

# SHOULDER HARNESSES

...a subject bibliography  
from HIGHWAY SAFETY  
LITERATURE

DOT HS-804 730

SB-35

JUNE 1979

## AVAILABILITY OF DOCUMENTS

Documents listed in this bibliography are **not** available from the National Highway Traffic Safety Administration unless so specified. They must be ordered from the sources indicated in the citations, usually at cost. Ordering information for the most common sources is given below.

**NTIS:** National Technical Information Service, Springfield, Va. 22161. **Order by title and accession number: PB, AD, or HS.** When no PB number is given for NHTSA Technical Reports, order by prefacing the HS number with DOT, i.e. DOT-HS-000 000.

**GPO:** Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. **Give corporate author, title, personal author, and catalog or stock number.**

**Corporate author:** Inquiries should be addressed to the organization listed in the individual citation.

**Reference copy only:** Documents may be examined at the NHTSA Technical Reference Division or borrowed on inter-library loan through your local library.

**See publication:** Articles in journals, papers in proceedings, or chapters in books are found in the publication cited. These publications may be in libraries or purchased from publishers or dealers.

**SAE:** Society of Automotive Engineers, Dept. HSL, 400 Commonwealth Drive, Warrendale, Pa. 15096. Order by title and SAE report number.

**TRB:** Transportation Research Board, National Academy of Sciences, 2101 Constitution Ave., N.W. Washington, D.C. 20418.

This bibliography has been prepared because of the interest in the subject by the staff in the program areas of NHTSA. The citations and abstracts have appeared in the publication *Highway Safety Literature* and are in the HSL information retrieval system.

**Notice:** Material published in this special bibliography is intended only for information. References to brand names, equipment models or companies does not imply endorsement by the NHTSA or the U.S. Department of Transportation.



National  
Highway Traffic Safety  
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SB-29	Manpower Development: Education and Training	HS-803 366
SB-30	Emergency Medical Services. Revised Edition	HS-803 552
SB-31	Heavy Duty Vehicles	HS-803 965
SB-32	Technical Reports of the National Highway Traffic Safety Administration; a Bibliography, 1978	HS-804 727
SB-33	Automobile Fuel Tanks	HS-804 728
SB-34	Child and Infant Restraint Systems	HS-804 729
SB-35	Shoulder Harnesses	HS-804 730

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16. Abstract <p>This bibliography represents literature acquired since the establishment of the National Highway Traffic Safety Administration (NHTSA) concerning the development and use of shoulder harnesses in motor vehicles. It is comprised of NHTSA contract reports, reports of other organizations concerned with highway safety, and articles from periodicals in related fields.</p> <p>Citations follow the format used in the monthly abstract journal <u>Highway Safety Literature</u> and are indexed by a key-word-out-of-context (KWOC) listing, author, corporate author, contract number, and report number.</p> <p>Documents listed herein may be examined in the Technical Reference Branch, NHTSA, Room 5108, 400 Seventh St. S.W., Washington, D.C. 20590. Availability is given in the individual citations.</p> <p>This bibliography was compiled in the Technical Reference Branch, NAD-41, NHTSA.</p>					
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## F O R E W O R D

This bibliography is one in a series of subject bibliographies to be published irregularly reflecting expressed interests of readers of Highway Safety Literature. Documents cited in these bibliographies may be examined in the Technical Reference Branch, National Highway Traffic Safety Administration. Few of the documents are available for distribution by NHTSA. Please note availability as given in individual entries.

Suggestions of subjects for future bibliographies should be forwarded to

Mrs. W. Desmond, Chief  
Technical Reference Branch  
National Highway Traffic Safety Administration  
400 Seventh St., S.W.  
Washington, D. C. 20590

## **ABSTRACT CITATIONS**

HS-000 577

**A STATISTICAL ANALYSIS OF 28,000 ACCIDENT CASES WITH EMPHASIS ON OCCUPANT RESTRAINT VALUE**

Evaluated effectiveness of 3-point combined lap- and diagonal shoulder harness with slip-joint.

by N.I. Bohlin  
AB Volvo, Sweden, Passenger Car Engineering Dept.  
Rept. No. SAE-670925 ; 1967 ; 10p  
Availability: SAE

HS-001 158

**STUDIES OF THREE-POINT RESTRAINT HARNESS SYSTEMS IN FULL-SCALE BARRIER CRASH AND SLED RUNS**

Describes tests evaluating effectiveness of the three-point harness system under various conditions.

by N.I. Bohlin  
Volvo A. B. Gothenburg, Sweden. Safety and Interior Trim Section  
Publ: Stapp Car Crash and Field Demonstration Conference, Detroit, 1966 p258-319  
1966 ; 62p  
Availability: see publication

HS-001 319

**LAP SEAT BELT INJURIES: THE TREATMENT OF THE FORTUNATE SURVIVOR**

Discusses multidisciplinary approach to treatment of traumatic lesions caused by lap seat belts and the possible prevention of such injuries.

by R.C. Schneider; W.S. Smith  
Michigan Univ., Ann Arbor, Medical School  
Publ: Michigan Medicine v67 n3 p171-86 (Feb 1968)  
1968  
Availability: see publication

HS-001 347

**SAFETY BELTS-CHOOSING AND USING THEM**

Research on different types of seat belts studies buying, fitting, adjustment of belts, and their role, in accident protection.

by I.D. Neilson  
England Road Res. Lab. Dept. of Scientific and Industrial Research  
Publ: International Road Safety and Traffic Review v12 n2 p5-10 1964  
1964  
Availability: see publication

HS-001 351

**SAFETY CONSIDERATIONS ON THE DESIGN OF MOTOR VEHICLES**

Design of safer motor vehicles was considered by improvements in design intended to prevent accidents, and by ways of protecting the occupants, with discussion of the shoulder harness.

by J.H. Starks  
England Road Res. Lab. Dept. of Scientific and Industrial Research  
Publ: International Road Safety and Traffic Review v13 n3 p32-36 1965  
1965  
Availability: see publication

HS-001 372

**PERSONNEL RESTRAINT SYSTEMS STUDY, BASIC CONCEPTS**

Discusses mans tolerance limits to deceleration, reviews dynamic tests on restraint systems, and tests dynamic loads on airframes.

Flight Safety Foundation, Inc., Phoenix, Ariz., Aviation Crash Injury Research  
DA44-177-TC-802  
Rept. No. TCREC 62-94 ; 1962 ; 66p  
Availability: Army Transportation Research Command, Fort Eustis, Va.

HS-001 980

**A REPORT: THE LOS ANGELES POLICE DEPARTMENTS EXPERIENCE WITH SHOULDER HARNESSSES IN POLICE VEHICLES**

Compares performance of seat belts and shoulder harnesses in high-performance vehicles used in hazardous traffic assignments.

by J.L. Fulton  
Los Angeles Police Dept., Calif., Inspection and Control Group  
Publ: Traffic Digest and Review p13-17 (Feb 1968)  
1968  
Availability: see publication

HS-003 625

**INJURY REDUCTION BY DIAGONAL AND OTHER VEHICLE SAFETY BELTS**

by D.C. Herbert  
Snowy Mountains Hydro-Electric Auth. Cooma (Australia)  
Publ: Medical Journal of Australia v1 n3 p61-67 (Jan 1964)  
1964  
Availability: see publication

HS-003 628

**COMPUTER SIMULATION OF THE AUTOMOBILE  
CRASH VICTIM IN FRONTAL COLLISION--A  
VALIDATION STUDY. FINAL TECHNICAL REPORT**

To examine validity of computer simulation and study effects of various restraint systems on anthropometric dummies in head-on collisions. Compares unrestrained, lap belt restrained, and lap belt and shoulder harness restraint.

by R.R. McHenry; K.N. Naab  
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.  
PH-108-65-174  
Rept. No. CAL-YB-2126-V-1R ; 1966 ; 240p  
Availability: U.S.Public Health Service, Experimental Res.  
Branch, Washington, D.C. 20201

HS-003 693

**LAP-SHOULDER BELT OFFERS SAFETY  
ADVANTAGE**

Momentum is a factor in 46% of accident fatalities. If motorists would properly affix lap-shoulder belts 8-10,000 lives could be saved annually; of 800,000 injuries requiring hospitalization 250,000 could be eliminated.

by Richard E. Marland  
National Center for Urban and Industrial Health, Cincinnati, Ohio  
Publ: Journal of the Amer. Society of Safety Engineers v13 n9  
1968  
1968  
Availability: see publication

HS-003 868

**SEAT-BELT FRACTURES OF THE SPINE AND  
STERNUM**

Improperly positioned or inadequately tightened, lap-type seat belts may act as a central fulcrum to produce transverse fractures of the lumbar vertebrae upon sudden deceleration. The bandolier or shoulder-type safety belt will prevent acute flexion of the spine but may be responsible for fractures of the sternum and rib cage, trauma to intrathoracic viscera, or rupture of the spleen and liver. Two case reports presented.

by B.G. Brogdon; B.D. Fletcher  
Johns Hopkins Hosp., Baltimore, Md.  
Publ: Journal of American Medical Association v200 n2 p167-68 (1967)  
1967  
Availability: see publication

HS-003 971

**CRASH HELMET FOR THE AUTOMOBILE DRIVER**

Describes a modernistic, fedora-style helmet with a chin strap, about twice as heavy as a standard man's hat but with ordinary appearance except for chin strap. Recommends that drivers should wear helmet as well as seat belts and shoulder harness.

by D.W. Florence  
Publ: Journal of the American Medical Association v203 n12  
p1073 (1968)  
1968  
Availability: see publication

HS-003 991

**A NEW PATTERN OF SPINE INJURY ASSOCIATED  
WITH LAP-TYPE SEAT BELTS: A PRELIMINARY  
REPORT**

Of 17 X-ray demonstrated spine injuries in seat belt wearers, 10 had unusual and consistent pattern of separation between posterior elements without usually expected decrease in anterior vertebral height. It is suggested that primary tension stress is responsible for unusual pattern seen in these injuries. Mechanism by which large tension forces may be brought to bear on lumbar spine has been described. It is likely that these injuries would not have occurred if patients had been wearing shoulder belts. This report is not indictment of lap belts. All cases studied were product of very severe collisions and would not have survived without seat belts. It is possible that shoulder belts could cause more serious spine injury at the cervical dorsal junction.

by H. Kaufer; W.S. Smith  
Michigan Univ., Ann Arbor. Medical School  
Publ: University of Michigan Medical Center Journal v33 n3  
p99-104 (1967)  
1967  
Availability: see publication

HS-004 013

**FACIAL INJURIES FROM AUTOMOBILE  
ACCIDENTS: A STUDY OF 400 CONSECUTIVE  
CASES**

Presents brief discussions on biophysics; soft-tissue injury; facial bone fractures; associated injury; treatment; anesthesia & tracheostomy. Concludes that 90% of the injuries could have been avoided with shoulder strap type of seat belt.

by R.C. Schultz  
Illinois Univ., Chicago. College of Medicine  
Publ: Plastic and Reconstructive Surgery v40 n5 p415-25 (1967)  
1967  
Availability: see publication

HS-004 021

**SEAT BELT INJURY: CASE OF COMPLETE  
TRANSECTION OF PREGNANT UTERUS**

Concluded that the pregnant women should not wear a seat belt that crosses the abdomen, but rather one that crosses the upper thighs, combined with a properly attached shoulder harness.

by D. McCormick  
Publ: Journal of the American Osteopathic Assoc. v67 p1139-1141 (Jun 1968)  
1968  
Availability: see publication

June 1, 1979

HS-004 377

HS-004 031

### A FRESH LOOK AT SEAT BELTS

Data on the effectiveness of seat belts (40% reduction of fatalities in one study) leads courts to a tougher attitude on their use. A fresh look is also being given shoulder belts.

American Mutual Insurance Alliance  
Publ: Journal of American Insurance v43 n5 p9-12 (1967)  
1967  
Availability: see publication

HS-004 081

### RESTRAINT SYSTEMS--ARE THEY REALLY EFFECTIVE

In summary, seat belts produce a major reduction in the occurrence of dangerous or fatal injury (except for head injuries). The possible benefits of shoulder belts are briefly mentioned.

by RC Haeusler  
Chrysler Corp.  
Publ: Traffic Safety v68 n10 p22-24, 35 (1968)  
1968  
Availability: see publication

HS-004 094

### AUTOMOBILE CRASH INJURIES

Speed and failure in driver performance are the most important factors in the causation of auto crashes. Their prevention will depend on passenger protection. A review of the history, research in seat and shoulder belt usage is offered.

Publ: American Surgeon v34 n4 p243-251 (1968)  
1968  
Availability: see publication

HS-004 095

### KEEP YOUR SEAT - SAVE YOUR LIFE

The injury Control Program (National Center for Urban and Industrial Health) worked with the Indiana State Police to determine reactions to wearing lap-belt, shoulder-harness combination restraint device. Concludes that this combination will be most effective in life saving.

by Richard E. Marland  
Publ: Archives of Environmental Health v15 p1-2 (Jul 1967)  
1967  
Availability: see publication

HS-004 128

### A SAFE AND ACCEPTABLE RESTRAINT

Discusses the type of shoulder and lap belts suitable police officers, who need freedom of motion and must get in and out of cars frequently. Recommends device with roof-mounted storage reel which has automatic locking device permitting un-

restricted movement of torso. Outlines ways in which shoulder and lap belts protect against injury.

by L.M. Patrick  
Wayne State Univ., Detroit, Mich. Biomechanics Res. Center  
Publ: Law and Order v16 n7 p52-53, 69-71 (1968)  
1968  
Availability: see publication

HS-004 190

### PATHOLOGY OF TRAUMA ATTRIBUTED TO RESTRAINT SYSTEMS IN CRASH IMPACTS

Types and severity of injuries attributed to lap belt, 3-point harness, single diagonal belt, double-torso harness, and experimental double-torso yoke with air bag restraint system have been assessed. Physical impact patterns typical of jet plane crash, light aircraft crash, and automotive impact were studied. Work included 60 experiments with baboons and a series of tests to determine effects of seat belts on pregnant baboon and fetus. Concludes that restraint systems should be studied as sources of tertiary collision phenomena. (Presented at 6th Scientific Session, Joint Committee on Aviation Pathology, Ottawa, Ontario, Canada, Sep. 12, 1967)

by C. C. Snow; R. C. Synder; J. W. Young; W. M. Crosby; G. T. Price  
Aeromedical Res. Lab. (6571st), Holloman AFB, New Mexico  
Publ: Aerospace Medicine v39 n8 p812-29 (1968)  
1968  
Availability: see publication

HS-004 204

### AUTOMOTIVE CRASH INJURY AND THE ANTERIOR CRANIUM

Frontal and supraorbital injuries continue to be seen often, despite use of seat belts. Suggests the use of shoulder harness and additional auto safety features. Discusses treatment of comminuted frontal sinus fracture associated with avulsion lacerations.

by H.G. Bingham; H.J. Forrest  
Publ: Missouri Medicine v64 n1 p46-49 (1967)  
1967  
Availability: see publication

HS-004 377

### TRAUMA OF THE LARYNX

Seat belts do not prevent secondary collisions in which larynx is often injured; shoulder belts should also be worn. Methods for surgical repair of larynx fractures and injuries are discussed.

by D.A. Shumrick  
Publ: Archives of Otolaryngology v86 p109-14 (Dec 1967)  
1967  
Availability: see publication

HS-004 391

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HS-004 391

### **STUDENT AND FACULTY SURVIVAL ON THE HIGHWAY**

Need for wearing seat belts has not been appreciated by either students or faculty at Syracuse University. Discusses how they should be worn and how they save lives. Briefly discusses role of small cars in accidents and role of alcohol and drugs.

by William D. Alsever  
Publ: Journal of the American College Health Association v16  
p214-23 (Feb 1968)  
1968  
Availability: see publication

HS-004 392

### **THE SEQUEL TO STUDENT AND FACULTY SURVIVAL ON THE HIGHWAY**

Describes cases in which shoulder harness was worn without seat belt. Victims slipped out from under shoulder harness, some suffering broken necks or decapitation. While seat belts may be worn without shoulder harness, the shoulder harness should never be used alone.

by William D. Alsever  
Publ: Journal of the American College Health Association v16  
p410-13 (Apr 1968)  
1968  
Availability: see publication

HS-004 427

### **STERNAL FRACTURES SECONDARY TO SEAT BELT INJURY: PRICE FOR SURVIVAL**

Two cases of fractured sternum in auto passengers wearing three point over-the-shoulder seat belts are presented to increase physician awareness of this injury. Other facts concerning motor vehicle accidents as well as a discussion centering on available safety measures and the subject of seat belts injury are also presented.

by R.P. Andrews; R.E. McAfee  
Publ: Journal of the Maine Medical Association v58 n9 p188-190, 195 (Sep 1967)  
1967  
Availability: see publication

HS-004 435

### **ELEMENTS OF AN EFFECTIVE CHILD RESTRAINT SYSTEM**

Success of an effective system for preventing child injury must be measured in terms of child acceptance as well as impact performance and anatomical considerations. Adult lap belts, child harnesses and vests, rearward facing seats, and

child auxiliary seats are compared. Different types of restraint systems are needed as children grow.

by R.A. Rogers; J.N. Silver  
General Motors Proving Ground, Milford, Mich.  
Rept. No. SAE-680776 ; 1968  
In Proceedings of Twelfth Stapp Car Crash Conference,  
Detroit, 22-23 Oct., 1968, p172-87.  
Availability: In HS-004 429

HS-004 437

### **USE OF CONTOURED RESTRAINT SYSTEMS IN EXPOSURE OF LARGE PRIMATES TO -150 Gx IMPACT**

Test with two chimpanzees indicates that whole body restraint system is more valuable protection than seat belts alone or shoulder harness alone.

by Jr. Sonntag, R.W.; W.A. Newsom; Jr. Leverett, S.D.; V.E. Keirtland  
Rept. No. SAE-680778 ; 1968  
In Proceedings of Twelfth Stapp Car Crash Conference,  
Detroit, 22-23 Oct., 1968, p201-6  
Availability: In HS-004 429

HS-004 499

### **INTESTINAL PERFORATION AND FACIAL FRACTURES IN AN AUTOMOBILE ACCIDENT VICTIM WEARING A SEAT BELT**

Certain accident hazards not adequately avoided by use of seat belts are discussed, with report of an unusual case. Advocacy of shoulder harness for better traffic safety is urged on members of the medical profession. Physicians should not assume that seat belts will protect abdomen from injury.

by David Wyatt Aiken  
Publ: Journal of the Louisiana State Medical Society v115 n7  
p235-6 (Jul 1963)  
1963  
Availability: See publication

HS-004 523

### **SEAT BELT INJURIES IN IMPACT**

Brings together clinical evidence concerning restraint syst injuries, discussing gross biomechanics of trauma. The double shoul harness (with lap belt) appears to offer greatest protection, while single diagonal belt (without lap belt) seems the most dangerous typ in certain impact situations.

by W. M. Crosby; R. G. Snyder; C. C. Snow; J. W. Young; P. Hanson  
Publ: In Michigan Univ. Prevention of Highway Injury p188-210  
1967  
Availability: In HS-004 500

June 1, 1979

HS-005 129

HS-004 564

### SEAT BELT INJURIES

Discusses several accidents in which persons wearing seat belts suffered abdominal injuries. In all kinds of auto accidents except crushing of the car, seat belts save lives. The cases in which they have caused injuries suggest that lap and diagonal belts would be better, or that they were worn too loosely.

