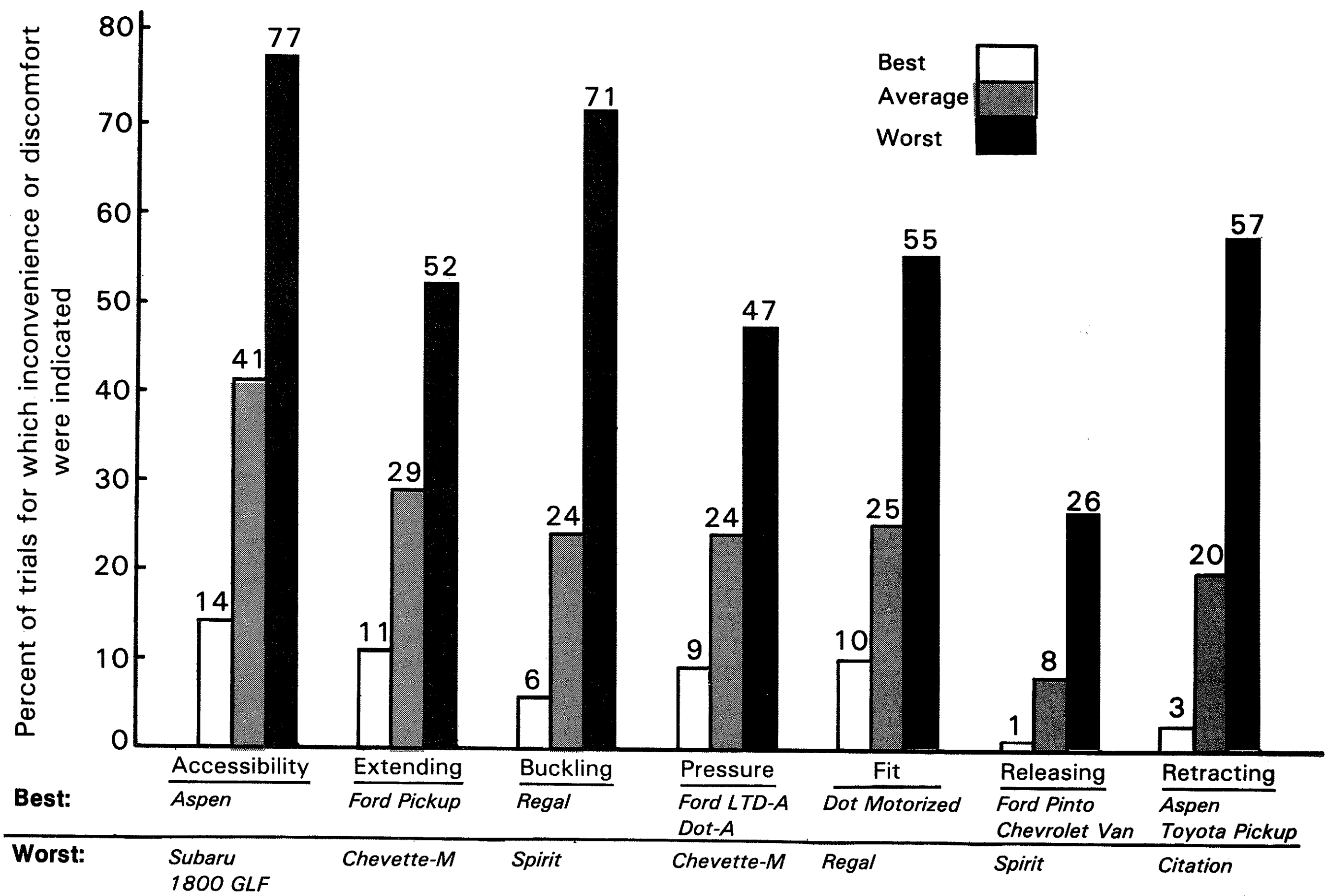


Figure III-L compares the best, average, and worst scores for each category of comfort and convenience. The best and worst rated vehicles are identified for each category. This comparison shows that if a manufacturer were to combine the best comfort and convenience features, a superior belt system could be produced.

Figure III-L **Best, Average and Worst Comfort and Convenience Scores**



A = Automatic belt
B = Manual belt

In addition, compliance measurements applicable to the proposed amendment on comfort and convenience were performed on these same vehicles in which shoulder belt fit and pressure, latch plate accessibility, and webbing retraction were evaluated. Head/webbing clearance and seat cushion/webbing clearance were also measured (when applicable) for automatic restraint systems. Also, the compatibility of vehicle safety belts with child restraint devices was assessed in front and rear passenger seating positions.

The results of these tests reveal that most vehicles meet the accessibility and retraction criteria of the recently proposed requirements. However, only about one out of three vehicles had a shoulder belt meeting the proposed belt pressure requirement, and only a few vehicles had shoulder belts meeting the fit requirements.

The Ford LTD, equipped with a prototype three-point automatic belt, was a notable exception in that it met all of the proposed requirements.

- <u>Public Attitudes on Automatic Safety Belts</u>

A recent survey* of owners of vehicles equipped with automatic safety belts in VW Rabbits and 1978 and 1979 model year GM Chevettes** was conducted by Opinion Research Corporation. Models with automatic safety belts were found to have significantly higher usage rates than models with manual safety belts.

	Approximate Number of People Surveyed	Percentage who say they wear safety belts "Always or Almost Always"
Automatic belt Rabbit owners	1,000	89
Automatic belt (pre-1980) Chevette owners	1,000	72
Manual belt Rabbit owners	200	46
Manual belt Chevette owners	200	34

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* Opinion Research Corp., <u>Automatic Safety Belt Systems - Owner Usage and Attitudes in GM Chevettes and VW Rabbits</u>, in print.

** GM's 1980 automatic safety belt is a new 3 point belt system. A 2 point shoulder belt and knee bolster was used in 1979. The Opinion Research survey applied only to owners of pre-1980 Chevettes.

Some of these claimed usage rates are at least ten percentage points higher than observed belt usage in these same cars. Nevertheless the large difference between manual and automatic belt usage from this survey data is considered valid.

The survey data show that on many key issues, Rabbit owners appear to be more favorably disposed toward the automatic belt system than do pre-1980 Chevette owners.

Asked if their reaction was favorable or unfavorable when they first saw the automatic seat belt, 45% of Chevette owners had a "favorable" reaction compared with 67% of Rabbit owners. For owners who had driven the car for a period of time, the percent responding in favor of the automatic system increased to 84% among Rabbit owners and to 51% among Chevette owners.

"Would you say your reaction was favorable or unfavorable when you first saw the automatic seat belt?"

	Automatic belt Chevette	Automatic belt Rabbit
Favorable	45%	67%
Unfavorable	41%	22%
No opinion	14%	11%

"Would you describe your impression of the automatic seat belt as favorable or unfavorable now after having owned the car for awhile?"

	Automatic belt Chevette	Automatic belt Rabbit
Favorable	51%	84%
Unfavorable	43%	13%
No opinion	6%	3%

The higher level of favorable opinion toward automatic restraint systems among Rabbit owners was again apparent when owners were asked which belt system -- automatic or manual -- they would choose if they were to purchase another car: 80% of Rabbit owners said they would choose the automatic belt system compared with 41% of Chevette owners.

Preference for Type of Belt System
If Purchasing Another New Car

	Owners of: Automatic belt Chevette	Automatic belt Rabbit
Prefer Automatic	41%	80%
Prefer Manual	49%	12%
Other or No opinion	10%	8%

Turning to specific issues concerning the comfort and convenience aspects of automatic belt systems, the study found marked differences in the attitudes of Rabbit owners vs. Chevette owners. The latter tend to be more critical of the automatic restraint system on points relating to comfort and convenience, which to some extent might explain the lower usage and the less favorable attitudes found toward the system as a whole.

A major problem with comfort cited by about half of Chevette owners (47%) is that the automatic shoulder harness rests on, or rubs across their neck or face. By comparison, one fourth of Rabbit owners (24%) consider this to be a problem. Also, more Chevette owners than Rabbit owners (38% vs. 26%) said that the shoulder harness chafes or rubs across their chest or another part of the body.

More than one half of Chevette owners (54%) but only one third of Rabbit owners (35%) reported that the automatic shoulder harness interferes with their opening the door and getting into or out of the car.

Chevette owners are particularly critical of the position of the upper mounting for the shoulder harness; 32% said it came too close to their face or head, and 25% said it interferred with their vision. Responding to the same factors, 7% of Rabbit owners reported face or head problems with the upper mounting and 4% reported that it interferred with their vision.

Percent of Automatic Belt Owners
Citing Specific Problem with Belt

	% Chevette Owners	% Rabbit Owners
Rests or rubs neck or face	47	24
Chafes across chest	38	26
Pressure against chest	17	26
Interferes with exit/entry	54	35
Upper mounting of belt	32	7
Upper mounting obscures vision	26	4

Another finding of the study was that Rabbit dealers did more selling of the automatic safety belt feature than GM dealers. Opinion Research found that in promoting the automatic restraint system to new car buyers a number of sales points can be made to the prospective buyers based on survey findings. Chevette and Rabbit owners who say they would prefer an automatic restraint system if purchasing another new car cite the following reasons:

-- It's safer because it forces one to be restrained.

-- It's convenient because it's always fastened and eliminates buckling-up each time.

-- It's automatic -- just get in and you're buckled-up.

It is also helpful to know what are likely to be the major obstacles to greater acceptance of automatic restraint systems among new car buyers. Asked what they like least about the automatic safety belt, Chevette and Rabbit owners most frequently cite the following:

-- Presence of an interlock to prevent starting the car if the belt is unfastened.

-- Difficulty entering and exiting the car.

-- Poor fit of belt.

Each of these sources of negative comments about automatic safety belts is being addressed by NHTSA's proposed rule on comfort and convenience of future systems. The interlock* is not required by FMVSS 208; and the proposed comfort and convenience standard would have provisions to ease entry and exit, and to require improved fit of the shoulder belt.

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* Several techniques have been voluntarily adopted by automobile manufacturers to discourage motorists from either disconnecting or otherwise not using the belts. Volkswagen and General Motors elected to add an ignition interlock to an emergency release buckle in their first generation automatic belts. For the 1980 Chevettes, with redesigned automatic belts, GM chose to eliminate both the emergency release buckle and the ignition interlock. Instead, GM chose to meet the emergency release requirement of the standard with a webbing spool release mechanism. This mechanism permits the occupant to manually release the belt reel allowing it to unwind so that the belt will not impede the occupant getting out of the car.

- Performance of 1979 Models in 35 mph Crash Tests

To examine the performance of new car occupant protection systems, NHTSA has run a series of highly instrumented crash tests. Beginning with large sized cars in 1982, standard 208 requires automakers to build vehicles which, when crashed into a fixed barrier at 30 miles per hour (mph), will not result in forces that exceed certain limits on the head, chest, and upper legs of an instrumented dummy simulating moderate injury.

The limits on the dummy are:

Head = 1,000 on the head injury criteria (HIC) scale.
Chest Load = 60 G's or 60 times the force of gravity.
Upper Leg (Femur) Load = 2,250 lbs.

The crash tests in this program used the injury criteria and test procedures from the 30 mph test, but were run at the higher speed of 35 mph. This was a more severe test of the vehicle's crashworthiness. In a 35 mph crash, the car must absorb about one third more energy than in a 30 mph crash. These crash tests represent the first step in a program, ordered by Congress, to develop a safety rating system for consumers. The tests were not to determine compliance with standard 208, but rather to provide consumers with relative indicators of higher speed safety performance in one common test.

Thirty-three cars were tested in the program in frontal crashes. Most of the cars were equipped with manual belts, only two had automatic belts. Selection of models for testing was based on sales volume (over 100,000), and the models tested represent about 85 percent of those cars manufactured domestically and 40 percent of those imported in 1978.

The test results were as shown in Table III-1.

Several small cars of newer design--the Chevrolet Citation, the Plymouth Horizon and the Ford Mustang passed every test. None of the smaller imported cars passed the occupant crash protection test at 35 miles per hour. These test results indicate that U.S. manufacturers are designing new cars that can easily meet standard 208 crash protection requirements with well designed restraints.

