

Automotive Product Liability

The Expert Approach

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AUTOMOTIVE PRODUCT LIABILITY

INTRODUCTION

By objective standards, today's cars are immeasurably safer than the past. Traffic death rates in the United States have declined steadily from the accident statistics of the 1960s until 1992. According to National Highway Traffic and Safety Administration (NHTSA), since 1992 deaths on U.S. roads have reached a plateau and may even be rising. Cars have become much more sophisticated from a safety point of view in the last decade. We have also improved road safety with greater use of median dividers, better lighting, and better signs.

The job of the automotive safety engineer is to determine ways of making further improvements to the safety features of vehicles which are economically viable, practical to incorporate and acceptable to the motoring public. Their task is not easy since the statistics seem to indicate that they are near the top end of the curve of diminishing returns. Even if the engineer makes substantial gains with new designs and new products, they only gradually increase the safety of the total fleet. The opportunities for fast gains no longer seem to be there.

As more and more automotive safety devices are introduced, the motoring public places more and more reliance upon them to prevent accidents, save their life and minimize their injury during an accident. By their very nature, the devices introduced into cars these days are very sophisticated and have a heavy reliance upon high technology electronics. Statistically, the more components a system has, the greater the potential for a failure to occur.

It would follow, therefore, that statistically certain companies engaged in developing and manufacturing high technology safety devices for automobiles run a risk of producing a defective component. This may occur despite modern quality control systems and sophisticated computer aided design and manufacture.

In an automobile product liability case it is often necessary to investigate beyond the obvious. Certain injuries to occupants result due to multiple failures and/or design defects. The forensic automotive engineer can assist the attorney in determining if vehicle occupant injuries were related to conditions including foreseeable hazards, product defects and product misuse.

This document was developed to aid in planning, initiating and monitoring automobile product liability incident investigations involving airbag systems, seat belts, anti-lock brake systems (ABS) and other automotive safety devices.

AUTOMOTIVE ACCIDENTS

In 1966, there were 50,894 deaths on U.S. roads, as compared to 39,250 for 1992, and 41,798 for 1995. Other indicators such as the number of deaths for every 100,000 licensed drivers or the number of deaths for every 100,000 registered vehicles also suggests that things are worsening, or at best, have reached a plateau. These worsening statistics come about despite the rising installation rates for airbags, anti-lock braking systems, traction controls, side impact protection, predictive sensing, smart cruise, predictive braking, blind spot detectors, etc. Automotive product liability cannot be blamed for all the statistical bad news, since there are many vehicular accident types and certain product misuse.

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Certain Vehicular Accident Types

- Drainage
- Intersections
- Lighting
- Right of way
- Maintenance
- Traffic control devices
- Traffic signal timing stroke / sequence
- Utility trenches
- Vehicles:
 - Bicycle
 - Pedestrian
 - Pedestrian dart-out
 - Roadside fixed object
 - Sidewalk
 - Utility pole
 - Vehicle
- Work zones

ANTI-LOCK BRAKING SYSTEMS

The Anti-lock Braking System (ABS) was sold as a safety device that would dramatically reduce the accident rate. That seemed plausible because ABS shortened stopping distances measurably in most vehicles for most climatic and road conditions. Over recent years the public has seemed to accept the new technology, and a percentage of cars equipped with ABS has risen steadily from about 2 percent in the mid 1980s to 56 percent in 1994. The National Highway Traffic Safety Administration (NHTSA) even considered requiring ABS on all new cars.

Then accident statistics began to roll in and the picture changed. A study of crash histories of selected 1987 to 1992 model cars published in 1995 by the Highway Loss Data Institute, and Insurance Industry Think Tank, reported no difference in claim frequencies for cars with standard anti-lock brakes compared with the same models without anti-lock brakes. In almost every instance, the difference in the frequency of claims was not statistically significant. NHTSA dropped this pursuit of an ABS mandate in February 1996, and demand for ABS has leveled off at about 66 percent of new car sales.

Engineers at Chrysler Benz, Nissan, and Toyota think one reason why ABS has not performed to its potential is that many drivers do not press down hard enough on the brake pedal to lock a wheel, so the ABS never has a chance to help. Toyota put 208 Japanese drivers (between the ages of 18 and 70) into an unexpected panic situation and found that 47 percent of the subjects failed to brake hard enough to engage the ABS. Similar tests conducted by Nissan found that drivers who do not push down hard enough on the pedal also tend to have slow reaction times.

Automobile manufacturers are now launching into an even more sophisticated variation upon the ABS brake system known as brake assist (BA) systems. The auto makers have decided that the car's brain must step in and determine when the driver's braking for emergency and then supply the full ABS braking force automatically. Variations upon the BA system are now being developed around the world, and in some cases are even in production. Variations appear to be falling into either one of two categories. These are mechanical systems or electronic systems.

