THE FOURTEENTH INTERNATIONAL TECHNICAL CONFERENCE ON ENHANCED SAFETY OF VEHICLES

PROCEEDINGS

VOLUME 1

1969 ENHANCED SAFETY OF VEHICLES 1994

[redacted]

MUNICH, GERMANY

MAY 23-26, 1994

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

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

The Fourteenth International Technical Conference on Enhanced Safety of Vehicles

Sponsored by:
U.S. Department of Transportation
National Highway Traffic Safety Administration

Hosted By:
Federal Republic of Germany

Held At:
Munich, Germany
May 23-26, 1994

Foreword

This report of the proceedings of the Fourteenth International Technical Conference on the Enhanced Safety of Vehicles was prepared by the National Highway Traffic Safety Administration, United States Department of Transportation.

We wish to thank the authors and all those responsible for the excellence of the material submitted, which aided materially in the preparation of this report.

For clarity and because of some translation difficulties, a certain amount of editing was necessary. Apologies are, therefore, offered where the transcription is not exact.

Introduction

The International Experimental Safety Vehicles (ESV) Program originated under NATO's Committee on the Challenges of Modern Society (CCMS) and was implemented through bilateral agreements between the United States Government and the governments of France, the Federal Republic of Germany, Italy, the United Kingdom, Japan, and Sweden. The participating nations agreed to develop experimental safety vehicles to advance the state-of-the-art in safety engineering and to meet periodically to exchange technical information on their progress. Over time the focus of the Conferences has shifted from concentration on the development of experimental safety vehicles to broader issues of motor vehicle safety. In 1991, the name of the Conference was changed to "The International Technical Conference on the Enhanced Safety of Vehicles" (ESV) to reflect these broader issues.

To date, thirteen international conferences have been held, each hosted by one of the participating governments. These conferences have drawn participants from government, the worldwide automotive industry, and the motor vehicle safety research community. International cooperation in motor vehicle safety research continues at the highest level.

The proceedings of each Conference have been published by the United States Government and distributed worldwide. These reports, which detail the safety research efforts underway worldwide, have been recognized as the definitive work on motor vehicle research.

We are certain that this outstanding example of international cooperation seeking reductions in motor vehicle deaths and injuries will continue its past success.

The Effect of Countermeasures To Reduce the Incidence of Unintended Acceleration Accidents

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ABSTRACT

This paper provides a description of "Unintended Acceleration" (*UA*) in passenger cars, provides data pertaining to the scope of the problem (number of accidents and injuries reported annually to NHTSA), identifies the known causes of *UA*, discusses countermeasures to reduce the incidence of *UA*, and provides analysis to asses the reductions in the *UA* accident rates which have resulted from the use of automatic shift locks.

UA reports are defined as incidents of high powered unwanted vehicle acceleration from a stationary position or very slow speed, accompanied by reportedly ineffective brakes. Previous studies and investigations performed by the National Highway Traffic Safety Administration (NHTSA), and by Canadian and Japanese government agencies have concluded that the major causes of such incidents has been drivers unknowingly depressing the accelerator instead of the brake pedal on automatic transmission equipped cars.

Based on data obtained from NHTSA's computerized consumer complaint file system, and information obtained in the course of agency defect investigations, the paper concludes that the best known countermeasure to *UA* has been factory installation of automatic shift lock systems which prevent the driver from shifting the transmission out of Park unless the brake pedal is being applied simultaneously. A comparison of reported *UA* accident rates (accidents per vehicles produced) for automatic transmission equipped cars indicates that cars equipped with shift locks have experienced *UA* accidents at approximately ½ to ¼ the rate of comparable cars without shiftlocks. Also, the effect on *UA* of retrofitting shift locks on one particular make/model is assessed.

INTRODUCTION

One Example of "Unintended Acceleration" (*UA*)

Washington Square Park in New York City is crowded with people enjoying the sunshine on one of the first pleasant warm afternoons in April 1992. The park is alive with a diversity of people: college students from nearby New York University, elderly retirees, mothers with children, street musicians, and a man walking his dog. Many people are sitting on benches lining both sides of a paved walkway which extends from the statue of Garibaldi to the street, while others walk or stand, conversing with friends on the more than 20 feet wide walkway.

Outside the park, the driver of a double parked car shifts the transmission into "Drive." To her horror, the wheels spin as the car lurches forward toward the park at the end of the street, almost 120 m straight ahead. "Knowing" her foot is on the brake, she pushes on the pedal as hard as she can, but the car continues to accelerate, crosses two intersections, and hits the curb at the edge of the park at over 80 km/h. The impact with the curb blows out a tire and deflects the car upwards through the air before it obliterates a concrete drinking fountain in the center of the walkway and comes back down. People try to get out of the way, but many are hit by the car and several people are thrown through the air. The car continues to move along the walkway, hits the occupied benches on the right, and veers slightly left across the walkway into the benches on the other side. Finally, after traveling more than 60 m inside the park, it stops with one person on the hood and two or three people underneath the car.

Some bystanders wanted to punch the driver, expecting to find a homicidal maniac or someone "high" on drugs. No one did so, because the driver was a frightened, slight, elderly woman who said she had been pushing on the brake pedal, but there was something wrong with the car. Five people died and 26 people, between the ages of 1 and 84, were injured. The police collected enough shoes scattered at the scene to fill a large plastic trash bag.

Vehicle defects which could have caused the car to accelerate so rapidly while the driver was pushing on the brake pedal were not found after the accident. Furthermore, witnesses indicated that the brake lights were not illuminated at any time during the *UA* incident, even though they were found to function normally after the accident. This was the worst *UA* accident on record.

Typical *UA* Incidents

The National Highway Traffic Safety Administration (NHTSA) frequently receives letters and telephone calls from drivers who report incidents involving vehicles which seemed to suddenly accelerate very rapidly from a stationary position until they crashed. Typically, the driver reports that pushing on the brake pedal had no effect whatsoever and that the vehicle only stopped when it crashed. In most cases the vehicle began to accelerate as rapidly as possible immediately after the driver shifted the automatic transmission into Drive or Reverse. Evidence of high engine power output is frequently found, consisting of acceleration skid marks (the wheels spun) which begin where the vehicle had been parked, and crash damage which indicates that the vehicle had accelerated at the maximum rate possible for that specific vehicle. The term "Unintended Acceleration" (*UA*) has been applied to describe such types of complaints, which involve all of the three following elements:

1. High-powered unwanted vehicle acceleration;
2. From a stationary position or very slow speed (parking lot, driveway speed); and,
3. Accompanied by apparently ineffective brakes

Less severe types of unwanted engine power problems, such as abnormally fast idle or throttle sticking problems which can be controlled with the brakes, are not considered to be *UA*, even though such problems can be safety related.

Scope of The Problem

Figure 1 shows the number of *UA* accidents which have been entered into NHTSA's computerized consumer complaint data system. This file only contains reports of accidents which were submitted voluntarily (Information obtained directly from manufacturers during specific investigations is not included in the data base.), but it is useful for making comparisons among different groups of vehicles. Figure 1 is based on reports received prior to March 31, 1993, which allege that an accident occurred, and which were entered under a fault code for "Engine Runaway/Sudden Acceleration or Surge." Only reports of accidents, rather than all incident reports, were considered because some of the reports of "Engine Runaway" or "Surge" contained in the file involve incidents which do not meet the criteria for *UA*. For example, an engine surging incident in which the driver was able to control the vehicle sufficiently to avoid an accident, probably did not involve the high engine power accompanied by ineffective brakes typically found during *UA* incidents. However, the unexpected high-powered acceleration of *UA*, accompanied by an apparent loss of braking effectiveness, almost always results in a crash.

Surging incidents which surprise the driver in a confined area, resulting in a collision before the driver has had time to make effective use of the brakes, can be difficult to classify because it is not clear whether or not the brakes would have stopped the car if more distance had been available. Classifying such accidents as *UA*, as was done for this analysis, is reasonable, since the majority of such accidents are reported by the drivers as having been caused by *UA*, and even a detailed reading of such reports frequently does not remove all ambiguity pertaining to braking effectiveness. Limiting the analysis to accident data removes some of the subjectivity from the classification process.

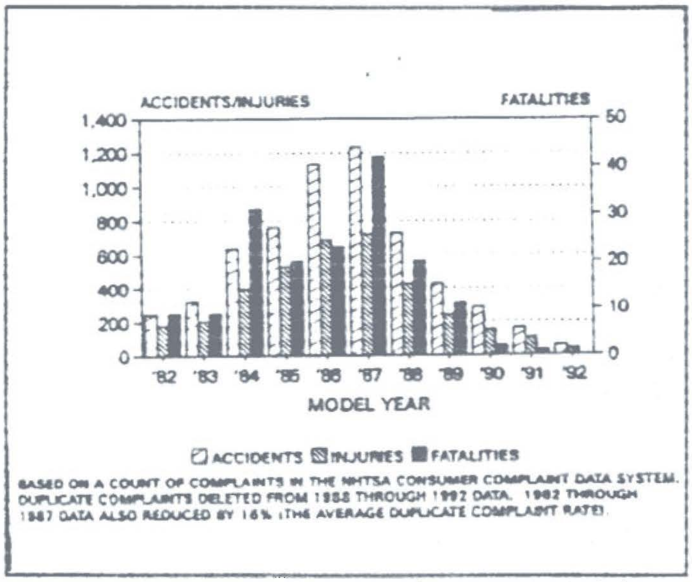

Figure 1. Reported *UA* Accidents Per Model year.