TABLE III-1

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
MINI COMPACTS (up to 2,150 lbs.)			Reason for Failure				
Datsun 210 # 2-dr. Sedan	35.2	Fail	Driver - Head Struck SW Rim & Dash (1358) Chest Struck SW Hub (69 G's) Passenger - Head Struck Dash (1745)	P	P	P	P
Volkswagen Rabbit # 2-dr. Hatchback	34.8	Fail	Driver - Head Struck SW Hub (1024) Chest Struck SW (67 G's) Passenger - Passed	P	P	P	F
Toyota Corolla[1] 2-dr. Sedan	34.95	—		P	P	P	P
Honda Civic 2-dr. Sedan	34.7	Fail	Driver - Head Struck SW (2030) Chest Struck SW (93 G's) Passenger - Head Struck Dash (2093)	P	F	P	P

[1] Data not available
Same construction in 1980
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
MINI COMPACTS (Cont'd.)			Reason for Failure				
Ford Fiesta # 2-dr. Hatchback	34.93	Fail	Driver - Head Struck SW Rim (1656) Chest Struck SW Hub (64 G's) Passenger - Head Struck Dash (1932)	P	P	P	P
Plymouth Champ # 2-dr. Hatchback Dodge Colt *	35.27	Fail	Driver - Head Struck SW Rim & Dash (1270) Chest Struck SW Hub (72 G's) Passenger - Head Struck Dash (1918) Chest (66 G's)	P	P	P	P
Chevrolet Chevette 5-dr. Hatchback	34.8	Pass	Passed	F	P	P	P
SUBCOMPACTS (2,151 - 2,650 lbs.)			Reason for Failure				
Mercury Bobcat # 2-dr. Hatchback Ford Pinto *	35.05	Fail	Passenger - Head Struck Dash (1878)	P	P	P	P

Same construction in 1980
* Similar cars - second car was used for rear impact test
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
SUBCOMPACTS (Cont'd.)			Reason for Failure				
Plymouth Horizon # 2-dr. Hatchback	34.86	Pass	Passed	P	P	P	P
Toyota Celica 2-dr. Liftback	34.8	Fail	Driver - Chest Struck SW (61 G's) L. Femur Struck Dash (2920 lbs.) Passenger - Head Struck Dash (1862)	P	P	P	P
COMPACTS/INTERMEDIATES (2,651 - 3,350 lbs.)			Reason for Failure				
Olds Cutlass Supreme V-8 2-dr. Coupe Pontiac Grand Prix *	35.1	Pass	Passed	F	P	P	F
Olds Cutlass Supreme V-6	34.84	Pass	Passed	P	P	P	Same as Grand Prix

Same construction in 1980
* Similar cars - Second car was used for rear impact test
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
COMPACTS/INTERMEDIATES (Cont'd.)			Reason for Failure				
Chevrolet Monza # 2-dr. Coupe Pontiac Sunbird *	35.06	Fail	Driver - Head Struck SW Rim & Dash (1108) Passenger - Head Struck Dash (1033)	P	P	P	P
1980 Chevrolet Citation 5-dr. Hatchback	35.0	Pass	Passed	P	P	P	P
Pontiac Firebird # 2-dr. Coupe Chevrolet Camaro *	35.24	Fail	Driver - Passed Passenger - No Contact with Vehicle HIC (1297)	P	P	P	F
Ford Fairmont # 4-dr. Sedan Mercury Zephyr *	35.4	Fail	Driver - Passed Passenger - Head Struck Dash (1583) Chest Struck Knees (85 G's)	P	P	P	P

Same construction in 1980
* Similar cars - second car was used for rear impact test
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
COMPACTS/INTERMEDIATES (Cont'd.)			Reason for Failure				
Ford Granada # 4-dr. Sedan Mercury Monarch *	34.6	Fail	Driver - Head Struck SW Rim & Dash (1442) Chest Struck SW (61 G's) Passenger - Head Struck Dash (1279)	P	P	P	P
Ford Mustang # 2-dr. Coupe	34.65	Pass	Passed	P	P	P	P
Mercury Capri # 3-dr. Hatchback	35.0	—	Driver - Data not available Passenger - Passed	P	P	P	Same as Mustang
Plymouth Volare # 2-dr. Sedan Dodge Aspen *	34.99	Fail	Driver - Passed Passenger - Head Struck Knees (1677)	P	P	P	P

Same construction in 1980
* Similar cars - second car was used for rear impact test
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
COMPACTS/INTERMEDIATES (Cont'd.)			Reason for Failure				
1980 AMC Concord 2-dr. Sedan	34.7	Fail	Driver - Head Struck SW Rim (1078) Chest Struck SW (61 G's) Passenger - Head Struck Dash (1457)	P	P	P	P
Volvo 244 DL # 4-dr. Sedan	34.98	Fail	Driver - Head Struck SW Rim (1782) Passenger - Head Struck Dash (1889)	P	P	P	P
STANDARD/FULL SIZE (3,351 - 4,050 lbs.)			Reason for Failure				
Chevrolet Impala # 4-dr. Coupe Pontiac Catalina *	35.17	Fail	Driver - Head Struck SW Rim (1277) Chest Struck SW (62 G's) Passenger - Head Struck Dash (1254)	P	P	P	P

Same construction in 1980
* Similar cars - second car was used for rear impact test
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
STANDARD/FULL SIZE (Cont'd.)			Reason for Failure				
Olds 98 Regency # 2-dr. Coupe Buick Electra *	34.99	Fail	Driver - Passed Passenger - Head Struck Dash HIC (1734)	P	P	P	F
Buick Riviera # 2-dr. Coupe	35.33	Pass	Passed	P	P	F	F
Ford LTD # 2-dr. Sedan	35.35	Fail	Driver - Head Struck SW Hub (1452) Passenger - Passed	P	P	P	Same as LTD Landau
Ford LTD II 2-dr. Sedan Ford Thunderbird *	34.89	Fail	Driver - Head Struck SW & Dash (1088) Chest Struck SW (61 G's) R. Femur Struck Dash (2775) Passenger - Passed	P	P	P	F

Same construction in 1980
* Similar cars - second car was used for rear impact test
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
STANDARD/FULL SIZE (Cont'd.)			Reason for Failure				
Mercury Marquis # 2-dr. Sedan Ford LTD Landau *	35.42	Fail	Driver - Head Struck SW Rim (1204) Chest Struck SW (61 G's) Passenger - Passed	P	P	P	P
Dodge Magnum 2-dr. Coupe Chrysler Cordoba *	35.3	Pass	Passed	P	P	P	P
Chrysler LeBaron 2-dr. Sedan Dodge Diplomat *	35.04	Fail	Driver - Head Struck SW Hub & Rim (2402) Passenger - No Contact HIC (1071)	P	P	P	F

Same construction in 1980
* Similar cars - second car was used for rear impact test
SW - Steering Wheel
P - Pass
F - Fail

TABLE III-1 (Cont'd.)

NEW CAR ASSESSMENT PROGRAM
TEST RESULTS - 35 MPH BARRIER CRASHES
1979 MODEL YEAR VEHICLES

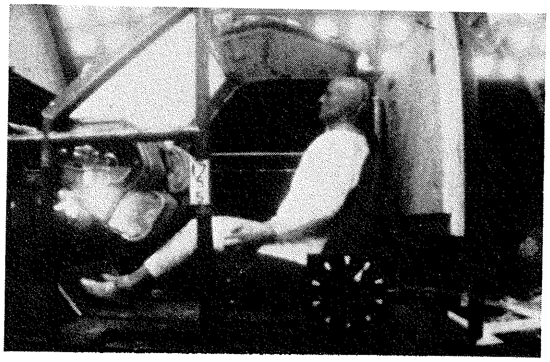
VEHICLE MAKE/MODEL	TEST SPEED (MPH)	OCCUPANT PROTECTION CRITERIA	ALLOWABLE LIMITS ON DUMMY Head, HIC = 1,000 Chest Load = 60 G's Upper Leg (Femur) Load = 2250 lbs.	WIND-SHIELD RETENSION	WIND-SHIELD INTRUSION	FRONT FUEL LEAKAGE	REAR FUEL LEAKAGE
STANDARD/FULL SIZE (Cont'd.)			Reason for Failure				
Dodge St. Regis 4-dr. Sedan Chrysler Newport *	34.93	Fail	Driver - Head Struck SW (1909) Chest Struck SW (67 G's) Passenger - Lost Head Data	P	P	P	P
Chevrolet Malibu ** 2-dr. Sedan	35.4	Fail	Driver - Head Struck SW Hub & Rim (1023) Passenger - Passed	NA	NA	P	Same as Grand Prix
LUXURY (over 4,050 lbs.)			Reason for Failure				
Lincoln Continental 4-dr. Sedan	35.1	Pass	Passed	P	F	P	Not tested

* Similar cars - second car was used for rear impact test
** 30° oblique angle collision into barrier
SW - Steering Wheel
P - Pass
F - Fail

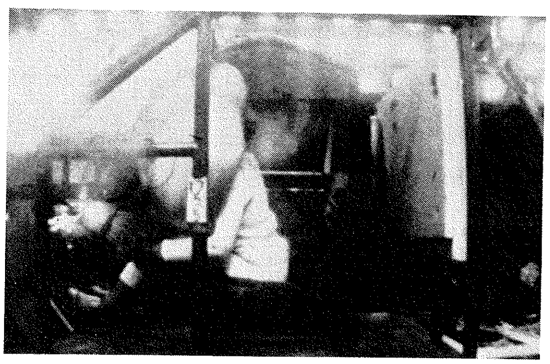
CHAPTER IV

Figure IV

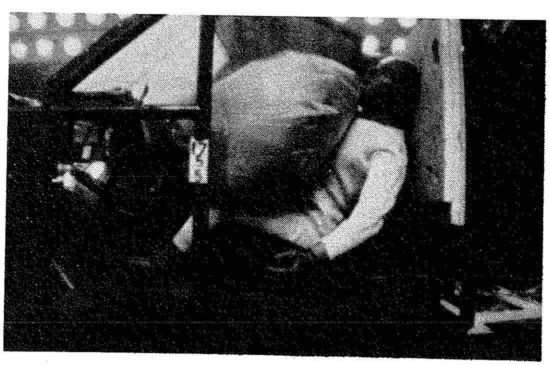
Air Bag Crash Simulation
(The Critical Seconds)



Before Crash



Cushioning within a fraction of a second during a crash



Air bag deflating in seconds after crash

IV. NEW DEVELOPMENTS IN AIR BAGS

"Politeness is like an air cushion. There is nothing in it, but eases the jolts very well."
--found in a fortune cookie in Detroit--

- Air Bag Systems

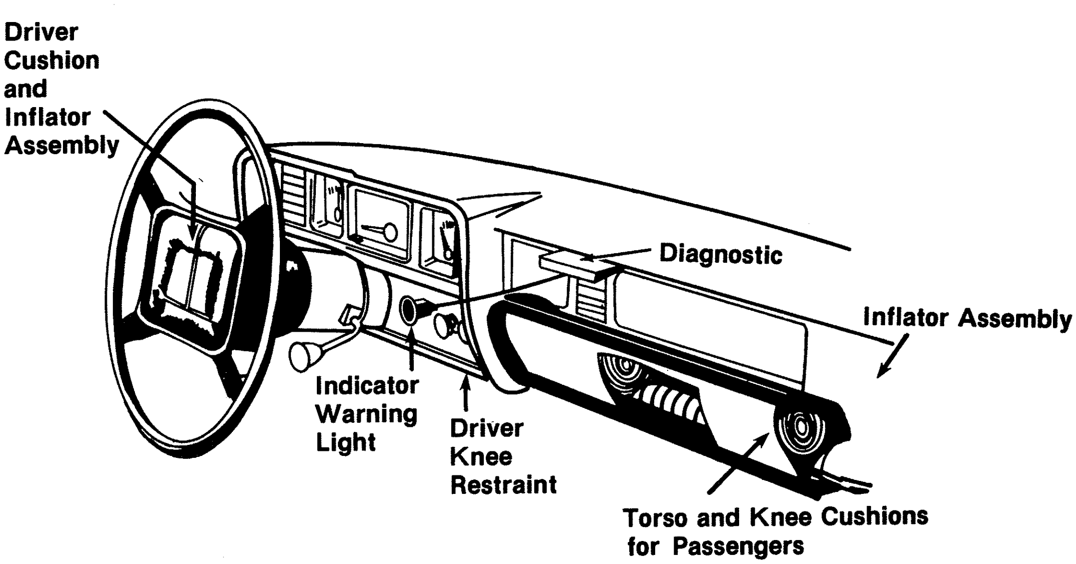
Air bags were invented in the 1950's and developed in the 1960's. Automobile manufacturers, potential suppliers of air bag system hardware, and research and engineering firms have all had extensive development programs to meet the requirements of the automatic crash protection standard.

A typical air bag restraint system is composed of the following:

Driver Cushion and Inflator Assembly
Passenger Cushion and Inflator Assembly
Knee Restraints
Front End Crash Sensor
Dashboard Crash Sensor
Electronic Diagnostic System and Indicator Light Assembly
Lap Belts (Optional)

All these components, except the indicator light, the driver's knee padding, and the optional lap belts, are stored out of sight as may be seen in Figure IV-A. When the car ignition switch is turned on, the electronic diagnostic system automatically performs a check of air bag crash, the sensors send an electrical signal to the inflators which fill the air bags within a small fraction of a second to cushion the collision of the occupant.