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ABS BRAKES PRODUCT LIABILITY INVESTIGATION & EVALUATION

Anti-lock brakes are sophisticated systems which have to be analyzed and, if possible, tested by knowledgeable engineers. There are certain characteristic traits associated with anti-lock brakes which can be useful in determining whether the ABS system was defective and responsible or contributory to an incident. It is important when investigating a suspect anti-lock brake system, to perform the following work as quickly as possible.

Evidence: Secure and Preserve

*Attempt to SECURE evidence immediately following an incident.
PRESERVE evidence for future evaluations.*

1. Accident site evidence (tire marks, if any), skid dimensions, road surface conditions, vehicle damage
2. Impact point
3. Point of final rest
4. Police reports
5. Photographs
6. Witness statements
7. Driver's statements
8. The vehicle

Examination: Vehicle

1. Photographs:
 - a. General pertinent information such as make, model, VIN #, year of manufacture, etc.
 - b. Brake system components
2. Manufacturer of braking system:
 - a. Model number of system
 - b. Serial number
 - c. Date of manufacture
3. Hydraulic fluid:
 - a. Level of fluid
 - b. Condition of fluid
 - c. Contaminants
4. Fault messages from CAB. These are retained on a non volatile memory and have to be recovered by a special scanning tool.
5. Brake pedal:
 - a. Brake pedal resistance
 - b. Condition of brake pedal pad
 - c. Imprints on driver's shoe
6. Dynamic Test:

This is not always possible with heavily damaged vehicles.
7. Hydraulic oil stains evidence both external and internal to vehicle.

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Examination: Accident Scene

Compare information obtained on incident date against examined conditions.

1. Photographs.
2. Environmental conditions:
 - a. Day lighting
 - b. Night lighting
 - c. Weather records
3. Vehicle markings:
 - a. Fixed objects
 - b. Fluids
 - c. Gouges on pavements
 - d. Tire marks
4. Highway/Pavement:
 - a. Drainage
 - b. Fixed object locations
 - c. Geometry
 - d. Pavement markings
 - e. Profile
 - f. Sight distance
 - g. Signage
 - h. Traffic controls
 - i. Type and condition
 - j. Unevenness

AIRBAG INVESTIGATION AND EVALUATION

The Insurance Institute for Highway Safety estimates that airbags cause injuries 42 percent of the time they deploy. Almost all the injuries are minor, but about 3 percent are moderate to severe. They include broken arms and ribs, torn hearts and bruised lungs.

It is undeniable that airbags have saved some 2,000 lives since 1990; however, they killed 87 people according to NHTSA. Between 1989 and 1995 one person was killed by an airbag for every 21,000 times the device deployed in a crash. Airbag systems are not free of certain design and manufacturing problems which have resulted in injuries which are moderate to severe. These include but are not limited to broken arms and ribs, torn hearts, bruised lungs, damage to the eyes, and severe burns. These injuries sometimes occur during unwanted deployments where otherwise the vehicle occupant would walk away annoyed with themselves for getting into an innocuous situation.

Airbags have killed selectively. Most of the people who have died fall into three groups - children, short women, and elderly. According to the census bureau, these groups make up a quarter of the U.S. population.

Deaths and injuries can be caused by the explosive force of the bags. Airbags have to deploy fast enough to provide a cushioning in the milliseconds between the beginning of a crash and the time car occupants start moving.

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Most airbag systems currently in use rely on crash detection systems containing sensors based on electromechanical or all electronic technologies to trigger deployment. The majority of the electromechanical systems contain multiple sensors located in different parts of the vehicle which are capable of identifying significant crashes in a timely manner. Industry emphasis on cost reduction and quality improvement has resulted in strong interest in alternative sensor technologies.

The sensor in an airbag crash sensing system must typically be capable of making a decision to deploy within tens of milliseconds depending on the severity and nature of the crash. The sensor must make this decision based on the identifying some signature of the crash. Sensors which detect crash deceleration or velocity change are the most commonly employed in vehicles. These sensors employ a sensing mass which is set into motion by deceleration of the vehicle and the degree of displacement determines whether the sensor fires.

After an airbag deployment incident it is essential to analyze carefully all the elements of the incident which lead to the deployment. It is, therefore, necessary to involve an expert to analyze a case as early as possible while the airbag system evidence, vehicle damage evidence, and incident scene evidence are still available. Careful evaluation of how, why, and when the airbag deployment occurred along with causation to the injured party must be established.