Publ: British Medical Journal v3 n5609 p4-5 (6Jul 1968)  
1968  
Availability: see publication

HS-004 606

### CAUSES OF DEATHS IN AUTOMOBILE ACCIDENTS. CAN SEAT BELTS REALLY SAVE LIVES?

Examination of 79 auto accident deaths, emphasizing the value of the seat belt in both front and rear seats. Certain features of the interior design of autos contribute to fatal injuries. 34% of the victims would have been saved by a simple lap-type seat belt. The superiority of the shoulder strap lap-belt combination is also discussed. Victims who were not killed by ejection received their fatal injury from secondary collision within the vehicle.

by Paul W. Gikas; Donald F. Huelke  
Publ: Journal of the Michigan State Medical Society v63 p351-4 (May 1964)  
1964  
Availability: see publication

HS-004 670

### RESTRAINT SYSTEMS IN RACING ACCIDENTS

Surveys 634 auto racing accidents, in 275 of which shoulder harnesses were used. A significant decrease in frequency and severity of injuries occurred after harnesses were introduced. Deep bucket seats providing better support for the body are also helpful. Harness used in the inverted Y double, separately anchored, shoulder harness.

by David Ryon; John D. States  
Rochester Univ., New York., Orthopaedic Surgery Div.  
Rept. No. SAE-690246 ; 1969 ; 9p  
Presented at International Automotive Engineering Congress, Detroit, Mich. Prepared in cooperation with Rochester Applied Science Associates, Inc., N.Y.  
Availability: SAE

HS-004 723

### CASE COMPARISONS OF RESTRAINED AND NONRESTRAINED OCCUPANTS AND RELATED INJURY PATTERNS

Injury is avoided or minimized by use of lap, shoulder, and diagonal seat belts in several types of crashes, under various angles of impact. Prevention of fatal ejection, 7 improved chances of retaining control of car, and attenuation of interior

collision forces, such as result in jack knifing, are discussed, as well as the contribution of major auto design improvements.

by Arnold W. Siegel; Wayne T. VanWagoner; Alan M. Nahum  
California Univ., Los Angeles. School of Medicine  
Rept. No. SAE-690245 ; 1969 ; 18p 15refs  
Presented at International Automotive Engineering Congress, Detroit, Mich.  
Availability: SAE

HS-004 853

### THE AUTOMOTIVE SAFETY BELT SITUATION

To promote wider usage by the motoring public, this brochure sums up the safety belt story: motivation (important milestones), implementation, proper use, misinformation (true-false questions), documentation and quotations.

by D.J. Schrum  
American Safety Belt Council, Inc., Hollywood, Calif.  
1967 ; 15p  
Availability: Corporate author

HS-004 964

### AN UNUSUAL INJURY DUE TO THE SEAT BELT

Case history of seat belt syndrome, in which the victim suffered abdominal injuries during an auto accident. Surgical repair was necessary. The use of the combined lap-shoulder belt rather than the seat belt is urged.

by S.H. Tolins  
Publ: Journal of Trauma v4 p397-9 (1964)  
1964  
Availability: see publication

HS-005 041

### REVIEW OF THE RELATIVE MERITS OF VARIOUS TYPES OF MOTOR VEHICLE SEAT BELTS

That safety belts are an effective safety device is evidenced in a review of data in reports from the United States, Great Britain, Australia, and Sweden. Presents merits of belts incorporating upper torso restraints. Also covers results of simulated car crashes using anthropometric dummies restrained by different types of seat belts.

by A.P. Vulcan  
Publ: Australian Road Research v2 n8 p33-40 (Jun 1966)  
1966  
Availability: see publication

HS-005 129

### TWO NEW SPECIFICALLY DESIGNED CHILD RESTRAINT SYSTEMS OFFERED

Describes new systems of Ford and General Motors for child protection, emphasizing that a successful restraint system must allow child to see out of the windows. Also gives rules for determining when and how children should use lap and

shoulder belts. Gives crash test results for various child restraint systems.

by Emile P. Grenier; Samuel A. Heap; William G. Cichowski; Jeffrey N. Silver  
Publ: SAE Journal v77 n1 p53-5 (Jan 1969)  
1969

Availability: see publication

HS-005 132

### **THIRTY-THREE FATAL CRASHES WITH SEAT BELTS**

Examines the reasons seat belts failed to protect lives. Five drivers were killed by steering shaft, which was displaced into the drivers' seating space 11/2 to 21/2 feet. Eight of the accidents were rollovers, in four of which car doors opened. Shoulder harness is needed to keep head and torso inside the car in such cases. Seat belts cannot prevent death from crushing of the car interior; better design is needed. Motorists need to wear seat belts and upper torso restraints, and autos need to provide more side impact protection and safer steering assembly.

by Horace E. Campbell  
Publ: Rocky Mountain Medical Journal v61 n8 p27-9 (Aug 1964)  
1964

Availability: see publication

HS-005 191

### **IN ACCIDENTS, LEAN FORWARD TO REDUCE IMPACT SEVERITY**

Seat belted occupants should lean forward and rest their arms and heads on a forward area, thus reducing the relative impact velocity between themselves and the vehicle interior. Rules for correct wearing of seat and shoulder belts are also given.

by W. G. Cichowski; J. N. Silver  
Publ: SAE Journal v76 n11 p38-40 (Nov 1968)  
1968

Availability: see publication

HS-005 370

### **AUTO SAFETY BELTS: WHATS WRONG?**

Few of the belt systems can be attached easily, worn comfortably, or stored conveniently. Some shoulder belts attached to the roof tend to ride the users neck and may contribute to neck injuries. Too many lap and shoulder belts must be fastened separately. Some lap belts tend to slide up over the abdomen, where they can cause serious injury. Both American and foreign cars are criticized for the design of their belt systems, but motorists are urged to wear them nevertheless.

Publ: CONSUMER REPORTS v33 n10 p537-9 (Oct 1968)  
1968 ; 3p

Availability: see publication

HS-005 513

### **SEAT HARNESS. EFFECT OF A HARNESS ON THE MOVEMENT OF THE OCCUPANT OF A CAR DURING A HEAD-ON COLLISION**

Maximum values for decelerations and forces of a seat-belted occupant during a head-on collision have been calculated. There is a difference in the movement of a seat-belted occupant and a seat and torso restrained occupant. Differences in deceleration of American and European cars are also considered.

by G. Grime  
Publ: Automobile Engineer v53 n1 p12-8 Jan 1963)  
1963

Availability: see publication

HS-005 611

### **THE AUTOMOTIVE SAFETY BELT: IN SAVING A LIFE MAY PRODUCE INTRA-ABDOMINAL INJURIES**

Four case histories are described. The mechanism of injury is discussed, and the use of shoulder harness in addition to lap belt is recommended. Early diagnosis and treatment are essential in the management of abdominal injuries from safety belts. Diagnostic criteria are outlined.

by Jr. lies, Bert A.; James S. Williams; Harry W. Hale, Jr.  
Publ: Journal of Trauma v6 n3 p303-13 (1966)  
1966

Availability: see publication

HS-005 668

### **CAR SEAT-BELTS. AN ANALYSIS OF THE INJURIES SUSTAINED BY CAR OCCUPANTS**

The details of 600 car accidents in which 837 drivers or front-seat passengers were wearing seat-belts have been analyzed. The types of seat belts in use and the injuries sustained by the wearers are described as well as the injuries sustained in the same accidents by persons not wearing seat-belts. The wearing of seat-belts resulted in a considerable reduction in injuries.

by R.D. Lster; Barbara M. Milsom  
Publ: Practitioner v191 p332-40 (Sep 1963)  
1963

Availability: see publication

HS-005 717

### **A FRESH LOOK AT SEAT BELTS**

Research now indicates that seat belts could save 14,000 lives a year. A jury found failure to use shoulder belt amounted to contributory negligence by the driver. Insurance Institute for Highway Safety is urging states to make seat belt usage mandatory.

by Anonymous  
Publ: Journal of American Insurance v43 n5 p9-12 (Nov-Dec 1967)  
1967

Availability: see publication

June 1, 1979

HS-006 411

HS-005 719

### **R. A. F. EXPERIENCE WITH SAFETY HARNESSSES**

Advances in shoulder harness design include recognition of need that attachment is to the airframe rather than the seat, that the center of gravity of the body is not lower than the junction of the straps, and that construction of harness is such that it will withstand forces encountered in very severe impacts. Relevance of the features of current harness to the requirements for safety belts for motor vehicles is briefly discussed.

by D.I. Fryer

Publ: Annals of Occupational Hygiene v5 p113-127 (Apr-Jun 1962)  
1962

Availability: see publication

HS-005 919

### **RESTRAINT SYSTEMS, DESIGN AND PERFORMANCE PARAMETERS**

The objective of an auto restraint system is to reduce injury potential, partially by attaching the occupant to the passenger compartment. Performance of the lap belt is affected by the angle and belt loop length. Belt performance is significantly affected by the crash test dummy or test device used to evaluate restraint systems. Test results and human tolerance data will contribute toward further reduction of vehicle accident injury potential.

by Jr. James, C.; Thomas W. Ruster  
General Motors Corp., Detroit, Mich.

Publ: Paper 16 in General Motors Proving Ground, Proc. of Automotive Safety Seminar, 11-12 Jul 1968  
1968 ; 9p

Availability: In HS-005901

HS-005 966

### **DUMMIES EVALUATED FOR SEAT BELT TESTING**

National Bureau of Standards automobile safety research has disclosed how differently anthropomorphic dummies respond from humans in tests of seat belts and harnesses. This may be because of the difference in articulation and because the human absorbs some energy by bracing his legs for an impact. Correction factors are being sought.

National Bureau of Standards, Gaithersburg, Md.

Publ: SAE Journal v77 n7 p48-51 (Jul 1969)  
1969

Availability: see publication

HS-006 039

### **INTEGRATED SEAT AND OCCUPANT RESTRAINT PERFORMANCE. FINAL REPORT**

The potential value of the integrated seat concept as a means for promoting the use of restraint systems by passengers is covered. Seat belts and upper torso restraints, both attractively designed and convenient, should reduce injury in head-on impacts and rollover accidents. Lateral restraint and protection against compartment penetration are required before injury reduction in side impacts can be achieved. Occupant restraint

for rear impacts may be achieved with yielding seat-backs and appropriate head rests. A program is recommended that is directed toward short term determination of performance requirements for an integrated restraint system and toward long range research and development to provide improved integrated occupant restraint.

Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

FH-11-6631

Rept. No. CAL-YB-2499-V-1 ; 1967 ; 145p65refs

Availability: CFSTI

HS-006 051

### **CRASH PERFORMANCES OF THE NEW AUTOMOBILE SAFETY FEATURES**

Field investigations of automobile crashes involving new model cars, with new safety features, indicate a marked increase in occupant safety. Areas of improvement by automobile manufacturers include: windshields, ejection, steering assemblies, instrument panels, passenger compartment integrity, lap and shoulder belts.

by William A. Chewning; Donald F. Huelke

Michigan Univ., Ann Arbor

Publ: In American Assoc. for Automotive Medicine, PRE-CRASH FACTORS IN TRAFFIC SAFETY, 17-18 Oct 1968  
p97-115

1968

Availability: In HS-006 046

HS-006 259

### **POST OFFICE VEHICLE CRASH STUDY**

A comprehensive test program has been carried out to study the indicated effectiveness of personnel restraining devices in reducing injuries and fatalities in post office vehicle accidents. The program consisted of a series of simulated vehicle crashes utilizing a dynamic impact sled and three actual crash tests.

by J.C. Gilkey; R.A. Rogers

General Motors Proving Ground, Milford, Mich.

Rept. No. SAE-670025 ; 1967

Presented at SAE Automotive Engineering Congress, Detroit, Includes oral discussion.

Availability: SAE

HS-006 411

### **CRASH SURVIVAL: HELP FROM THE TRACK**

Some design ideas used in racing cars have already been adopted by auto manufacturers. Among the ideas discussed are crushproof structure, shoulder harnesses, safer brakes and tires, fuel cells rather than tanks which can rupture and burn, safety foam mixed with the fuel itself, racing clothing, and fire extinguishing systems. The use of these devices enables racing drivers to survive 150 mph crashes without injury.

by Harold M. Nelson

Publ: Automotive Industries v141 n7 p57-63 (1 Oct 1969)

1969

Availability: see publication

HS-006 421

**SEAT BELTS: A FOLLOW-UP STUDY OF THEIR USE UNDER NORMAL DRIVING CONDITIONS**

Observations were made of 868 cars in summer 1968; comparison with a similar survey in 1967 shows an increase in seat belt usage. Seat belt usage was related to several factors. It was higher among drivers of belt-equipped newer model cars, out-of-state drivers, white drivers, male drivers, and older drivers. About 30-35% of the drivers with shoulder harnesses available to them were using the devices. The study was made in North Carolina.

by F.M. Council  
 Publ: Journal of Safety Research v1 n3 p127-36 (Sep 1969)  
 1969  
 Availability: see publication

HS-006 434

**REDUCING HIGHWAY SLAUGHTER**

Doctors can play a role in reducing accidents by conducting further research on the effects of drugs and medical conditions that impair perception or driving performance, sudden death at the wheel, heart diseases, alcoholism, and suicides. The value of restraint systems is discussed, including seat belts, shoulder harnesses, and air bags. A restraint system for small children is needed. Better emergency medical services are also needed.

by Anonymous  
 Publ: Medical World News v10 n35 p22-6, 28-9 (29 Aug 1969)  
 1969  
 Availability: see publication

HS-006 548

**ABDOMINAL TRAUMA FROM SEAT BELTS**

Eight cases of abdominal injury due to the use of seat belts are described. Most victims had a contusion in the shape of the belt. If the lap type belt is used alone, its correct application across the bony pelvic ring is important. The association of lumbar spine injuries is stressed. The use of the shoulder strap in conjunction with the lap belt is recommended.

by W.W. Jr Morgan; F.A. Traylor; J.I. Lucero; J.C. Owens  
 Publ: American Surgeon v35 n5 p313-6 (May 1969)  
 1969; 11refs  
 Availability: see publication

HS-006 610

**FATAL NECK INJURIES CAUSED BY USE OF DIAGONAL SAFETY BELTS**

Three cases are described in which the subjects slipped out of diagonal safety belts and were ejected from their cars and in which the belts caused fatal neck injury. Two of the victims were decapitated. These cases reflect the risk involved in the combination of inadequate car door locks and a diagonal belt. The cervical spine is also subject to injury when a victim wearing a diagonal safety belt is ejected.

by Tom Saldeen  
 Publ: Journal of Trauma v7 n6 p856-62 (1967)  
 1967  
 Availability: see publication

HS-006 826

**SAFETY BELTS FOR MOTOR VEHICLES**

German safety standards for automotive safety belts are described and compared with corresponding foreign specifications. Loads and forces on safety belts are defined mathematically. Test specifications and the results of statistical belt tests are also given.

by E. Keil; H. Werner  
 Publ: Automobiltechnische Zeitschrift v64 n5 p149-52 (May 1962)  
 Rept. No. AD-291 415; 1962  
 Availability: CFSTI

HS-007 075

**LA SICUREZZA DELL'AUTOVEICOLO (MOTOR VEHICLE SAFETY)**

The highway safety campaign in Italy is proceeding along two directions: accident prevention and occupant protection. For the vehicle, preventive safety is ensured through logical design and quality construction. The most important development in occupant protection is the three point safety belt. Impact tests using these belts are described.

by D. Giacosa  
 Publ: A.T.A.: Giornale ed Atti dell'Associazione Tecnica dell'Automobile v19 n11 p640-52 (Nov 1966)  
 1966  
 Availability: see publication

HS-007 464

**RESTRAINT SYSTEMS-ARE THEY REALLY EFFECTIVE?**

Reasons for the failure of drivers to use seat belts are outlined, ranging from unavailability of belts shortly after their development to fears of their ineffectiveness and fears of their causing injury. Results of several studies are summarized to indicate that belted occupants are far less likely to be seriously injured or killed, especially from thoracic injury. These studies also indicate that seat belts are often worn improperly (too loose or too high) and that shoulder belts in addition to seat belts would provide still better protection.

by Roy Haeusler  
 Chrysler Corp Automotive Safety Engineering Office  
 1968; 8p  
 Presented at the Canadian Highway Safety Council 14th Annual Conference, Victoria, B. C., 6-8 May 1968.  
 Availability: In HS-007 437

HS-007 482

**THE VEHICLE AND SAFETY**

The constructive view of protection against drunken or inattentive drivers is to design a vehicle that will minimize the effects of crashes. Measures in vehicle design to improve safety include: guarded outside door release buttons; inside door release levers flush with the door; single button locking of all doors simultaneously; child-proof rear door lock buttons; seat belts as required equipment; improved design and availability of shoulder belts; padded and non-reflective instrument

panels; padded sun visors; recessed center steering wheels; improved safety glass; head restraints. Future steps suggested are: obtaining greater acceptance and cooperation from the motorist; providing protection requiring no active cooperation from the motorist; accelerating the program to develop additional safety performance standards. Discussion is included.

by Roy Haeusler  
Chrysler Corp., Detroit, Mich. Automotive Safety and Engineering Office  
Publ: Traffic Safety: A National Problem p47-68 (1967) 1967 ; 22p  
Presented at National Academy of Engineering Symposium, Washington, D. C., 28 Apr 1966.  
Availability: In HS-007 477

HS-007 484

### ENGINEERING STUDIES OF MOTORIST INJURY EXPOSURE FROM REAR-END COLLISIONS

Results of UCLA experiments with rear-end collisions are given. (1) The motorist's unsupported, unrestrained body develops a velocity difference from the car, which is cancelled by the secondary collision. (2) "Whiplash" effect occurs when the motorist's body accelerates and the unsupported head is subjected to inertial forces. (3) Whiplash injury can be significantly influenced by contact speed, vehicle design, and human variations. (4) Shoulder and lap restraints are valuable for occupants of the striking car, and head restraints for occupants of the struck car. (5) Other injuries resulting from rear-end collisions include mid-back, low-back, and facial injuries. (6) Automobiles should be rated on collision performance, and manufacturers should develop retrofit units for currently-installed safety devices. Discussion is included.

by Derwyn Severy  
California Univ. ITTE. Los Angeles  
Publ: Traffic Safety: A National Problem p91-117 (1967) 1967 ; 27p  
Presented at National Academy of Engineering Symposium, Washington, D. C., 28 Apr 1966.  
Availability: In HS-007 477

HS-007 486

### TREATMENT OF THE INJURED

More education in simple, effective roadside first aid is needed for the general public. The order of priority for good management by on-the-spot persons should be: ensure the patient's optimal breathing, control external hemorrhage, cover open wounds, and splint fractures. Any movement of the patient must be gentle, knowledgeable, and avoid flexing the body. At the hospital, one doctor must coordinate management of the patient's injuries. The suggested order of priorities for the surgeon is: establishment of an adequate airway and control of hemorrhage; closure of gastro-intestinal tract perforations; elevation of fractured skull depressions; repair of significant internal organ lacerations; repair or replacement of major tears in extremity arteries; surgical treatment of large

massively injured muscles and decontamination and closing of open wounds; setting of fractures. Discussion is included.

by Henry H. Balch  
Georgetown Univ., Washington, D.C.. School of Medicine  
Publ: Traffic Safety: A National Problem p147-59 (1967) 1967 ; 13p  
Presented at National Academy of Engineering Symposium, Washington, D. C., 28 Apr 1966.  
Availability: In HS-007 477

HS-007 497

### SEAT BELTS: A FOLLOW-UP STUDY OF THEIR USE UNDER NORMAL DRIVING CONDITIONS

Observations of 868 cars were made to determine the actual use of seat belts, and results compared with a 1967 survey. For newer, belt-equipped cars, the percentage of usage was up 14% to 35.8% total. Usage was related to several factors. Drivers of newer cars, out-of-state drivers, white drivers, male drivers, and older drivers were more likely to wear seat belts. Shoulder harnesses were being used by 30-35% of the drivers who had them available. Although usage has increased since the 1967 study, about two out of three people with belts available are still not wearing them.

by Forrest M. Council  
North Carolina Univ. Hwy. Safety Res. Center, Chapel Hill  
1969 ; 25p 7 refs  
Availability: Corporate author

HS-007 596

### SEAT BELTS FOR TRUCK OCCUPANT SAFETY

Small trucks with conventional seats may use seat belt systems already available for passenger cars. Large trucks with suspension seats may use duplex systems having a seat belt to secure the driver to the seat and an additional belt to secure the seat to the cab structure. The usage made of seat belts in cars and trucks is too low, and mandatory use of seat belts by truck drivers is proposed. Current developmental efforts of seat belt manufacturers are directed toward providing greater convenience and comfort when seat belts are in use and simpler, cleaner stowage of the seat belts when not in use.

by H. George Johannessen  
Hamil Mfg. Co., Monroeville, Pa.  
Rept. No. SAE-700347 ; 1970 ; 7p  
Presented at SAE Mid-Year Meeting, Detroit, Mich., 18-22 May 1970.  
Availability: SAE

HS-007 820

### THE INFLATABLE OCCUPANT RESTRAINT SYSTEM IN THE SMALL CAR

The design and development of inflatable restraints for a small car poses some special problems because of the reduced space in the front of the vehicle. The occupant sits closer to any object the car may strike and it is more difficult to produce the same air bag deployment performance as is obtained in the

larger car. A system is described consisting of a torso bag and a smaller knee bag.

by A. Gaskill

General Motors Corp., New York

Publ: International Conference on Passive Restraints, General Motors Proving Ground, Milford, Mich., 11-12 May 1970, p53-7

1970

Availability: In HS-007 822

HS-007 824

### **PANEL QUESTION AND ANSWER SESSION (INTERNATIONAL CONFERENCE ON PASSIVE RESTRAINTS)**

Problems involved in the technology of air bag restraint systems are discussed. The effectiveness of seat and shoulder belts and their low percentage of actual use is emphasized. Questions raised include the reliability of the air bag, the lead time needed by the auto industry, the amount of testing done on the system.

by Chairman Toms, Douglas

North Atlantic Treaty Organization, Paris (France)

Publ: International Conference on Passive Restraints, General Motors Proving Ground, Milford, Mich., 11-12 May 1970, p141-52

1970

Availability: In HS-007 822

HS-007 907

### **EFFECT OF BODY RESTRAINTS ON DRIVER REACH**

Increased use of upper torso restraints directs attention toward possible effects on driver reach. The results of a survey of male and female driver reach envelopes or ergospheres in American and European vehicles are presented. Contour sections representing 5th percentile shells of the ergospheres resulting from various degrees of torso restraint are presented in comparison with the ergosphere characteristic of lap belt only restraint. Differences in the effects on reach are pronounced and suggest that the inertia reel type of torso restraint reduces the ergosphere least.

by John W. Chaffee

Ford Motor Co., Dearborn, Mich.