Figure IV-A **Typical Air Bag Installation**



- Automobile Manufacturers' Plans

The NHTSA has recently contacted U.S. and foreign automobile manufacturers to learn more about their progress in implementing automatic restraint technology. In industry progress continues in the development of the technologies of automatic crash protection. Implementation of the automatic crash protection standard by some manufacturers, however, is somewhat disappointing, particularly GM's most recent decision to not offer air bags in its 1982 models.

Mercedes-Benz has decided to provide air bag crash protection as standard equipment in all of its models to be sold in the United States beginning with the 1982 model year. This is particularly noteworthy since it is a year ahead of the automatic crash protection requirements of standard 208 for most Mercedes-Benz cars. This company could have used automatic safety belts to meet the standard since its cars have only two front seating positions. In its decision, Mercedes-Benz has recognized the advantages of air bag technology for its cars in the U.S. market.

Mercedes-Benz will offer driver air bags as an option on its 1981 model S series vehicles to be sold in countries other than the United States and Canada. Mercedes-Benz also plans to conduct a fleet test program of its air bag equipped vehicles in the United States beginning in July, 1980.

Ford intends to introduce air bags as an option on its 1981 Lincoln and Mark models during the model year. They are working with Essex Corporation on the air bag system sensor, with Talley Industries on the driver air bag module, and with Hamill Manufacturing Company and Rocket Research Corporation on the passenger air bag module. Ford does not plan to offer automatic belts before the effective date of the standard.

General Motors has made several decisions on air bags in the past year. In September of 1979, GM announced it would not fulfill its plan to re-introduce air bags as optional equipment on some 1981 full-size models. GM claimed it was having difficulties with its air bag design in properly protecting otherwise unrestrained small children. In December 1979, after resolving its difficulties, GM expressed plans (as stated in its 1980 General Motors Public Interest Report) to offer "an inflatable restraint (IR) extra cost option on most full-size 1982 model cars."

Shortly afterwards, in comments to the agency, GM stated it "currently does not plan to offer inflatable restraints in medium or small size cars." Then at the beginning of June 1980, GM announced that it would not offer air bags on its 1982 model year full-size cars.

The result is that GM presently is not expected to re-introduce air bags on full-size cars until 1983, if then, nor on small or medium size cars in the foreseeable future.

Consumers want vehicles which are both safe and fuel efficient. As shown by GM, government as well as privately sponsored surveys, a substantial portion of the car buying public--not just large car buyers--is willing to pay a premium for air bag equipped vehicles. GM's decision runs counter to both the market interest and the growing need for small car safety, as the increasing number of small cars on the road inevitably result in more collisions between small cars and larger vehicles. The agency expects that some manufacturers will step forward to respond to public demand for smaller cars with air bags.

Chrysler does not plan to offer either air bags or automatic belts on any of its 1980 and 1981 models; and American Motors does not have any definite plans to offer automatic restraints ahead of the required dates.

Several foreign auto makers have indicated plans for the introduction of either air bags or automatic belts before they will be required by the standard. Some of these plans are still tentative.

BMW has an active air bag development program and is considering the use of air bags to meet the requirements of the standard.

Volkswagen has developed prototype air bag systems that could be offered in at least some of its lines, but has not made definite plans to do so.

DeLorean Motor Company (DMC), had previously announced that it would install air bags in its cars beginning with the start of production in April 1980. DMC has now indicated that it will not be able to offer air bags until suppliers can provide components for small, two passenger vehicles in volume production quantities.

Saab is working on air bags and automatic belts and is considering offering automatic belts prior to the 1984 model year mandatory date for its cars. Volvo is continuing its work on both air bags and automatic belts, but has no announced plans to offer either system before 1982.

Nissan Motor Co., Ltd., which manufactures Datsuns, is developing both air bags and automatic belts, and is preparing to introduce the modified, diagonal-type, automatic belt as an option on one of its 1982 models prior to the date required by the standard. It has not announced definite plans to introduce air bags.

Renault indicated that it is working with both air bags and automatic belts, but has not reached a decision whether to offer either system in its cars before the required date.

Fiat, Rolls Royce, Peugeot/Citroen, Honda and Mazda are developing both air bags and automatic belts, but have announced no plans to offer either system in advance of the required dates.

Jaguar, Rover, and Triumph (British Leyland) indicated that they have no plans to offer automatic restraints in their cars before the required date.

- <u>Preparations for Production by Suppliers</u>

A number of companies around the country are presently preparing for the production of components for air bag systems for the automobile industry.

Some of these companies are traditional automobile company suppliers, and some were involved in the production of components for air bags for General Motors in the mid-70's. The companies that will manufacture the air bag inflators are all primarily aerospace companies that have extensive experience with propellant systems and with systems of high level reliability. They are using techniques developed in the aerospace program for assuring the safety of astronauts.

Talley Industries of Mesa, Arizona will manufacture driver air bag inflators and modules. Talley made the driver systems for General Motors for the air bags that were offered from 1974 through 1976. Tooling is nearly complete, and initial production is scheduled to begin later this year.

Thiokol Chemical Corporation of Brigham City, Utah, a major manufacturer of rocket motors, including those that will be used on the NASA space shuttle to be launched later this year, will manufacture both driver and passenger air bag inflators. Thiokol has built and is presently equipping a plant for production in Ogden, Utah. The propellant for these units will be prepared at Thiokol's main plant west of Brigham City. Thiokol will also begin manufacturing inflators for use in production cars in late 1980. Thiokol has been involved in research and development on air bag technology for approximately a decade, and has been responsible for many of the advances in inflator technology.

Rocket Research Company, a division of Rockcor Corporation of Redmond, Washington, is a major supplier of monopropellant rockets that are used to control satellites and other space vehicles. It has also been involved in research and development on air bag inflators for about a decade. Rocket Research has formed a partnership with Hamill Manufacturing Division of Firestone Tire and Rubber Company, a long-time supplier of safety belts and other equipment to the automobile industry, to produce air bag inflator modules for the front passenger side of production cars. Rocket Research is in the final stages of setting up a production facility to manufacture the propellant cartridges for inflators in Moses Lake, Washington. Hamill is equipping a plant in Ubly, Michigan to assemble the cartridges into complete air bag modules. Production is scheduled to begin this year.

These four companies have together invested tens of millions of dollars in plant and production equipment to meet the requirements of the automobile industry. They will all use the most advanced quality control systems and reliability testing programs of the aerospace industry to ensure that motorists can have full faith in these systems. The inflator industry will initially employ several hundred people in engineering, production, materials handling, and quality control. Suppliers of parts and materials for these systems will employ significant numbers of people as well.

Uniroyal of Mishawaka, Indiana, which supplied air bags for the earlier General Motors cars, will revise existing machinery and add new equipment for cutting, sealing, and folding driver air bags.

The other major components to be used in air bag systems are the crash sensors, the electronic diagnostic modules, and the wiring systems to connect the various components. The crash sensors will be built by the Essex Group of Detroit, Michigan (which is a subsidiary of United Technologies Corporation) and by the AC Delco Division of General Motors.

The sensor to be manufactured by Essex was developed by the Breed Corporation of Union, New Jersey, and is manufactured under license. Essex is constructing a "clean room" in one of its manufacturing facilities in which it will set up a new automated line to assemble crash sensors. The temperature, humidity, and dust are closely controlled in the clean room to assure that the reliability of the hermetically sealed sensor is not compromised during assembly.

The electronic and wiring components are being supplied by such companies as Toshiba and AC Delco, and all must pass very stringent reliability and quality requirements that have been imposed by the automobile manufacturers. In addition to these suppliers, foreign car companies that are planning to introduce air bags into their production cars are using foreign suppliers, in addition to some of the U.S. companies.

The NHTSA has recently visited and reviewed the industrial preparation of the major air bag component suppliers. These companies are adequately preparing to provide the automobile manufacturers with the components that will be needed to meet their production schedule and to comply with the requirements of the automotive crash protection standard.

The agency is pleased not only by the high level of industrial commitment to providing air bag components, but also by the exceptional care that is being taken to ensure that highly reliable components meeting stringent specifications will be supplied to the automobile companies on schedule.

The agency is concerned, however, that the constant changes in manufacturers' plans may cause component suppliers to get out of this business.

- Preparation for Disposal of Air Bag Equipped Cars

Air bags will be used by the major automobile manufacturers to provide automatic crash protection in some of their new automobiles in the early 1980's. Virtually all auto companies that are planning to offer air bags will use systems employing sodium azide to produce the pure nitrogen gas that inflates the bags.

Several programs have been sponsored by the automobile companies, the air bag inflator suppliers, and the NHTSA, to evaluate alternative design configurations, and to examine the impacts and potential risks associated with the use of these restraint systems upon people, property and the environment. Recent studies have been completed for the Motor Vehicle Manufacturers Association by Arthur D. Little, Inc. and Battelle Columbus Laboratories, and for the Ford Motor Company by Thiokol Chemical Corporation. In general, the results from these studies indicate that the only areas of concern associated with the use of air bags would occur during the disposal of cars with non-deployed inflator modules.

A. D. Little, Inc. recently completed a study for NHTSA to provide identification and assessment of the various ways of ensuring that pyrotechnic inflator modules are properly handled during the disposal and recycling of scrap automobiles.

The results of this study suggest that there are several devices that could be utilized to discharge scrap inflator modules. The alternative design options were evaluated and one method of discharge was found to be immediately available for implementation. Specifically, selective application of a controlled electric current can provide a safe and effective mechanism for discharging air bag inflators. There are no requirements for major hardware modifications which could compromise the reliability of the air bag. Costs to both the automotive manufacturer plus the dismantler are lower than those for any other option considered. Safety and health hazards are minimal and problems with inadvertent discharge are limited. If there are any shortcomings associated with this system, they relate to the ease with which the unit can be discharged by someone with a 12-volt dc power source. However, security precautions can be provided to insure that the plug connector is properly protected and that access requires the use of appropriate tools for removal of a special protective cover plate.

NHTSA has been working with two key industry associations, the Institute of Scrap Iron and Steel, Inc. and the Automotive Dismantlers and Recyclers of America, to develop effective national practices for the dismantling and recycling of automobiles equipped with air bags. The agency is working on development of a standardized system which will permit dismantlers to easily discharge air bag inflators at the end of the vehicle's useful life.

The Automotive Dismantlers and Recyclers of America recently wrote to the Administrator pledging their, "support with regards to the unique plug development system." *

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* Bruce Parsons, Safety Committee Chairman, Automotive Dismantlers and Recyclers of America, letter dated November 13, 1979 to Administrator Claybrook.