Evidence: Secure and Preserve

*Attempt to SECURE evidence immediately following an incident.
PRESERVE (evidence for future evaluation).*

1. Airbag modules (including inflators)
2. Clock spring
3. Photographs
4. Police report
5. Sensors
6. Vehicle(s)

Examination: Vehicle, Accident Scene, and Interview Injured Party

Compare information obtained on the incident date against examined conditions.

1. Photographs:
 - a. General pertinent information such as model, VIN #, year of manufacture, etc.
2. Airbag system:
 - a. Airbag modules (deployed or not deployed):
 - I. Make
 - II. Model
 - III. Year of manufacture
 - b. Sensors:
 - I. Make
 - II. Model
 - III. Year of manufacture

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- IV. Fault codes
- V. Sensor position roads up to impact damage??
- 3. Vehicle condition:
 - a. Impact damage/crush dimensions
 - b. Seat belt evidence
 - I. Onwebbing, guide fittings, and buckles
 - II. State of pre-tensioners
 - c. Seat positions
 - I. Driver's side
 - II. Passenger side
- 4. Steering wheel position
- 5. Windshield marks
- 6. Evidence of marking from injuries
- 7. Damage to vehicle's internal trim
- 8. Condition of tire and wheel rims
- 9. Vehicle specification:
 - a. Weight
 - b. Radius of gyration
 - c. Front and rear overhang dimensions
 - d. Center of gravity
 - e. Force deflection curves for bumpers

Accident Scene

- 1. Photographs:
- 2. Environmental conditions.
 - a. Weather conditions
- 3. Vehicle markings:
 - a. Fixed objects
 - b. Fluids
 - c. Pavement markings, gouges, scrapes, etc.
 - d. Tire marks
- 4. Highway/Pavement:
 - a. Fixed object location
 - b. Profile
 - c. Sight distance
 - d. Drag factor
 - e. Gradient
 - f. Type and conditions
 - g. Curve weight

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Information from Driver/Injured Person

1. Personal:
 - a. Height
 - b. Weight
 - c. Injuries
 - d. Medical records from accident
2. History of incident:
 - a. Estimated speed
 - b. Sequence of events
 - c. Pre-incident conditions of airbag system
 - d. Memory of incident

SEAT BELTS

According to NHTSA, a driver who wears a seat belt cuts their risk of dying by 45 percent. If an airbag is added, that statistic only climbs to 50 percent. For drivers who do not buckle up, airbags can cut the fatality risk by only 14 percent. In other words, if 100 unbelted drivers died in crashes, 45 would have been saved had they buckled up.

In November 1970, the U.S. Motor Vehicles Safety Standard 208 (MVSS 208) which addresses vehicle occupant crash protection was amended to incorporate original requirements for passive occupant protection in the front seated position of all passenger cars manufactured on or after the first day of July 1973 for sale in the U.S. common market. The original requirements and the original effective date embodied in the amendment were challenged and further considered in the series of subsequent actions from 1970 to the present. NHTSA called for passive occupant protection in front outboard seating position on a phased in schedule with installations in a minimum of 10 percent of each manufacturer's car built after September 1, 1986, 25 percent after September 1, 1987, 40 percent after September 1, 1988, and 100 percent after September 1, 1989.

The passive system for vehicles occupant protection that showed the greatest promise of providing the maximum protection was by far the passive seat belts. Many conceptual designs of passive seat belts were investigated. Several distinctive classes may be identified as 2, 3, or 4 point systems based on the number of load bearing connections to the vehicle structure. The automatic seat belt may be all mechanical or may be all or partially motorized. They may have a retractor located in either inboard or outboard locations and fixed anchor is located either inboard or outboard. Some may require knee bolsters to control lower body movement. All must have some provision permit disengaging the seat belt after an incident.

According to the SAE publication *Restraint Technologies: Front Seat Occupant Protection SP-69*, the general design considerations for all seat belts are as follows:

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Manual seat belt systems:

- Performance in emergency events
- Reliability
- Durability
- Vulnerability to damage
- Vulnerability to deliberate or inadvertent tampering
- Simplicity in operation
- Comfort in normal operation
- Convenience in normal operation
- Acceptable packaging in car
- Aesthetic considerations
- Cost

Automatic seat belts:

- All of the considerations listed above
- Automatic donning and doffing

New trends integrate seat belt and airbag performances. It is already well known that one of the benefits of wearing the seat belt in a car fitted with airbags is that the seat belt helps to assure that the occupant is in the correct position during the airbag deployment. This occupant positioning is further enhanced by the use of seat belt pre-tensioners in certain vehicles which fire during an accident event and reel in any loose seat belt webbing prior to the occupant moving forward relative to the seat. The idea behind integrating seat belts and airbags is to provide a constant force to the occupant and to level which prevents the occupant from making contact with the steering wheel or dash board, but at the same time, allows for maximum excursion within the vehicle's passenger compartment. This can be accomplished by tailoring initial restraint system stiffness, high output pre-tensioning, and occupant ride down in the airbag. As stated before, the more complicated and sophisticated the restraint system becomes, the greater the potential for a defective condition to exist. It is also important to hire an expert who is aware of the various interactions between the various restraint system components.