Publ: International Auto. Safety Conf. Compendium (P-30) New York, 1970 p70-81

Rept. No. SAE-700359 ; 1970

Includes summaries in French and German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

Availability: SAE; also in HS-007 859

HS-007 909

### **THREE-DIMENSIONAL SIMULATION OF ADVANCED AUTOMOTIVE RESTRAINT SYSTEMS**

Development and use are described of a three-dimensional mathematical model of vehicle occupant kinematics for the purpose of studying various seat, restraint system, and occupant configurations in a crash environment. This model includes three masses representing the head, torso, and lower

limbs. Contacts between the occupant and a large variety of moving interior vehicle contact surfaces are allowed. Decelerations in the three linear directions as well as vehicle pitch, roll, and yaw can be accepted as input to the computer program. Seat belt and shoulder harness configurations are compared. Mathematical models of this nature can be used to optimize restraint system performance, and the techniques can also be applied to rear end impact protection.

by D. Hurley Robbins

Michigan Univ. Hwy. Safety Res. Inst., Ann Arbor

Publ: International Safety Conference Compendium (P-30) New York, 1970 p1008-23

Rept. No. SAE-700421 ; 1970

Includes summaries in French and German. Presented at 1970 International Safety Conference Compendium: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

Availability: SAE; also in HS-007 859

HS-007 987

### **CRASH TESTING OF HUMANS IN AUTOMOBILE SEATS**

Auto interior design is largely based upon data gathered under static conditions. The requirements of the human operator or passenger during a crash are not well documented. To alleviate this shortage of human impact data, tests were conducted to gather comparative data about human and dummy test subjects under crash conditions using auto seating and restraint systems. Data are presented on 32 human tests of controlled impacts of approximately the same magnitude. Variables are the type of restraint, either lap belt or lap belt plus single diagonal, and subject size. Data include the displacement paths of the subjects during the impact, the maximum velocity along the path, anthropometric data, loads generated in the restraint system, and medical and subjective evaluation of the impacts.

by Richard F. Chandler; Robert A. Christian

National Bureau of Standards, Gaithersburg, Md.

Publ: 1970 International Auto. Safety Conf. Compendium (P-30) New York, 1970 p112-32

Rept. No. SAE-700361 ; 1970

Includes summaries in French and German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

Availability: SAE; also in HS-007 859

HS-008 228

### **AUTOMOTIVE RESTRAINT DEVICES FOR THE PEDIATRIC PATIENT**

Motor vehicle accidents kill 6,300 children under 15 yearly. This number would have been reduced if all children and infants had been properly restrained. This paper describes restraining devices so that physicians can prescribe suitable ones for their patients. Infants from birth to 12 pounds should be transported in a rear seat bassinet or car bed held in place by safety belts. Children from 12 to 24 pounds should be placed in a rear seat safety harness. Children from 24 to 48 pounds should be placed in a rear seat, shield-type system. Children weighing over 50 pounds should use adult lap belts, adding the adult shoulder harness when they are 55 inches tall.

by Frederic D. Burg; John M. Douglass; Eugene Diamond; Arnold W. Siegel

Publ: Pediatrics v45 n1 pt.1 p49-53 (Jan 1970)

1970

Availability: see publication

HS-008 616

**RESTRAINT SYSTEMS: HOW EFFECTIVE ARE THEY?**

Many facts, figures, and statistics are presented showing what occurs during an automobile accident, what restraint systems are available to the occupants of motor vehicles, and how effective they are. Each system is discussed and evaluated on its own merits in reducing injury to occupants. Flaws are pointed out when necessary. Percentage of seat belt usage, injury survival, and seat belt availability are given. It is noted that the effectiveness of any safety system component cannot be judged adequately except in the context of the entire system.

by D. J. Van Kirk

Publ: Proceedings of the 13th Annual Conf of the AAAM, 1969, p165-84  
1969 ; 61 refs

Presented at the 13th annual conference of the American Assoc. for Automotive Medicine, Minneapolis, Minn., 16-17 Oct 1969.

Availability: In HS-008 596

HS-008 635

**THIRD GENERATION OF AUTOMOTIVE TEST DUMMIES**

To meet today's demands for a higher degree of accuracy and repeatability in automotive crash testing, a new advanced anthropometric dummy is under development. This third-generation test dummy is designed to be in a 90 deg seated position and complies with all requirements of present SAE J963 specifications. The head is a completely new design. The skull, which is covered with a removable skin, is symmetrical for better test repeatability. The newly developed neck concept produces more human-like response. New materials used in the neck and the lower vertebrae eliminate ringing effects. The new shoulder assembly features better contour and muscle tone, and withstands the expected shoulder harness loads. The chest of the previous generation dummies is replaced with a plastic contoured rib cage of the required load deflection characteristics. To provide a better means of restraint system evaluation, the new pelvis is human-like in contour. For better simulation of muscle tone, more reliable friction setting of joints is included. Finally, for easier handling, the skin closure zippers are located in the rear and paddings are secured in place.

by Peter I. Mate; Leonard E. Popp

Sierra Engineering Co., Sierra Madre, Calif.

Publ: Proceedings of Fourteenth Stapp Car Crash Conf., 1970, p329-40

Rept. No. SAE-700908 ; 1970

Presented at the Fourteenth Stapp Car Crash Conference, Ann Arbor, Mich., 17-18 Nov 1970.

Availability: In HS-008 628

HS-008 656

**EVALUATION OF THE LAP BELT, AIR BAG, AND AIR FORCE RESTRAINT SYSTEMS DURING IMPACT WITH LIVING HUMAN SLED SUBJECTS**

Abrupt linear decelerations (-Gx) were conducted with human volunteers in order to study the loading to the human anatomy while restrained with the lap belt, lap belt plus air bag, and Air

Force harness systems. Impulses and peak forces in the lap belts and peak forces in the seat pan, seat back, and foot cells were measured and compared. Each subject was compared with himself using the different systems, and the range and mean of these comparisons are shown. The results indicated that in comparison with the lap belt only system, both the lap belt plus air bag and the Air Force harness systems significantly reduced the impulses and peak forces transmitted to the pelvis.

by C. D. Bendixen; C. D. Gragg; T. D. Clarke; H.

Klopfenstein; S.; J. F. Sprouffske

Aeromedical Res. Lab. (6571st), Holloman AFB, N.Mex.

Publ: Proceedings of Fourteenth Stapp Car Crash Conf., 1970 p241-62

Rept. No. SAE-700904 ; 1970

Presented at the Fourteenth Stapp Car Crash Conference, Ann Arbor, Mich., 17-18 Nov 1970.

Availability: In HS-008 628

HS-008 660

**THE NATURE OF SEAT BELT INJURIES**

A study was made of the histories of accidents in which the victims were injured by safety belts. The three types of safety belts—lap, two point and three point—each produced a characteristic injury pattern. Without restraining systems, more of the accidents would have resulted in fatalities but the safety belt injuries were often extremely severe. Statistics are given of the number and type of injury for each form of safety belt, and the conclusion is drawn that a combination of shoulder and lap belt is the most effective in preventing injury and mortality.

by James S. Williams

Rochester Univ., N.Y. School of Medicine

Publ: Proceedings of Fourteenth Stapp Car Crash Conference, 1970, p44-65

Rept. No. SAE-700896 ; 1970

Presented at the Fourteenth Stapp Car Crash Conference, Ann Arbor, Mich., 17-18 Nov 1970.

Availability: In HS-008 628

HS-008 922

**SAFETY BELTS: THEIR FITTING AND USE. ENQUIRY 1968/1969 AMONG ROAD-USERS ON ROADS OUTSIDE BUILT-UP AREAS**

Outside built-up areas in the Netherlands, 22% of the passenger cars surveyed had safety belts. Of these, 39% were actually being used; hence only 8.5% of drivers interviewed used safety belts. The diagonal belt is used least, the lap belt is used more, and the three point belt is used more than either. Men use belts more than women do, and younger drivers less than other drivers. Design and convenience of the belts have some effect on their usage.

by P. M. DE Grefte; H. G. Paar

Stichting Wetenschappelijk Onderzoek Verkeersveiligheid,

Voorburg (Netherlands)

1970 ; 43p

Availability: Reference copy only

HS-008 923

### **PATHOLOGY OF TRAUMA ATTRIBUTED TO RESTRAINT SYSTEMS IN CRASH IMPACTS**

The types and severity of injuries attributed to lap belt, 3-point harness single diagonal belt, double-torso harness, experimental double-torso inverted -Y yoke with inertia reel, and air bag restraint system has been assessed. Physical impact patterns typical of jet aircraft crashes, light aircraft crashes, and automotive impacts were studied. The study included 60 experiments with baboons and series of tests to determine effects of seat belts on the pregnant baboon and fetus. It is concluded that while restraint systems may protect occupants from serious trauma, the system itself may cause lesser but significant injury. Intensive research should be conducted on restraint caused injuries, referred to tertiary collision injuries.

by Clyde C. Snow; Richard G. Snyder; Joseph W. Young; Warren M. Crosby; G. Townley Price  
Federal Aviation Administration, Oklahoma City, Okla.  
Rept. No. AD-695 415; AM-69-3 ; 1969 ; 36p 84 refs  
This paper, as published in Aerospace Medicine v39 n8 p812-29 (1968), was previously announced in HSL as HS-004 190.  
Availability: NTIS

HS-009 011

### **INFORMATION ON INJURIES OBTAINED FROM REPORTS OF ACCIDENTS TO CAR OCCUPANTS WEARING SAFETY BELTS**

An analysis of accident reports returned to a safety belt manufacturer showed that about two-thirds of the injuries to wearers of lap-and-diagonal belts were caused by striking parts of the car, and only one-third were due to restraining forces due to belts. Leg, knee, and arm injuries caused by impact with parts of the car were comparatively numerous and severe. Many leg and knee injuries are probably preventable by changes in the design of the car interior. Injuries due to the belt were mainly to shoulder, chest, ribs, and neck. Neck injuries were rarely serious. Automatic belts were more effective than ordinary lap-and-diagonal belts, particularly in preventing head injury to the driver.

by G. Grime  
University Coll., London. Res. Group in Traffic Studies  
Publ: Conference on Road Safety. Vol. 1, Brussels, 1968, pA8-1 to A8-32  
1968  
Availability: Reference copy only

HS-009 014

### **SEAT BELT INJURIES IN IMPACT**

Although the seat belt has been demonstrated to provide effective reduction of injuries and fatalities in automobile accidents by preventing ejection, a pattern of injuries directly attributable to impingement on the belt itself is becoming evident. The clinical evidence of restraint system injuries is surveyed, the gross biomechanical mechanisms of trauma are discussed, and the potential of four types of restraint systems in producing injuries is evaluated. Results of impact tests with primates are described. The double shoulder harness with lap belt appears

to offer the greatest protection while the single diagonal belt without lap belt is most dangerous.

by W. M. Crosby; R. G. Snyder; C. C. Snow; J. W. Young; P. Hanson  
Federal Aviation Administration, Oklahoma City, Okla.  
1969 ; 29p  
Availability: NTIS

HS-009 094

### **OPTIMUM UTILIZATION OF THE VEHICLE AVAILABLE OCCUPANT SPACE TO ENSURE PASSENGER PROTECTION**

An improved utilization of the frontal survival space between front seat occupants and the occupant enclosure. The authors propose a belt design and a crash seat transversally pivoted at the base with rotational shock absorber. This would apportion the deceleration forces on the passenger better. Impact tests of this system with dummies are described. The levels of impact producing minor and serious injuries to different parts of the body are discussed.

by R. Rebiffe; C. Tarriere; J. Hamon; G. Mauron  
Automobiles Peugeot, Paris (France)  
Publ: HS-007 859 (P-30), International Automobile Safety Conference Compendium, New York, 1970 p82-1111  
Rept. No. SAE-700360 ; 1970  
Includes summaries in French and German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970; Brussels, Belgium, 8-11 Jun 1970.  
Availability: In HS-007 859

HS-009 632

### **DESIGN ASPECTS OF AUTOMOBILE SAFETY**

The development of safety engineering practices in the automobile industry from 1952 until 1963 is reviewed. The safety components thus developed and incorporated in passenger cars as of the date of this paper include seat belts and harness, padded instrument panels, crashworthy door latches and energy absorbing steering wheels. Full-scale and computerized crash tests are also discussed.

by Alex L. Haynes  
Ford Motor Co.  
1963 ; 23p 13refs  
Prepared for presentation at Liberty Mutual's Council on the Automobile and Public Health, Panel 3, Boston, 21 Nov 1963.  
Availability: Reference copy only

HS-009 965

### **FEDERAL SAFETY SPECIFICATIONS FOR AUTOMOBILES, TRUCKS, AND BUSES**

This article lays much of the blame for the high toll of deaths and injuries on faulty design and construction of the automobile. A case is made for designing the car interior to eliminate unnecessary protrusions and installing crash padding. Seat belts, shoulder harnesses, and hydraulic bumpers are also cited as features that can reduce the incidence of death and injury in an accident. Encouragement for the car manufacturers to install such devices must come through safety legislation at

June 1, 1979

HS-010 155

the federal level. The forces of deceleration and the role of alcohol in fatal accidents are also discussed.

by Horace E. Campbell  
Publ: Nebraska State Medical Journal p510-5 (Sep 1962)  
1962 ; 25 refs  
Presented at annual convention, Nebraska State Medical Assoc., May 1962.  
Availability: see publication

HS-009 970

### WHAT DO THE EXPERTS THINK?

Twenty-five auto writers responding to a questionnaire were outspoken about the industry. Samples were: best developments in the '71 cars are trend to smaller simpler machines, easier servicing, adaptation to lead-free gas; safety improvements are few since styling still sells cars; safety could sell cars if ads pushed it; air bags are not wanted even if offered free (several writers felt more development of these restraints needed); seat belts are liked, but not shoulder harnesses or head restraints; 18 writers felt companies are not doing all they can on safety; greatest industry problems in next 10 years are pollution, safety, costs and sales against overseas competition.

by Len Barnes  
Publ: Motor News v53 n11 p18-21 (May 1971)  
1971  
Availability: see publication

HS-009 996

### CAUSES OF DEATHS IN AUTOMOBILE ACCIDENTS. CAN SEAT BELTS REALLY SAVE LIVES?

The results of a detailed personal investigation of 79 deaths in automobile accidents are presented with special emphasis on correlating patterns of injury of the victims with patterns of damage to the vehicle and occupant compartment. This correlation was also applied to ejection or retention within the vehicle. It was found that a minimum of 34% of the victims would have survived if a simple lap-type seat belt had been worn. Another 11% would have probably survived with a shoulder strap-lap belt combination. The influence of certain features of the interior design of motor vehicles on the type of fatal injury is discussed.

by Paul W. Gikas; Donald F. Huelke  
Grant PHS-AC-00107  
Publ: Journal of Michigan State Medical Society v63 n5 p351-4 (May 1964)  
1964 ; 2 refs  
Availability: see publication

HS-010 063

### SHOULDER BELT UTILIZATION

This study was designed to provide an estimate of the percentage of drivers using an available shoulder belt during normal driving. A total of 1,707 field observations of drivers moving in traffic were collected in North Carolina and analysis of this data revealed an overall shoulder belt utilization rate of 10.06% in rural areas and 6.41% in urban areas. Drivers

operating small foreign vehicles used the shoulder belt more often (19.86%) than drivers operating vehicles manufactured in the U.S. (5.96%). Apparent driver age was another important factor; young drivers (utilization rate 11.15%) were found to use shoulder belts more than either mature (7.16%) or older drivers (5.32%). Also, drivers operating vehicles registered out of state were found to have a higher utilization rate (12.19%) than drivers of North Carolina registered cars (7.19%). Results of this study revealed that shoulder belt utilization is relatively small for all groups.

by Theodore E. Anderson  
North Carolina Univ. Hwy. Safety Res. Center, Chapel Hill  
1971 ; 25p 5 refs  
Availability: Corporate author

HS-010 102

### THE ANGLE OF SHOULDER SLOPE IN NORMAL MALES AS A FACTOR IN SHOULDER HARNESS DESIGN

This study was undertaken to provide information on the normal value of shoulder slope angles for use in shoulder harness design. The study data were from a random sample of 55 from some 500 somatotype photographs of male Air Traffic Service trainees. All subjects had passed a physical examination essentially equivalent to that given annually to commercial airline pilots. Mean age for the sample was 27.9 years, weight 161.8 pounds, and height 69.56 inches. Shoulder slopes were measured for both trapezial and deltoid segments; no significant differences existed. Differences between left and right trapezial angles probably are associated with handedness, but are negligible for shoulder-harness design. The mean shoulder slope angle from the vertical, based on weighted means of left and right trapezial segments, was 67.5 degrees, with a standard deviation of 5.0 degrees.

by A. Howard Hasbrook; Clyde C. Snow  
Federal Aviation Agency  
Rept. No. AD-689 808; PB-169 175; AM-65-14 ; 1965 ; 6p 3refs  
Availability: NTIS

HS-010 155

### SEAT BELT ROUNDTABLE I. A STATUS REPORT ON SEAT BELTS

This report contains highlights, quotations, and digested commentary of a roundtable discussion by men prominent in the traffic safety field on the seat belt movement. What has been accomplished to date and where to go from here; what changes have come about; and what may be expected from all areas of concern: legislation, standards, public education, the auto industry, and the seat belt industry, were topics covered.

by Paul Hill; Chas. H. Pulley; Frank Palmer; B. J. Campbell; Arch McKinlay; Russell Neff; Donald Lhotka  
American Seat Belt Council  
1964 ; 13p  
Availability: Reference copy only

HS-010 236

**WHIPLASH**

The different causes, the symptoms, the diagnosis and treatment of whiplash injury are presented. Restraint system usage is suggested as the best means of preventing whiplash injuries.

by Harold I. Magoun, Sr.  
 Publ: Health p5-8 (Jan 1970)  
 1970  
 Availability: see publication

HS-010 237

**THE NATURE OF SEAT BELT INJURIES**

This study investigates the nature of safety belt injuries based on an analysis of cases which appear in the literature as well as some not previously reported. The injury pattern characteristics of the three types of restraint systems, the lap-type belt, the two-point diagonal or shoulder restraint, the three-point (shoulder-lap) belt are described. It is concluded that a combination shoulder and lap restraint system is most effective in preventing injury and mortality.

by John R. Kirkpatrick; James S. Williams  
 Publ: Journal of Trauma v11 n3 p207-18 (Mar 1971)  
 1971 ; 53 refs  
 Presented at American Assoc. for the Surgery of Trauma 28th annual meeting, Montreal, 18-20 Oct 1968.  
 Availability: see publication

HS-010 313

**SEAT BELT INJURIES OF THE SPINE AND ABDOMEN**

Although the safety value of automobile seat belts has been proven, the seat belt is capable of producing serious injury to the spine and intra-abdominal contents during an abrupt deceleration crash. The trauma to the spine is produced by severe flexion of the torso over the belt, causing a tearing of the posterior elements, with less involvement of the vertebral bodies. Following seat belt trauma to the abdomen, the most common injury is perforation of the small bowel with associated trauma of its mesentery. Multiple injuries are common and combined injuries of the spine and intra-abdominal contents occur. The shoulder harness used with the lap belt should be evaluated to replace the lap-and-diagonal belt, along with other structural improvements in automobile design.

by John R. Dehner  
 Publ: American Journal of Roentgenology, Radium Therapy, and Nuclear Medicine v111 n4 p833-43 (Apr 1971)  
 1971 ; 24 refs  
 Availability: see publication

HS-010 363

**HET AFFEKT VAN AUTOCORDELS (EFFECTIVENESS OF SEATBELTS)**

The publication regards particulars of accidents with automobiles. The effectiveness of different types of seat belts is considered. A general view is given with respect to the way of

wearing seat belts. Finally, a comparison is made of belted and un-belted car occupants.

by J. C. Bastiaanse  
 Rijksverdedigingsorganisatie TNO (Netherlands)  
 Publ: Conference on Road Safety. Vol.1. Biomechanics of Accidents, Brussels, 1968 pA7-(1-13)  
 1968 ; 14 refs  
 Text in Dutch, Summaries in English, French, and German.  
 Availability: In HS-010 357

HS-010 564

**THE EFFECT OF LAP BELT RESTRAINT ON PREGNANT VICTIMS OF AUTOMOBILE COLLISIONS**

A prospective study was made of 441 pregnant victims of automobile accidents, in which 69 wore lap belts and 372 were unrestrained. There was no significant increase in either maternal or fetal mortality associated with lap belt restraint. The absence of maternal or fetal protection is discussed; the advantage of lap belt restraint in nonpregnant occupants appears to be nullified in pregnancy by the uterine compression produced by the snubbing action of the lap belt. It is concluded that there are no disadvantages of lap-belt restraint for pregnant travellers, and that the prevention of ejection provides a clear indication for its use. The lap belt should be secured low across the bony pelvis, not over the mid- or upper-fundus. When available, the lap belt and shoulder harness combination is recommended.

by J. Paul Costiloe; Warren M. Crosby  
 Oklahoma Univ.  
 FH-11-7339  
 Publ: Proceedings of the 14th Annual Conference of the American Association for Automotive Medicine, 1970, p97-110  
 1970 ; 18 refs  
 Presented at the annual conference, Ann Arbor, 19-20 Nov 1970.  
 Availability: In HS-010 504

HS-010 565

**COMPARISONS OF CONCEPTS IN AUTOMOBILE OCCUPANT RESTRAINT PROTECTION**

This paper compares various concepts in occupant restraint protection such as inflating restraint systems and various belt arrangements. The source of information is a large body of impact sled test data which has been gathered at the Highway Safety Research Institute within the past year. It will be demonstrated that the level of effectiveness possible with an inflating restraint system is significantly greater than that with various belt systems based on the level of protection offered and on the rate of usage. The index of protection or injury criterion which has been used in this work will be discussed and compared with other recent developments in the area of human tolerance.