Figure 1 does not provide a completely accurate comparison between different model years, because it is cumulative data, and the older cars have had greater exposure. Exposure, however, does not by itself account for all of the apparent decline in the *UA* accident rate, because most of the complaints for a given model year are obtained during the first 2 years on the road, and the annual complaint rate continues to decline as the vehicles become older. The exceptionally high rates for 1986 and 1987 model years appear to have resulted partially from an increased "reporting" rate resulting from extensive news media publicity concerning *UA* which was disseminated in 1986 and 1987.* The apparent reduction in the *UA* accident rate of 1988 and newer models is discussed later in this report in the section titled "Effectiveness of Shift Locks In Passenger Cars."

CAUSES OF UNINTENDED ACCELERATION

Pedal Misapplications

Most drivers who experienced *UA* claim that the vehicle must have malfunctioned in some mysterious way, but in the vast majority of cases, no vehicle defects which would explain the vehicle's apparent behavior are ever found. The vehicle's manufacturer usually claims that the driver simply stepped on the accelerator pedal instead of the brake pedal. Such a pedal misapplication by the driver just before shifting out of Park provides a logical explanation, because this would cause a vehicle to accelerate abruptly as soon as the transmission engages in a moving gear. A driver who believes that his/her right foot is on the brake pedal could be expected to react to sudden unexpected acceleration by pushing more forcefully on that pedal to obtain maximum braking. As a result, the accelerator pedal would be depressed as far as possible, causing it to feel firm like a brake pedal, the throttle would be held in the fully open, maximum engine power position, no braking action would be produced, and no relevant vehicle defects would be found afterwards. That explanation is also consistent with the following facts and observations:

- Most *UA* incidents began as soon as the driver shifted an automatic transmission out of Park or into or out of Reverse.

  Pedal misapplications are more likely to occur when the driver makes the first brake application after entering the car or when the upper body is rotated to look behind the vehicle.

- Reports of *UA* are not received for cars with manual transmissions.

* Reinhart, W. 1989. Investigative Report, ODI Case No. C86-001 (1978-1986 Audi 5000 Passenger Cars) NHTSA. 32-33.

A car with a manual transmission cannot be put in motion unless the driver correctly places one foot on the clutch and the other on the accelerator pedal.

- o Reports of *UA* have been received for all common makes, models, and model years of cars sold in substantial quantities with automatic transmission during the last 20 years.

  Many different engine and braking system design features have been utilized, and many changes in vehicle design have been made during the last 20 years, but the basic characteristics of human beings pertaining to perception, neuro-muscular control and feedback, panic reactions, etc., have not changed.

- o Elderly drivers have experienced a disproportionally large number of *UA* accidents. For certain domestic cars, the mileage based reported *UA* accident rate for drivers over the age of 70 was approximately 5 times above average.*

  The fact that drivers over the age of 70 have also experienced a substantially higher accident rate for other types of accidents, most of which do not involve vehicle defects, demonstrates that elderly drivers are more likely to make driving errors than younger drivers.**

- o Drivers of borrowed or newly obtained cars have experienced a disproportionately large number of *UA* accidents.***

  Drivers who have only limited experience driving a newly obtained car, in spite of extensive experience with other cars, are more likely to experience an "aiming error."*

- o The average height of drivers who experienced *UA* is less than the height of the average for all drivers.**

  The ergonometric relationship between drivers and the control pedals is different for drivers of different heights.

UA type symptoms can also result if the driver's foot contacts both the brake and the accelerator pedal at the same time. The visible wear found on the rubber brake pedal pads of high mileage passenger cars indicates that most drivers step on the right side, rather than in the middle of the brake pedal. This causes a portion of the driver's shoe to project beyond the right edge of the brake pedal, but this is harmless as long as the accelerator pedal is sufficiently distant in either the horizontal or vertical plane to prevent the shoe from also depressing it. However, dual pedal application can be a problem if the horizontal and vertical offset are both small, and if the brake pedal must be pushed below the height of the accelerator pedal before substantial braking action is produced. Some braking action is obtained in such cases, but the vehicle can accelerate to a moderate speed if the power output exceeds braking action at certain levels of pedal force.*** Dual pedal application can also occur in cars with normally sufficient vertical pedal offset if the driver's foot is angled so that the right side of the shoe is lower, as may occur if the driver's body is twisted to look backwards.

One situation which does not actually constitute a pedal misapplication, but which involves *UA* resulting from driver action, can occur when a vehicle has been stopped parallel to a curb. If the front wheels are turned into the curb without the driver's knowledge, then the vehicle will not move forward after the transmission has been shifted into

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* Reinhart, W. 1986. Engineering Analysis Action Report EA78-110 (1973-1986 GM passenger cars). NHTSA.

** Williams, A. and Carsten, O. 1989. Insurance Institute of Highway Safety Status Report Vol. 24, No. 5.

*** The median experience driving an Audi 5000 passenger car which experienced an *UA* accident was 6 months. Reinhart W. 1989. Investigative Report, ODI Case C86-001. NHTSA.

* Schmidt, R. A. 1989. Unintended Acceleration: A Review of Human Factors Contributions. Human Factors 31(3), 345-364.

** Reinhart, W. 1989. Investigative Report, ODI Case No. C86-001 NHTSA.

*** 1978 through 1983 Audi 5000 vehicles were recalled (Recall Campaign 83V-095) voluntarily by the manufacturer to prevent *UA* by attaching a spacer plate to raise the surface of the brake pedal.

Drive and the driver releases the brake, because the vehicle is restrained by the curb. If the driver then increases power gradually, the vehicle still will not move until engine power output is sufficient to suddenly lift the front of the vehicle over the curb. The driver then has to hastily apply the brake because power output is excessive once the curb no longer restrains the car. A *UA* accident can result if the driver makes a pedal misapplication as he or she tries to hastily apply the brake while being repeatedly jostled physically as each wheel goes over the curb, or if the driver is not able to apply the brake during the short distance which may be available to stop on the sidewalk.

Relevant Vehicle Defects

An important aspect of *UA* is the fact that drivers allege that pushing on the brake pedal did not noticeably affect the unwanted acceleration. This means that, in addition to the vehicle having a defect which produces unwanted engine power, the braking system also would have had to fail. Tests conducted with numerous vehicles demonstrated that pushing on the brake pedal with reasonable force decelerates and stops any passenger car with normal brakes,* even if the accelerator pedal is held in the maximum power position.**

Since defects in two different vehicle systems must occur simultaneously to produce *UA*, it is not surprising that such defects are found only in rare instances. In such rare cases, the relevant braking system malfunction is then repeatable and detectable. For example, if the driver fully depressed the accelerator pedal before starting the engine, and if the pedal or throttle linkage then became stuck, then the engine would produce very little vacuum for a vacuum power-assisted brake system. If the power brake booster check valve was also defective and failed to retain stored vacuum, then the driver would be confronted with unexpected engine power and a weak braking system as soon as the transmission was shifted out of Park, and *UA* could result. However, this scenario does not occur during the vast majority of reported *UA* incidents, because post-accident investigations of cars which experienced *UA* almost always indicate that the power brake booster stored adequate vacuum for normal power braking action.

Another possible scenario involves a defect (e.g., a stuck throttle) which results in unwanted engine power. If the braking system has a mechanical weakness, such as an abraded hydraulic brake pipe or hose, or a deteriorated seal, then it may fail when the brake is being applied with exceptional force to overcome the unwanted engine power. However, this does not occur during most of the reported *UA* accidents, because post accident investigations in most cases produce no evidence of braking system failures, even though such evidence would have been easily detectable, since the brakes would never again function normally until repairs were made.

In some instances, vehicle defects have been found which contributed to *UA*, even though the brakes would have been capable of stopping the vehicle. For example, if the engine is idling abnormally fast before the transmission is shifted out of Park, a short duration power surge, possibly as severe as one third "g," can be felt by the driver as the rotating parts of the engine, which have considerable flywheel momentum, are coupled to the drive train.* This can startle a driver into making a pedal misapplication, especially if the vehicle is parked in a confined area where the driver's perceptions of speed are enhanced.** Also, incidents involving unwanted engine power caused by vehicle defects are sometimes described as *UA* if the driver does not have sufficient time to make effective use of the brake before hitting a nearby object. Cruise control system defects can also produce unwanted acceleration as long as the brakes are not applied, although a rare combination of two or more simultaneous problems within the

* Pollard, J. 1989. An Examination of Sudden Acceleration. Transportation Systems Center. Report No. DOT-HS-807-367

** Some exceptionally powerful cars with rear wheel drive and good rear tire traction may slow to walking speed, rather than come to a complete stop, as the rear wheels push the car and the front tires slide with locked front brakes. However, evidence of this having occurred has not been found during investigations of *UA* accidents.

* Vehicle Research and Test Center 1987. Inspection and Testing of a 1984 Audi 5000S For Surprise Acceleration. Investigative Case C86-001, Exhibit E15.15 NHTSA.

** Vehicle Research and Test Center 1987. Driver Reaction To Unexpected Fast Engine Speed And Sudden Acceleration. Investigative Case C86-001, Exhibit E15.16 NHTSA.

cruise control system would be required to increase engine power.