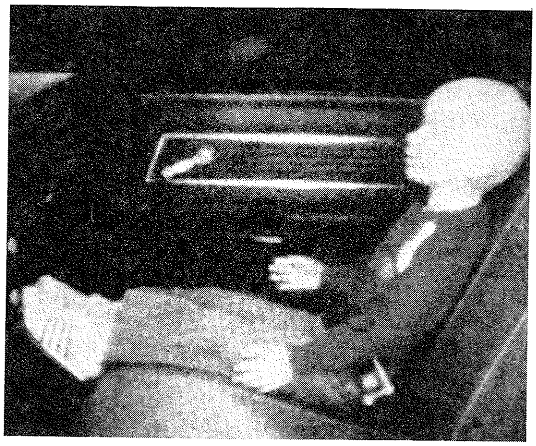
Figure V

Child Crash Simulation

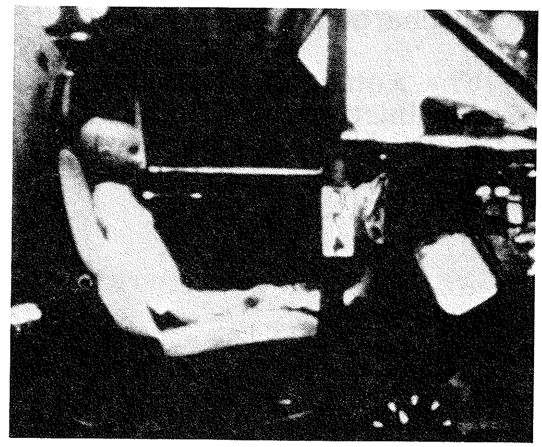
Child Size Manikins

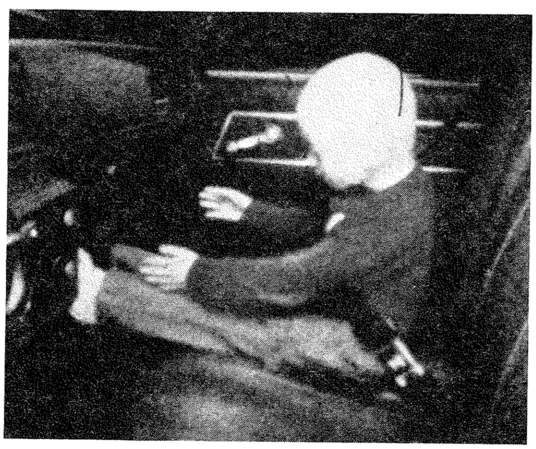
Safety Belt Protection

Air Bag Protection

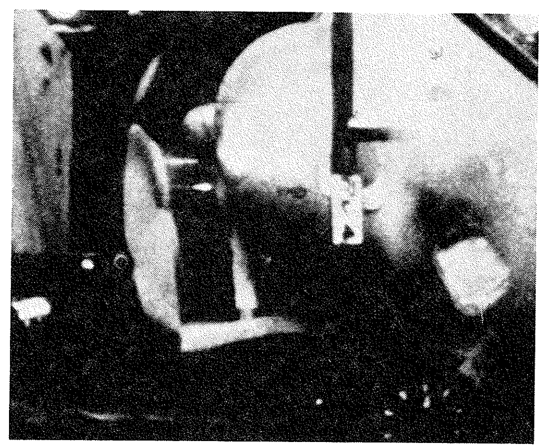


Before the Crash

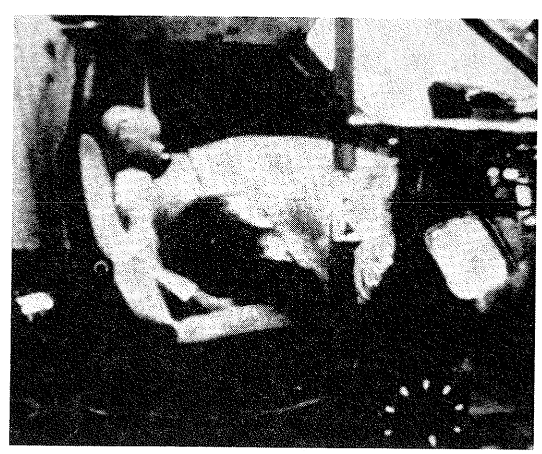




The Moment of the Crash



Immediately After the Crash



V. CRASH PROTECTION FOR CHILD OCCUPANTS

Children hold a special place in our society. Generally, Americans believe that children should be given special protection from harm. Nevertheless, each year more than 700 children aged five and under are killed, and more than 4,000 are seriously injured in crashes as motor vehicle occupants. For children under age fifteen, the number killed each year is nearly 2,000. Protecting children from injuries in motor vehicle accidents presents special problems because of their small size and their general dislike of being confined.

When a vehicle hits another object, or when sudden braking brings it to a fast stop, the occupants continue to move forward at the speed the vehicle was moving ... until something stops them. Unrestrained children literally become flying missiles. It happens so fast and with such force, even in low speed crashes, that a violent impact with other passengers or with some hard surface within the vehicle cannot be prevented.

Some parents mistakenly think they can protect infants and young children from injury by holding them. In a 30 mile per hour crash, for example, a child is thrown forward with a force equal to 30 times its weight. A 10 pound baby would be thrown forward with a 300 pound force, and few people can hold that much weight. The parent who was holding the child also will be thrown forward with a force equal to 30 times his or her weight and the child may be crushed between the parent and the dashboard.

What is safe is a good child restraint system properly used. Children need to have the crash forces spread more evenly over their fragile bodies ... which is exactly what a good child restraint will do. Of course, if no child restraint is available, it is much better to buckle children into regular safety belts, preferably in the middle rear seat, than to let them ride unprotected.

- National Conference on Child Passenger Protection

The NHTSA sponsored a national conference on child restraint safety on December 10-12, 1979, in Washington, D.C., that was attended by more than 400 people from the medical community, consumer and service organizations, juvenile product and auto industries, and State and local highway safety agencies. The three days of meetings were part of a year-long, nationwide campaign to promote child passenger protection. Research findings and techniques to increase use of child safety seats and seat belts were discussed.

The conference itself provided a unique opportunity to recognize the contributions of many people and organizations who have brought the question of child protection to the public's attention.

Administrator Joan Claybrook presented NHTSA's highest award -- The Award for Public Service -- to:

-- Action for Child Transportation Safety (ACTS) a Seattle-based volunteer organization, for its model community action groups;

-- Physicians for Automotive Safety for their activities to involve members of the medical and legislative community in child passenger protection;

-- The League General Insurance Company of Michigan which organized a free child restraint distribution program for its policyholders;

-- The Insurance Institute of Highway Safety for developing a powerful film on child passenger safety;

-- The Michigan Motor Vehicle Occupant Protection Program for their efforts to develop a model State program to promote child passenger safety and for its innovative educational materials and guidelines on how to set up a loan-a-seat program.

Administrator Claybrook awarded Certificates of Appreciation to Mr. C. Ernest Cooney for developing an audio-visual slide program that is shown in hospital maternity wards and child birth education classes; to the Highway Safety Research Center of the University of North Carolina for the 1979 series of child restraint workshops; and to Sutliff Chevrolet, a Harrisburg, Pennsylvania car dealer that works with the State of Pennsylvania to promote safety seat use.

NHTSA is continuing its efforts to promote child safety by: a) publishing educational materials, b) conducting regional workshops, and c) conveying useful information to parents, expectant parents, and children through cooperative efforts with the following:

-- Department of Health and Human Services, Surgeon General's Office.

-- Insurance industry.

-- American Academy of Pediatrics.

-- Automobile dealers.

-- Child restraint manufacturers.

• Car Interior Design and Child Crash Protection

> "Instrument panel is smooth and flush. Back of front seat is heavily tufted to protect rear seat passengers in case of an emergency stop. Door handles are smooth, rounded and curve inward for safety!"
> --A 1940 Ad for Dodge.*

Manufacturers have the first line of responsibility to design vehicles which are safe for children as well as adults. However, automobiles generally have not been designed to protect children. With minimal efforts much could be done.

Interior surfaces of vehicles to this day often have sharp or hard edges which, on impact, can unnecessarily inflict harm to children. For decades, automotive safety engineers have known of the need and techniques of designing soft interior surfaces to cushion and protect a child in a crash.

For years, manufacturers have built child restraints which use a top tether to hold the child in a crash. But for years manufacturers did not include a convenient mounting point in the vehicle so that the child restraint could be easily and properly anchored in the vehicle for child protection.

The introduction of hatchback vehicles brought yet another hazard to children. Little thought was given the protection of children in most hatchback designs. In a rear-end crash hatchback doors, tend to pop open, permitting children to be ejected from the vehicle. Any occupant's chance of survival is greatly reduced upon ejection from a vehicle. The hatchback door could be designed to meet the same criteria for resistance to opening in a crash as side doors.

In many European countries,** laws have been adopted which require children to ride in the back seat for greater safety. Observations of U.S. practices have found that the majority of children ride in the back seat of automobiles, but 48% of children under age 5 ride in the front.

Compatibility With Child Restraint Devices - NHTSA recently conducted an evaluation*** of the compatibility of the safety belt systems in 1980 model

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* Auto Ads, Jane and Michael Stern, Random House, New York, 1978, p. 48.

** Belgium, Hungary, Luxemburg, Netherlands, Poland, Spain, Switzerland, and West Germany.

*** Verve Research Corporation, The Comfort and Convenience of Safety Belt Systems in 1980 Model Vehicles, in print.

vehicles with 6 popular child restraint devices. The most significant problems uncovered were:

1. front seat belt systems were too short to fasten around the child seat when the car seat was moved fully forward;

2. latch plates were so bulky that it was not possible to thread the belt through one of the child restraint devices; and

3. belts in many of the cars did not permit securing the child restraint tightly to the car seat because of the design of the retractor (an additional locking device must be purchased by the parent to secure the child restraint properly).

NHTSA has included in the proposed comfort and convenience standard a provision that would require manufacturers to respond to the difficulty of effectively securing child restraint systems with appropriate designs of lap belts in 1982 model vehicles. Until such time, parents purchasing new child restraint devices should make certain that the child seat being considered for purchase is compatible with the safety belts in their vehicle.

Table V-1 lists problems found with current models.

- <u>Child Restraint Systems</u>

Lap and shoulder belts in cars are designed primarily to protect adults, and special restraint systems are available that are designed specifically to protect infants and small children. More than half of the small children who are now killed and injured in automobile crashes could be saved if they were properly restrained in cars. While about one-half of all infants are restrained in a car seat, fewer than one out of ten children above the age of one are restrained. Furthermore, in about half of the cases, either the child restraint is not properly installed with the car's safety belts or the top tether strap (if so equipped), or the child is not correctly buckled into the child seat. In some cases, infant or child carriers used in cars are not even designed to provide crash protection.

Last December, the NHTSA issued an upgraded standard for infant and child restraints, FMVSS No. 213, which is intended to improve the protection of children in motor vehicle crashes. The new standard will apply to all types of child restraints, including car beds, infant carriers, and child harnesses.

Under the new standard, all child restraints will be subject to tests simulating 30 mile-per-hour frontal crashes. Child seats that are equipped with a top tether must be tested in a simulated 20 mile per hour frontal crash with the top tether detached to simulate the

Table V-1 Safety Belt Compatibility Problems with Child Restraints

	No. of Child Seats Unable to Fit Due to Short Belts(c)(d)	Rear Seat Bulky Retractors	Rear Belts Need Locking Device	Front Belt Needs Locking Device
AMC Jeep Pickup[a]	6			
AMC Spirit	2			
BMW 320i – automatic			X	X
Chrysler Horizon	2			
Chrysler Aspen	2			X
Datsun 210	3	X		X
Datsun Pickup	2			X
Fiat Strada			X	X
Ford Fairmont	1			
Ford Pinto				X
Ford Mustang	1			
Ford Van[b]	2			
Ford Pickup	2			X
General Motors Citation	2			
General Motors Chevette – manual	2			
General Motors Van				X
General Motors Pickup	1			X
Honda Civic	3			
Mazda GLC	2	X		X
Subaru 1800 GLF		X		X
Toyota Corona – automatic			X	X
Toyota Corolla	1		X	X
Toyota Pickup				X
Volkswagen Rabbit				X
Volkswagen Rabbit – automatic				X

(a) Middle seating position
(b) Belts short in front and middle seats
(c) Tested with the front seats in the most forward position
(d) Belt length not a problem in rear seats

Note: 6 Popular Child Restraint Devices Tested

Types of Restraints Available and How to Use Them

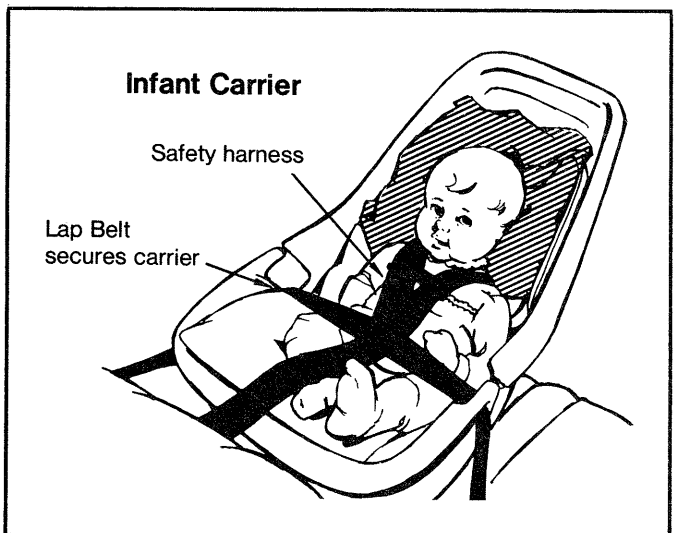

Figure V-A
For the infant . . . From Birth to About 9–12 Months of Age

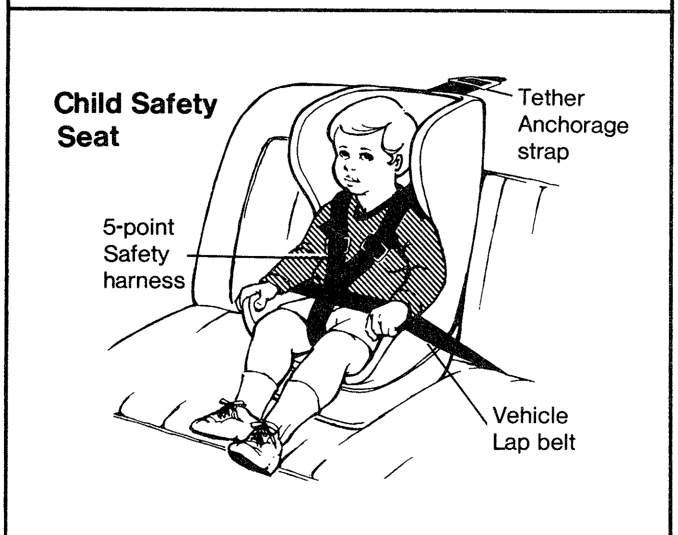

Figure V-B

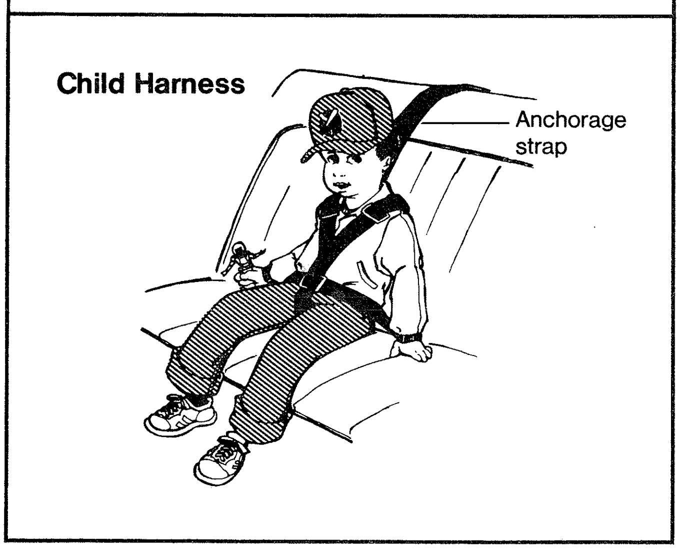

Figure V-C

common tendency for people not to bother attaching the top tether. The restraints will be required to hold the test dummy and to retain their structural integrity in the tests. Also, during the tests, the systems must meet limitations that have been set on the amount of force that can be exerted on the head and chest of the child test dummy. The seating systems will have to be attached to the vehicle by means of the vehicle's seat belts. If top tether straps are supplied by the child restraint manufacturer, they will be used in addition to the lap belt as a means of attachment during the 30 mph crash test.