by A. W. Henke; D. H. Robbins  
 Michigan Univ., Hwy. Safety Res. Inst., Ann Arbor  
 FH-11-6962  
 Publ: Proceedings of the 14th Annual Conference of the American Association for Automotive Medicine, 1970. p111-20  
 1970 ; 12 refs  
 Presented at the annual conference, Ann Arbor, 19-20 Nov 1970.  
 Availability: In HS-010 504

HS-010 790

**A PROPOSAL FOR PERSONNEL RESTRAINTS IN THE AUTOMOBILE**

The crashing motorist must enter the decelerative situation in the erect posture for two reasons: there is no room in the automobile for noninjurious jackknifing; in even moderate jackknifing, rupture of the diaphragm by the heavy abdominal organs and rupture of the heart or great vessels by blood-column displacement, may occur. The current two-inch shoulder strap represents a great advance, but in heavy crashes it imposes a high-energy x2- load over a too-limited area. In experimental crashes upon pregnant baboons, the inverted-Y configuration proved the least traumatic. It is suggested that this configuration be supplemented by; a) a four-inch strap across the chest connecting the two shoulder straps; or b) a ten-inch connection extending from the suprasternal notch to below the xiphoid, employing a rugged heavy-duty zipper; or c) an extension of this structure overlapping the seat belt.

by H.E. Campbell

Publ: Journal of Trauma v10 n7 p611-5 (Jul 1970)  
1970

Availability: see publication

HS-010 861

**CAR RESTRAINT DEVICES DESIGNED FOR CHILDREN**

A child's size and weight generally determine the most appropriate type of restraint for him. If an infant carrier is not used, babies weighing less than 12 pounds should be placed in a car bed in the back seat with the axis parallel to that of the car, the infant's feet pointed towards the front of the car. A net covers the bed and the middle front and rear seat belts are wrapped around the legs of the bassinet to secure it. From 12 to 24 pounds an adequately designed safety harness restraining the child across the high-chest and pelvic areas is recommended. From 25 to 50 pounds a shield type seat gives the best protection, but a good safety seat will be adequate. Children who weigh more than 50 pounds and who are less than 55 inches should use an adult safety belt but no shoulder harness. Any child taller than 55 inches may use both the adult seat belt and the shoulder harness.

by John M., Douglass; Frederick D., Burg; Eugene, Diamond;  
Arnold W. SiegelPubl: Modern Medicine p112-4 (8 Mar 1971)  
1971

Availability: see publication

HS-010 889

**DYNAMIC TESTS OF THE CALIFORNIA TYPE 20 BRIDGE BARRIER RAIL**

Five full-scale impact tests were run against the bridge rail system, a rigid structure of contoured concrete with a steel tube rail. The test results indicated that this system will retain and redirect a 4,900 pound passenger vehicle impacting at speeds up to 65 mph and at angles of from 7 to 25 degrees with the barrier. Vehicle damage varied from negligible at a 7 degree impact angle to severe at a 25 degree impact angle. The tests results indicated that the vehicular decelerations sustained during 25 degree, 65 mph impacts into this system

will result in occupant injuries varying from severe, if no restraints are used, to no more than moderate, if both a seat belt and a single diagonal shoulder harness are used.

by E.F. Nordlin; J.H. Woodstrom; R.P. Hackett; J.J. Folsom  
Publ: Highway Research Record n343 p57-74 (1971)  
1971Sponsored by Committee on Traffic Safety Barriers and Signs,  
Signal and Lighting Supports and Committee on Bridge Design  
and presented at the 50th annual meeting of Highway  
Research Board.

Availability: see publication

HS-011 267

**RESTRAINT SYSTEM EFFECTIVENESS**

The effectiveness of lap-shoulder belts in reducing injury severity was studied. About 40% of passenger cars registered in the United States are equipped with lap and shoulder belt systems, but few persons use them. By 1973 about 62% of the car population will be equipped with these systems, but by 1983 it is projected that only 11% of the cars will have them, and that passive restraint systems will have replaced them. The motoring public may develop a false sense of security during the transitional period, thus increasing the injury risk from failure to use active restraints. The use of lap-shoulder belt systems should be encouraged. Injury reduction benefits that have occurred in field accidents are discussed.

by W. D. Nelson

General Motors Proving Ground

Rept. No. GM-Eng-Pub-4775 ; 1971 ; 23p 5refs

Prepared for presentation to 15th annual conference, American  
Assoc. for Automotive Medicine, 20-23 Oct 1971.

Availability: Reference copy only

HS-011 327

**RESTRAINT SYSTEM EFFECTIVENESS**

Actual field collision vehicles are illustrated with the details of the lap and shoulder restrained occupants to support the theme that properly used lap and shoulder restraint systems can reduce injury severity in automobile collisions. Presently, approximately 40% of the passenger cars registered in the United States are equipped with lap and shoulder belt systems, but few persons use them. The motoring public is apt to assume a false sense of security during the transitory years of change to passive restraint systems because of lack of public awareness campaigns to "buckle up." This, in turn, is apt to result in a decreased use of voluntary restraints, and, therefore, an increased injury risk. The consequence could result in a reversal of the current downward injury trend.

by W. D. Nelson

General Motors Corp.

Publ: HS-011 284, American Association for Automotive  
Medicine Proceedings of Conference (15th), New York, 1972  
p27-46

1972 ; 5refs

Presented at the conference held in Colorado Springs, 20-23  
Oct 1971.

Availability: In HS-011 284

HS-011 328

**INCREASED SEAT BELT-SHOULDER HARNESS USAGE BY A STARTER INTERLOCK SYSTEM**

A simple, inexpensive device that makes it impossible to start the car unless the seat belt and/or shoulder harnesses in all occupied seats are fastened is briefly described. It is estimated that the present usage rate of about 33% for lap belts and less than 5% for shoulder harnesses can be dramatically increased with resultant reduction in deaths and injuries, if all cars were equipped with this device. It has been approved by NHTSA as an acceptable alternative to the passive restraint system until August 1975. It is urged that this system be used until passive restraints have been adequately tested or a better system found.

by Charles H. Pulley  
Irvin Industries, Inc.

Publ: HS-011 284, American Association for Automotive Medicine Proceedings of Conference (15th), New York, 1972 p222-30  
1972

Presented at the conference held in Colorado Springs, 20-23 Oct 1971.

Availability: In HS-011 284

HS-011 389

**THE VEHICLE AND CRASH SURVIVABILITY**

Impact sleds and barriers are used to study all kinds of crash situations. From this research have come improvements in vehicle crashworthiness which have made cars safer. The problem of failure to use seat belts and shoulder harnesses remains. An estimated 75% of fatal crashes occur at speeds of less than 60 mph. These crashes should be survivable for occupants wearing their restraint systems.

by Franklin M. Kreml  
Publ: Analogy n11 p12-9 (1971)  
1971

Availability: See publication

HS-011 396

**DYNAMIC TESTS OF GENERAL AVIATION OCCUPANT RESTRAINT SYSTEMS 3**

A series of twenty-two dynamic tests was conducted on general aviation occupant restraint systems. These tests utilized lap belt and lap belt/shoulder harness restraint systems. The Federal Aviation Regulations require only lap belt restraint systems for emergency landing conditions. Based on the longitudinal deceleration/time response of anthropomorphic dummy occupants, it was demonstrated that the lap belt/shoulder harness restraint systems offered occupants successful restraint at occupant inertia force levels substantially above the current regulatory level. The tests, preliminary in nature, warranted continuation of the test program. The lap belt/shoulder harness restraint system showed promise for regulatory inclusion by virtue of the fact that results were achieved with restraint systems offered as options in recent

years, requiring minimal weight increase with fuselage reinforcement adaptable to retrofit as well as new assembly.

by Hector Daiutolo  
Federal Aviation Administration  
1972 ; 73p 6re  
Presented at National Business Aircraft Meeting, Wichita, 15-17 Mar 1972.  
Availability: SAE

HS-011 398

**COMING SOON: PASSIVE RESTRAINTS**

Although ejection from a vehicle during a crash increases chances of fatal injury by 500%, a great many people will not use their seat belts. Passive restraints are considered necessary because less than a third of motorists use their seat belts and less than 5% use their shoulder harnesses. Various types of passive restraints are described, especially the air bag. Beginning with 1976 model cars, auto makers will be required to use some kind of passive restraint system.

by H. R. Whitaker  
Whitaker  
Publ: Analogy n11 p21-5 (1971)  
1971  
Availability: See publication

HS-011 457

**BELTS SNAP BACK WITH AIR BAGS DELAYED: TRY THESE ON FOR SIZE**

Since the requirement for installation of passive restraints has been postponed, automobile manufacturers have the option of installing lap and shoulder belts with electrical interlocks and inertial reels. Several automobile safety experts think the inverted Y yoke offers greater protection. When installed with inertia reels, Y yoke harnesses provide greater safety and more convenience and comfort. NHTSA approval for the Y yoke is to be sought.

by William Flanagan  
Publ: Automotive Engineering v79 n12 p33-5 (Dec 1971)  
1971  
Availability: See publication

HS-011 459

**BELTS THAT MAKE SENSE**

A belt design called the Takata Electro Safety System (TESS) has been developed by a Japanese company. It is a lap and shoulder belt combination which can be fastened with one hand. A buzzer and flashing light warn if the belts are not fastened. The belts allow freedom of movement and comfort under normal conditions. The system includes a sensor which in case of a collision or other shock, locks the passengers into a restrained and secure position, releasing them a few seconds later. The system is suggested as an alternative to the air bag.

Publ: Road Test v8 n3 p42-3, 90 (Mar 1972)  
1972  
Availability: See publication

June 1, 1979

HS-011 776

HS-011 536

### **ALL YOU NEED TO KNOW ABOUT...THE FEDERAL MOTOR VEHICLE SAFETY STANDARDS**

The background on the Federal Motor Vehicle Safety Standards is given. Standard SS208 requires passive restraint systems or a lap and shoulder belt system capable of protecting occupants in a 30 mph frontal crash. Air bags and various other restraint systems being developed to meet this standard are discussed.

by Don Fox

Publ: Popular Imported Cars v7 n2 p10-3, 59, 65-6 (Mar 1972) 1972

Availability: See publication

HS-011 586

### **HUMAN HEAD LINEAR AND ANGULAR ACCELERATIONS DURING IMPACT**

Head linear and angular accelerations of 14 humans were investigated during exposure to abrupt linear deceleration ranging from 7.7 to 10.3 g. Three different restraints, lab belt only, Air Force shoulder harness-lap belt, and air bag plus lap belt were used. The results indicated that peak head angular and linear resultant accelerations were elevated with the air bag in contrast to the Air Force shoulder harness or lap belt only restraints. However, the peak angular and linear accelerations may have less traumatic consequences than the degree of head-neck hyperextension.

by Thomas D. Clarke; C. D. Gragg; James F. Sprouffske; Edwin M. Trout; Roger M. Zimmerman; William H. Muzzy  
Aerospace Medical Res. Lab. (6570th); Naval Aerospace Medical Res. Lab.

Publ: HS-011 551, Stapp Car Crash Conference (15th)

Proceedings, New York, 1972 p269-86

Rept. No. SAE-710857 ; 1972 ; 7refs

Presented at the fifteenth Stapp Car Crash Conference, Coronado, Calif., 17-19 Nov 1971.

Availability: In HS-011 551

HS-011 621

### **EFFECTS OF LAP BELT AND THREE-POINT RESTRAINTS ON PREGNANT BABOONS SUBJECTED TO DECELERATION**

A series of 24 pregnant baboons was impacted under similar conditions. The only major variable was the difference in maternal restraint. The fetal death rate of 8.3% (1/12) among maternal animals impacted with three-point restraint was significantly different from five fetal deaths among 10 maternal animals impacted under lap belt restraint alone. It is concluded that shoulder harness restraint should be recommended for use by pregnant travelers as being significantly more protective of fetal welfare than lap belt restraint alone.

by Warren M. Crosby; Albert I. King; L. Clarke Stout; Rolf H. Eppinger

Wayne State Univ.

FH-11-6970

Publ: HS-011 551, Stapp Car Crash Conference (15th)

Proceedings, New York, 1972 p68-83

Rept. No. SAE-710850 ; 1972 ; 7refs

Presented at the fifteenth Stapp Car Crash Conference, Coronado, Calif., 17-19 Nov 1971.

Availability: In HS-011 551

HS-011 709

### **MECHANISMS OF INJURY IN AUTOMOBILE CRASHES**

Data were gathered from a ten-year study of collisions that caused injury to the occupants of the cars. Injuries caused by ejection, steering assembly impacts, windshield impacts, instrument panel impacts, and rear end collisions are briefly discussed. In a comparison of injuries in the newer model automobiles--vehicles equipped with safety features--with those in older model cars not equipped with the present-day occupant protection devices, significant reduction in injury severity was noted.

by Donald F. Huelke

Publ: California Medicine v116 n2 p23-9 (Feb 1972)

1972 ; 15refs

Availability: See publication

HS-011 774

### **THREEPOINT ENERGY-ABSORBING SEAT BELT SYSTEM WITH COMBINED VEHICLE- AND WEBBING-SENSITIVE EMERGENCY RETRACTOR**

The principles of seatbelts for the VW-vehicles with a retractor which is sensitive to vehicle deceleration and to webbing acceleration is described. In addition, possibilities are shown to reduce the severity index with energy absorbing devices in the seat belt retractor or in the B-pillar-ring. The results show that the requirements from the NHTSA up to Notice No. 16 of Docket 69-07 cannot be fulfilled in relation to the Severity Index (SI).

by Ulrich W. Seiffert; Erich Carbon; Helmut Ristau

Volkswagenwerk A. G. (West Germany)

Rept. No. SAE-720434 ; 1972 ; 11p 3refs

Presented at the 2nd International Conference on Passive Restraints, Detroit, 22-25 May 1972.

Availability: SAE

HS-011 776

### **A SEMIPASSIVE SEAT BELT SYSTEM**

This paper describes a semipassive seat belt system that was one of a series developed during a program to examine the possibilities of modifying seat belt designs to meet the passive occupant restraint requirements in the original proposed amendment to FMVSS 208. As such, many features are prohibited by the interlock ignition option of the latest amended 208. This semipassive seat belt installation utilizes a system of electrical interlocks to achieve an improved seat belt wearing rate. It is estimated that a usage rate of 95% would be achieved, making it more effective than an air bag.

by D. P. Peck

Triumph Motor Co. (England)

1972 ; 10p 6ref

Presented at 2nd International Conference on Passive Restraints, Detroit, 22-25 May 1972.

Availability: SAE

HS-011 778

**STARTER-INTERLOCK SYSTEMS AS PASSIVE RESTRAINTS**

The Ford test program, the NHTSA and GSA programs, and others have demonstrated beyond doubt that the starter-interlock system could become popular enough to increase belt use to the 75-90% ratio that is desired. Here is a simple, readily available means of increasing safety harness protection. This device requires no extensive, long-term development but merely adaptation to various model cars. It is available now, and can be installed in production quantities for very little cost on all new cars within a matter of weeks. It has the added advantage that it can be retrofitted to older model cars that already have safety belt fittings. There is a second means of quickly and dramatically increasing safety belt usage: mandatory use laws passed by the states and cities. Usage tests were conducted in Houston, Minneapolis, and Washington, D. C.

by Charles H. Pulley  
American Safety Belt Council, Inc.  
Rept. No. SAE-720437 ; 1972 ; 6p 15refs  
Presented at the 2nd International Conference on Passive Restraints, Detroit, 22-25 May 1972.  
Availability: SAE

HS-011 897

**PASSENGER CAR OCCUPANT RESTRAINT ALTERNATIVES. DEMONSTRATION AND DISPLAY: A CONSUMER RESEARCH STUDY**

Using interviews and questionnaires, a survey was made in Kansas City, Mo., to obtain consumer reactions to and preferences for various occupant restraints based upon perceptions of performance, convenience, and overall usefulness. Specific cost factors were excluded. Two of the restraint alternatives were a cushion system and a semi-automatic or continuous belt arrangement. The research was designed to determine whether or not further development was warranted. Preferences shifted to 82% for seat belts, 5% for air bags, and 11% for extra, crushable panels after the filmed performance demonstrations. Final preferences following the vehicle inspections were similar, with a slight shift toward extra, crushable panels and away from air bags. Among the 83% preferring seat belts, better than four out of five wanted both lap and shoulder belts. A minority of 22% preferred the continuous lap belts over the self-locking retractor lap belts.

by Robert S. Baxter  
Chrysler Corp.  
Rept. No. SAE-720430 ; 1972 ; 13p  
Presented at the 2nd International Conference on Passive Restraints, Detroit, 22-25 May 1972.  
Availability: SAE

HS-011 898

**A CONSUMER VIEWPOINT ON CAR RESTRAINT SYSTEMS**

Lap-shoulder belts became standard with very little, very ineffective explanation of why they should be used. National effort is needed to persuade all to use them, and auto industry to improve them, and see the effect of buzzers and interlocks before mandating airbags or equivalent. This paper looks at the past history of restraints, forecasts the future if airbags are

to be mandated without explaining them. AAA of Michigan motorist survey shows a strong dislike of airbags, a preference for seat belt-shoulder harness if a choice must be made, a strong feeling that it is not the business of government to mandate airbag or seat belt use. The question is raised about claims of the number of lives that airbags will save. Are they too high?

by L.R.R. Barnes  
Automobile Club of Michigan.  
1972 ; 22p  
Presented at 2nd International Conference on Passive Restraints, Detroit, 22-25 May 1972.  
Availability: SAE

HS-011 899

**THE BIOMECHANICAL DEVELOPMENT OF INJURY-ATTENUATING MOTOR VEHICLE DESIGN**

From an engineering standpoint, the problem of protecting the occupant of a vehicle consists of defining the crash environment in quantitative physical terms, determining the human tolerance to the crash environment, and providing safety devices. The biomechanics of human tolerance and the mechanics of impact are discussed. Safety design is discussed in terms of passenger compartment integrity, restraint systems, padding, energy-absorbing steering columns, and air cushions.

by L. M. Patrick  
Publ: Journal of Trauma v10 n3 p220-31 (1970)  
1970 ; 67refs  
Availability: See publication

HS-011 975

**AUTOMOTIVE RESTRAINT SYSTEMS-- DEVELOPMENT AND USE**

The origin and history of seat belts are discussed and attempts to educate the public in the need for their use are reviewed. A discussion of seat belt usage and public apathy is presented. Possible approaches to the problem are offered: mandatory use laws, automatic seat belt devices, and increased promotional activities.

by D. C. Lhotka  
National Safety Council  
1971 ; 19p  
Presented at Human Factors Society Symposium, New York, 21 Oct 1971.  
Availability: Corporate author

HS-012 034

**AUTO SAFETY NEEDS A NEW ROAD MAP**

It is felt that in the preoccupation with crash survivability not enough research and money are going into other aspects of automobile safety. Automobile companies question whether development of the air bag is far enough along to warrant adoption for 1976 models. A one-year trial involving 20,000 cars might at least indicate how much additional testing is needed. The experimental safety vehicle is briefly discussed. Other aspects of safety for which more attention is urged are

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elimination of roadside hazards, control of drunk drivers, better vehicle lighting, and driver aid systems.

by W. Bowen

Publ: Fortune v85 n4 p99-101, 142-5 (Apr 1972)  
1972

Availability: See publication

HS-012 069

### ACCEPTANCE TESTS OF VARIOUS UPPER TORSO RESTRAINTS

This study demonstrates that people can be motivated to utilize and, in fact, eagerly accept the use of upper torso restraint equipment for the prevention of head and chest injuries induced by flailing during crash decelerations, provided that specific design criteria are followed by structural engineers. By giving attention in this study to design of specially constructed restraint equipment to incorporate the maximum in features for comfort, neatness of appearance, ease of stowage, and ease of donning and escape, it was found that over 90% of the test subjects utilized these upper torso restraint systems throughout the two-year test period. In contrast, only an estimated 3 to 5% utilization of the factory-installed torso restraint equipment in over 10,000,000 automobiles manufactured since January 1, 1968 has been attained to date.

by J. J. Swearingen  
Federal Aviation Administration  
1971 ; 15p  
Availability: NTIS

HS-012 080

### ESTIMATING THE EFFECTS OF CRASH PHASE INJURY COUNTERMEASURES--1. THE REDUCTION OF THE FATALITY RISK

This paper studies crash types and injury sources; assesses the effects of countermeasures both individually and in combinations; and determines the reduction in fatality risk for a potential victim. The countermeasures studied whose effects upon fatalities are major and have been sufficiently well established were safety belts, high-penetration-resistant windshields, and energy-absorbing steering column assemblies. For lap belts alone, a 35% reduction of fatalities is estimated as the overall average in accidents where they are used. For the windshields alone, a fatality reduction of 5% is estimated. One study suggests a reduction of fatal injuries due to the energy absorbing steering column by 17%, the actual fatality savings may be lower since other injuries may become more frequent; an estimate of 10% savings appears more realistic.

by H. Wuerdemann; H. C. Joksch  
FH-11-7228  
Publ: Accident Analysis and Prevention v4 n2 p89-108 (Jun 1972)  
1972  
Complete report available from NTIS as PB-191 209.  
Availability: See publication

HS-012 086

### EXPERIMENTAL SAFETY VEHICLES: WHERE DO WE GO FROM HERE?

Developments in experimental safety vehicles in West Germany, Japan, Britain, Italy, France, and Sweden are described. These countries are working on safety subsystems for application to cars smaller than the American standard car. Aspects discussed are heavily padded passenger compartments, alternatives to the air bag such as a passive shoulder belt and knee restraint system, and crashworthy bodies.