Alleged Intermittent Vehicle Defects

Drivers who reported *UA* usually reject the pedal misapplication explanation, based primarily on their own perceptions and the fact that they had never applied the wrong pedal on any previous occasion. Drivers who continued to push on the same pedal until the vehicle crashed are not easily convinced to change their beliefs that they had been pushing on the brake pedal. Such drivers may suspect that something was overlooked during the vehicle examination, especially if the vehicle was equipped with electronic components, which can be suspected of having experienced intermittent malfunctions even if no problem was verified. Some drivers involved in *UA* accidents who were certain that they had not stepped on the wrong pedal hired private experts to find a vehicle defect. Unable to find a verifiable vehicle defect, yet not willing to disbelieve their clients' testimony about applying the brakes, some experts developed theories about vehicle defects which could have caused intermittent malfunctions. Theories about intermittent malfunctions, unlike other theories, are not convincingly disproved merely because the malfunction is not observed after the accident.

One such theory alleges that *UA* is caused by malfunction of the electronic fuel injection system. This theory conflicts with the fact that power output on all modern gasoline engines is controlled by the amount of air which flows past the throttle valve into the combustion chambers of the engine, since fuel cannot be combusted, and power cannot be created, unless the fuel is mixed with air in the proper proportion. Fuel injection systems (and carburetors) are designed to provide the proper amount of gasoline for any given airflow, and only a slight power increase can be obtained by increasing the amount of fuel above the ratio which provides best fuel economy and emissions performance.* No malfunction of the electronic fuel injection system can produce the power exhibited during *UA* accidents, since adding too much fuel actually reduces power, and in extreme cases causes the engine to stop running.

Another theory is that electronic engine idle speed control system malfunction causes *UA*. Most systems control a valve which permits air to bypass the throttle valve, but some others rotate the throttle valve a limited amount. However, such systems cannot produce the high power output which is exhibited during *UA* accidents, because they can either, only move the throttle a limited amount, or control a valve which permits air to bypass the throttle through an air passage. The size of idle air bypass passages is only large enough to permit sufficient airflow, even if the electronic control system opens the idle air valve 100 percent, to produce only a fraction (less than 20 percent) of the power which the engine could produce with a fully open throttle.

Electromagnetic interference (EMI) or radio frequency interference (RFI), sometimes allegedly produced by television transmitters or airport radar, have been speculatively cited as possible causes for idle speed control or fuel injection system malfunctions which were not repeatable. However, EMI or RFI could not have caused all of the elements of *UA* because, as previously explained, neither the idle speed nor the fuel injection system is capable of producing the magnitude of power which is exhibited during *UA* accidents. Cruise control system malfunctions could in extremely rare instances open the throttle and produce near maximum power output, but the majority of the vehicles which experienced *UA* were not equipped with a cruise control system. Also, many cruise control systems utilize a brake pedal controlled switch which releases the vacuum used to power the cruise control servo, thereby mechanically depriving the cruise control system of the force needed to hold the throttle open in opposition to the force of the throttle return springs.

Most *UA* accidents reported to date in the United States involve passenger cars with braking systems which are completely independent of the electrical system (most did not have ABS braking), so that braking system failure could only have occurred if a hydraulic or mechanical component had failed. The fact that braking systems were found to operate normally (or had only crash damage) after almost all of the *UA* accidents which

* The Transportation Systems Center calculated that power on certain Audi engines could be increased by a maximum of 5 percent by changing the air-fuel ratio to maximize power. Pollard and Sussman 1989. An Examination of Sudden Acceleration. TSC. Appendix H.

were investigated is significant, because such braking system failures would not be intermittent, since broken parts or ruptured hydraulic lines, hoses, or seals do not repair themselves.

Another fact which contradicts theories claiming that malfunction of electronic components or other engine related components are the sole cause of *UA* is that *UA* has been reported for all major make, model, and model year vehicles, including vehicles with one, two, three, or four ventury carburetors, all different types of fuel injection systems, as well as Diesel engines. Not only does this group of vehicles include a great diversity of electronic components, but many of the older vehicles which experienced *UA* did not utilize any electronic components which could increase engine power or affect the brakes.

Although it is not impossible that, in general, an investigator might occasionally fail to find an existing defect, the fact that numerous investigators, investigating different *UA* accidents in different countries, in almost all cases have not found defects which could have produced maximum engine power and simultaneous brake failure, serves as extremely strong evidence that such intermittent defects did not exist. It is extremely unlikely that engine control and braking system defects would suddenly occur at the same time and then correct themselves after an accident.

COUNTERMEASURES

Introduction of Automatic Shift Locks

In August 1986, the importer of Audi 5000 passenger cars (Audi) began to retrofit a shift lock system in the 1984 through 1986 Audi 5000 vehicles which were the subject of a NHTSA investigation which was based on reports of *UA*.* Shift lock systems, which were invented by Audi, were designed to preven *UA* accidents by preventing drivers from shifting an automatic transmission out of Park unless the brake pedal was being depressed simultaneously. Shift locks do not make pedal misapplications completely impossible, but they greatly reduce the frequency of pedal misapplications, because a driver is less likely to depress the wrong pedal after having correctly applied the brake pedal at the beginning of each driving session. In January 1987, Audi voluntarily agreed to complete the shift lock retrofit program as a formal safety recall campaign involving all 1978 through 1986 Audi 5000 vehicles included in the NHTSA investigation.*

Effectiveness of Retrofitted Shift Locks In Audi 5000 Passenger Cars

By the end of December 1986, the percentage of Audi 5000 vehicles equipped with shift locks had increased to approximately 35 percent, and a reduction in the number of *UA* accidents which reportedly occurred each month began to be noticeable. Figure 2 shows that the decline in the number of *UA* accidents which reportedly occurred each month continued until the number stabilized by approximately October 1987, when the percentage of Audi 5000 vehicles equipped with shift locks had reached approximately 70 percent. Shift locks continued to be installed after October 1987, but at a relatively slow rate. A 100 percent completion rate was not possible because some vehicles had been scrapped, and some vehicle owners could not be located or chose not to participate in the recall campaign.

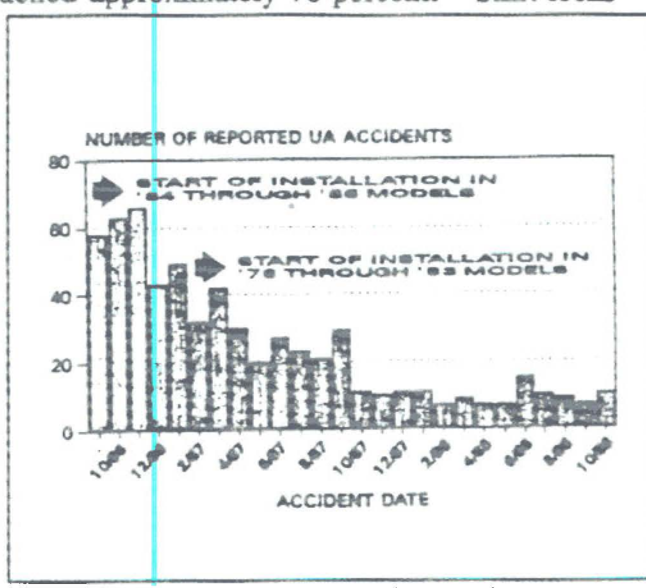

Figure 2. Effect of retrofitting shift locks on the number of *UA* accidents reported for each month for Audi 5000 passenger cars.

* Investigative Case C86-001. Sudden Unwanted Acceleration in 1978 through 1986 Audi 5000 passenger cars equipped with automatic transmissions.

* Shift lock installation was begun as Audi Service Action FY; which was replaced by NHTSA Recall Campaign No. 87V-008.

The analysis of shift lock system effectiveness is complicated slightly by the fact that Audi also performed recall campaigns to correct erratic engine idling problems in some of the Audi 5000 vehicles beginning in February 1987,* and October 1987.** These recalls also relate to *UA* because an unexpected fast engine idle condition can startle drivers at an inopportune time and location, thereby increasing the likelihood that a pedal misapplication may occur. However, Figure 2 shows that the number of *UA* accidents reported for each month had already declined significantly by February 1987, when approximately 40 percent of the Audi 5000 vehicles had been equipped with shift locks, but the idle speed control recalls were just beginning to be performed. Furthermore, the last idle speed control recall (begun in October 1987) did not appear to have a substantial effect, based on the data presented in Figure 2.

In December 1987, after shift locks had been retrofitted in most of the Audi 5000 vehicles, NHTSA mailed a questionnaire to approximately 100,000 Audi 5000 owners to find out if they had experienced any problems related to *UA*. The vehicle manufacturer provided specific information for each vehicle whose owner had reported a relevant problem, including whether or not a shift lock system was installed, and the date it was installed. This provided an opportunity to evaluate the effectiveness of shift locks, since most of the vehicles had been operated for substantial periods of time without, and then with, shift locks.

After the dates of the reported *UA* accidents were compared to the dates when shift locks were installed in each specific vehicle, it was found that cars without shift locks had experienced an average of 2.8 times the *UA* accident rate of cars equipped with shift locks. This data is shown in Figure 3.

* NHTSA Recall Campaigns 87V-008 (all 1978 through 1986 models), and 87V 009 (1985 and 1986 models without turbo-chargers).