Infant car beds, when used, will have to be installed laterally across the vehicle seat, using the available seat belt. Further requirements under the new standard are aimed at reducing misuse of child restraint systems. Instruction labels informing parents on how to use the child restraint system must be permanently attached to the system and be visible when the child restraint is in place. In addition, each system must come with an instruction manual that explains proper installation and use of the restraint.

- Children in Cars with Automatic Restraints

Automatic belts - Since automatic restraint systems became technologically feasible about a decade ago, experts have known that small children would have to be given special consideration in the design of such systems. Volkswagen recommends that children not ride in the front seat of its cars with automatic belts until they are at least 4 feet 10 inches tall. In its 1980 model Chevettes with automatic belts, General Motors provides a special belt for the right front seat to hold a child seating system, and a special mounting point for the lap portion of the automatic belt for older children who are still too small to use the adult belts.

Air Bags - From 1973 through 1976, General Motors built and sold to the public more than 10,000 cars equipped with its Air Cushion Restraint System. These cars have traveled about 800 million miles on public roads, and have been involved in nearly 200 crashes in which the air bags deployed. Although there have been fewer than 30 children, age 10 and under, involved in these crashes, there have been no instances in which children are known to have been injured by deploying air bags.

Before they first produced air bag equipped cars, General Motors and Volvo each carried out developmental air bag system tests with small animals as surrogates for small children. In their development of the new generation of air bags to meet this standard, GM and Volvo have again carried out such developmental test programs using animals so that they could ensure that their systems are as safe as possible for small children. Other companies developing air bag systems have used child dummies for their developmental testing.

In January 1979, General Motors reported to the National Highway Traffic Safety Administration (NHTSA) that it was having difficulty with the design it had chosen for its air bag system to be offered as an option on some of its 1981 production cars. GM said that it had not met the corporation's criteria for the protection of unrestrained small children located near the point of air bag deployment. GM said that it was delaying introduction of its air bag system as an option on its 1981 model production cars until six months after the beginning of the model year in order to redesign and test its system.

During the spring and summer of 1979, GM made major design changes in its system that resulted in a substantial reduction in the likelihood that a small child could be injured by the deploying bag. Nevertheless, in September 1979, GM announced a further postponement of the introduction of its passenger air bag system because the company was still not completely satisfied with its performance.

GM made a presentation to the NHTSA at that time in which it discussed its theory of the potential for injury to small children in cars equipped with air bags, and presented limited evidence to support its theory. GM showed that young children are less vulnerable to injury than adults in serious crashes, and theorized that one factor was that if there was panic braking, an unrestrained child would be thrown into the instrument panel before the crash, and it would restrain the child during the crash.

On the other hand, if the child were against the instrument panel during a crash in a car with an air bag, GM theorized that if the air bag system was not carefully designed, the child might be injured by the inflating bag. On the basis of its animal tests, GM identified several potential injury mechanisms that are strongly dependent on the design of the air bag system, the position of the child in front of the instrument panel, the crash speed, and other conditions. GM's tests also shows that unrestrained small children who are normally seated (away from the instrument panel) at the time of a crash would receive significant crash protection from the air bags, and would not risk harm from their deployment.

It is important to note that none of the child injuries theorized by GM have been observed in the real world crashes of cars with air bags. GM does not know whether injuries to animals in its tests indicate that children would receive similar injuries under the same crash conditions.

Because the basis for the GM decision was somewhat speculative, the Administrator of the NHTSA appointed a special team of experts from within the agency to examine the theory and to collect further evidence so that GM's decision could be better understood.

In December 1979, GM said that it had essentially satisfied its criteria for the protection of children with its new air bag system, and that it planned to offer a full front seat inflatable restraint system as an option on its full size 1982 model cars. GM's decision was based on the fact that animals, used as surrogates for small children, located in various positions near the instrument panel were no longer receiving serious injuries from their latest air bag designs when they deploy.

- Children in Automobile Crashes

Data developed by the NHTSA relating the conditions that occur just before and during a serious crash to the safety of children include:

1. observations of how frequently and in what positions children ride in cars;

2. analysis of the spectrum of injuries, particularly to children, in automobile crashes;

3. information on pre-crash braking from accident files; and,

4. tests to determine the response of unrestrained small children to pre-crash panic braking.

The analysis shows that, on balance, air bags will provide substantial crash protection to otherwise unrestrained small children in crashes. In particular, the analysis indicates that in one million car-years of operation, it is probable that two small children would be saved from fatal injuries by air bags, and 12 would be protected from serious injury that would occur without air bags. By comparison, in the same fleet, no more small children and infants would be in the vicinity of the instrument panel at the time of a crash in which the air bag would deploy, and it is improbable that any of them would be injured by the deploying bag. In addition, more than 100 older children and adults would be saved from fatal injuries and another 500 spared serious injuries in the one million car-years by the air bags.

Unfortunately, most small children, like their parents, ride unrestrained in cars. Consequently, they are not protected from the violent crash forces in automobile accidents. They ride in a wide variety of places and positions inside a car.

Infants are very often carried in some kind of infant carrier or in an adult's arms inside a car. Although most are sufficently restrained from being thrown into the instrument panel by panic braking, fewer than a quarter have adequate restraint during a crash. Beyond infancy, children typically want to ride with their heads high enough to be able to see out the car windows. Very few of them are properly restrained.

During 1979, the NHTSA observed 16,359 cars in 19 cities throughout the U.S. Nearly five percent of these cars had one or more small children in them, but only half that number had infants or small children in the front seat. Of the small children (age 1 to 4) riding in the front seat, about one quarter were sitting unrestrained in the front seat with their backs against the seat back. Nearly one fifth were in the lap of an adult, a very dangerous position because the child can readily be crushed between the adult and the instrument panel. Fewer than 7 percent were in any kind of child restraint, and nearly half of those were not being correctly used. About one fifth were standing on the seat, and the remainder were in various other positions. Only 2.6 percent were sitting on the floor in front of the seat.

These observations are generally consistent with observations made by other researchers, and with accident data collected recently by the NHTSA.

Data from the National Crash Severity Study (NCSS) provide the best currently available information on the spectrum of automobile crashes and the injuries that result from them. There are approximately 100 million passenger cars on the road in the U.S. today. Each year, about two and a quarter million cars experience enough damage in a crash that they must be towed from the scene of the accident (a tow-away accident). About three and a half million people are in the passenger cars involved in these crashes. Their ages and level of injuries suffered are shown in Table V-2.

General Motors has theorized that pre-crash braking may be important to the safety of small children in cars equipped with some type of air bags. GM was concerned that panic braking may throw unrestrained small children into the instrument panel where they could be vulnerable to injury from the deploying air bag.

In order for pre-crash braking to throw a small child into the instrument panel at the time of the crash, it must produce a deceleration rate high enough to overcome friction between the child's clothing and the seat and other forces holding the child, and must be of sufficient duration to allow the child to reach the instrument panel before the crash.

In order to evaluate General Motors' theory, the NHTSA embarked on several research investigations. These included:

1. studies of accident data to determine occupant injury rates and to see what information could be gleaned on the occurrence, magnitude, and duration of pre-crash braking;

TABLE V-2
ESTIMATES OF NUMBER OF INJURED OCCUPANTS IN TOW-AWAY AUTOMOBILE CRASHES, BY AGE OF OCCUPANT

Age of Occupant	Number Involved In Tow-Away Accidents	Number Receiving Injuries by Severity Level			
		Minor	Moderate	Serious (Non-Fatal)	Fatal
0 - 1	12,000	2,000	200	600	157
1 - 4	96,000	16,000	2,000	600	429
5 - 10	110,000	24,000	2,100	1,000	383
11 - 16	290,000	50,000	13,000	9,000	1,791
17 & older	3,000,000	660,000	140,000	100,000	25,353
Totals	3,500,000	750,000	157,000	111,000	28,113

NOTE: This table shows the estimated number of automobile occupants involved in the statistically calculated 2,250,000 "tow-away" crashes which occur in the U.S. each year. The figures provide estimates by age and level of injury severity. Figures for the number of people involved and injured in tow-away crashes were estimated by the National Center for Statistics and Analysis using data from the National Crash Severity Study and the Fatal Accident Reporting System. These estimates do not include truck and van occupants.

2. tests of vehicles in panic braking on various road surface conditions with small, unrestrained dummies to learn about the trajectory of such occupants under pre-crash braking; and

3. computer simulations of child occupant trajectories under pre-crash braking.

The number of cars produced with air bags will be limited by the manufacturers in the first few years of the standard to approximately one million units. In one million car years of exposure of air bag equipped cars, one would expect approximately 4,000 crashes in which the air bags would deploy. An estimate of the number of occupants of various ages that would be involved is:

Occupant Age	Total Number in the Front Seat
0 to 1 (infant)	18
1 to 4 (small child)	90
5 to 10 (child)	110
11 to 16 (older child)	340
17 and older (adult)	5100

Of the 18 infants, at least 15 would be restrained against pre-crash braking forces in some way, and probably would not reach the instrument panel before a crash even if there were pre-crash braking. Of the small children, about 22 would also be restrained against panic braking forces.

A calculation of the number of small children who could be thrown into the instrument panel by pre-impact braking forces (using data on pre-crash braking and on the time it takes children riding in the front seat of a car to be thrown into the instrument panel) shows that in one million car years of operation, approximately 15 small children and fewer than 1 infant would be thrown into the instrument panel at the time of a crash.

The fact that these children may end up near the instrument panel does not mean that they would be injured. To be injured by a deploying air bag requires that the child not only be in close proximity to the part of the instrument panel from which the air bag deploys, but also that he or she be in a position to be struck by the deploying air bag in such a way that it could cause an injury. The air bags that will be introduced for sale in the U.S. will have been designed and extensively tested with various child surrogates to minimize the likelihood of such harm regardless of the position of the child.

By contrast, in one million car years of operation of manual belt equipped cars about eight infants and small children would lose their lives and about 35 will receive moderate to critical injuries. Of those, it is estimated that air bags would save at least 2 from fatal injuries, and at least 12 from moderate to critical injuries. In addition, more than 100 people other than infants and small children will be saved from fatal injuries, and 500 will receive less serious injuries in cars with air bags before the end of 1983 compared with the number who would have died in cars with manual belts.

In conclusion, there is not only a substantial net societal benefit from having air bags in passenger cars, but there is a net benefit even for the specific class of occupants considered here -- infants and small children in the front seat. Those benefits will be further enhanced by the special attention that the automobile manufacturers are paying to the protection of small children in the design of their systems.

Production Air Bag System Performance with Children - Three companies: Ford, General Motors, and Volvo, each produced small fleets of air bag equipped cars (a total of fewer than 2,000 cars) in the early to mid-1970's. These cars were used only in special fleets and were not sold to the public. However, from 1974 through 1976, GM built more than 10,000 cars with air bags that were sold to the public.

The GM cars with air bags that were sold to the public have traveled about 800 million miles, and have been involved in nearly 200 crashes in which the air bags deployed. A small but significant number of children have been involved in these crashes. Their experience is summarized in Table V-3.