Publ: Automotive Engineering v80 n8 p19-27 (Aug 1972)  
1972  
Availability: See publication

HS-012 166

### END OF THE AIR BAG? VOLKSWAGEN'S ESV SHOWS NEW THINKING ON PASSANGER RESTRAINT

Safety belts which move into position by engine manifold suction and are tensioned by gas cell action are described. Volkswagen's anti-lock braking system and experimental safety car are described.

by S. Bladon  
Publ: Autocar v136 n3968 p48-50 (4 May 1972)  
1972  
Availability: See publication

HS-012 396

### IMPACT TOLERANCE AND RESULTING INJURY PATTERNS IN THE BABOON: AIR FORCE SHOULDER HARNESS--LAP BELT RESTRAINT

The tolerance to abrupt linear deceleration and impact trauma patterns resulting from the use of the Air Force shoulder harness-lap belt restraint were investigated. Eighty-nine deceleration tests were performed with 37 adult male baboons. Peak sled decelerations ranged from 6.5-134 g. The stopping distance varied from 0.5-3.5 ft. at 6 in. increments. The results imply that for the exposure range of these tests, impact lethality is dependent upon the magnitude of peak sled deceleration, irrespective of the pulse duration, sled velocity, or stopping distance. At all stopping distances, the primary cause of death was lower brainstem or cervical spinal cord trauma. The pelvic, abdominal, and thoracic injury patterns were significantly different at the various stopping distances.

by T. D. Clarke; D. C. Smedley; W. H. Muzzy; C. D. Gragg; R. E. Schmidt; E. M. Trout  
Aerospace Medical Res. Lab. (6570th)  
Publ: HS-012 325, Stapp Car Crash Conference (16th) Proceedings, New York, 1972 p365-411  
Rept. No. AMRL-TR-72-74; SAE-720974 ; 1972 ; 25refs  
Presented at the conference held in Detroit, 8-10 Nov 1972.  
Availability: In HS-012 325

HS-012 489

**HUMAN ENGINEERING AND THE COST-EFFECTIVENESS OF AIR-SAFETY DEVICES**

A mathematical model was developed to describe the benefit-to-cost ratios. The model is primarily intended for use by general aviation manufacturers, owners, or operators as a systematic way of selecting the most cost-effective devices. The basic measure of a device's effectiveness is the ratio of the projected accident loss reductions, or its benefits, divided by its true-total cost. The model uses the expected-value concept to determine the benefits by multiplying the probability of occurrence times the average cost of an accident times the effectiveness of the device to prevent the type of loss.

by A. E. Diehl  
Wichita State Univ.  
Rept. No. SAE-710487 ; 1971 ; 9p 17refs  
Presented at National Business Aircraft Meeting, Wichita, 24-26 Mar 1971.  
Availability: SAE

HS-012 629

**MANDATING THE USE OF AUTOMOTIVE SAFETY BELTS IN NEW YORK STATE. RESEARCH REPORT**

If everyone involved in N. Y. accidents in 1971 had worn safety belts, it is estimated that 1,648 lives would have been saved and 34,178 injury cases prevented. Results from the 1970 Australian safety belt law during a nine month period are applied to the volume of accidents in New York and indicate there would have been a reduction of 187 deaths in rural areas in 1971 and 162 deaths in metropolitan areas. Enforcement of a mandatory safety belt law to produce universal compliance is unrealistic. However, a high degree of compliance is attainable. Children under age eight, and any one with a certifiable medical or psychiatric condition which counterindicates the wearing of a safety belt should be exempt from mandatory belt use. If safety belt use is mandated, consideration should be given to requiring only the use of the lap belt.

by D. B. Negri  
New York State Dept. of Motor Vehicles  
1973 ; 12p  
Availability: Corporate author

HS-012 685

**DYNAMIC TESTS OF A YIELDING SEAT BELT SYSTEM**

The performance of seat belts can be improved by incorporating energy absorbers to allow the system to yield at constant force. The principle can be applied to the whole system or to critical components. Dynamic tests were carried out with lap/shoulder seat belts incorporating energy absorbers in the shoulder straps. For comparison, conventional assemblies were also tested. The tests showed that with energy absorbers allowing an increase in dummy movement of five inches or less the shoulder strap forces could be reduced by 30%. Alternatively, energy absorbers allowed an increase of 50% on the input deceleration without increase in shoulder strap force. It was considered that energy absorption in the seat and lap belts could allow similar improvement in these components. The load distribution between the straps and the friction force between the dummy and seat was examined and it was found

that the seat force was of similar magnitude to the combined lap strap forces.

by S. R. Sarrailhe  
Aeronautical Res. Labs. (Australia)  
1972 ; 41p  
Availability: Corporate author

HS-012 689

**BIODYNAMICS OF SPORTS INJURIES**

Helmets and restraint systems used in automobile racing and modified football shoe cleats and release ski bindings have reduced the injury risks in these sports. Boxing injuries do not appear controllable with safety equipment because the victor must disable his opponent usually by injuring his opponent's brain. Knowledge of human injury tolerance has been gained through the study of sports accidents particularly the determination of injury mechanisms. Conversely, injury tolerance data determined in the laboratory has been useful in designing sports safety equipment.

by J. D. States  
Rochester Univ., Res. Accident Investigation Team  
Publ: AGARD Conference Proceedings n88 (AGARD-CP-88-71),  
1971  
Presented at the Aerospace Medical Panel Specialist Meeting, AGARD Conference Linear Acceleration of Impact Type, Oporto, Portugal, 23-26 Jun 1971.  
Availability: See serial citation

HS-012 931

**RESTRAINT-SYSTEM EFFECTIVENESS**

The potential number of lives that could be saved each year through the universal installation and use of seat belts, shoulder harness systems, and air bag restraint systems was calculated and the estimates for each restraint system were compared. Two tasks were undertaken to obtain the lives saved estimates. One task involved mathematical modeling of each occupant restraint and vehicle system in order to establish potential head and chest decelerations in each of a number of crash situations. Human tolerance formulations were then used to convert these decelerations into values reflecting the ability of the restraint to save lives in each given crash situation. The second task in the study was an examination of traffic accident records to determine the relative frequency of fatalities occurring in each crash situation. Results indicate that the shoulder harness system could potentially save more lives than the simulated air bag system. The harness system is valuable, however, only if used.

by E. S. Grush; S. E. Henson; O. R. Ritterling  
Publ: Highway Research Record n420 p16-29 (1972)  
1972  
Includes discussion by C. Y. Warner and author's closure.  
Sponsored by Hwy. Res. Board Com. on Vehicle Characteristics.  
Availability: See serial citation

HS-013 213

**THE UNIVERSITY OF MICHIGAN URBAN VEHICLE**

The design and construction of a small, low cost, Wankel-powered, rear engine, rear-drive urban vehicle by engineering and industrial design students is outlined. The goal of this group was to submit a competitive entry to the Urban Vehicle Design Competition conducted in August 1972, and hopefully to provide some fresh solutions to the problems of urban transportation. Constraints set by the UVDC Committee as well as proposed federal emission and safety standards were considered as governing parameters in the design process. This report describes some of the many features of the University of Michigan entry and includes a discussion of the primary merits of the project. Safety features of the vehicle included 5plus mph energy absorbing bumpers, an alcohol detection and interlock system, a crashworthy body, a seat belt and an inverted Y yoke shoulder harness, passenger compartment padding, a high seating position and large glass area, and improved lighting.

by D. W. Chicovsky; T. G. Chicovsky; J. A. Roby; C. P. Theodore  
Michigan Univ.  
Rept. No. SAE-730512 ; 1973 ; 16p  
Presented at Automobile Engineering Meeting, Detroit, 14-18 May 1973.  
Availability: SAE

HS-013 540

**THE VOLKSWAGEN ESV**

Volkswagen's experimental safety vehicle (ESV) is a four door sedan for four occupants. The general design of the ESV and special safety characteristics are described. The passive restraint system for all passengers consists of a shoulder belt and a knee belt with the preloading mechanism located in the central tunnel. Each has a force limiter. Tests conducted on the ESV are mentioned and some results of impact tests are presented. The Volkswagen ESV is a practical automobile which meets, or exceeds, the ESV specifications. However, the total additional ownership cost of this ESV is estimated to be \$5,100. Benefit cost studies indicate that much of the excessive ESV costs come from the high-speed crash requirements of the specifications. Because real-world crashes at these high speeds are rare, the gain in occupant safety is limited despite the high cost of such protection.

by E. Fiala  
Volkswagenwerk A.G., Wolfsburg (West Germany)  
1972  
Availability: In HS-820 217, International Technical Conference on Experimental Safety Vehicle (3rd) Report, Washington, D. C., 1972 p2-198--2-212

HS-013 613

**IN DEPTH STUDY OF SEAT BELTED ACCIDENTS**

Examinations of 60 persons involved in 46 accidents were conducted. It was found that police reports underestimated seat belt usage by up to 20%. Of the 36 persons known to have been wearing three point restraint systems, eight received fatal injuries, 13 severe or very severe injuries, and 15 lesser injuries. Eleven persons received seat belt caused injuries, of whom seven suffered minor abrasions and bruises and four

severe internal abdominal and skeletal injuries. The excessive number of side impacts suggested that impacts from the opposite side of the car are more injurious than impacts on the same side. Crash-involved occupants had restraint systems adjusted with the upper and lower loops much looser than the optimum, and wore the buckle much farther forward on the body. The mechanical performance of the three point restraint system was satisfactory, but over half (54%) of the 54 restraint systems examined were faulty.

by G. A. Ryan; R. J. Baldwin  
Monash Univ., Clayton, Vic. (Australia)  
1972 ; 49p  
Sponsored by Australia Dept. of Shipping and Transport.  
Availability: Corporate author

HS-014 108

**ANALYSIS OF THE BENEFITS DERIVED FROM CERTAIN PRESENTLY EXISTING MOTOR VEHICLE SAFETY DEVICES: A REVIEW OF THE LITERATURE**

A review of the literature on the effectiveness of certain crash protection devices introduced into automobiles in the 1960's is presented. Reviews on lap belts are included, along with shoulder belts, energy absorbing steering columns, high penetration resistant windshields, head restraints, and side door beams. Only those articles which evaluated safety devices by sampling real-world accidents were reviewed. Articles which evaluated the devices in controlled crash situations, and articles based on clinical evaluations of unique accidents were not considered.

by L. I. Griff., 3rd  
North Carolina Univ., Chapel Hill. Hwy. Safety Res. Center  
MVMA-ECON-3-HSRC  
1973 ; 50p 39refs  
Prepared for the Motor Vehicle Manufacturers Association of the United States, Inc.  
Availability: Corporate author

HS-014 248

**HUMAN WEIGHT DISTRIBUTION DURING IMPACT-LAP BELT, AIR BAG AND AIR FORCE HARNESS RESTRAINT SYSTEMS**

Thirty-two sled tests were conducted with 19 human volunteers using the lap belt, air bag, and Air Force harness restraint systems. The component parts of the restraint systems were instrumented and force-time recordings were made during impact. The impulse-momentum theorem was used to find the proportion of human weight which went into each component of the restraint system. The component weights were converted to percentages and a mean computer for each component of each system, and drawings were made to portray the weight distribution into the three systems. The weight distribution information will prove useful in the design and verification of dummies to be used in impact testing, and to designers of mathematical models of human impact.

by T. D. Clarke; C. D. Gragg; J. F. Sprouffske  
Aeromedical Res. Lab. (6571st), Holloman AFB, N. Mex.  
Rept. No. AMRL-TR-73-103; AD-769 541 ; 1971 ; 17p 7refs  
Reprinted from Proceedings of the 17th Annual Meeting of Inst. of Environmental Sciences, Los Angeles, Apr 1971.  
Availability: NTIS

HS-014 261

**SERIOUS SEAT BELT INJURIES**

Two cases of serious intra-abdominal and skeletal injury, peculiar to abrupt deceleration of an automobile when the occupants are restrained by a lap-type seat belt alone, are reported. Two other occupants of the vehicle, in the same accident, but restrained by both lap-type seat belts and shoulder harnesses, sustained only minor and insignificant injury.

by W. T. Gill

Publ: Rocky Mountain Medical Journal v67 n5 p27-31 (May 1970)

1970 ; 14refs

Availability: Reference copy only

HS-014 528

**A COMPARISON OF INJURY SEVERITY PATTERNS FOR UNRESTRAINED, LAP BELTED, AND TORSO RESTRAINED OCCUPANTS IN AUTOMOBILE ACCIDENTS**

The multidisciplinary accident investigation reports comprising a census of towaway accidents in Washtenaw County, Michigan, were statistically analyzed to observe the effects on injury associated with wearing a lap belt or torso restraint. The analysis controls on accident configurations, crash severity, seated location, and ejection.

by R. M. Shortridge

Michigan Univ., Ann Arbor. Hwy. Safety Res. Inst.

Publ: HS-014 519, Conference of the American Association for Automotive Medicine (17th), Proceedings, Oklahoma City, 1973 p130-47

1973 ; 7refs

Refined version of section of "A Study of Restraint-System Use and Effectiveness," by R. Shortridge and F. Preston, June, 1973, 241p. Conference held in Oklahoma City, 14-17 Nov 1973.

Availability: In HS-014 519

HS-014 549

**BELT OCCUPANT RESTRAINT EFFECTIVENESS**

Data from a previous paper on seat belt occupant restraint effectiveness are briefly reviewed. Reports of the effectiveness of seat belt usage legislation in Australia are examined with regard to ejection prevention, injury prevention in side impacts, frontal crash modes and distribution of impact forces, and severe human trauma. Shoulder belt slack to prevent submarining is questioned, along with the effects of the trend toward smaller cars, and animal and volunteer tests with air cushion systems.

by C. Y. Warner

Brigham Young Univ., Provo, Utah

Publ: HS-014 519, Conference of the American Association for Automotive Medicine (17th), Proceedings, Oklahoma City, 1973 p491-501

1973 ; 8refs

Conference held in Oklahoma City, 14-17 Nov 1973.

Availability: In HS-014 519

HS-014 606

**THE FUTURE OF SEAT BELTS**

Recent and probable future developments in seat belts are reviewed. Seat belt legislation in the United Kingdom and United States is discussed, along with configurations and injury criteria requirements. Testing is reported which studied details of the belt system, head severity index, peak head deceleration, maximum chest deceleration, peak shoulder belt load, and forward head movement. Research into passive seat belt systems and their injury criteria is examined, along with testing techniques and characteristics of the ideal passive belt material. Final consideration is given to a comparison of seat belt and air bags.

by E. Nichol

Publ: Journal of Automotive Engineering v3 n10 p9-15 (Nov 1972)

1972

Availability: See publication

HS-014 694

**URBAN AREA SAFETY BELT USE IN AUTOMOBILES WITH STARTER-INTERLOCK BELT SYSTEMS: A PRELIMINARY REPORT**

Lap and shoulder belts in combination were in use by 44% of drivers of 1974 interlock equipped cars compared to 8% use in 1973 buzzer-light equipped cars, based on observations in three cities. In spite of the interlock system, however, nearly half (47%) of the drivers in the 1974 vehicles were not using any belts. Belt use in 1974 cars was not related to registration date, or age, sex, and racial appearance of driver. Belt use was significantly higher in 1974 cars produced by General Motors and Chrysler than in 1974 cars produced by Ford and Volkswagen.

by L. S. Robertson

Insurance Inst. for Hwy. Safety, Washington, D. C.

1974 ; 20p 12refs

Availability: Corporate author

HS-014 805

**CHILD RESTRAINT SYSTEMS. FRONTAL IMPACT PERFORMANCE**

State of the art design concepts, medical knowledge, regulations, and impact performance of different child restraint systems in Sweden are defined, and compliance test procedures and performance criteria are recommended. Some 34 frontal impact tests were made with 25 systems. Impact speed was 30 mph and the deceleration level 15-20 g. Fully instrumented Alderson 3 and 6-year-old anthropomorphic dummies were used, and the measurements included dummy and sled accelerations, forces and displacements. It is shown that the rearward facing systems have a considerably better protection performance than forward facing systems, lap belts, shields, cushions, harnesses, and hookover seats, especially concerning head acceleration and displacement. It is proposed that the head accelerations be used as the main performance

criteria. General recommendations for protection and handling improvements of rearward facing seats are included.

by T. Turbell  
Statens Vag- Och Trafikinstitut, Stockholm  
1974 ; 124p

Sponsored by the Transport Res. Delegation. One of a series of investigations to promote safer transportation of children. See also HS-014 806, HS-014 807.

Availability: Corporate author

HS-014 806

### **CHILD RESTRAINT SYSTEMS. HANDLING PERFORMANCE OF BUCKLES AND HARNESES ON CHILD SEATS**

Two psychological and technical studies of child car seats are reported, the first dealing with two-to-five year-old children's potentially dangerous capacity for opening different buckles, and the second dealing with adults' difficulties in removing children from different types of child seats under simulated conditions of darkness. In the first experiment all but one of the children over four years of age opened all the buckles; half were opened by one or more of the youngest children. One of the buckles classified as technically difficult and strenuous could not be opened by any child under four. In the experiment with adults, opening times differed greatly, and it took more than two minutes before one or more of the subjects had rescued the child-dummy from five of the 10 seats. It is concluded that proposals altering the design of child seats are needed.

by P. W. Arnberg  
Statens Vag- Och Trafikinstitut, Stockholm  
1974 ; 65p

Sponsored by the Transport Res. Delegation. One of a series of investigations to promote safer transportation of children. See also HS-014 805 and HS-014 807.

Availability: Corporate author

HS-014 886

### **BEFORE THE CRASH: HOW BIOMECHANICS REDUCES FATALITIES AND INJURIES**

Biomechanics, the study of forces against the body is discussed. Safety devices such as seat belts, shoulder harnesses, energy absorbing steering columns, padded dash boards, side door beams, high penetration resistant windshield and air bags emanated from biomechanical studies. Further research progress in this field, including human tolerance studies, is presented. The air bag is discussed. It proved safe in frontal collisions, but doubtful in angular crashes or rollovers. Production of Experimental Safety Vehicles was expensive and impractical.

by S. Raphael  
Publ: Ward's Auto World v10 n6 p51-4, 56 (Jun 1974)  
1974

Availability: See publication

HS-014 914

### **SENSITIVITY STUDY OF OCCUPANT RESPONSE IN SIMULATED CRASH ENVIRONMENT**

The sensitivity of response of crash victim simulation was investigated using a two-dimensional, mathematical eight-mass model. The model was exercised in the forward collision mode in a three-point restraint system using a trapezoidal forcing function. Mass and inertia parameters of the occupant simulation, its setup, and the restraint systems were evaluated individually and as groups, in terms of their effects on the occupants head and chest acceleration. The study also investigates and rates the effects of shape and time duration of the forcing function upon the response of the occupant.

by S. H. Backaitis  
National Hwy. Traf. Safety Administration,  
1974 ; 21p

Presented at the Automotive Engineering Congress, Detroit, 25 Feb-1 Mar 1974.