SEAT BELT RESTRAINT AND INVESTIGATION AND EVALUATION

As with ABS brakes and airbag systems, it is important for the attorney to secure and preserve evidence immediately after the accident. As with airbags, examination of vehicle, the accident scene and an interview with the injured party is advisable.

Attempt to Secure the Following Evidence Immediately After the Accident

1. Vehicle
2. Seat belt systems
3. Seat belt pretensioners (if fitted)
4. Photographs
5. Police report

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Examination of Vehicle, Accident Scene, and Injured Party

1. Photographs:
 - a. General pertinent information such as make, model, VIN #, and year of manufacture of vehicle
2. Seat belt system:
 - a. Make, model, and year of manufacture
 - b. Pre-tensioners:
 - I. Make
 - II. Model
 - III. Year of manufacture
3. Vehicle condition:
 - a. Impact damage to vehicle
 - b. Crush dimensions
 - c. Airbag evidence
 - d. Condition of seat belts:
 - I. Webbing
 - II. Guide fittings
 - III. Buckles
 - e. Seat positions
 - I. Driver's side
 - II. Passenger side
 - f. Steering wheel position
 - g. Windshield marks
 - h. Position of marking from occupant injuries
 - i. Damage to interior trim
4. Vehicle specification

Accident Scene

See evidence collection for airbags.

Interview with Driver/Injured Person

See evidence collection for airbags.

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THE ROLE OF THE ENGINEER IN AN AUTOMOBILE INVESTIGATION

Automobile accidents are very complex cases, and it is not always obvious whether product liability is involved. It is difficult for the attorney to interpret and assess technical documents with which he is not familiar. The engineer can assist the attorney by interpreting the incident circumstances and advising if product liability is suspected. The engineer can assist in developing the case by performing the following work:

- Collect evidence surrounding inspected product
- Assist the attorney on technical issues
- Arrange or conduct testing
- Code of federal regulations
- Technical assistance regarding SAE publications and studies
- Complaint review
- Deposition notes
- Technical assistance regarding acceptable manufacturing practices
- Examination of manufacturing quality control documents
- Exhibit preparation
- Interface with other consultants
- Interview witnesses and client
- Photograph evidence
- Assisting in opposing liability arguments
- Prepare report if warranted
- Questions and technical wording for discovery requests
- Research publications
- Review technical documents
- Review and obtain manufacturer's manuals
- Review engineering drawings
- Testify if warranted
- Translate engineering language into common terms
- File cross examination questions
- Trial monitoring
- Trial preparation

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2. Frank Markus, Brakeless Sitemaps: When ABS Isn't Enough, Car and Driver, December 1997.
3. John Merline, How Good Are Auto Airbags? Investors Business Daily, November 5, 1997.
4. H. George Johannessen, Historical Review of Automatic Seat Belt Restraint Systems, Published by SAE, Restraint Technologies: Front Seat Occupation Protection SP-690, February 1987.
5. Mark Phelan, Safety Hits the Wall, Automotive Industries, May 1997.
6. Integrating Seat Belt and Airbag Performance, Automotive Engineering, August 1996.

RESOURCE LIST

1. CFR – Code of Federal Regulations published by the Office of the Federal Register National Archives and Records Administration, Notable from U.S. Government Printing Office, Superintendent of Documents, Mail SSOP, Washington, DC 20402-9328.
2. CFAS – Center for Auto Safety, Washington, DC.
3. NUTI – Northwestern University Traffic Institute.
4. NHTSA – National Highway Traffic Safety Administration.
5. NAPARS – National Association of Professional Accident Reconstruction Specialists, P.O. Box 65, Brandywine, MD 20613.
6. ITAI – The Institute of Traffic Accident Investigators, 20 Nightingale Road, Woodley, Reading, RG5 3LS United Kingdom.
7. NTIS – National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22151.

The information presented in this booklet is intended only to be used as a guide in assisting clients concerned with or involved in the legal process where litigation or potential litigation is an issue. The information is further intended to inform clients that Consulting Engineers & Scientists, Inc. has both the expertise and the capability to provide direction and guidance in the specific disciplines and areas presented in this booklet. It is important to note that the information also is general and is not intended to completely cover the specific nuances of a particular matter. If there are any questions concerning this information, please feel free to contact us.