The information in Table V-3 summarizes the experience of all children involved in crashes severe enough that the air bags deployed. The one fatality was an otherwise unrestrained infant that was thrown under the instrument panel by pre-crash braking. No children are known to have suffered more serious injuries because of the air bags, and in several cases it is believed that the air bags reduced the children's injuries.

TABLE V-3. SUMMARY OF INJURIES TO CHILDREN IN CRASHES OF CARS EQUIPPED WITH AIR BAGS

Age of Child	None	Minor	Moderate	Serious (Non-fatal)	Fatal
	(Number of Children Injured)				
0 to 1	(1)	---	---	---	1
1	(1)	---	---	---	---
2	(1)	---	1	---	---
3	---	1	1	---	---
4	(1)	(2)	1	---	---
5	---	2	---	---	---
6	---	2	---	---	---
7	1	(1)	---	---	---
8	---	2 + (2)	---	---	---
9	---	1 + (3)	---	---	---
10	1	(1)	---	1	---
11 to 15	5 + (6)	11 + (9)	---	---	---

Level of Injury spans None through Fatal.

NOTE: Numbers in parentheses are the number of children located in the rear seat of the car at the time of the crash.

The information in Table V-3 summarizes the experience of all children known to have been in air bag equipped cars involved in crashes severe enough that the air bags deployed. The one fatality was an otherwise unrestrained infant that was thrown under the instrument panel by pre-crash braking. No children are known to have suffered more serious injuries because of the air bags, and in several cases it is believed that the air bags reduced the children's injuries.

The only crash in which a child suffered serious injuries involved a seven week-old unrestrained infant in a collision with a truck. There was significant pre-impact braking in this crash slowing the car from an estimated 50 miles per hour to about 35 mph before the impact. It is believed that the infant who was fatally injured had already been thrown to the floor under the air bag at the time of its deployment.

There have been reported six fatalities, five serious to critical injuries, and 49 moderate to severe injuries in the 12,187 cars with air bags that have been used on public roads. These figures are about one-half the numbers that would have been expected from similar fleets of cars without air bags. This performance by cars equipped with air bags is fully consistent with estimates of the effectiveness of air bags made several years ago by the Department of Transportation.

Furthermore, manufacturers' testing to date demonstrates that the air bags that will be used in cars in the 1980's are substantially improved over those used in the early to mid-1970's, so that their safety performance is expected to be even better than was shown in the first generation production systems.

Conclusions and Recommendations of the NHTSA Special Team - On the basis of the investigation to date of the safety of children in cars equipped with air bags, the special team drew the following conclusions:

1. Air bags are beneficial to most children involved in a crash. In one million car years of operation, they will save the lives of approximately 10 children aged 0 to 16, and will reduce injuries to as many as one hundred more.

2. In production cars on the road, air bags have performed well in protecting otherwise unrestrained children, and no particular problems have been identified in the real-world crashes involving children.

3. There is a small but significant possibility that an unrestrained infant or small child may be thrown by pre-crash braking into the region where an air bag initially deploys. However, in one million car years of operation, a maximum of only 15 infants and small children are likely to be in the region of the air bag at the time of deployment, and few if any of them are likely to be injured by bag deployment.

4. The risk of injury to a small child located near the point of deployment of an air bag can be substantially reduced by careful design, tuning, and developmental testing of air bag systems before they are produced. Both GM and Volvo have indicated that through improved design of their systems, they believe that they have eliminated any unreasonable risks to small children with the air bag systems they intend to produce in the early 1980's.

5. For unrestrained infants and children, the increased protection from death and serious injury provided by air bags greatly outweighs the small possible risk of injury that has been speculated as a consequence of the deployment of an air bag.

6. While animal testing may be useful in providing indications of the relative performance of different air bag systems with otherwise unrestrained small children, the correlation between the results of such testing and the response of children has not been established, but remains the subject of continued scientific study.

7. Children can be well protected from crash forces by putting them in the back seat in child restraints or buckled in the car's safety belts.

On the basis of its findings, the special team recommended the following further actions be taken by the NHTSA:

1. The agency should continue its work on the biomechanics of children in accidents so that in the future, questions about the crash protection of children can be better understood and evaluated.

2. The agency should carry out further, limited testing of vehicles under panic braking, and should attempt to determine the responses of small children, to confirm the results already obtained.

3. The agency should continue to monitor the developmental work of the automobile companies, particularly in the area of the protection of children, and to provide agency expertise as appropriate.

4. The evaluation plan for FMVSS 208 should be modified to ensure that the performance of the various production air bag systems with children is evaluated by the earliest possible date.

5. The agency should continue to promote the use of child restraints and vehicle belt systems to minimize the number of unrestrained children exposed to all types of crash hazards, and should promote the idea that children are safer in the back seat in all cars, whether they are restrained or not.

CHAPTER VI

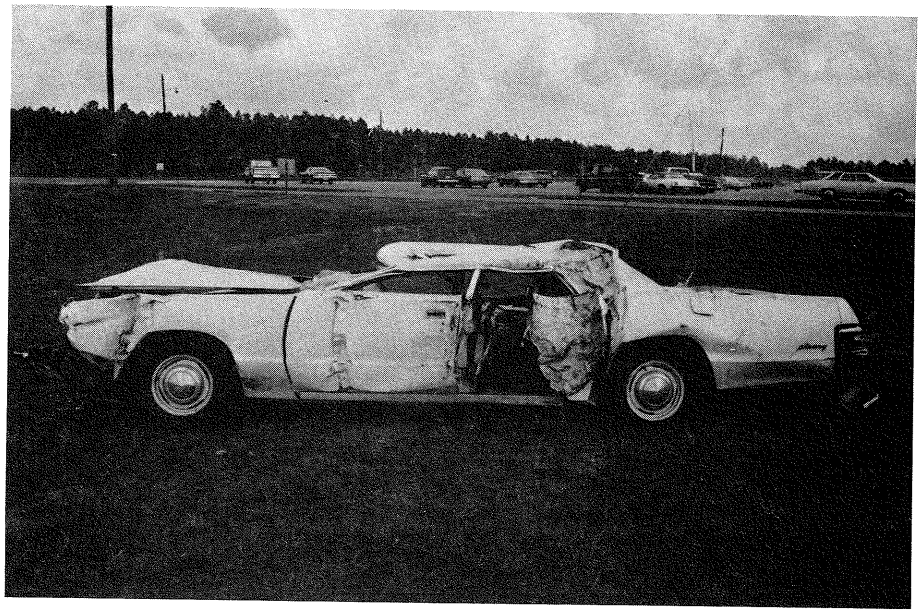

Figure VI-A

Side View of Air Bag Equipped Vehicle which crashed in Barnwell, S.C.

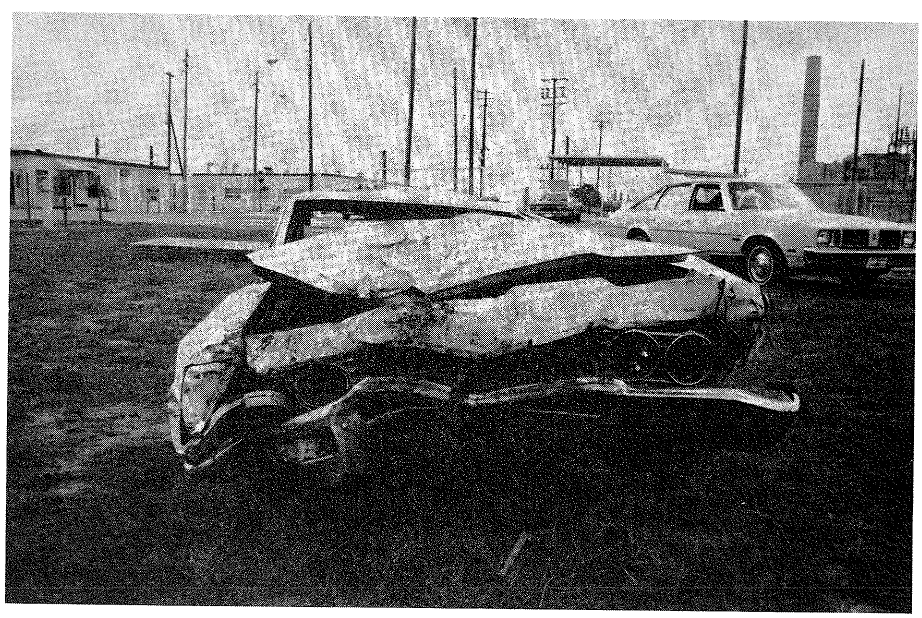

Figure VI-B

Front View

VI. EVALUATION OF AUTOMATIC CRASH PROTECTION

"...nearly all my friends...have been begging for air bags since they saw what happened to me in the accident, and we have all been disappointed and distressed that we have been unable to buy them."

--A Kansas City, Missouri medical doctor who survived a crash in an air bag car which collided with a large city bus.

• Field Performance of Systems Now in Use

Air bags have been installed on a few makes and models of automobiles since 1972. Automatic safety belts have been available as optional equipment by one company since 1975. There are now over 150,000 automobiles equipped with automatic restraints on the road, and more are expected to be sold prior to the effective dates of the Federal standard for automatic crash protection.

Field Performance of Air Bags - An Example - A recent accident involving an air bag equipped car has been investigated. A 1972 Mercury Monterey (as shown in Figures VI-A and B) crashed near Barnwell, South Carolina on October 17, 1979. The car had a factory installed passenger air bag and was retrofitted with a driver air bag after it was built.

The driver, a 40 year old, 135 pound 68 inch male was apparently suffering from insulin shock. At an estimated 55 mph the vehicle struck a closed metal (pipe) gate barricade at a nuclear power facility, tearing the gate from its mounting post. The vehicle continued, striking a sign post beyond the gate, tearing it from its mounting. The vehicle continued for approximately 0.8 miles and left the roadway striking numerous pine trees (5" - 12" in diameter) and shearing them at their base. The vehicle rotated and rolled over one complete turn. The air bag deployed during one of the initial tree (9" pine tree) impacts.

The driver was wearing a lap belt but not the available shoulder belt. His injuries were classified as minor on the Abbreviated Injury Scale (AIS-1). Injuries consisted of laceration of the left ear (stitches required due to glass cut), whole body complaint of pain with major complaint in the neck area (ascribed to rollover whipping), and various abrasions and contusions of a minor nature.

Field Performance of Air Bags - General Experience - NHTSA regularly updates estimates and analyses of the performance of both automatic and manual restraint systems based on the most recent data available from experience on the road. The latest evaluation* (available in NHTSA public docket 74-14, General Reference) of air bag performance in the field is summarized in Figure VI-C. It shows deaths and injuries have been reduced by about 50 percent in air bag equipped vehicles. Even when occupants of air bag equipped cars sustained injuries in crashes, they tended to receive fewer injuries per crash than occupants who were unrestrained or who were wearing belt systems.

Air bag equipped cars (currently between 10,000 and 12,000) have been on U.S. highways since 1972, and have traveled about 800 million miles. They have performed exceptionally well. If these vehicles had not been equipped with air bags, approximately 11 fatalities and 131 injuries from all types of crashes would have been expected during this amount of travel. The accident experience of this fleet, however, resulted in only 6 fatalities and only 67 injuries ranging from moderate to critical.

A review of the six fatal accidents involving air bag cars provides additional indirect testimony to the effectiveness of air bags. The conditions in five of the six cases were so severe as to be beyond reasonable expectation of protection by any existing restraint system built into cars. In the sixth case (Memphis, February 29, 1976) where the air bag might have been expected to have prevented fatal injury, the cause of death was unknown. Summaries of the six cases follow:

-- May 16, 1973, Shererville, Indiana. A 1973 Chevrolet traveling at nearly 35 mph crashed, at an angle, into the right front of a six wheel delivery truck moving at nearly 30 mph in the opposite direction. Prior to the crash, an unrestrained 7-week-old infant was thrown into the instrument panel and then to the floor when the driver of the vehicle braked to try to avoid the crash. The infant was probably underneath and in front of the passenger air bag at the time of the crash, and was killed by forces to its unprotected head prior to and during the crash. An infant's head is particularly vulnerable because the protective bone structure of the skull is not yet fully formed and hardened. The driver, protected by the air bag, experienced only moderate injuries.

-- July 11, 1974, George West, Texas. A 1972 Mercury crossed over the centerline of a rural highway where it was struck and run over by the rear wheels of a tractor trailer. The left side of the occupant compartment was crushed, and the driver was killed. It is highly unlikely that any restraint system could have prevented this fatality.