** NHTSA Recall Campaign 87V-170 (All 1984 models and turbocharged 1985 models).

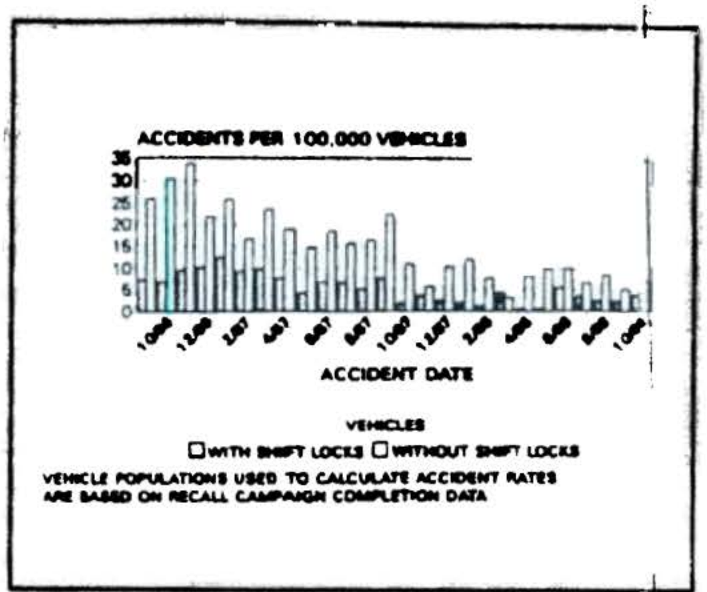

Figure 3. Effect of Retrofitting shift locks on the monthly reported *UA* accident rates for 1978 through 1986 Audi 5000 passenger cars.

Shift Lock Installations In Passenger Cars

The 1987 model year Audi passenger cars were the first cars which were sold in the United States equipped with factory installed shift locks. Nissan also began to install shift locks in 1987 Nissan 300ZX cars,* and the Japan Automobile Manufacturers Association agreed in December 1987 that its members would begin to phase in shift locks until all cars with automatic transmissions produced in Japan for sale in Japan would have shift locks. Toyota introduced shift locks in its 1988 Corolla models, and Honda, Mazda, and Nissan produced several 1989 models with shift locks. The Ford Motor Company began to install shift locks in some 1990 Ford models, and General Motors Corporation began to install then in some 1991 models. Appendix A lists all 1988 through 1992 passenger car models which were sold in the United States equipped with shift locks. Figure 4 shows the increase in shift lock installations.

* Shift locks were retrofitted to 1979 through early production 1987 models during a recall campaign (NHTSA No. 87V-091).

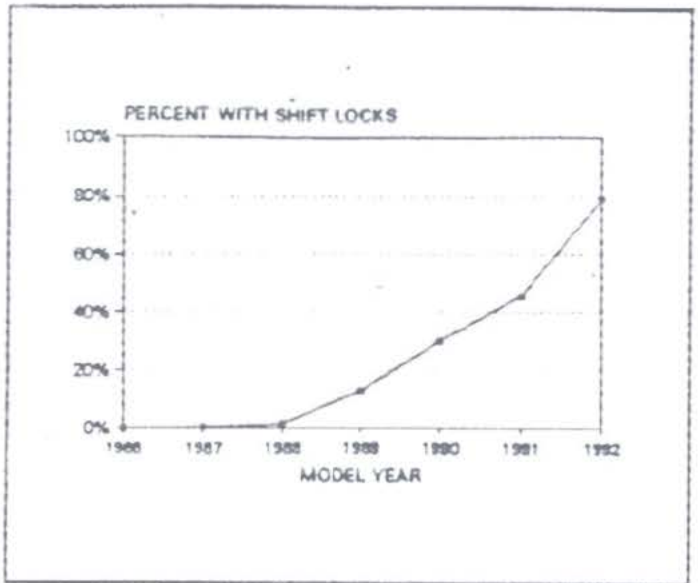

Figure 4. Percent of automatic transmission passenger cars sold in the U.S. equipped with shift locks.

Effectiveness of Shift Locks

A comparison of the *UA* accident rates reported to NHTSA for passenger cars with and without shift locks was made utilizing NHTSA's computerized consumer complaint data system. Table I compares the *UA* accident rates for cars with and without shift locks for each specific model year since 1988 (the first year when a substantial number of vehicles were equipped with shift locks). Different model years are not directly comparable because the older vehicles have had more exposure time.

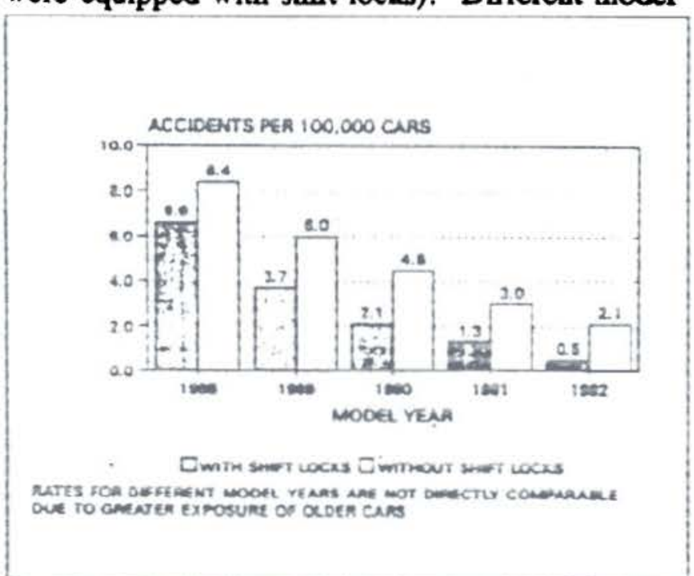

Figure 5. Reported *UA* accident rates for passenger cars with and without shift locks.

Table 1
Comparison of Accident Rates

Model Year	1988	1989	1990	1991	1992
Automatic Transmission Cars Without Shift Locks					
Reported Accidents	721	391	237	121	31
Vehicles Sold (thousands)	8,560	6,540	5,250	3,990	1,496
Accident Rate (per 100,000)	8.4	6.0	4.5	3.0	2.1
Cars With Shift Locks					
Reported Accidents	8	36	48	44	30
Vehicles Sold (thousands)	121	975	2,290	3,350	5,730
Accident Rate (per 100,000)	6.6	3.7	2.1	1.3	0.5
All Cars With Automatic Transmissions					
Percent With Shift Locks	1.4%	13%	30%	46%	79%
UA Accidents Avoided By Shift Locks *	22%	38%	54%	57%	76%

Percent *UA* accidents avoided due to shift locks in Table 1 was calculated as: [1-(accident rate for cars with shift locks/accident rate for cars without shift locks)] x 100%. Table 1 is derived from data presented in Appendix A.

Table 1 and Figure 5 provide strong evidence that shift locks have prevented a substantial number of *UA* accidents. The effectiveness of shift locks provides evidence that pedal misapplications have been the major cause of *UA*, since shift locks do not correct any engine or braking system defects, but only influence driver behavior.

It is notable that the calculated shift lock effectiveness for 1988 models is less than half the calculated effectiveness of later model years. This probably resulted from the fact that shift locks were installed in only those 1988 model year cars (less than 2 percent) which had in prior model years experienced the highest rates of reported *UA* accidents, and which had been the subjects of

NHTSA investigations.* It may be that the reduction in pedal misapplications due to the shift locks in the 1988 models was partially obscured by the greater propensity of those specific models to be subjected to all types of pedal misapplications, including those situations during which shift locks cannot prevent them (e.g., when *UA* was not immediately preceded by a transmission shift out of Park). Also, the percentage of *UA* accidents which were reported and entered into the database was probably higher for the models which were identified in publicity resulting from the NHTSA investigations. The benefits of shift locks became more apparent as manufacturers added shift locks to more of their models during subsequent years and the population of shift lock equipped cars became more typical of the entire automatic transmission equipped passenger car population.

Situations Affected by Shift Locks

The reports for 1991 and 1992 models were reviewed to determine the shifting sequence which preceded each reported *UA* accident.** Table 2 shows the shift sequence which was reportedly performed just before the *UA* began.

The shift sequences in Table 2 are based primarily on the recollection of the subject drivers pertaining to the transmission shift which triggered the *UA*. Shifting performed after the *UA* had begun and shifts made shortly, but not immediately, before the *UA* began are not shown in Table 2. For example, if *UA* began when the driver reportedly applied the brake one or two seconds after having completed shifting out of Park into Drive, then the incident would be coded as D/D for Table 2. Also, in some instances the actual shift sequence may have been different than what the driver remembers. For example, 11 of the reports indicate that the vehicle accelerated in Park, even though the car should not move in Park. Probable explanations include a misadjusted gear selector linkage which caused the transmission to be in Reverse gear (the position adjacent to Park) in some instances, or driver confusion in other cases.

Table 2
Shift Sequence Immediately Prior to Each *UA* Accident

Shift * Sequence	Cars Without Shift Locks		Cars With Shift Locks	
	Reports	Percent	Reports	Percent
P/R	23	25%	5	12.5%
P/N	1	1%	0	0%
P/D	40	44%	3	7.5%
Total From Park	64	70%	8	20%
P/P	9	10%	1	2.5%
R/R	3	3%	2	5%
N/N	0	0%	2	5%
D/D	11	12%	23	57.5%
Total No Shift	23	25%	28	70%
N/D	0	0%	1	2.5%
R/D	3	3%	2	5%
D/P	1	1%	1	2.5%
Total Other	4	4%	4	10%
Total Reviewed	91		40	

* Shift Sequence: From/To. No shift if both are the same.
P = Park, R = Reverse, N = Neutral, D = Drive.