Availability: SAE

HS-014 943

### **SASH DISCOMFORT IN SEAT BELTS**

Three point restraint systems are mandatory in Australian cars. In some cars the location of the sash anchorage point for lap/sash belts in front seating positions permits the sash strap to either fall off the shoulder of many wearers or to cause discomfort by pressing on their necks. This paper describes a newly developed sash guide that can easily be fitted in practically any car that displays either of these problems, and effectively corrects the belt layout to one that is comfortable and convenient, without degrading the safety of the belt. The comfort features of the sash guide are mandatory provisions of new Australian Design Rules effective on January 1, 1975. Existing cars may be corrected in the meantime by fitting them with this sash guide.

by D. C. Herbert; V. Leitis  
New South Wales. Dept. of Motor Transport, Sydney  
1973 ; 33p  
Availability: Traffic Accident Research Unit, Dept. of Motor Transport, New South Wales, Sydney, Australia

HS-014 999

### **EASY BELT--SOFT SALLET SEAT. THE ITALIAN TECHNICAL PRESENTATION. SECT. 2, PT. 7**

An occupant restraint system using sophisticated passive belts working in conjunction with a head restraint device is described. Emphasis is on what happens to the occupant himself. The traditional 3-point belt system is modified by Alpha Romeo to enable the occupant to use the belt easily and automatically. The system consists of two moving arms, each with one end hinged about halfway up the seat back, with fitted lap belt retractors at the other extremities of the arms. An emergency locking retractor under the seat is also included. The soft sallet head restraint device aims at restraining the head, in its movement relative to the torso, by means of a woven cur-

tain which would automatically position itself in front of the occupant's head in case of an accident.

by C. B. Anderloni; A. Schieppati  
Alpha Romeo S.p.A. Milan (Italy)  
Publ: HS-013 939, International Technical Conference on  
Experimental Safety Vehicles (4th), Washington, 1973 p439-41  
1973

Conference held in Kyoto, Japan, 13-16 Mar 1973.  
Availability: In HS-013 939

HS-015 028

### **SOME INTERNATIONAL DATA ON TRAFFIC ACCIDENT CONFIGURATIONS AND THEIR ASSOCIATED INJURIES**

The NATO Committee on the Challenges of Modern Society initiated a trial program to test the feasibility and value of obtaining standardized vehicle crash damage and injury information on an international basis. The program goals were to obtain better data on the degree of protection which a vehicle provides to its occupants in crashes, so that these data could aid automotive designers in producing safer vehicles and assist government engineers in assessing safety standard effectiveness.

by G. M. Barnwell; J. R. Cromack; A. F. Muller; J. Kuiperbak  
Southwest Research Inst., San Antonio, Tex.  
Publ: International Conference on the Biokinetics of Impacts,  
Proceedings, 1973 p225-30  
1973 ; 4refs

Conference held in Amsterdam, 26-27 Jun 1973.  
Availability: National Road Safety Organization, Ave. du  
General Mallert-Joinville 94, Arcueil, France

HS-015 276

### **CAL RESEARCHERS SAY "YES" TO BUCKLE-UP LAW**

The seat belt usage law controversy is examined. Benefits of lap and shoulder belts are reviewed along with the unpopularity of seat belt legislation in general, although its effectiveness in Victoria, Australia is cited; The principle argument against enforced usage, that it infringes on the individual's rights is considered, with precedents cited. It is shown that public education regarding seat belt safety is difficult, and false arguments against wearing them are countered. Statistical reports and experiments are offered in support of belt usage.

by J. W. Garrett  
Publ: TRAFFIC SAFETY p1-4(Oct 1972)  
1972  
Reprint.  
Availability: See publication

HS-015 277

### **SAFETY BELT USE IN AUTOMOBILES WITH STARTER-INTERLOCK AND BUZZER-LIGHT REMINDER SYSTEMS**

Safety belt use was shown to increase in urban areas by the introduction of the interlock system in 1974 vehicles. At least a lap belt was in use twice as frequently in 1974 vehicles equipped with the interlock system as in 1973 vehicles

equipped with the buzzer-light system observed under the same conditions; but 41% of the 1974 vehicle-drivers were not using any belts. A large difference among usage rates in vehicles produced by different manufacturers is noted. Smaller or nonexistent differences in belt usage were found between racial, sex, and age groupings. The validation study shows some underestimation of lap belt use without the shoulder harness, but the error is less than that found in studies finding overestimates using interviews. The impact on public health policies and safety regulations is noted.

by L. S. Robertson  
Insurance Inst. for Hwy. Safety, Washington  
1974 ; 31p  
Availability: Corporate author

HS-015 300

### **A COMPARISON OF ATTITUDES TOWARD SEVERAL CROSS-CHEST SAFETY BELT SYSTEMS AFTER OPERATIONAL EXPERIENCE**

Through questionnaire responses obtained after three month's experience a comparison was made of the attitudes of Arizona Highway Patrol officers toward several conventional factory-installed cross-chest safety belt systems and an inertia reel-mounted system. The weight of positive responses was received by the inertia reel-mounted system, which was apparently less inhibitive of normal movements in operation of the vehicle; By more convenient coupling and uncoupling the inertia reel system permitted the officers to get in and out of the cars more rapidly and contributed to a lessened concern about the restrictive aspects of the equipments.

by R. K. McKelvey  
Environmental Control Administration, Providence,  
1970 ; 31p  
Prepared in cooperation with the Arizona Hwy. Patrol.  
Availability: GPO

HS-015 322

### **CHEST TRAUMA**

Thoracic injury research is reviewed, and the relationships between impact and injury are examined. The ideal feasible experiments to study them are cited as those involving animals, anthropometric configuration, computer simulations, and cadavers. Critical areas which need to be examined are the relationships between chest impact in the most common kinematic configurations, and the pathophysiologic changes which are commonly reported in studies of human injury patterns. Key points to study must include the structural characteristics of the thoracic cage and how deflection and/or failure in part or whole are related to superficial and deeper injuries of the thoracic area. Means must be devised to measure chest wall damage and deflection, intravascular pressure and displacement, and changes which can be associated with serious or fatal pathophysiologic alternations. Chest impact tolerance data from human experiments must be derived from the forces at the chest restraint interface. It is suggested that impact in-

June 1, 1979

HS-015 721

tensity, impact duration, and chest wall deflection are the most useful measurements for total anterior chest tolerance.

by A. M. Nahum  
California Univ., Los Angeles  
1973 ; 7p  
Reprinted from BIOMECHANICS AND ITS APPLICATION  
TO AUTOMOTIVE DESIGN, SAE (P-49).  
Availability: Corporate Author SAE

and answers follow on deactivation of seat belt buzzers and the need for usage laws.

by D. F. Huelke; J. L. Weygandt; R. C. Haeusler; J. Moon  
Publ: Conference on Medical, Human and Related Factors  
Causing Traffic Accidents, Including Alcohol and Other  
Drugs, Proceedings, 1973 p223-5  
1973  
Conference held in Montreal, 30-31 May 1972.  
Availability: See publication

HS-015 420

### RESTRAINT SYSTEM EFFECTIVENESS

The effectiveness of three passenger car occupant restraint systems is examined: lap belts, shoulder harnesses, and air bags. For each system studied, it was assumed that the car was equipped with an advanced steering column incorporating improved energy-dissipating characteristics. It is found that the shoulder harness system could potentially save more lives than the simulated air bag system, but the harness is valuable only if used. The air bag system is beneficial in many situations regardless of the actions of the occupants. Either system requires the use of the lap belt to be fully effective. It is estimated that in equipped cars, 40% of the occupants use the lap belts, but only 4% use the shoulder harnesses. It is concluded that some way of increasing belt usage would be the most cost-effective way of increasing substantially the number of lives saved.

by E. S. Grush; S. E. Henson; O. R. Ritterling  
Ford Motor Co., Dearborn  
1970? ; 28p  
Availability: Reference copy only

HS-015 667

### SEAT BELT USAGE AND BENEFITS IN NORTH CAROLINA ACCIDENTS

Restraint system benefits are evaluated, based on lap belt and shoulder harness usage rates and injury reduction benefits for all seating positions in North Carolina accident-involved vehicles. The restraint system data were collected in addition to the accident information normally collected by the North Carolina State Highway Patrol in the summer of 1970. Detailed analyses were conducted based on accident type, impact site, estimated speed just prior to contact, and non-belted and belted frequencies for both serious and minor injuries. Depending on the available sample sizes, chi-square, Poisson, or binomial tests were employed to detect significant differences between the belted and unbelted groups. The results further document previous findings which show the effectiveness of lap belts and shoulder harnesses and point out the continuing need for programs aimed at increasing restraint system usage rates.

by F. M. Council; W. W. Hunter  
North Carolina Univ., Chapel Hill. Hwy. Safety  
1974 ; 82p  
Sponsored by the North Carolina Governor's Hwy. Safety  
Program (Traf. Records Grant N-310-73-001-001) and the  
Insurance Inst. for Hwy. Safety.  
Availability: Corporate author

HS-015 571

### PANEL DISCUSSION--PHYSICIANS VIEW SAFETY BELT USE

Injuries resulting from non-use of seat belts are described from the viewpoint of a hospital emergency room physician, and mandatory usage laws are advocated. Questions and answers are given relating to child safety restraint systems, the Australian seat belt law, parental responsibilities in child safety, shoulder harness injuries, school bus safety, small child safety using standard seat belts, and legislation needs.

by J. D. Mills  
American Coll. of Emergency Physicians  
Publ: HS-015 558, National Safety Belt Usage Conference,  
Proceedings, Washington, D. C., 1973 p74-9  
1973 ; 2refs  
Availability: In HS-015 558

HS-015 721

### A USER-ORIENTED PROGRAM FOR CRASH DYNAMICS

The conversion of a crash analysis program is described from its original batch program form with awkward input to an efficient, user-oriented interactive tool. The program simulates a vehicle occupant with a two dimensional, seven link mathematical model restrained by a seat belt and shoulder harness. A nonlinear finite element capability was added to enable modeling of a seat which would interact realistically with the occupant. A new differential equation solver was developed which achieved a 60% reduction in the computer time required for the transient response analysis. The modified program incorporates user aids such as free-field data input and an on-line data edit capability. Output was reformatted to provide

HS-015 607

### SYMPOSIUM ON CAR CRASH INVESTIGATIONS AND THEIR USEFULNESS. GENERAL DISCUSSION

The need for advertising traffic safety is stressed, particularly for seat belt usage by pregnant women and children. Questions

user-selected time history and occupant configuration plots as well as readable printout.

by R. N. Karnes; J. D. Sebastian; J. L. Tocher; D. W. Twigg  
Boeing Computer Services, Inc., Seattle, Wash.  
N00014-72-C-0223

Publ: HS-015 706 (SAE-P-52), International Conference on  
Vehicle Structural Mechanics Proceedings, New York, 1974  
p154-63

Rept. No. SAE-740331 ; 1974 ; 8refs  
Presented at the Conference held in Detroit, Mich., 26-28 Mar  
1974.

Availability: In HS-015 706

HS-016 022

### THREE-POINT HARNESS ACCIDENT AND LABORATORY DATA COMPARISON

A combined program of accident investigation, staged collisions, and simulated collisions involving three-point harnessed occupants in frontal force collisions has provided a means of correlating injury with forces and/or other physical parameters associated with the injuries. With a strict screening to ensure complete data on each accident, 128 cases involving 169 occupants at barrier equivalent velocities from 2-53 mph were compared with the results from 11 staged collisions and 72 simulated collisions. There were 14 rib cage injuries ranging from single sternum fracture to seven rib fractures at velocities of 10-53 mph at abbreviated injury scale levels (AIS) of 2 and 3. A single AIS 4 injury was the most serious injury and consisted of a ruptured spleen. The most serious brain injury was an AIS 2. Two cervical vertebra fractures were found. Only 14 occupants had AIS 3 injuries. No abdominal organ injuries, thoracic organ injuries, breast injuries, clavicle fracture, or eye injuries were reported. It is concluded that: the harness is highly efficient in mitigating injuries, rib and sternum fractures are the more prevalent, submarining is not a major problem, females are injured at lower collision severity than males, and age is an important factor in injury susceptibility. The overall tolerance level for 50% injury at the AIS 3 level is 45 mph at an upper shoulder harness load of 1930 lb, a chest Gadd Severity Index of 560, and a peak resultant chest acceleration of 85 g.

by A. Andersson; L. M. Patrick  
AB Volvo

Publ: HS-016 016, Stapp Car Crash Conference (18th)  
Proceedings, Warrendale, Pa., 1974 p201-82

Rept. No. SAE-741181 ; 1974 ; 10refs

Availability: In HS-016 016

HS-016 169

### COMPARISON OF THREE POINT HARNESS ACCIDENT AND LABORATORY DATA. FINAL REPORT

A combined program of accident investigation, staged collisions, and simulated collisions involving three point harnessed occupants in frontal force collisions has provided a means of correlating injury with forces and/or other physical parameters associated with the injuries. A total of 128 cases involving 169 occupants at barrier equivalent velocities from two to 53 mph were compared with the results from 11 staged collisions and 72 simulated collisions. There were 14 rib cage injuries ranging from single sternum fracture to seven rib fractures at velocities of 10 to 53 mph at injury levels of AIS-2 and -3. A single

AIS-4 injury was the most serious injury (a ruptured spleen). The most serious brain injury was an AIS-2. Two cervical vertebra fractures were found, one of which was a 12 year old male and the other a 76 year old female. Only 16 occupants had AIS-3 injuries. No abdominal organ injuries (except the ruptured spleen), thoracic organ injuries, breast injuries, clavicle fracture, or eye injuries were reported, and there were no AIS-5 or fatalities in the sample. It is concluded that: the harness is highly efficient in mitigating injuries; rib and sternum fractures are the most prevalent injuries; submarining is not a major problem; females are injured at lower collision severity than males; age is an important factor in injury susceptibility; and the overall tolerance level for 50% injury level at AIS-3 is 45 mph at an upper shoulder harness load of 1930 lbs, a chest Gadd

by L. M. Patrick; N. Bohlin; A. Andersson  
Wayne State Univ., Detroit, Mich. 48202 Volvo A.B.,  
Goteborg (Sweden)  
1974 ; 121p

Supported by the American Safety Belt Council. Prepared for  
the Motor Vehicle Manufacturers Assoc., Detroit, Mich.  
Availability: Wayne State Univ., Detroit, Mich. 48202

HS-016 301

### RESTRAINT SYSTEM EFFECTIVENESS (A STUDY OF FIFTEEN SYSTEMS)

A comprehensive assessment is presented of the injury-reducing potential of various automobile occupant safety restraint systems, including both existing and proposed systems, some of which require occupant participation (active systems), some of which do not (passive systems), and some systems with both active and passive elements. Elements considered were: lap belts, shoulder harnesses, air bags, and impact resistant panels. These were considered in various combinations, for various seating positions, with the belt systems using current webbing and constant force webbing. All drivers were assumed to be protected by a third-generation energy absorbing steering column. The benefit criterion used was the number of motor vehicle fatalities among unrestrained occupants which would be avoided through use of a safety restraint system. Mathematical models were used to develop a method of assigning an effectiveness value to any given system. This effectiveness value was then applied to fatal accident data from the 1969 National Safety Council report and from Cornell Aeronautical Laboratory, to compare one restraint system's effectiveness with another. Systems were evaluated in terms of human acceleration tolerances, vehicle deceleration characteristics, occupant size, impact speed, impact angle, single impact frontal collisions, seating position, multiple impact collisions, rollovers, accident and injury severity, human impact tolerances, and ejection. Findings include: about 20% of all drivers would be saved by the energy absorbing steering column alone; adding a constant force harness would increase this protection to include about 67% of those drivers who would otherwise be killed; lap belts and air bags save about the same number of front passenger lives; and with 44% usage of active restraint components, the constant force harness system for all occupants produces savings identical to those of the air bag system.

by E. S. Grush; S. E. Henson; O. R. Ritterling  
Ford Motor Co., Automotive Safety Affairs Office, P.O. Box  
2053, Dearborn, Mich. 48121  
Rept. No. S-71-40 ; 1971 ; 111p 14refs  
Availability: Corporate author

HS-016 723

### A CONTROLLED STUDY OF THE EFFECT OF TELEVISION MESSAGES ON SAFETY BELT USE

This study shows that television campaigns have little effect on the use of safety belts, thus supporting the argument that approaches directed toward changing behavior are inefficient and often ineffective means of reducing highway losses. A controlled television campaign designed to increase the usage of seat belts and shoulder harnesses is thoroughly related. The attending study observed and recorded the use of seat belts by drivers from homes where the television messages were received on cable television as well as drivers who were from homes on the control cable without the messages. There was no significant difference in seat belt usage between the two groups. The apparent failure of a number of mass media safety belt campaigns to increase use may not mean that it is impossible to create a campaign which will increase seat belt use. However, the evidence on lack of effect of past efforts is sufficiently strong that the burden of proof of substantial further gains in belt usage resulting from such campaigns is on those who advocate use of mass media to promote use of safety belts.

by A. B. Kelley; L. S. Robertson; B. O'Neill; C. W. Wixom; R. S. Eiswirth; W. Haddon, Jr.  
Insurance Inst. for Hwy. Safety, Washington, D.C.  
Publ: American Journal of Public Health v64 n11 p1071-80 (Nov 1974)  
1974  
Availability: See publication

HS-016 894

### REVIEW AND CRITIQUE OF NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION'S REVISED RESTRAINT SYSTEM COST BENEFIT ANALYSIS

The initial and amending documents called "Analysis of Effects of Proposed Changes to Passenger Requirements of MVSS 208" are critiqued. Particular concern is focused around the use of baseline quantities of deaths and injuries of unrestrained occupants and dollar costs of deaths and injuries, which were used to develop a cost-benefit analysis to show the effectiveness of lap belt-air bag systems over lap-shoulder harness systems. Aside from the cost of car related death and injury, other areas covered were: restraint system costs, both of installation and in relation to car-lifetime operation costs; seat belt usage; and restraint system effectiveness and benefits, in terms of fatality and injury prevention. While the National Hwy. Traffic Safety Administration (NHTSA) concluded that lap belts and airbags were more effective than lap-shoulder harnesses, the conclusion of this analysis is the reverse. Recommendations were: NHTSA should reexamine its estimates of restraint system effectiveness and costs, life and injury values, baseline injury quantities and belt usage (specifically; effectiveness estimates of belt restraints should be brought into line with real-life observation; effectiveness of the air bag should be established by large-scale real-world sampling results instead of by subjective judgement; life and injury valuations should be made realistic by eliminating exaggerated dollar estimates of unmeasurable intangible costs; the numbers of unrestrained occupant injuries used as a baseline should be adjusted so that aggregate injury costs are in line with reality; restraint system costs to the consumer should be based on the state of the art instead of optimistic projections; and belt use estimates should be in accordance with actual ob-

servations, rather than pessimistic projections). NHTSA should take the steps necessary to promote belt harness development and use by: dropping the air bag requirements of MVSS 208, so that money and effort can be put into harness development; states should be encouraged with funding to promulgate mandatory seat belt usage; and a sequential buzzer and light warning system should be required. Finally, NHTSA should continue testing air bags so that realistic cost-effectiveness data can be developed.

by Howard P. Gates, Jr.  
Economics and Science Planning, Inc., 1200 18th St., N.W., Washington, D. C. 20036  
Publ: HS-801 745, Proceedings, International Congress on Automotive Safety (4th), Washington, 1975 p209-344  
1975 ; refs  
Presented at the Fourth International Congress on Automotive Safety, San Francisco, 14-16 Jul 1975.  
Availability: Corporate author; also in HS-801 745

HS-016 901

### BELT USE IN 1975 CARS: INITIAL DATA FROM ONE METROPOLITAN AREA

Seat belt use in the Houston metropolitan area during March, 1975 is assessed. Belt use or nonuse was visually observed at 30 sites, such as freeway entrances and exits, and other points where vehicles ordinarily slow to less than 15 mph. Of 394 observed 1975 cars, 27% were using the lap and shoulder harness combination and an additional 8% were using only the lap belt. This was compared to the findings of a similar survey taken in 1974, which showed 28% using the three point belt and 8% using the lap belt. The overall finding was that, despite the proliferation of buzzers, lights, and interlocks in the interim, observed use of any belt in 1972-1975 cars in 1975 was 29% compared to 23% in 1968-1971 cars.

by L. S. Robertson  
Insurance Inst. for Hwy. Safety, Washington, D.C.  
1975 ; 9P  
Availability: Corporate author

HS-016 971

### RESTRAINT SYSTEM USAGE: A LITERATURE SURVEY

Thirty-three references on restraint system usage are listed and arranged in chronological order (earliest to most recent) according to the year the study was conducted. Data provided in these references was charted by year of study, region (or population base) of study, the method used to conduct the survey (interview, questionnaire, accident reports, or observation), years of automobiles surveyed, percentage of seat belt use, percentage of seat belt and shoulder harness use, day or night survey, and sample size.

by A. C. Grimm, COMP.  
University of Michigan, Hwy. Safety Res. Inst.  
1975 ; 11p  
Availability: Corporate author

HS-017 288

### SHOULDER HARNESS USAGE IN THE POPULATION OF DRIVERS AT RISK IN NORTH CAROLINA

Shoulder harness usage rates based on observations of vehicles in North Carolina in the summer of 1971 are reported. Tabulations of usage rates based on 19,333 observations are presented on a variety of demographic and environmental factors. A model of usage patterns is developed using a method of analysis of categorical data by linear models. The clusters derived with the highest predicted usage rates (33.3%) were foreign car drivers from out-of-state on Interstates, mature and older white male out-of-state drivers of foreign cars on rural non-interstate roads and young white male out-of-state foreign car drivers on rural four-lane divided highways. Values of variables which most consistently positively influenced usage rates were rural areas, foreign cars, road size, and male drivers. The overall usage rate is 4.8 percent with the males' rate being 5.4 percent and the females' rate being 3.2 percent. The influence on usage rate of 3-point versus 4-point shoulder harness systems in United States cars is examined with no real difference demonstrated. The effect of driver's shoulder harness usage patterns on right front passenger usage is discussed, and a usage rate of 51.1 percent for passengers whose drivers were wearing shoulder harnesses is reported.

by William W. Hunter; Jean L. Freeman; Gary G. Koch; John H. Lacey  
University of North Carolina, Hwy. Safety Res. Center,  
Chapel Hill, N. C.  
1975 ; 115p

Supported by the Government's Hwy. Safety Prog. and a grant from the Inst. of General Medical Sciences.