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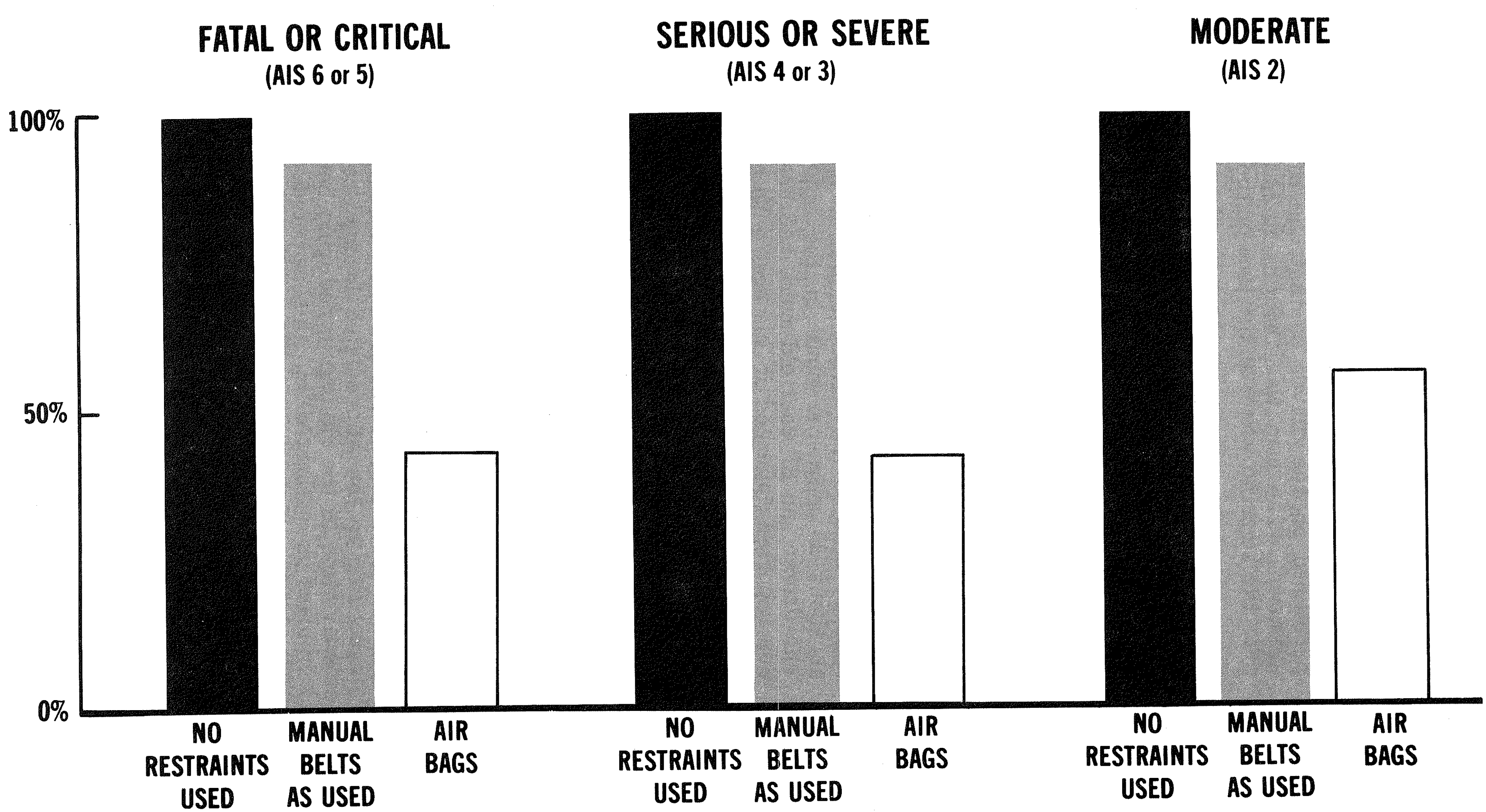
* "Injury and Fatality Rates for Equivalent Cars With and Without Air Bags," NHTSA, November 9, 1979 Update.

Figure VI-C **Vehicles Equipped With & Without Air Bags**

Observed Rate of Injuries



*Based on accident statistics from equivalent fleets of cars (large, GM, post 1973 models), as of June 30, 1979.

-- February 29, 1976, Memphis, Tennessee. A 1974 Oldsmobile 88 crashed into a pole. The driver of the vehicle had a blood alcohol level of 0.19 at the time of the accident. The speed of the vehicle at the time of the crash was estimated to be approximately 30 miles-per-hour. No autopsy was allowed to be performed on the driver so that the cause of death is unknown. The man was thought to have been draped over the steering wheel at the time of the crash.

-- March 11, 1976, Lake Villa, Illinois. A 1974 Oldsmobile 88 crashed head-on into a Chrysler at a closing speed estimated to have been in excess of 100 miles-per-hour. The drivers of both vehicles were killed.

-- July 1, 1978, Gadsden, Alabama. A 1974 Oldsmobile Ninety-Eight ran off the road and into a grove of trees. The left side of the vehicle was very badly damaged by one of the trees and the driver's door was torn open. The driver was partially ejected from the vehicle and suffered fatal injuries as a result. The passenger in the right front seat suffered only minor injuries.

-- September 29, 1978, New Ulm, Minnesota. A 1975 Buick LeSabre crossed the centerline and hit a truck traveling at about 35 miles-per-hour in the opposite direction. The driver, an 81 year old male, had been drinking and was reported "slumped in his seat with his head resting on the driver's door" immediately before impact. Upon impact the car partially underrode the cargo bed of the truck. The car's "A," "B" and "C" pillars were completely severed and the entire left side of the vehicle opened. The driver was found partially decapitated and ejected from the vehicle. There were no other occupants of the air bag vehicle.

In each of the fatal crashes, the air bags deployed properly, and the fatalities that occurred were all caused by factors that the air bag was not designed to counter, with the possible exception of the Memphis crash in which the cause of death was not determined.

A summary of the results of the latest evaluation of air bag effectiveness is shown in Table VI-1. Injury levels are categorized ranging from "moderate" to "fatal", according to the Abbreviated Injury Scale (AIS) of 0 to 6. Note that the effectiveness of the air bag in reducing both fatalites and moderate to critical injuries is estimated by this updated analysis to be about 50 percent. The latest results are consistent with earlier estimates made by the Department of Transportation.

TABLE VI-1

REDUCTION IN DEATH AND INJURY WITH AIR BAGS

This table shows the reduction in fatalities and injuries among occupants restrained by air bags compared with unrestrained occupants -- the effectiveness of air bags in protecting occupants. (Accident data as of June 30, 1979)

	All Air Bag Equipped Cars(1) 59,190 Car-Years		National Representative Population of Equivalent Cars(2) 103,600 Car-Years		Air Bag Effectiveness Over Unrestrained Occupants in Equivalent Cars
Occupant Injuries	Number of Injured Occupants	Rate Per 1,000 Car-Years	Number of Injured Unrestrained Occupants	Rate Per 1,000 Car-Years	
Fatal or Critical (AIS 6 or 5)	6	.10	23	.22	54%
Serious or Severe (AIS 4 or 3)	23	.39	92	.89	56%
Moderate (AIS 2)	44	.74	134	1.29	43%

NOTE: (1) 10,281 Publicly Owned 74-76 MY (Buicks, Oldsmobiles, and Cadillacs) plus Manufacturers Test Fleets (881 '72 Mercurys, 1,000 73 Chevrolets and 85 Volvos) through June 30, 1979.

(2) From NHTSA's National Crash Severity Study (NCSS) File. Includes all GM cars heavier than 4,000 pounds of model year 1974 or later.

Reliability of Air Bags - NHTSA has reviewed the subject of air bag reliability, and determined that air bags used in production automobiles will be among the most reliable components in a car. The companies that will make inflators -- Thiokol Chemical Corp., Talley Industries, and Rocket Research -- are all companies which have extensive experience with the most advanced quality control and quality assurance programs of any industry because of their exacting work on military and aerospace products.

Review of the field experience with production air bag systems that have been sold to the public has resulted in a confirmation of the high levels of reliability and performance that can be attained with production systems.

The 10,281 General Motors production cars with air bags that were sold to the public from 1974 to 1976 have compiled an excellent record in more than 600 million miles of use:

Deployment Crashes	189
Air Bags Deployed	378
Inflator Malfunctions	none
Failure to Deploy	none
Estimated Reliability	99.995% or higher

Commercially produced air bag systems and their inflators are among the most reliable safety components in a car. For comparison with the very high estimated air bag reliability shown above, vehicle brakes, tires, steering, and lights have been shown to have failure rates of 2 percent to 14 percent (i.e., 86% to 98% reliability) in periodic vehicle inspections.

Field Performance of Automatic Safety Belts - NHTSA has updated its analysis of the field performance of Volkswagen Rabbits. This latest evaluation* (available in NHTSA public docket 74-14, General Reference) of automatic belt performance in the field is summarized in Table VI-2. These cars have been offered with automatic belts as optional equipment since their introduction in the 1975 model year. The data base used was NHTSA's Fatal Accident Reporting System (FARS) which includes all fatal crashes involving motor vehicles as reported by all jurisdictions in the United States.

From January 1975 through December 1978, 225 front seat occupant fatalities have been reported in Volkswagen Rabbits that could be identified by their vehicle identification number (VIN). Of these, 193 occurred in Rabbits with manual belt systems, and 32 in Rabbits with automatic belts.

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* "Safety Belt Effectiveness Based on Accident Statistics," NHTSA, Dated November 9, 1979.

TABLE VI-2

REDUCTION IN DEATH WITH AUTOMATIC BELTS

This table shows the reduction in fatalities among occupants restrained by automatic belts compared with unrestrained occupants -- the effectiveness of automatic belts in protecting occupants. (Accidents and exposure through December 31, 1978)

Fleet	All Occupant Fatalities All Accidents	Estimated Exposure in Car-Years	Fatality Rate per 1,000 Car-Years	Effectiveness of Automatic Over Manual Belts As Used
All Automatic Belt Equipped VW Rabbits	32	217,000	.147	
All Manual Belt Equipped VW Rabbits of Same Model Year	193	674,000	.286	
Comparison				49%

The exposure of the two sets of vehicles can be measured in the number of vehicle-years they have accrued. The Rabbits with manual belts have been on the road a total of 674,000 vehicle-years, while the automatic belt cars have been on the road a total of 217,000 vehicle-years. Taking a ratio of the fatalities to the number of vehicle-years of exposure, the table that follows shows that in the automatic belt vehicles, fatalities are occurring at about half the rate at which they are occurring in the manual belt vehicles.

There is little doubt that the improvement in fatality reduction has come from the increased usage of belts in the cars with automatic belts. Observations of Volkswagens with automatic belts indicate that usage in these cars is about 79 percent, while owners of manual belt Rabbits use their belts about 35 percent of the time in the U.S.

<u>Field Use and Performance of Manual Safety Belts</u> - As a part of a continuing program to monitor safety belt usage in the United States, NHTSA, through Opinion Research Corporation, conducts a continuing survey of safety belt usage by the drivers of cars in the general population. More than 150,000 observations, in 19 metropolitan areas, have been accumulated in the last two years.

Most recent results show a further reduction from the disappointingly low rates of safety belt usage reported previously by NHTSA. Only 10.9 percent of the drivers in 1979 overall (11.5 percent of the men and 14.2 percent of the women) were observed wearing either the lap and shoulder or the lap belt alone. The percent of adult passengers using seat belts is 7 percent which is substantially lower than that of drivers.

It is important to note that the survey shows that nearly 9 out of every 10 American motorists do not wear safety belts. Usage in late model subcompact cars (18.5 percent) is about double that in full-size cars (8.6 percent).

In Seattle, the city in the survey with the highest belt usage, only a quarter of the motorists were observed using belts. By region, the West has the highest usage rate, but even there 8 out of 10 do not wear their belts. North Central states had the lowest usage rates (8.6 percent).

- <u>Public Acceptance of Automatic Crash Protection</u>

Numerous surveys and studies have been conducted to gauge public support for automatic crash protection for motor vehicle occupants. Highlights of the most recent findings are:

Teknekron Research Inc. - May 1979 - "When asked their preference for air bags or automatic safety belts, 51 percent favored air bags even if they cost $200 more than belts. Forty percent favored belts and nine percent didn't care or didn't know."

Virginia Highway and Transportation Research Council - April 1979 - (for the Virginia Department of Highway Safety) -- 55 percent favor requiring manufacturers to equip new cars with air bags or automatic belts. While 41 percent are opposed to such a requirement, 56 percent said they would purchase air bags or automatic belts for their next new car even if the cost was about $200.

General Motors Corporation - Marketing studies conducted by GM, in 1971, 1978, and 1979 and presented to Congressman John L. Burton, Chairman of the House Government Operations Subcommittee on Transportation, showed the following:

-- A 1979 study found that "70 percent of the total principal driver sample selected the Air Cushion Restraint System (air bag) as their final first choice preference" over manual or automatic belts - even with air bags adding $360 to the price of the car.