It can be seen from Table 2 that the largest category (64 reports; 70%) of the reported *UA* accidents for cars without shift locks occurred when the driver shifted out of Park. This category only constitutes eight reports (20%) of the reported *UA* accidents for cars equipped with shift locks. The conclusion that pedal misapplications made just before or while shifting out of Park have been the major cause of *UA* is supported by this data, which shows that avoidance of that specific type of accident has enabled shift lock equipped cars to experience a substantially lower *UA* accident rate than cars without shift locks. Conversely, it is not

* The 1978 through 1987 Audi 5000 cars had produced a combined reported *UA* accident rate of 586 reports per 100,000 cars.

** Shift sequence was determined from the computer summary for each individual report, or where necessary, by reading the actual complaint document.

surprising that the largest category of *UA* accidents for cars with shift locks involves *UA* which began when the transmission was not being shifted.

One seemingly unexpected result is that 20 percent of the reported *UA* accidents for cars with shift locks allegedly occurred when the transmission was shifted out of Park, even though the shift lock system should not have permitted shifting out of park if the driver was stepping on the wrong pedal. One possible explanation is that the *UA* may have begun shortly, but not immediately, after the driver shifted out of Park. For example, if a driver is startled by an abnormally fast idle condition which was not noticed until the driver released the brake immediately after shifting out of Park, the driver may then hastily attempt to re-apply the brake but make a pedal misapplication. Also, in confined areas, an accident can result even if a driver, surprised by a fast idle speed, correctly steps on the brake pedal, because it may be too late to stop the vehicle within the small distance available. Such incidents may then incorrectly be described as *UA*. In general, many drivers who experienced a *UA* accident (with or without shift locks) became confused and disoriented by the rapid, frightening events occurring during the incident, to the extent that their best recollection of the precise details surrounding the events which occurred may be faulty.

Safety Defect Recall Campaigns

On numerous occasions, NHTSA has been asked by vehicle owners and other parties to investigate complaints of *UA*, to identify relevant vehicle defects which could then be corrected during recall campaigns performed by the manufacturers. In spite of numerous different investigations conducted throughout the last 20 years, defects which resulted in full power acceleration accompanied by complete brake failure have never been found applicable to a group of vehicles.

However, numerous recall campaigns have been conducted to correct defects which were related to *UA* because they produced unwanted engine power. In a few cases involving special circumstances and vehicles with vacuum assisted power brakes, braking effectiveness could be reduced to the extent that some drivers might report apparent brake failure. For example, some 1965 through 1970 passenger cars had a design which permitted the throttle to be pulled open if a rubber engine mount failed and engine torque caused the engine to roll slightly within the engine compartment.* Normally, with such a failure, the brakes would still easily stop the car, but if the power brake vacuum hose from the intake manifold also pulled the vacuum check valve out of the power brake booster, then the brakes would revert to a manual mode, and some drivers might not have sufficient strength to obtain adequate braking. A similar loss of power braking assist could also occur on other cars if the stored vacuum in the power brake booster had leaked out while the car was parked and, at the same time, the throttle linkage became stuck as the driver depressed the accelerator pedal before starting the engine. It is noteworthy that after 1978 through 1983 Audi 5000 vehicles were recalled to prevent accelerator pedals from getting stuck in the fully depressed position, those vehicles continued to generate a disproportionate number of new reports of *UA* until an additional recall was performed to install shift locks.** The accelerator pedal defect apparently was less of a problem than pedal misapplications, probably because only a small percentage of the accelerator pedals actually became stuck.

The most common vehicle defects found in the past which relate to *UA* involve unwanted engine power. As previously stated, unwanted engine power can normally be easily controlled with the brakes, but the element of surprise can result in accidents which may be described as *UA*, and, in some cases, *UA* may actually result if the driver makes a pedal misapplication. Appendix B lists all NHTSA investigations and recall campaigns directly and indirectly related to *UA*.

Control Pedal Design

Several studies have been performed which attempted to correlate vehicle control pedal designs with the *UA* accident rate, since it was suspected that certain pedal design features would influence the frequency of pedal misapplications. One early study, performed in 1982 as part of a defects

* NHTSA Recall No. 71V-235 (1965-1970 Chevrolets)

** NHTSA Recall No. 82V-037 (1978 through 1983 Audi 5000) investigation, failed to establish a link between control pedal dimensions and *UA* on 84 different 1973 through 1981 model year domestic passenger cars.* Two additional studies, one involving 24 different 1976 through 1982 model year domestic cars,** and the other involving 10 different 1976 through 1982 imported cars,*** were performed in 1984. These studies, which included measuring additional pedal dimensions, as well as pedal force/displacement characteristics, also did not provide a basis for predicting the frequency with which drivers were likely to step on the wrong pedal. However, 1978 through 1983 Audi 5000 vehicles were recalled to raise the height of the upper brake pedal surface, after Audi was informed that NHTSA test results indicated that dual pedal misapplications were more likely to occur with 1978 through 1983 Audi 5000 vehicles than with any of the other cars tested.****

It is intuitively obvious that separating the brake and accelerator pedals with large distances in both the horizontal and the vertical planes would reduce the frequency of pedal misapplications. However, possible pedal locations are limited by the space available in the vehicle, as well as comfort considerations for a wide range of drivers of different sizes. Also, increasing vertical offset increases the time required for a driver to quickly release the accelerator pedal and lift his or her foot up and over the brake pedal to make an emergency brake application. During a study performed at Virginia Polytechnic Institute using a laboratory simulator on which the pedals were adjusted to duplicate the dimensions of four different actual cars, the largest number of "pedal errors" occurred with a vehicle with a relatively large vertical pedal offset, but which had experienced a below average

* General Adjustment Bureau. 1982. Control Pedal Evaluation Engineering Analysis E78-110. NHTSA

** Vehicle Research and Test Center. 1984. Control Pedal Performance Evaluation - Domestic Vehicles. NHTSA

*** Vehicle Research and Test Center. 1984. Control Pedal Performance Evaluation - Imported Vehicles. NHTSA

**** NHTSA Recall No. 83V-095 (1978-1983 Audi 5000 Passenger Cars)

UA accident rate in the real world.* The observed "pedal errors" involved drivers scuffing their feet underneath the brake pedal, an action which would not have caused *UA*, but which would have lengthened the effective stopping distance of the vehicle. Although providing a large vertical offset may help prevent *UA* accidents for a few drivers, such a design also produces negative safety consequences in the form of longer braking reaction time for all drivers.

A study performed by the Texas Transportation Institute,** based on both real-world and laboratory observations of drivers, found no single location where all drivers would expect to find the brake pedal. The study produced general guidelines for control pedal design, but no pedal design was found which would prevent all pedal misapplications without producing other negative consequences.

Driver Education

Many of the injuries and some of the fatalities which resulted from *UA* accidents could have been avoided if the drivers had simply turned off the ignition key as soon as the vehicle began to accelerate uncontrollably. Some drivers have experienced panic reactions which caused them to "freeze" and prevented them from steering the car or taking any action other than continuing to push on what they believed was the brake pedal. Another common reaction is for drivers to concentrate on steering, while continuing to push on what they believed was the brake pedal. In some instances, drivers have attempted to shift the automatic transmission into Neutral or Park. That course of action can be helpful, but in many instances the drivers were unable to select the desired gear (probably because they were occupied steering the car), and this sometimes resulted in the vehicle changing direction but crashing nevertheless.

In general, it appears that most of the drivers who experienced *UA* did not respond in the most favorable way, probably because they were

* Rogers, S.B. and Weirwille, W.W. 1988. The Occurrence of Accelerator And Brake Pedal Actuation Errors During Simulated Driving. Human Factors, 30.

** Reinhart, W. 1986. Engineering Action Report EA78-110. NHTSA confronted with an unexpected, stressful situation for which they were never prepared, and which occurred too fast to enable them to take any action other than acting on conditioned reflexes. It would be useful if drivers were prepared to interpret *UA* as a signal that they might not be pushing on the brake pedal, and responded by applying the brake with the left foot and lifting the right foot. However, training drivers not to panic, and how to cope with *UA* once it has begun, has severe practical limitations, especially since most drivers who experienced *UA* obtained their drivers' training many years before the *UA* accident occurred and would have had no opportunity to practice or otherwise refresh such training. Also, *UA* is sufficiently rare that it is doubtful that sufficient driver education resources would be directed at this problem to be effective.

A more practical approach involves educating new drivers in good procedures which should always be followed. The primary procedure applicable to preventing *UA* involves being sure that the brake pedal is being applied before shifting the transmission out of Park. When one manufacturer secretly filmed the feet of drivers, it was found that many drivers who said (and believed) that they had applied the brake before shifting out of Park had actually begun to move the transmission gear selector before they completed moving the right foot onto the brake pedal.* If an aiming error occurred and the foot went on the wrong pedal, such a driver would receive no indication of a problem until the vehicle suddenly accelerated and the driver was confronted with an immediate emergency situation.