Availability: Corporate author

HS-017 477

### THE EFFECTS OF AUTOMOBILE SAFETY REGULATION

A general discussion of the effects of automobile safety regulation is presented. The background of the major safety standards and design changes in automobiles (seat belts, shoulder harnesses, energy-absorbing steering column, penetration-resistant windshield, dual braking system, and padded instrument panel) is sketched. The following areas are discussed: the rationale for the direction of safety regulation; the determinants of automobile accidents (alcohol, youth, and vehicle speed); and estimates of the determinants of accident rates before and after regulation and the effects of safety devices (on death rates, injury and property damage, and driver risk taking) for both time-series and cross-section data. It is concluded that: the offsetting effects of nonregulatory demand for safety and driver response to safety devices are virtually complete, so that regulation has not decreased highway deaths; and time-series data imply some saving of automobile occupants' lives at the expense of more pedestrian deaths and more nonfatal accidents, a pattern consistent with optimal driver response to regulation.

by Sam Peltzman  
Publ: Journal of Political Economy v83 n4 p677-725 (1975)  
1975 ; 27refs  
Availability: See publication

HS-017 553

### CONCEPTS IN SAFETY BELT TESTING. FINAL REPORT

Concepts for more representative testing of emergency-locking retractors (inertia reels) and shoulder harness automobile occupant restraint assemblies were explored. It was determined that a vehicle acceleration pulse having a low acceleration onset would be the most critical condition for retractor performance. A mockup of a single retractor acceleration test device (illustration provided) was fabricated for producing constant onset values in the lower range estimated for aircraft accidents. Preliminary testing with the mockup test device raised questions on the locking characteristics of current retractor designs, but the results were inconclusive. It was found that shoulder harness assemblies should be tested as an assembly to properly assess the interaction of the various segments on buckles and webbing connectors. A static test method was explored (with a new test block design based on a 50th percentile male), and found to be potentially adaptable to all shoulder harness configurations. Dynamic testing is another method of assessing a complete safety belt assembly. Accuracy and repeatability of a dynamic test facility are important. SAE Recommended Practice No. J117, presenting a concept minimizing the potential for a double standard between dynamic and static criteria, is considered. Based on this concept, a discussion is presented on aspects to consider in designing an accurate and repeatable dynamic test procedure:

by James W. Ross, Jr.  
Federal Aviation Administration, Flight Standards  
1975 ; 40p  
Prepared for the Society of Automotive Engineers' Business Aircraft Meeting, Wichita, Kansas, 8-11 Apr 1975.  
Availability: NTIS

HS-017 610

### SHOULDER-BELT-FORCES AND THORAX INJURIES

To investigate the tolerance limit of the human thorax in frontal collisions with a shoulder harness, tests were carried out on 51 male and female cadavers from 12 to 82 years of age wearing a 3-point-belt with automatic retractor, a diagonal-shoulder-belt with automatic retractor combined with a kneebar, or a diagonal-shoulder-belt, knee-belt, with automatic retractor, belt-force limiter, and preloading device. Forty-four tests were conducted with crash velocities of 50 kilometers (km) per hour; 6 tests with velocities of 64 km per hour; and one test with a crash velocity of 80 km per hour. Locations of thoracic deformations are analyzed in detail. It was found that: enlargement of the bearing surface of the belt can reduce injury severity; on the right side, fractures of the upper six ribs predominated and on the left side fractures concentrated in the middle thorax area; most rib fractures were shear fractures; in 7 out of the 51 cases, the thoracic spine was broken; the more often the thorax skeleton was instabilized through fractures, the more frequent were injuries of the internal organs; the wearing of shoulder harnesses can protect younger occupants (up to 30 years) from having thorax injuries when crashing

June 1, 1979

HS-018 843

against a rigid wall at 50 km per hour; and the injury severity risk will increase progressively with age.

by Dimitrios Kallieris; Rainer Mattern  
University of Heidelberg, Inst. of Forensic  
Publ: Air Force Driver  
1974 ; 14p

Presented at the Proceedings of the International Meeting on Biomechanics of Trauma in Children, Lyon, France, Sep 1974.  
Availability: Reference copy only

HS-018 027

**STUDY OF THE DYNAMIC BEHAVIOR OF THE HEAD-NECK SYSTEM IN CHILDREN AGED 9-11 WHEN LOW AMPLITUDE SINUSOIDAL FORCES ARE APPLIED (ETUDE DU COMPORTEMENT DYNAMIQUE DU SYSTEME TETE-COU LORS DE L'APPLICATION DE FORCES SINUSOIDALES DE FAIBLE AMPLITUDE CHEZ L'ENFANT AGE DE 9 A 11 ANS**

The behavior of various body links, and of all body segments in the head-neck system of small children was studied, in order to devise a system of seat belts adapted to the size-characteristics of children. Children between the ages of 9-11 were chosen, seated on an adjustable seat and firmly held by a shoulder harness. The forearm and head were then tested. Displacement was measured by means of a potentiometer and displayed on the screen of a cathode ray oscilloscope. Subjects exerted their strength against a dynamometer by means of a strap around the head or around the wrist. The dynamic behavior of the two body systems of the child were found to follow the same laws as those of the adult when low amplitude forces were applied. However, muscular strength was well below that of an adult, and when the body was brutally decelerated, the musculature necessary to counterbalance the forces of inertia were proportionately much greater than in the adult--activated at the level of the head. Thus, the role of musculature in absorbing energy, is limited. It is essential, therefore, to limit as much as possible the strain on the head-thorax bond by not subjecting the head to excessively brutal deceleration by stringent restraint of the thorax.

by J. P. Verriest  
ONSER, Shock Lab., Lyon, France  
1976 ; 19p refs

Unofficial translation from Proceedings of the International Meeting on Biomechanics of Trauma in Children, Lyons, France, 17-19 Sep 1974, n.p., n.d., p216-36. Text also in French.

Availability: Reference copy only

HS-018 345

**PROTOTYPE FABRICATION AND TESTING OF A MODIFIED MA-2 HARNESS. FINAL REPORT**

The use of new low elongation webbing materials in the MA-2 integrated parachute/restraint harness system used by pilots was investigated. The MA-2 harness system is worn by a flight crew member prior to entering the aircraft. The harness contains all the necessary webbing for the parachute and for the lap belt and shoulder harness, needing simply to be attached to fittings in the seat. The webbing materials tested in this study were the low elongation Polyester material and the DuPont Fiber "B" (Kevlar) material, both of which were being

developed for use as low elongation seat belt webbing material. Each of these materials was used to replace the nylon webbing in one MA-2 harness. Lap belts, shoulder belts, and inertia reels were also constructed of each of these materials. A complete Polyester system and a complete Kevlar system were then crash tested on a horizontal accelerator and in drop tests. A 50th percentile Sierra dummy weighing about 164 pounds was used in the horizontal tests, while a 95th percentile dummy was used in the drop tests. The test data showed no clearly superior webbing configuration. Unanticipated problems with stitching and weave pattern with the Kevlar and Polyester webbings appear to be the cause of these results. These problems negated the effects of the low webbing elongation. Manufacturers of the materials have indicated that these problems can be overcome, but further research is required to demonstrate the usefulness of these materials in improving crew survival in crash situations. It also appears that the MA-2 harness in itself does not allow for taking advantage of improved webbing materials, and that significant redesign of the MA-2 system may be necessary if the material substitutions are to make any significant difference in improvement of the harness functioning. Photographs of the test set-ups and graphs of acceleration data are provided.

by M. Pavlick; M. Schwartz; J. O'Rourke  
Budd Co.; Naval Air Devel. Center, Warminster, Pa. 18974  
N62269-74-C-0007  
Rept. No. NADC-75034-40; AD-A013 640 ; 1975 ; 57p  
Availability: Naval Air Systems Command, Washington, D. C. 20361

HS-018 843

**STATE OF THE ART OF SEAT BELTS IN AUSTRALIA**

This paper reviews the history of introduction of seat belts in Australian motor vehicles. Emphasis is placed on the role of the manufacturer. A lap belt was the first restraint system used. This was followed by the shoulder harness, the lap/shoulder harness assembly and the full harness belt. Most current Australian vehicles use the continuous loop lap/shoulder harness belt. Australian government standards for seat belts were adopted, the first being ASE 35. This controlled belt design, bolt size, webbing size and strength. It combined safety with technical and manufacturing capabilities available at the time. Testing of belts was now necessary. Australian seat belt manufacturers joined the Federation of Automotive Products Manufacturers and worked on an advisory panel for seat belt performance. The result was an improved design rule ADR 4. This design rule is very stringently enforced. Improvements made to seat belts since ADR 4 include adjusters, buckles, webbing, retractors, webbing guides, buckle location and accessibility. National Safety Councils together with the police, automobile associations and similar groups joined in a campaign to promote the use of seat belts. They are now installed as part of the original equipment and wearing is compulsory. Future trends should include increasing the strength of seat belts, lengthening the durability of the components, and use of energy absorbers.

by R. B. Heath  
Rainsfords Metal Products Pty. Ltd., Australia  
Rept. No. Paper-5 ; 1976 ; 14p  
Presented at Seat Belt Seminar, Melbourne, Australia, 9-11 Mar 1976, sponsored by Commonwealth Department of Transport.  
Availability: In HS-018 935

HS-018 851

**SEAT BELT CRASH PERFORMANCE IN AUSTRALIA**

A literature summary is presented, describing Australian experience of the crash performance of 3-point combination lap/shoulder harness belts supposedly constructed, fitted and worn in compliance with the laws of Australian States and Territories. Sections of the paper deal respectively with the statistics of belt usage, abdominal injuries associated with belt wearing and head injuries sustained in spite of belt wearing. Details of belt failures and defects are provided. It is concluded that few belts fail to perform as designed, few significant injuries are produced by belts and that further counter-measures should be designed, especially measures to protect the heads of belt wearers. Photographs are included.

by D. C. Herbert; B. A. Vazey; J. M. Henderson  
Traffic Accident Res. Unit, Dept. of Motor Transport,  
N.S.W., Australia  
Rept. No. Paper-13 ; 1976 ; 33p 49refs  
Presented at Seat Belt Seminar, Melbourne, Australia, 9-11  
March 1976, sponsored by Commonwealth Department of  
Transport.  
Availability: In HS-018 935

HS-018 852

**DYNAMIC TESTS WITH ENERGY ABSORBING SEAT BELT RESTRAINTS**

Dynamic tests were carried out with shoulder harness seat belts in their conventional configuration, and with energy absorbers developed at the Aeronautical Research Laboratories incorporated in the shoulder strap and seat mounting. The tests were done on the Hyge Crash Simulator at the General Motors Holden's test center near Melbourne. When tested with a sled acceleration of 240 meters per second squared, the forces in the straps of the energy absorbing system were 30% lower than those in the conventional system, and the seat force was approximately 50% lower. The forces in the energy absorbing system at a sled acceleration of 300 meters per second squared were approximately the same as those developed in the conventional system at a sled acceleration of 180 meters per second squared. The "trade off" of reduced load against increased dummy movement with the energy-absorbing system is indicated.

by S. R. Sarrailhe  
Aeronautical Res. Labs., Dept. of Defense, Melbourne,  
Australia  
Rept. No. Paper-15 ; 1976 ; 23p 7refs  
Presented at Seat Belt Seminar, Melbourne, Australia, 9-11  
Mar 1976, sponsored by Commonwealth Dept. of Transport.  
Availability: In HS-018 935

HS-019 063

**THE DUMMY MISSILE PROJECT**

A rocket-propelled passenger car carrying two anthropomorphic dummies was impacted into a concrete abutment at 52 mph to study tornado force vulnerability and effects, and to develop some appropriate visual aids for safety education purposes. Data presented on impact effects on the dummies tested indicate that human passengers would have been killed in the same circumstances. Damage to the car and to the dummies carried in the car is described and illustrated.

The impact forced the bumper grille and radiator backward two feet two inches, front wheels and engine were also forced rearward, and tires remained intact and inflated. The front seat moved forward 18 inches at impact, breaking the shoulder harness strap on dummy 1 seven inches from the bolted end. The dummy destroyed the steering wheel, bent the steering column, veered to the right, and passed the steering wheel, striking the windshield with its head and the dashboard with its knees and hands. The lap belt on dummy 1 showed some structural deformation, but remained intact. Dummy 2 (unrestrained) moved forward into the dashboard and windshield, its head shattering it and knocking it loose from the mounting, and destroying the windshield wiper apparatus. Several large and small dents appeared in the roof of the car, over rear doors, and in the kick plate below the front door. Neither rear door could be opened by hand. The duration of the forces of deceleration was approximately 60-80 ms. Computer plotted graphs of the acceleration forces are also provided.

by Lee Stinnett  
Sandia Labs., Albuquerque, N.M. 87115  
AT(29-1)-789  
Rept. No. SAND75-0360 ; 1975 ; 63p 4refs  
Availability: NTIS

HS-019 113

**ONTARIO'S BUCKLE-UP LAW IS PAYING OFF. FIRST QUARTER ACCIDENT STATISTICS SHOW DRAMATIC REDUCTION IN FATALITIES AND INJURIES**

The history of the legislation and the campaign for its implementation are reviewed, showing stiff opposition initially to the law and subsequent acceptance and support. Early in the campaign of enforcement, noncompliant motorists were cautioned or warned; strict enforcement of the law soon followed. Educational material and publicity for the new law and its intended effects for motorists' protection were described, emphasizing positive results of the use of seat belts in specific accident situations. Provisions of the law require that if a vehicle is/was equipped with seat belts or shoulder harnesses at the time of manufacture, then that assembly must be used by the driver at all times and by passengers seated in equipped spaces. Each adult is held responsible for himself, with exceptions made for driver in reverse, delivery personnel, and medical cases. Additional provisions excepted: children under the age of five or weighing less than 50 pounds (due to availability of child safety seat units); optional shoulder harness usage for cars equipped pre-1974 (due to difficulties in proper adjustment); and cab drivers (for personal safety in the event of attack or armed robbery). Mandatory safety belt laws are advocated for adoption in other regions because of the impressive statistics in saving human life and preventing injury.

by P. G. Green  
Publ: Traffic Safety v76 n7 p8-11, 34-5 (Jul 1976)  
1976  
Availability: See publication

HS-019 228

**EFFECTIVENESS, BENEFITS, AND COSTS OF FEDERAL SAFETY STANDARDS FOR PROTECTION OF PASSENGER CAR OCCUPANTS. REPORT TO**

**THE COMMITTEE ON COMMERCE, UNITED STATES SENATE BY THE COMPTROLLER GENERAL OF THE UNITED STATES**

Costs and estimated benefits of Federal motor vehicle safety standards for minimum performance providing protection for passenger car occupants in accidents as prescribed by the National Highway Traffic Safety Administration are analyzed by the General Accounting Office (GAO). Data from over two million cars involved in accidents in North Carolina and New York were compared to obtain driver death and injury rates for model years of cars. Factors considered in judging performance of pre-standard vehicles (pre-1967) with that of post-standard vehicles included State seat belt laws, General Services Administration's requirements for cars bought by the government, initiative of manufacturers, and (after 1967) safety standards issued by the Federal government based on prior government standards. Approximately equalizing conditions affecting accident severity for all model years of cars investigated, it is estimated that in relation to pre-1966 model cars: 15-25% fewer deaths and serious injuries occurred in 1966 to 1968 model cars, 1969 and 1970 model cars had from 25-30% fewer deaths and serious injuries, and there was little further improvement in 1971 to 1973 model cars. Implications of these results were approximated in terms of occupant lives saved to estimate that the 1966-1970 standards may have saved about 28,230 lives between 1966 and 1974. It was also estimated that total costs for complying with the standards on 1966 through 1974 model cars was about \$8.5 billion for seat belts, shoulder harnesses, windshield mounting, energy-absorbing steering columns, reinforced roof and side doors, and other required devices. Estimated costs for the 1966-1970 standards were about \$7.2 billion for cars sold in 1966-1974, while costs for standards introduced in 1971 through 1973 models were about \$850 million. Various research studies of the effectiveness of specific occupant protection standards and related benefit estimates are also reviewed, showing that head restraints, energy-absorbing steering columns, and seat belts have significantly affected (lowered) injuries and fatalities, with large initial improvement to driver safety and then subsequent leveling off. GAO concludes that cost-effectiveness of standards for 1971-1973 models is much lower than that for previous standards for previous model years. An interrogation and comments correspondence between the GAO and the Department of Transportation on this conclusion is presented in Appendix IV, demonstrating the need for further supportive evidence to validate this conclusion. Other appendices contain Federal motor vehicle safety standards, technical analyses, and amortized cost of standards introduced in model year 1966.

General Accounting Office, Washington, D.C.  
Rept. No. CED-76-121 ; 1976 ; 126p 29refs  
Availability: General Accounting Office, Distribution Section,  
P.O. Box 1020, Washington, D.C. 20013, \$1.00

HS-019 367

**INFLATABLE BODY AND HEAD RESTRAINT**

A vehicle occupant restraint system which inflates upon impact includes lap and shoulder harnesses which resemble conventional restraint systems in their uninflated state, but which inflate upon impact, as does an additional inflatable bladder which cushions the chest area and minimizes head rotation toward the chest. The object of the invention is to provide an automatic restraint device which includes the means for

minimizing forward whiplash movement of the head in an accident situation. The restraint system inflates upon a threshold impact to form a body buffer for the vehicle occupant, in a system which can be integrated with a conventional strap restraining system in the uninflated or stowed condition and which is constructed for convenient ingress and egress. The restraint system is provided with integral, porous bladder structures formed from a loosely woven synthetic material. In the uninflated state the bladders are folded accordion-like and loosely stitched down to resemble conventional webbing. An integral gas generator is located centrally with respect to the harness in a terminus housing. Upon impact a sensor switch closes and supplies energy to fire the gas generator. The bladder structures which form the major portions of the lap and shoulder harness inflate virtually instantaneously as does an additional bag of material which unfurls across the chest to minimize head rotation into the chest. Advantages of the invention are its automatic operation, low cost, attractive appearance, ease of stowing, reliability, and effectiveness in preventing injury.

by Marvin Scholman  
Department of the Navy, Washington, D.C.  
Rept. No. AD-D001 257 ; 1974 ; 13p  
Serial No. 483,603; filing date 27 Jun 1974.  
Availability: NTIS

HS-019 470

**SEAT BELT POTENTIAL STILL UNTAPPED**

The design of seat-belt systems as related to their potential for use by the motoring public is reviewed, emphasizing problems of discomfort, inconvenience, and cost to the consumer and redesign and regulatory compliance as related to manufacturing costs. Seat-belt design has evolved continuously since Jan 1964 when the first state laws requiring belts for front out-board passengers went into effect. Lap-belt systems have been joined by shoulder harnesses, warning systems, automatic retractors, harness stowing mechanisms, and a temporary ignition interlock system. Ford has developed a shoulder-belt system which retracts into the seat back at a position considered more comfortable for most passengers and less likely to be unused due to entanglement or inconvenience, but the system has not been installed because a proposed rule relating to seat back heights and seat back strengths would render obsolete all existing seat designs and would force obsolescence of new designs in a few years. Also, the air bag ruling is still undecided and possibly will be mandated. Fisher Body manufacturers will be introducing two new seat belt systems on 1977 model cars. In the first system, one retractor will operate with a window shade mechanism, and in the second system, two retractors will be used to permit the user to pull the belt across his body continuously, even if motion is interrupted or reversed. The window shade concept may introduce a dangerous amount of belt slack if the webbing is set accidentally or deliberately with too much extension prior to setting, and the slack of the shoulder belt could be passed to the lap belt in the single retractor version. A new add-on device for belt retractors is available to ensure good retraction and stowage and also a low level of force that is automatically operative when webbing is extracted and retracted. The device, called Comfort Zone, applies the low tension over a chosen range of belt travel, allowing for individual wearer's normal movements without interfering with operation of the main retractor. Other improvements which may be made to current seat belt systems include: changing the level of sensitivity for operation of the

emergency lock retractor to a lower level to detect lower levels of braking that might precede a crash, reducing flexibility and elasticity to make the resistance effect closer to average load, and improving seat-belt reminder systems. Public acceptance of seat-belt systems is seen as the key to improving their use rate and thus affording greater vehicle occupant protection, a potential which as yet has not been fully realized.

by Carl A. Gottesman

Publ: Automotive Industries v155 n4 p24-6 (Sep 1976)  
1976

Availability: See publication

HS-019 612

### **HUMAN INJURY MECHANISMS AND IMPACT TOLERANCE**

The complex subject of human injury mechanisms and impact tolerances in automobile accidents is reviewed; injury patterns are described; and the status of knowledge in the biomechanics of trauma of the head, neck, chest, abdomen, and extremities is discussed. Lack of documentation, complicated human structures, difficulty in evaluating injury, inadequate instrumentation, and imperfect animal models make research difficult. Head and chest injuries are the most critical followed by injuries to the abdomen and extremities. The head and neck are the most frequent injuries, but are not of a critical nature as often as thoracic injury, particularly rupture of the thoracic aorta. Head injuries may be produced by direct impact that involves short durations and high acceleration or by inertial loading with large angular motions and longer time periods. In the neck, some low-velocity impacts can produce injury as severe or more severe than high-velocity impacts. Abdominal tolerance to injury is low. While seat belts and shoulder harness have helped to prevent injury to the head and upper torso, lap belt related abdominal trauma causes concern because it is hard to diagnose and there is a serious threat of hemorrhage and infection. To prevent abdominal injury, safety belts must remain below the iliac crest and the pelvis should bear all the load. Injury to the extremities is frequent but not life-threatening, and the elimination of rigid edges in the car interior would reduce injury. Appropriate levels for tolerable impact forces, accelerations, and deflections have not yet been established; and until such time as research provides more definitive information, the car designer will have to rely on conservative estimates and values. Energy-absorbing restraint systems, collapsible steering columns, improved windshields, and redesign of car interiors and dashboards are necessary to avoid head impact and to reduce the angular and linear accelerations of the head, and to minimize injury to other parts of the body. Seat belts must be designed to make it impossible for the wearer to keep them loose or twisted, and to make them comfortable so that they will be worn.

by John W. Melvin; Dinesh Mohan; Richard L. Stalnaker  
University of Michigan, Highway Safety Res. Inst.