-- The February 1979 GM report states: "The uncluttered, roomy interior of the Air Cushion Restraint System car and its ability to sit three passengers in the front seat were the major reasons for its selection."

-- A 1978 study found that air bags "received the highest ratings on all operation, comfort and appearance items evaluated" compared to manual belts and automatic belts.

-- Even as far back as 1971 a GM study found that 50 percent of interviewed consumers preferred air bags, with the rest divided between a preference for no restraints, manual belts or automatic belts. Between air bags and automatic belts - both of which will be permitted under the standard - 56 percent preferred air bags.

On the Road Use of Automatic Belts - Since 1975, more than 140,000 Volkswagen Rabbit cars were purchased equipped with the automatic belt system. It is significant that the automatic belt option was not available on the basic Rabbit model, but only on the higher priced Rabbit models as part of a package of luxury features.

Moreover, field usage surveys find that the automatic belts remain popular after purchase. Observations show that four out of five occupants in VW Rabbits with automatic safety belts use them. One factor in the high usage rate may be that the automatic belt Rabbits are equipped with ignition interlocks which prevent starting of the engine if the belt is unfastened. When owners of Chevettes and Volkswagen Rabbits equipped with automatic belts and interlocks were interviewed after about one year of ownership, only about 10 percent of the interlock circuits were found disconnected.

The safety belt usage summary shown below is based on the most recent results from a NHTSA sponsored study by Opinion Research Corporation with over 150,000 observations to date.

A number of owners of 1979 Chevettes and all VW Rabbits equipped with automatic belts were surveyed to determine their attitudes toward these systems. While the Rabbit owners were generally more enthusiastic about their restraint systems, a majority fo the Chevette owners said they used their automatic belts, and made generally positive comments about them. A significant minority of owners of Chevette automatic belts equipped cars, however, were critical of various features of that restraint system.

Fleet	Driver Safety Belt Usage* 1978-1979
All VW Rabbits (Automatic Belt)	79%
All VW Rabbits (Manual Belt)	34%
All Foreign Cars on the Road	19%
All U.S. Cars on the Road	11%
All Cars on the Road	12.5%

* Opinion Research Corp., Safety Belt Usage in The Traffic Population, in print.

- <u>Evaluation Plan for the Automatic Crash Protection Standard</u>

NHTSA has proposed a plan* for evaluating automatic restraint systems and Standard 208 during the period 1980-86. The plan announced in the October 22, 1979 Federal Register (44 FR 60771), covers passenger automobiles built with automatic crash protection both prior to and after the standard's effective dates.

The General Accounting Office has commended the agency for its "diligent efforts." Also, in a letter to the Administrator, the Chairman of the National Transportation Safety Board, James B. King, wrote:

> "You are to be commended for your performance in organizing the various Standard 208 evaluation elements into a single plan and for having that plan published in the Federal Register (F.R. Vol. 44, No. 205, Monday, October 22, 1979, pp. 60771). We realize that this effort required the commitment of a great deal of the National Highway Traffic Safety Administration resources."

Preparation of the plan has required the time and efforts of many NHTSA professionals over a seven month period. The agency estimates that on the order of $100,000 was spent on its preparation.

The evaluation plan addresses an extensive list of specific questions. Most of the questions are not new, but will continue to be examined. To date, answers to most of them have been developed as a result of extensive programs of testing, data collection, and analyses of automatic restraints. Estimates of the effectiveness of restraints, their cost, and the likely usage rates of automatic belts, are periodically reviewed and refined as additional information becomes available.

The purpose of the evaluation plan is to identify and inform the public of the benefits achieved in lives saved and injuries prevented. Further refinements in the assessment of the actual, on-the-road experience of automobiles with automatic restraints also will be made as the standard takes effect. Also, should unexpected problems occur with particular cars equipped with automatic restraints, the evaluation plan will enable NHTSA and the auto makers to become aware of them promptly and to take remedial action.

Such information could encourage car manufacturers to increase the variety of automatic restraint system designs available to the public. If consumers have a choice of restraint systems, and have available the

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* "Evaluation Plan for Motor Vehicle Safety Standard 208, Occupant Crash Protection," NHTSA, October 1979, DOT-HS-805-066.

information developed in the evaluation, they are more likely to choose systems that will give them the best protection. The primary objective of the evaluation program is to confirm and refine knowledge of automatic crash protection by continuing to:

-- measure the actual overall effectiveness of automatic restraints in reducing fatalities and injuries in highway crashes.

-- observe the operational characteristics of restraint systems on the road and their effectiveness in specific crash situations.

-- assess the public acceptance and utilization of automatic restraints.

-- assess the industrial consequences of the Standard.

-- perform a cost analysis of the Standard, including manufacturing, repair, and replacement, and to analyze insurance savings, etc.

The NHTSA evaluation plan consists of 14 projects that will be scheduled to provide timely and reliable results. The projects involve accident investigation and analysis, economic analysis and consumer surveys. NHTSA considers the plan to be feasible and consistent with potentially available resources. The specific projects are:

-- National Accident Sampling System data collection and analysis

-- Fatal Accident Reporting System data analysis

-- State accident data analysis

-- In-depth accident investigation and clinical analysis

-- Analysis of consumer reports to NHTSA's "Auto Safety Hotline"

-- Analysis of information from auto manufacturers and restraint system suppliers

-- Acquisition of new car registration data

-- Analysis of on-the-road belt usage observations

-- New car owner survey

-- Public survey

- Controlled tests of automatic belt comfort and convenience
- Cost and weight study based on component teardown of production restraint systems
- Analysis of auto repair manual data to determine the number of restraint system replacements, and repair jobs
- Analysis of insurance cost data

APPENDIX A

SELECTED LIST OF MATERIALS ON OCCUPANT RESTRAINTS

An excellent source document has been prepared by a confederation of groups concerned with encouraging public understanding and use of automobile occupant restraint systems. Entitled "A Resource Guide to Automobile Occupant Restraint Materials," it provides a compendium of available materials (TV and Radio spots, pamphlets, films, games and posters) all designed to inform the public of the benefits of restraint system usage. A copy can be obtained by writing Dr. James Nichols, NHTSA (NTS-14) Washington, DC 20590.

Additional reference documents are as follows:

Passive Restraint Rule, U.S. Senate, Hearings before the Committee on Commerce, Science and Transportation, Subcommittee for Consumers, 95th Congress, 1st Session (1977), Serial No. 95-126.

Installation of Passive Restraints in Automobiles, U.S. House of Representatives, Hearings before the Committee on Interstate and Foreign Commerce, Subcommittee on Consumer Protection and Finance, 95th Congress, 1st Session (1977), Serial No. 95-89.

The Department of Transportation Automobile Passive Restraint Rule, U.S. House of Representatives, Report of the Committee on Interstate and Foreign Commerce, Subcommittee on Consumer Protection and Finance, 95th Congress, 1st Session (1977), Committee Print No. 95-23.

Automobile Crash Protection, U.S. Senate, Committee on Commerce, Science and Transportation, 95th Congress, 1st Session (1977), Report No. 95-481.

Decision of the U.S. Court of Appeals in Pacific Legal Foundation v. Department of Transportation, 593 F. 2d 1338, (D.C. Circuit 1979).

"The Safety and Fuel Economy Performance of the NHTSA's Research and Safety Vehicles." Boehly, William A. - Proceedings of First International Automotive Fuel Economy Conference, 1979.

"A Summary of the Minicars RSV Program." Struble, D.E. - Proceedings of Sixth International Technical Conference on Experimental Safety Vehicles, October 1976.

"Status Report on the Calspan/Chrysler Research Safety Vehicle." Fabian, G.J. and Frig, G. - Proceedings of Seventh International Technical Conference on Experimental Safety Vehicles, June 1979.

Occupant Protection Program Progress Report, NHTSA, August 30, 1978.

Occupant Protection Program, Progress Report No. 2, NHTSA, April 1979, DOT-HS-804-418.

Passive Restraints: Ready When You Are, Allstate Insurance Company, (available from Jack E. Mortens, Automotive Engineering Director, Allstate Insurance Company, Allstate Plaza, Northbrook, Illinois 60062).

Occupant Restraint Issue, Insurance Institute for Highway Safety, June 1, 1978, (available from IIHS, Watergate Six Hundred, Washington, D.C. 20037.)

Listed below are publications from NHTSA'a Safety Belt Instructional Series. Single copies are available without charge from the NHTSA General Services Division, NAD-42, Washington, D.C. 20590. In quantity they are available from the U.S. Government Printing Office, Public Documents Department, Washington, D.C. 20402, at the prices shown plus $1 for each mail order.

Safety Belt Activity Book, Stock No. 050-003-00246-1, Price each: $1.30.

The Safety Belt Message, Stock No. 050-003-00224-5, Price each: 45¢.

Getting The Safety Belt Message Across, Stock No. 050-003-00245-3, Price each: 35¢

Teaching The Safety Belt Message, Stock No. 050-003-00248-8, Price each: 35¢.

Encouraging Employees to Use Safety Belts, Stock No. 050-003-00247-0, Price each 75¢.

"How Many of These Fairy Tales Have You Told?", Stock No. 050-003-00251-8, Price each: 70¢.

The Automobile Safety Belt Fact Book, Stock No. 050-003-00250-0, Price each: 80¢.

The Safety Belt Game, Stock No. 050-003-00246-1, Price each: $1.30.

Some recent NHTSA publications on Occupant Crash Protection:

"Seat Belt Performance of Manual and Automatic Systems Installed in the GM Chevrolet Chevette and the VW Rabbit", DOT-HS-805-203, December 1979.

"Restraint Usage and Effectiveness on the National Crash Severity Study", DOT-HS-805-151, September 1979.

"1979 Survey of Public Perceptions on Highway Safety", DOT-HS805-165, July 1979.

"An Examination of the Comfort and Convenience of 1979 Safety Belt Systems", DOT-HS-8-01984, January 1979.

"Safety Belt Usage, Survey of Cars in the Traffic Population", Interim Report, DOT-HS-7-01736, December 1978.

"Consumer Resource Guide", DOT-HS-805 269, May 1979.

APPENDIX B

DOMESTIC MANUFACTURERS OF SAFETY COMPONENTS

Airbag Component Manufacturers:

Delco Electronics (Division of General Motors)
700 E. Firmin Street, Kokomo, Indiana 46901.

Essex Group (Division of United Technologies Corporation)
5200 Auto Club Drive, Dearborn, Michigan 48126.

Hamill Manufacturing Company (Division of Firestone Tire & Rubber Company)
61166 Van Dyke Avenue, Washington, Michigan 48094.

Rocket Research Corporation (Division of Rockor Corporation)
York Center, Redmond, Washington 98052.

Talley Industries, Inc.
Box 849, Mesa, Arizona 85201.

Thiokol Chemical Corporation
Box 524, Brigham City, Utah 48302.

Toshiba America, Inc.
Suite 165, 23777 Greenfield Road, Southfield, Michigan 48075.

Uniroyal
312 North Hill Street, Mishawaka, Indiana 46544.

Safety Belt Manufacturers:

Allied Chemical Corporation, Automotive Products Division
353 Cass Avenue, Clemens, Michigan 48043.

American Safety Equipment Corporation
16055 Ventura Boulevard, Encino, California 91316.

General Safety Corp.
23001 Industrial Drive, West, St. Clair Shores, Michigan 48080.

Hamill Manufacturing Company (Division of Firestone Tire & Rubber Company)
61166 Van Dyke Avenue, Washington, Michigan 48094.

Irvin Industries, Inc.
2100 Greenleaf Street, POB 391, Evanston, Illinois 60202.

Jeffrey-Allan Industries, Inc.
2100 Greenleaf Street, POB 391, Evanston, Illinois 60202.

Pontonier Division of Gateway Industries, Inc.
8825 South Greenwood Avenue, Chicago, Illinois 60619.

Superior Industries International, Inc.
POB 7603, Van Nuys, California 91409.

Seat Belt Webbing Manufacturers:

Charley Company, Inc.
POB 2655, Palm Beach, Florida 33480.

International Webbing, Inc.
6th & Union Streets, Whitehall, Pennsylvania 18052.

Murdock Webbing Co.
27 Foundry Street, Central Falls, Rhode Island 02863.

Narricot Industries, Inc.
1131 East Venango Street, Philadelphia, Pennsylvania 19134.

Phoenix Trimming Company
910 Skokie Boulevard, Northbrook, Illinois 60062.

Southern Weaving Company
POB 367, Greenville, South Carolina 29602.

Thread Manufacturers:

Eddington Thread Manufacturing Company
Eddington, Pennsylvania 19020.

Henry Myer Thread Manufacturing Company
530 East Santa Rosa Drive, Des Plaines, Illinois 60018.

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Allied Chemical Corporation, Fibers Division
1411 Broadway, New York, New York 10018.

Celanese Fibers Marketing Company
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