A different study based on observing the foot movements and shifting habits of 216 drivers in their own cars found that 35 percent of the drivers did not have any foot on the brake pedal when they shifted out of Park.** Apparently some drivers allow the engine to idle in Park until they are ready to go, at which time they shift into Drive without any pedal being depressed. If the engine idle speed is abnormally fast, or if due to traffic or other reasons, the vehicles' acceleration has to be slowed, the first brake application since the driver entered the car may have to be made in haste. A driver who already has a foot on the brake pedal is in a much better position to respond to unexpected events which may not become apparent until the transmission is shifted out of Park.

Educating drivers to always be certain the brake is being applied before shifting out of Park has some merit, but shift lock systems provide a more reliable method of achieving the desired result. With a shift lock system the driver must apply the brake before the vehicle can be moved, so that the driver's foot will be positioned on the brake pedal at the time when the engine can begin to move the car. Furthermore, driving a shift lock equipped car helps those drivers who had not previously done so develop the habit of always depressing the brake before shifting out of Park.

SUMMARY

- Pedal misapplications by drivers who inadvertently and unknowingly stepped on the accelerator instead of the brake pedal have constituted the most common cause of *UA*.

- Vehicle defects which by themselves caused all of the symptoms of *UA*, including high powered acceleration from a stationary position accompanied by completely ineffective brakes, have been found only in rare isolated instances.

- Vehicle defects which produce unwanted engine power, even though the brakes remain capable of stopping the car, can generate reports of *UA* for two reasons; drivers may not be able to react fast enough to use the brake to stop in certain confined parking areas, and drivers who are startled at inopportune times are more likely to make a pedal misapplication.

- Automatic shift lock systems which prevent the driver from shifting an automatic transmission out of the Park position unless the brake pedal is being applied simultaneously constitute the most effective known countermeasure for preventing *UA* accidents.

* Reinhart, W. 1986. Engineering Action Report EA78-110. NHTSA

** Brackett, Pezoldt, Sherrod, and Roush. 1989. Human Factors Analysis of Automotive Foot Pedals. Texas Transportation Institute. DOT Report DOT HS 807 512

Consumer complaint data received by NHTSA indicates that passenger cars equipped with shift locks have experienced a reported *UA* accident frequency substantially less than half the rate of comparable cars without automatic transmission shift locks.

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MAKE	MODEL	1988 MODELS VEHICLES SOLD	1988 REPORTED ACC.	1988 RATE	1989 MODELS VEHICLES SOLD	1989 REPORTED ACC.	1989 RATE	1990 MODELS VEHICLES SOLD	1990 REPORTED ACC.	1990 RATE	1991 MODELS VEHICLES SOLD	1991 REPORTED ACC.	1991 RATE	1992 MODELS VEHICLES SOLD	1992 REPORTED ACC.	1992 RATE	NOTES
ACURA	ALL ACURA							88,386	5	5.7	85,513	3	3.5	90,094	1	1.1	
ACURA	LEGEND				57,061	3	5.3	Y			Y			Y			
AUDI	ALL AUDI	11,866	2	16.9	11,781	1	8.5	17,099	0	0.0	9,381	0	0.0	9,421	0		(1)
BMW	ALL BMW													45,000	1	2.2	(2)
BUICK	SKYLARK													60,647	0		
BUICK	LESABRE										90,756	2	2.2	171,551	0		
BUICK	PARK AVENUE										109,482	0	0.0	68,942	0		
BUICK	RIVIERA													5,200	0		(3)
BUICK	ROADMASTER													85,532	1	1.2	
CADILLAC	DEVILLE/FLEETWOOD										147,910		0.7	142,328	0		
CADILLAC	ELDORADO													31,151	0		
CADILLAC	SEVILLE													43,954	0		
CHEVROLET	CAPRICE													116,781	1	0.9	
CHEVROLET	CAVALIER													187,952	0		
DODGE/PLYMOUTH	COLT							8,514	1	11.7	13,528	2	14.8	9,000	0		
DODGE	STEALTH										6,932	0	0.0	0	0		
EAGLE	SUMMIT							6,517	0	0.0	15,018	1	6.7	5,469	0		
EAGLE	TALON							6,800	0	0.0	12,104	0	0.0	10,479	0		(4)
FORD	CROWN VICTORIA													86,000	0		(5)
FORD	ESCORT										199,203	3	1.5	70,314	1	1.4	
FORD	FESTIVA							15,659	0	0.0	8,273	0	0.0	7,278	0		
FORD	MUSTANG										61,711	2	3.2	46,555	0		
FORD	PROBE							69,675	0	0.0	53,216	1	1.9	24,826	0		
FORD	TAURUS													334,248	3	0.9	
FORD	TEMPO													194,485	0		
FORD	THUNDERBIRD										80,909	1	1.2	72,636	0		
GEO (GM)	ALL GEO							155,538	2	1.3	74,926	0	0.0	220,107	1	0.5	
HONDA	ALL HONDA							680,989	8	1.2	901,582	6	0.7	755,747	4	0.5	
HONDA	ACCORD				237,729	9	3.8	Y			Y			Y			
HYUNDAI	ALL HYUNDAI										65,000	2	3.1	62,025	0		(6)
INFINITI	ALL INFINITI							18,469	0	0.0	34,025		0.0	24,756	0		
ISUZU	ALL ISUZU										5,302	0	0.0	673	0		
ISUZU	IMPULSE							1,634	1	61.2							

MODELS FOR WHICH NUMBER OF VEHICLES SOLD IS BLANK DO NOT HAVE SHIFT LOCKS

MAKE MODEL	1988 MODELS VEHICLES SOLD	1988 REPORTED ACC.	1988 RATE	1989 MODELS VEHICLES SOLD	1989 REPORTED ACC.	1989 RATE	1990 MODELS VEHICLES SOLD	1990 REPORTED ACC.	1990 RATE	1991 MODELS VEHICLES SOLD	1991 REPORTED ACC.	1991 RATE	1992 MODELS VEHICLES SOLD	1992 REPORTED ACC.	1992 RATE	NOTES
MERCEDES		18			14											
MERCURY		39			42			26			10			8		
MERCUR		5			1											
MITSUBISHI		6			1											
NISSAN		14			6											
OLDSMOBILE		54			27			24			7			6		
PEUGOT		1														
PLYMOUTH		7			2			4			3			1		
PONTIAC		49			19			11			10			1		
RENAULT		12														
SAAB		2			2											
SUBARU		10			2											
TOYOTA		33			3											
VOLKSWAGEN		7			1											
VOLVO		17			21											
Auto. Trans. Cars Without Shift Locks	8,555,000	721	8.4	6,543,000	391	6.0				3,993,949	121	3.0	1,496,101	32	2.1	
Total Cars With Shift Locks	121,000	8	6.6	975,425	36	3.7	2,289,141	48	2.1	3,350,546	44	1.3	5,729,549	30	0.5	
Percent Reduction Due to Shift Locks	22%			38%			54%			57%			76%			
Percent Of Automatic Trans. Cars With Shift Locks	1.4%			13%			30%			46%			79%			

NOTES: SALES DATA FROM "AUTOMOTIVE NEWS" UNLESS OTHERWISE INDICATED
POPULATIONS ESTIMATED WHERE NOTES INDICATE ONLY A PORTION OF THE MODEL, MODEL YEAR PRODUCTION WAS EQUIPPED WITH SHIFT LOCKS.

(1) POPULATION DATA FROM MFR.
(2) ALL EXCEPT CONVERTIBLE SINCE 9/91
(3) ONLY AFTER 2/92
(4) EXCEPT VERY EARLY MYR. '90 PROD.
(5) ONLY AFTER 11/26/91
(6) '91 POPULATION ESTIMATED
(7) ONLY AFTER 11/14/91 PRODUCTION
(8) MYR. '89 POPULATION ESTIMATED
(9) ONLY AFTER JAN. '89 PRODUCTION
(10) EXCEPT EARLY MYR. '90
(11) TORONADO W. CONSOLE SHIFT ONLY AFTER 2/92
(12) SEE PLYMOUTH FOR COMBINED DODGE/PLYM. COLT DATA
(13) DATA FROM WARD'S AUTOMOTIVE REPORTS
(14) EXCEPT '89 L-SERIES HATCHBACKS
(15) EXCEPT BETWEEN EARLY '90 & LATE '92 MODELS

MODELS FOR WHICH NUMBER OF VEHICLES SOLD IS BLANK DO NOT HAVE SHIFT LOCKS

ACTION_NO	MFR	VEHICLES	SUBJECT	DATE OPENED	DATE CLOSED	RECALL	UNINTENDED ACCEL *
EA77-051	FORD	TRUCK, C600/C700, 1977	THROTTLE PLATE HANGS UP	15-Jun-77	08-Dec-77		N
C77-032	JAGUAR ROVER	TRIUMPH TR7, 1975-1977	THROTTLE CABLE FAILURE-ACC STICKS	18-Jul-77	17-Jul-79	77V-143	N
EA77-069	JRT	AUSTIN MARINA, 1974-1975 & 1970-1977 TRIUMPH	ENGINE SURGE	27-Jul-77	27-Jul-78		N
EA77-082	FIAT	FIAT 1975-1977	THROTTLE RETURN SPRING	27-Sep-77	19-Jan-78	78V-010	N
C77-040	JAGUAR ROVER	MG MIDGET 1970-1974	THROTTLE CABLE MAY STICK	28-Sep-77	28-Aug-79		N
EA78-034D	AMC	CARS 1977	CAR STUMBLE AND SURGE	12-Jan-78	26-Apr-78		N
EA78-038	VOLVO	1970-1978	THROTTLE MALFUNCTION	09-Feb-78	10-May-78		N
EA78-039	GM	F/S CHEV/PONTIAC 1975-1978	ACCEL. PEDAL JAMS	09-Feb-78	09-May-78		N
EA78-041	FORD	FORD 1977	CRUISE CONTROL	14-Feb-78	30-Apr-78		N
EA78-061	ANNUNCIONICS	PACESETTER CRUISE CONTROL	CRUISE CONTROL JAMS THROTTLE	16-May-78	20-Nov-78		N
EA78-034Q	GM	CUTLASS 1978, PONTIAC 1977	HESITATION/ENGINE SURGE	17-May-78	23-Jun-78		N
EA78-034Z	CHRYSLER	TRANSMISSION	MID-SPEED SURGE COLD DRIVE	18-May-78	25-Jun-78		N
EA78-066B	FORD	LIGHT TRUCKS WITH 302 CID ENG., 1977	ENGINE SURGE	22-May-78	08-Jun-78		N
EA78-066V	VW	RABBIT 1978	THROTTLE KICKER W A/C	16-Aug-78	15-Nov-78		N
EA78-110	GM	AUTOMATIC TRANSMISSION MODELS, 1973-1986	SUDDEN ACCELERATION	30-Aug-78	05-Aug-86		Y
EA78-117E	MACK	R,RD,U AND R FIRE TRUCKS	ACCEL. RTN. SPRING BREAKAGE	22-Sep-78	24-Oct-78		N
EA79-016	SUBARU	ALL MODELS 1974-1978	COLD WEATHER THROTTLE STICK	07-Nov-78	16-Nov-78	79V-016	N
EA79-004J	FORD	FIESTA 1978	CARB. HOT SOAK SURGE, HESITATION	08-Nov-78	14-Dec-78		N
EA79-044	GM	CADILLACS 1977-1978	SUD ACCEL WHEN 1ST IN GEAR	22-Jan-79	02-May-79	79V-111	Y
EA79-080	CHRYSLER	OMNI/HORIZON, 1978-1979	ALLEGED THROTTLE STICKING	22-May-79	10-Sep-81		N
EA79-068P	FORD	CARS AND TRUCKS 1977-1978	SECONDARY THROTTLE PLATES	23-May-79	18-Apr-80		N
EA79-068V	FORD	3200 MOD. CARB. 1974-1978	THROTTLE SHAFT ICING	08-Aug-79	03-Nov-79		N
EA79-068Y	SAAB	900	ELECTRONIC SPEED CONTROL	17-Sep-79	20-Dec-79		N
C80-004	VW	DIESEL RABBIT 1977-1980	ENGINE RUNAWAY	22-Jan-80	23-Jul-82		N
EA80-050	TOYOTA	MODEL RT 134	ACCELERATOR LINKAGE	12-Feb-80	27-Apr-80		N
EA80-052	NISSAN	DATSUN 1974-1983	SUDDEN ACCELERATION	29-Feb-80	30-Apr-85		Y
EA80-074	TOYOTA	CELICA,COROLLA,CORONA 1975-1978	ACCELERATOR PEDAL STICKING	17-Apr-80	29-Sep-83		N
EA80-097	A.R.A. MFG	AFTERMARKET CRUISE CONTROL	CRUISE CONTROL SYSTEM	02-Jul-80	22-Dec-80		N
EA80-109	GM	CHEVETTE 1979	THROTTLE STICKING	14-Aug-80	15-Nov-83		N
EA81-005	FIAT	STRADA 1979	THROTTLE STICKING	01-Oct-80	05-Jul-84		N
EA81-006	JRT	TRIUMPH TR-7, 1977	THROTTLE STICKING	05-Nov-80	15-Jul-81		N
C81-002	VW	RABBIT,FOX,DASHER,SCIROCCO, 1975-1980	ALLEGED THROTTLE STICKING-CABLE	09-Jan-81	27-Sep-82	81V-012	N
EA81-010J	EAGLE	VARIOUS BUSES	THROTTLE LINKAGE	19-Jun-81	28-Jul-81		N
EA82-002	VW	AUDI 5000 1978-1981	SUDDEN ACCELERATION	31-Oct-81	10-May-82	82V-037 (a)	Y
IR82-009	SEARS	AFTERMARKET CRUISE CONTROL	CRUISE CONTROL	27-Nov-81	14-Jan-82		N
EA82-045	GM	CAMARO/FIREBIRD 1982	THROTTLE STICKING	28-Sep-82	06-Aug-84		N
IR83-041	GM	X-BODY CARS, 1981	VACUUM HOSE/THROTTLE HANGUP	07-Mar-83	15-Jul-83		N
IR83-044	BENDIX	CRUISE CONTROL SYSTEM	THROTTLE PROBLEMS	22-Mar-83	14-Jul-83		N
IR83-076	IHC	SCHOOLBUS 1983	THROTTLE STICKING	29-Jun-83	09-Jul-83		N
IR83-087	DEUTZ	VARIOUS TRUCK VANS	THROTTLE CABLE FAILURES	23-Aug-83	28-Aug-84		N
EA83-020	TOYOTA	CORONA/CELICA/CRESSIDA, 1979-1982	SUDDEN ACCELERATION	20-Sep-83	26-Nov-84		Y
EA84-001A	BLUEBIRD	WANDERLODGE 1983-1984	CRUISE CONTROL MOD	19-Oct-83	28-Dec-83		N
IR84-017	HONDA	HONDA 1981-1982	SUDDEN ACCELERATION	28-Oct-83	04-Feb-85		N
IR84-020	VW	QUANTUM 1982	ACCELERATOR PEDAL STICKS	08-Nov-83	21-Jul-84		Y
EA84-003	MERCEDES	MERCEDES 1978-1982	SUDDEN ACCELERATION	09-Nov-83	23-Jan-84	84V-007	Y
IR84-054	IHC	SCHOOL BUS 1983	THROTTLE STICKS	22-May-84	07-Sep-84	84V-091	N

ACTION_NO	MFR	VEHICLES	SUBJECT	DATE OPENED	DATE CLOSED	RECALL	UNINTENDED ACCEL *
IR84-061	RADATRON	AFTERMARKET CRUISE CONTROL UNIT	THROTTLE HELD OPEN	26-Jun-84	16-Nov-84		N
PE85-030	GM	J BODY CARS, 1982-1985	ENGINE SURGE	14-Feb-85	04-Feb-86		N
EA85-029	NISSAN	280Z/300Z 1979-1987	SUDDEN ACCELERATION	09-May-85	11-Jul-89	87V-098	Y
PE85-051	GM	CHEVETTE 1979-1982	THROTTLE STICKING	01-Jul-85	08-Nov-85		N
PE85-056	MAZDA	GLC 1981-1982	THROTTLE STICKS	08-Aug-85	23-Oct-85	85V-136	N
EA85-043	AMC	ALLIANCE/ENCORE 1983-1984	UNWANTED VEHICLE ACCELERATION	21-Aug-85	21-Jul-87		N
EA85-045	TOYOTA	CRESSIDA 1981-1984	SUDDEN ACCELERATION	30-Aug-85	18-Feb-88	86V-132	Y
PE85-065	FORD	FULL / MIDSIZE CARS 1983-1985	SUDDEN ACCEL AND SURGING	06-Sep-85	05-Aug-86		N
PE86-050	VOLVO	ALL MODELS 1980-1986	SUDDEN ACCELERATION	28-Apr-86	01-Oct-86	86V-129	N
EA86-013	GM	CAMARO 1984	CRUISE CONTROL	08-May-86	28-Sep-87		N
C86-001	VW	AUDI 5000, 1978-1986	SUDDEN ACCELERATION	05-Aug-86	11-Jul-89	87V-008 (b)	Y
PE87-001	MERCEDES	300E, 1986	SUDDEN ACCELERATION	02-Oct-86	14-Jan-87		Y
EA87-007	GM	J BODY CARS 1982-1985	SUDDEN ACCELERATION	16-Dec-86	07-Aug-87		N
PE87-018	CHRYSLER	COLT 1985-1986	SUDDEN ACCELERATION	03-Feb-87	06-Jul-87		Y
EA87-012	HONDA	ACCORD, 1986-1987	SUDDEN ACCELERATION	06-Mar-87	10-Sep-87		Y
EA87-021	FORD	FUEL INJECTED 3.8L & 5.0L ENGINES, 1983-1986	ENGINE SURGE	29-Jun-87	16-Mar-89		N
PE87-061	ALFA ROMEO	SPIDER 1985	THROTTLE STICKING	30-Sep-87	30-Nov-87		N
EA88-003	MERCEDES	MERCEDES 300E 1986-1987	SUDDEN ACCELERATION	29-Oct-87	29-Oct-87		Y
EA88-010	GM	H BODY CARS, 1986-1987	THROTTLE CONTROL	30-Nov-87	30-Nov-87	88V-080	Y
EA88-023	GM	CARS WITH 5L. ENG., 1984-1985	CRUISE CONTROL	12-Feb-88	23-Mar-89	89V-102	N
PE88-029	CHRYSLER	JEEP 1987-1988	THROTTLE CONTROL	23-Feb-88	19-Sep-88		N
EA88-026	HONDA	ACURA,STERLING 1986-1988	SUDDEN ACCELERATION	08-Mar-88	10-Jan-91		Y
PE88-033	GM	FIERO 1984	THROTTLE CABLE	10-Mar-88	06-May-88		N
EA88-031	GM	C BODY CARS, 1985-1987	SUDDEN ACCELERATION	22-Apr-88	23-Oct-89	88V-080	Y
EA88-034	MERCEDES	ALL MODELS EXCEPT 300E 1986-1988	SUDDEN ACCELERATION	15-Jul-88	31-Jul-90		Y
PE88-082	NAVISTAR	MODEL S SCHOOL BUS 1985-1988	SUDDEN ACCELERATION	18-Jul-88	03-Nov-88		Y
PE88-090	GM	G SERIES VANS WITH 6.2L DIESEL ENG., 1988	CRUISE CONTROL	08-Aug-88	28-Oct-88		N
PE88-097	FORD	T-BIRD,COUGAR 1987-1988	FLOORMAT/ACCEL.PEDAL INTERF.	31-Aug-88	02-Dec-88		N
EA89-001	CHRYSLER	PLYMOUTH SUNDANCE 1987 & 1988	CONTROL LOGIC MALFUNCTION	05-Oct-88	17-Nov-89		N
PE89-019	FORD	TRUCKS/SCHOOL BUSES 1987	THROTTLE STICKING	01-Dec-88	05-Mar-89		N
PE89-095	CHRYSLER	JEEP CHEROKEE 1987	CRUISE CONTROL	01-Mar-89	28-Jun-89		N
PE89-097	GM	TRUCKS WITH 5.7 & 7.4 L ENG., 1988	CRUISE CONTROL	06-Mar-89	05-Jun-89		N
EA89-037	FORD	MUSTANG,CAPRI,TEMPO,TOPAZ, 1986-1987	CRUISE CONTROL	19-Apr-89	06-Sep-89		N
PE89-149	YAMAHA	FZR400, FZR600 MOTORCYCLES, 1989	THROTTLE STICKING	03-Aug-89	28-Sep-89		N
EA89-035	WILLIAMS	ELECTRICAL ACCELERATOR PEDAL, 1985-1988	ELECTRONIC ACCELERATOR PEDAL	29-Aug-89	16-Nov-90	90E-010	N.
PE89-163	L.A.G.	BUS THROTTLE CABLE, 1986-1987	THROTTLE CABLE	11-Sep-89	07-Nov-89	89V-201	N
PE90-003	ARA MFR.	CRUISE CONTROL	CRUISE CONTROL	10-Oct-89	05-Feb-90		N
PE90-014	GM	REGAL, CUTLASS SUPREME, 1985-88	CRUISE CONTROL LINKAGE	31-Oct-89	28-Feb-90		N
PE91-031	VW	JETTA 1985 & 1986	ENGINE MOUNT FAILURE	31-Oct-89	29-Apr-91		N
PE90-019	FORD	TAURUS, SABLE 1986-1988	CRUISE CONTROL	27-Nov-89	27-Mar-90		N
PE90-026	GM	SUBURBAN 1984-1988	CRUISE CONTROL	02-Dec-89	09-Apr-90		Y
EA90-009	FORD	COUGAR, THUNDERBIRD, 1988-1989	THROTTLE STICKING	08-Feb-90	28-Feb-91		N
PE90-051	FORD	PICKUP & VANS WITH EFI 1985-1990	IDLE SPEED	05-Mar-90	05-May-90		N
PE90-058	GM	LUMINA 1990	CRUISE CONTROL	15-Mar-90	20-Jun-90		N
PE90-081	CHRYSLER	RENAULT MEDALLION 1988-1989	THROTTLE LINKAGE	11-May-90	14-Aug-90	90V-138	N
EA90-042	FORD	TAURUS, SABLE 1986-1989	THROTTLE STICKING	31-Aug-90	31-Dec-91		N

APPENDIX AL INVE ONS SINCE 1967 ELATED NINTENDED AC RATION

		VEHIC	SUBJECT	DATE OPENED	DATE CLOSED	RECAL	NDE AC
PE91-001	BMW	3,6,&7 SERIES CARS WITH MOTRONIC EFI	MOTRONIC IDLE SPEED CONTROL	03-Oct-90	28-Jan-91		N
PE91-029	GM	CAD. DEVILLE & FLEETWOOD 1990	THROTTLE LINKAGE INTERFERENCE	07-Jan-91	16-Apr-91		N
PE91-080	CHRYSLER	SPIRIT, ACCLAIM WITH 2.5L ENG., 1991	ENG SPEED FLUCTUATIONS	30-May-91	30-Sep-91		N
PE91-088	MAZDA	MPV, MX6, 626, 929, 1989-1991	THROTTLE STICKING	18-Jun-91	21-Oct-91		N
PE91-089	FORD	MUSTANG WITH 5.0L ENG.,1990	THROTTLE STICKS, HIGH IDLE	19-Jun-91	26-Nov-91		N
EA91-032	HONDA	ACURA INTEGRA 1991	SPEED CONTROL FAILURE	12-Jul-91	13-Jul-92		N
EA91-034	FORD	EXPLORER 1991	THROTTLE RELEASE FAILURE	17-Jul-91	10-Apr-92		N
EA91-005	CATERPILLAR	3304,3306,3006B,3406,3406B ENG.	GOVERNOR PIN, THROTTLE	26-Nov-91	24-Feb-92	005	N
EA92-015	GM	S10,BLAZER,JIMMY WITH 4.3L TBI ENG.,'89-'91	HIGH IDLE SPEED FLARE	07-Jan-92			N
EA92-005	GM	CAMARO,F.BIRD,CORV. W. 5&5.7L TBI ENG.'85-'88	THROTTLE STICKING	30-Jan-92	29-Jan-93		N
PE92-014	FORD	TAURUS,SABLE,CONT. W. 3.0L &3.8L ENGS.'88-'90	ENGINE MOUNTS	04-Feb-92	25-Jun-92		N
EA92-024	GM	GM A, J, L, & W BODIES W. 2.8L ENG. '87-'91	THROTTLE STICKING	26-Jun-92			N.
EA93-004	FORD	EXPLORER & NAVAJO. 1992	TRANS. GEAR INDICATOR MISALIGNMENT	09-Sep-92			N
EA92-044	TOYOTA	CAMRY & CELICA W. 2.0L ENG. '87-'89	THROTTLE STICKING	18-Dec-92			N
PE92-090	GM	CAPRICE W. 4.3L. V-6 ENG.	THROTTLE STICKING	22-Dec-92			N
EA93-003	FORD	EXPLORER, 1991	FLOOR MAT/ACCEL PEDAL INTERFERENCE	15-Jan-93			N
PE93-010	FORD	'91 TAURUS/SABLE & '91 & '92 LIGHT TRUCKS	IDLE AIR SPEED CONTROL VALVE	02-Mar-93			N
PE93-011	FORD	MUSTANG, 1986 -1988	CRUISE CONTROL	02-Mar-93			N
PE93-014	DAMON	CHALLENGER MOTORHOMES, 1992	THROTTLE LINKAGE INTERFERENCE	08-Mar-93			N

ACTION NUMBERS BEGINING WITH:

"PE" OR "IR" ARE PRELIMINARY EVALUATIONS
"DP" ARE DEFECT PETITION ANALYSIS
"EA" ARE ENGINEERING ANALYSIS
"C" ARE INVESTIGATIVE CASES

ADDITIONAL RECALLS:

AUDI AUDIT (A83-02)	(a)	83V 095	Y
AUDI CASE (C860-01)	(b)-1	87V-009	Y
AUDI CASE (C860-01)	(b)-2	87V-170	Y

PEs," "IRs," OR "DPs" MAY BE UPGRADED TO "EAs"
EAs MAY BE UPGRADED TO INVES IGATIVE CASES ("C"
ACH INVESTIGATION ("PE," "DP " "EA," ETC.) IS COUNTED ONL NCE ("PE" IS NOT COUNTED IF UPRADED TO A," ETC

* UNINTENDE ERATION EFINED AS HIGH-POWERED, NWANTED ACCELERATION FROM SLOW OR STATIONARY SPEE COMBINED WITH INEF AKE

INVESTIGATIONS ARE CLASSIFIED AS UNINTENDED ACCELERATION BASE N INCIDENT DESCRIPTIONS BY DRIVERS OR OTHER INTERESTED PARTIE REGARDLESS OF TECHNICAL CONSIDERATIONS.

INVESTIGATIONS PERTAINING TO UNWANTED ENGINE POWER AT SLOW OR STATIONARY SPEED ARE CONSIDERED TO BE RELATED INVESTIGATIONS BECAUSE, ALTHOUGH SUCH PROBLEMS CANNOT BY THEMSELVES CAUSE UNINTENDED ACCELERATION, THEY CAN IN SOME SITUATIONS STARTLE DRIVERS AND CONTRIB INADVERTANT APPLICATION OF THE ACCELERATOR INSTEAD OF THE BRAKE PEDAL (THE MOST COMMON CAUSE OF UNINTENDED ACCELERATION).

INVEST TIONS PERTAINING TO BRAKING SYSTEM PROBLEMS WITHOUT UNWANTED ENGINE POWER ARE NOT NSIDERED RELATED BE DO NOT USE HIGH-POWERED ACCELERATION

ENTED ONS