Publ: HS-019 610 (TRR-586), "Design for Crash Survival of Automobile Occupants," Washington, D.C., 1976 p11-222  
1976 ; 47refs

Prepared for the 54th Annual Meeting of the Transportation Research Board.

Availability: In HS-019 610

HS-020 172

### **CONSUMER REACTION TO SEAT BELT COMFORT AND CONVENIENCE**

Slides and the accompanying text which show the general chronology of seat belt system evolution, in terms of State and Federal requirements, are provided. Improvements in elements of seat belt systems include push-button buckles attached to partially-stiffened webbing support to keep buckle from sliding between seat cushions, latchplates easier to find, torso harness webbing less apt to ride against neck, and retractors for lap belt and torso harness portions of seat belts. Driver personality types include those who rebel against being told what to do, those who do not want to bother with a system requiring them to remember something, those who believe in safety, those who know that safety is important but wonder why it is so difficult to come by, and those who may or may not use seat belts from time to time. Poor design features of seat belts include seat belt anchoring that is determined by shape and structure of vehicle models, lap belts anchored to the floor, lap belt anchoring points behind the seat, low positioning of buckles, belt-sensitive retractors, arm rests and consoles located in areas which impede access to latchplate or buckle, nonstandardized buckles, single loop, single retractor concept in belt systems, and guide position not given best-fit consideration. Results of a survey of seat belt users in which questions were designed to elicit answers that were more design oriented are given in terms of problems concerning lap belts, shoulder harnesses and single belt, single retractor systems. Results of laboratory studies designed to determine the extent to which certain system elements (buckle configurations and release mechanisms, push button configuration, push button release force, belt retractor tension, retractor systems, and webbing geometry) are given. Two optimized, three-point belt systems based on results of these studies are described, and results of an evaluation of the optimum systems versus four other state-of-the-art systems are given. Comfort and convenience can be substantially improved from existing systems in late model cars, passive belt systems require further development. Detailed specifications for optimum system are available in NHTSA-HS-801 277.

by Wesley E. Woodson

Man Factors, Inc., San Diego, Calif.

1976 ; 46p 2refs

Presented before the National Motor Vehicle Safety Advisory Council, Motor Vehicle Safety Seminar, Washington, D.C., 12 Jul 1976.

Availability: Reference copy only

HS-020 340

### **ATTITUDINAL FACTORS IN THE NON-USE OF SEAT BELTS**

A stepwise method for the assessment of public opinions was developed and used to investigate attitudes of people living in Regina, Saskatchewan (Canada) towards seat belts. The first step or Pre-Pilot stage consisted of a series of interviews with "experts" in the area of car safety. On the basis of two sets of interviews, a schedule was prepared which provided the basic structure for a series of open-ended, nondirected interviews (Pilot stage) conducted with a subsample of 51 members of the public selected at random. A questionnaire was constructed which was comprised of a series of highly structured tasks to be completed by respondents. The items were not only obtained entirely from material proffered by respondents in the

earlier stages, but they also preserved the actual wording of previously solicited responses. In addition to questions concerning demographic information, the response tasks included a set of 55 statements, selected to cover the entire range of opinions about seat belts that had been expressed in the earlier interviews; these statements comprised the Opinion Measure employed in the final stage of the study. Respondents were asked to indicate varying degrees of agreement or disagreement with assertive statements. For the final sample, 535 clusters of dwellings were randomly selected with one household randomly selected from each and one person asked to fill out a questionnaire. A sample of 465 people representative of the population responded of which 74.4% presently drove cars (85.8% for active and former drivers), 89% had seat belts (43% having both lap belt and shoulder harness), and 24% of whose cars had some buzzer/light warning system associated with seat belt usage. Scores on the 55 items previously mentioned were assigned values from one to seven and then were subjected to principal axis factor analysis. At the same time, respondents reported their claimed frequency of wearing seat belts in the city, using a five point classification ("always," "mostly," "occasionally," "rarely," "never"), the data being used to construct three groups of respondents according to seat belt usage. The process was repeated using reported levels of seat belt usage on the highway. Mean scores for each of the 55 Opinion Measure items were calculated for all three groups for both driving environments. A multiple correlation was calculated using the seven-point ratings on each of 55 items as a predictor battery and the five-point ratings of degree of seat belt usage as criterion. Most people accept that seat belts are effective, despite the fact that a large majority usually or always drive with belts unfastened. This failure appeared to result primarily from a failure to acquire the habit of buckling up, rather than distrust of seat belts or any very deep-seated systems of attitudes and beliefs. Public-education programs will not increase the use of seat belts, but measures are called for which take the decision to wear a belt out of the hands of individual drivers and passengers.

by C. K. Knapper; A. J. Cropley; R. J. Moore  
 Publ: Accident Analysis and Prevention v8 n4 p241-6 (1976)  
 1976 ; 13refs  
 Availability: See publication

HS-020 676

### **INJURIES, CRASHES, AND CONSTRUCTION ON A SUPERHIGHWAY**

Data from the Illinois Tollway on crashes, injury crashes, and vehicle miles at risk were analyzed to determine whether periods when this superhighway was undergoing construction had an effect on crash and injury-crash rates. The rate of injury crashes during construction years, 76.1 per 100 million vehicle miles (mvm), was 1.8 times greater than the average rate on the years preceding construction; and the rate of all crashes during construction years, 318.1 per 100 mvm, was 2.6 times greater than the average. Since the observed construction effect is based only on data from 1973 and before, the 1974 change in speed limits could not have been a factor in these significant increases. Maintaining separation of traffic during construction on a superhighway is a safer procedure than diverting traffic from a roadway which is being repaired into the other normally one-way road. Since the death rate on all U.S. roads, 4.3 per 100 mvm, is higher than the estimated rate on the divided highway interstate system, 2.4 per 100 mvm, it is possible that construction on narrower two-way roads might

have an even greater effect on rates of crashes and injury-crashes than that observed on the Tollway. Applying average crash rates during pre-construction years to the parts of the Tollway which had major construction, it was calculated that 385 property damage crashes and 81 injury crashes could be attributed to construction in 1972, and 239 property damage and 29 injury crashes could be attributed to construction in 1973. Since major construction, such as addition of lanes or replacement of roadways, will probably result in excess crashes and injuries, the development of effective countermeasures is necessary. These might begin with enforcement of reduced speed limits, traffic separation by non-injurious media barriers, bright illumination of construction zones, and delineation of lanes and roadways with highly visible stripes. Motor vehicles which better cushion and protect their occupants during crashes are positive developments of past years, as is the seat belt-shoulder harness. The epidemiologic approach can contribute much to an understanding of the serious problem of motor vehicle injury and can demonstrate and quantitate specific phenomena, activities, and factors involved, for which preventive measures should now be planned and tested.

by Theodore C. Doege; Paul S. Levy  
 Publ: American Journal of Public Health v67 n2 p147-50 (Feb 1977)  
 1977 ; 11refs  
 Presented, in part, at 25th Annual EIS Conference of the Public Health Service, Atlanta, 6 Apr 1976.  
 Availability: See publication

HS-021 426

### **AIRBAGS: THE GREAT STATISTICAL INFLATION**

No hard scientific data on airbags in terms of whether they will save lives are available. The lack of data on the Volkswagen-type passive three-point harness is noted. The validity of data collected by General Motors in an airbag pilot program conducted from 1973 to 1976 with 11,000 vehicles is questioned. In order to assess its raw data, General Motors summarized the outstanding characteristics of 132 accidents triggering airbag deployment. The results indicated that airbags are only 10% effective in preventing fatalities compared to circumstances in which passengers are totally unrestrained. Another study concluded that the upper estimate of airbag effectiveness is less than 40% of the effectiveness of lap and lap-shoulder harnesses in mitigating fatalities. The Insurance Inst. for Hwy. Safety arrived at only a marginal advantage for airbags over three-point harnesses. The use of airbags is not supported by the author for four reasons: airbags are not true passive restraints; insurance companies do not intend to grant discounts to motorists with cars having airbags; no consensus has been reached on the cost of installing and maintaining airbags; and airbags will not necessarily protect from injury the same people who would otherwise wear three-point harnesses.

by Michael Jordan  
 Publ: Car and Driver v23 n5 p62, 64-5 (Nov 1977)  
 1977  
 Availability: See publication

HS-021 775

### OPTIMAL DESIGN OF AUTOMOBILES FOR PEDESTRIAN PROTECTION

With the objective of determining the physical properties which a vehicle front end and hood should possess in order to minimize the injury to a pedestrian struck by the vehicle, a system of computer programs has been developed and applied to simulate the injuries suffered by a pedestrian struck by an automobile. The system provides a semiautomatic search for safer hood/grille/bumper configurations and stiffnesses. After the software system was developed, three major optimizations, interspersed with modeling changes to improve the accuracy of the simulations, were performed. Results from the optimization series were used to help design full-scale impact tests using child and adult dummies. In turn, experimental measurements were used to improve the mathematical model of the impact simulator. The results of these studies have provided some insights into vehicle design parameters which produce safer vehicles. Much was learned about modeling the pedestrian motion; the method of modeling joint dynamic and static properties is critical, and the ability to model inelastic failure of the joints is essential. Pedestrian simulation with its complex body/vehicle impacts places greater demands on a simulation program than crash simulations of a victim restrained by seat belt, shoulder harness or air bag inside a crashing vehicle. A simple geometric rule explaining the factors which determine the optimal hood shape for a particular pedestrian was not found. Although a hood geometry was found which was near optimal for two widely differing pedestrians (an adult and a child), this geometry cannot be assumed to protect a large spectrum of the population in a variety of situations. The principal design problem is that of avoiding head impact. A physical "self-defense" mechanism was suggested by the optimization. In simulations in which the hood surface had a large coefficient of friction, an arm or elbow thrown out by the pedestrian at the hood protected the head. The most critical factor associated with the stiffness properties of the hood is the available crush distance, i.e. the thickness of the padding. Mere softness without crush depth affords little protection because the material quickly bottoms and loses its softness. Padding the upper hood with foam is more effective than a sheet metal hood with an equivalent buckling distance. The sheet metal upper hood surface can provide considerable crush distance by dimpling inward. Padding the grille and bumper does significantly reduce lower body injury.

by David W. Twigg; James L. Tocher; Rolf H. Eppinger  
National Hwy. Traffic Safety Administration  
DOT-HS-356-3-719  
Rept. No. SAE-770094 ; 1977 ; 16p 11refs  
Presented at International Automotive Engineering Congress  
and Exposition, Detroit, 28 Feb-4 Mar 1977.  
Availability: SAE

HS-022 180

### SAFETY BELT USAGE IN THREE MICHIGAN CITIES. BEFORE AND AFTER STUDIES TO DETERMINE THE EFFECTIVENESS OF MVMA MOTOR VEHICLE MANUFACTURERS

### ASSOCIATION SAFETY BELT MASS MEDIA CAMPAIGN

Safetybelt usage among drivers in three Michigan cities (Detroit, Traverse City, Marquette) before and after the initiation of an advertising and publicity campaign to promote the use of safety belts was determined in order to assess the effectiveness of that campaign. The results were as follows: Detroit, 3921 (before), 7754 (after); Traverse City, 5142 (before), 4368 (after); and Marquette, 4803 (before), 4172 (after). The "before" study was conducted during the period 18-28 Aug 1977, inclusive; the "after" study was conducted during the period 1-14 Nov 1977, inclusive. The mass media campaign covered only two months, Sep and Oct 1977; and a longer or different campaign might have achieved more positive results. For all types of safety belt systems combined, usage in terms of both full protection and some protection was almost identical both before and after for each of the three cities. The level of usage, both before and after, was highest in Traverse City and lowest in Marquette. Usage was highest in the most recent model cars, and lowest in the older models which have only the lap belt. Usage was intermediate for systems in which the lap belt and shoulder harness are separate.

Opinion Res. Corp., Princeton, N.J. 08540  
DOT-HS-7-01736  
1977 ; 6p  
Availability: Reference copy only

HS-022 526

### THE SOCIALLY RESPONSIBLE CAR

RESEARCH PROGRAMS BEING CARRIED OUT BY CALSPAN CORP. AND MINICARS, INC. TO DEVELOP RESEARCH SAFETY VEHICLES (RSV'S) UNDER THE SPONSORSHIP OF THE NATIONAL HWY. TRAFFIC SAFETY ADMINISTRATION (NHTSA) ARE DESCRIBED. THE FOUR-PHASED NHTSA PROGRAM BEGAN IN JAN 1974, THE OBJECTIVE OF WHICH IS TO HELP ESTABLISH FEDERAL STANDARDS FOR WHAT COULD BECOME A SAFE, PRACTICAL AND ENERGY-EFFICIENT FAMILY CAR BY THE MID-1980'S. PHASE 1 OF THE PROGRAM INCLUDED ESTABLISHMENT OF INITIAL RSV SPECIFICATIONS; PHASE 2, WHICH BEGAN IN JUL 1975, INVOLVED DESIGN AND FINALIZATION OF RSV SPECIFICATIONS AS WELL AS TESTING OF PROTOTYPE CARS; PHASE 3 CALLS FOR DESIGN OPTIMIZATION; PHASE 4 WILL INVOLVE TESTING AND EVALUATING THE VEHICLES, DATA FROM WHICH WILL HELP TO FORMULATE FEDERAL STANDARDS. BOTH RESEARCH FIRMS ARE SCHEDULED TO DELIVER ACTUAL TEST CARS BY APR 1978. CALSPAN HAS DESIGNED A FIVE-PASSENGER RSV WITH THE IDEA OF PRODUCING A CAR THAT COULD BE MANUFACTURED RIGHT NOW. THE BASE VEHICLE IS A CHRYSLER SIMCA 1308, A FOUR-CYLINDER SUBCOMPACT THAT WAS "SAFETY CAR OF THE YEAR" IN EUROPE IN 1976. THE CALSPAN RSV WEIGHS UNDER 2700 POUNDS, GETS OVER 25 MILES TO THE GALLON, AND HAS A BODY STRUCTURED TO PROTECT OCCUPANTS IN FRONTAL BARRIER CRASHES AT SPEEDS UP TO 50 MPH, 45 MPH ON THE SIDE, AND 50 MPH IN THE REAR. IT HAS A "SOFT" FRONT END AND SOFT BUMPERS FOR PEDESTRIAN PROTECTION AND LOW DAMAGEABILITY.

TY. ITS INTERIOR TRIM PANELS ABSORB SOME OF THE ENERGY GENERATED BY A CRASH. IT ALSO HAS AN "INFLATABELT" PASSENGER RESTRAINT SYSTEM, A SHOULDER HARNESS MADE OF SOFT TUBING THAT INFLATES UPON IMPACT. THE BELT SYSTEM AUTOMATICALLY GOES INTO PLACE WHEN THE CAR DOORS ARE CLOSED. THE CAR ALSO HAS TIRES THAT RUN FLAT FOR 50 MILES AT 50 MPH. MINICARS HAS DESIGNED A MORE FUTURISTIC CAR. THE FOUR-PASSENGER MINICARS EAGLE II WEIGHS ABOUT 2200 POUNDS BUT PROVIDES THE SAME AMOUNT OF PASSENGER PROTECTION. A NOSE SECTION SUPPORTING THE FRONT BUMPER PREVENTS DAMAGE IN IMPACTS BELOW 10 MPH. AT THE SAME TIME, THE LIGHTWEIGHT STRUCTURE MINIMIZES FUEL COSTS. RESILIENT PLASTIC MATERIAL COVERS THE ENERGY-ABSORBENT STRUCTURE, WHICH IS DESIGNED TO CRUSH INITIALLY AT LOW FORCE LEVELS IN FRONTAL IMPACTS WITH THE VULNERABLE SIDES OF OTHER CARS. SIDE IMPACT AND ROLLOVER PROTECTION IS AFFORDED BY WELL-PADDED DOOR INTERIORS, REINFORCED DOOR CONSTRUCTION AND STRONGER DOOR LATCHES. OTHER UNCONVENTIONAL FEATURES OF THE VEHICLE ARE "FULL-WING" DOORS WHICH OPEN FROM THE TOP AND SWING OUTWARD AND UPWARD, AND A DASHBOARD WITH A BUILT-IN ELECTRONIC RADAR MICROCOMPUTER PROVIDING A HIGHLY ADVANCED DRIVER WARNING SYSTEM. ANOTHER RSV DEVELOPED BY VOLKSWAGEN, THE EXPERIMENTAL VW RABBIT, WAS PRESENTED TO THE DEPT. OF TRANSPORTATION IN JUL 1977.

Publ: JOURNAL OF AMERICAN INSURANCE V53 N2  
P23-6 (SUMMER 1977)  
1977  
Availability: SEE PUBLICATION

HS-023 421

#### **RESTRAINT SYSTEM USAGE SURVEYS: A LITERATURE REVIEW. 3RD ED.**

THIS LITERATURE REVIEW CONTAINS REFERENCES TO 59 SURVEYS CONDUCTED IN THE U.S. ON THE USAGE OF AUTOMOBILE PASSENGER RESTRAINT SYSTEMS. LISTED FIRST ARE THE REFERENCES, ARRANGED BY AUTHOR OR CORPORATE AUTHOR. SECONDARY TREATMENTS OF THE SAME SURVEYS HAVE BEEN OMITTED. THE SECOND SECTION GIVES, IN TABULAR FORM, SEATBELT, SHOULDER HARNESS, AND/OR CHILD RESTRAINT USAGE RATES AND SURVEY INFORMATION (YEAR OF STUDY, AREA OF STUDY, HOW CONDUCTED, YEARS OF AUTOMOBILES, DAY/NIGHT, RESTRICTIONS/NOTES, AND SAMPLE SIZE) FOR EACH REFERENCE; ENTRIES ARE ARRANGED IN CHRONOLOGICAL ORDER. NO ASSUMPTIONS HAVE BEEN MADE REGARDING THE VALIDITY OF THE REPORTED STUDIES; HENCE, IT MAY BE NECESSARY TO REFER TO THE ACTUAL REPORT IN SOME INSTANCES, FOR CLARIFICATION.

by COMP. GRIMM., ANN C.  
UNIVERSITY OF MICHIGAN, HWY. SAFETY RES.  
INST., ANN ARBOR, MICH. 48109  
Rept. No. UM-HSRI-78-22 ; 1978 ; 16P  
Availability: CORPORATE AUTHOR

HS-700 206

#### **RECENT DEVELOPMENTS IN CAR DESIGN FOR INJURY REDUCTION**

The automobile industry adopted interlocking latches in 1955 to keep doors shut and occupants retained in crashes. By 1967, safety release levers were available to prevent accidental door opening by passengers during an accident. Seat belts have been effective in reducing fatalities caused by ejection, but injury severity could be more greatly reduced by the combined use of seat belts and shoulder harnesses. Cushioned instrument panel and sun visors, tougher windshield glass, windshield washers and multispeed wipers, outside mirrors, backup lights, and emergency flashers have become standard equipment.

by R. Haeusler  
Chrysler Corp.  
Publ: Papers Given at the Meeting of the American Association for Automotive Medicine, Rochester, Minn. 1965, p16-24  
1965  
Availability: Reference copy only

HS-700 223

#### **CAR DESIGN AND OPERATION IN RELATION TO ROAD SAFETY**

The limitations of present-day automobiles include visibility; communication of information from one driver to another or to a pedestrian or cyclist; vehicle control, particularly in emergencies; and occupant protection when an accident occurs. These limitations could be removed or ameliorated by improved vehicle design and rear viewing devices to increase the driver's field of view, automatic headlamp aiming and use of polarized headlamps, conspicuously mounted brighter turn signals, and the development of antiskid brakes and more rigid shoulder harnesses.

by G. Grime  
Publ: The Practitioner v188 n1126 p447-56 (Apr 1962)  
1962 ; 12refs  
Availability: See publication

HS-700 305

#### **ESSAIS DYNAMIQUES DE LA CEINTURE DE SECURITE--EQUATIONS DU MOUVEMENT DU PASSAGER (DYNAMIC TESTING OF A SAFETY HARNESS--EQUATIONS OF THE MOVEMENT OF THE OCCUPANT)**

Movements of dummies wearing safety harnesses were tested on an impact sled, and equations of motions were developed for comparison. Stiffness of the straps is of great importance to control forward displacement with acceptable deceleration. During forward movement, stiffness should be reduced, then the strap should be allowed to return with its own stiffness, which may be very great. Damping devices based on this principle have given encouraging results.

by Jolys; Le Guen  
Publ: Technical Aspects of Road Safety n67/30 p3.1-3.58  
1967 ; 13refs  
Text in French, includes and English summary.  
Availability: See publication

HS-700 445

**TWO-DIMENSIONAL CRASH VICTIM SIMULATOR  
USERS' MANUAL. PT. 1--MANUAL. APPENDIX A OF  
FINAL REPORT NO. 2**

A test case for the Highway Safety Research Institute Two-Dimensional Crash Victim Simulator is presented. Sufficient information is included in this instruction manual for the determination of all input variables used in the computer program as well as instructions for constructing an input data deck. A complete test run of this program is also included. Instructions for the interpretation of the program printout are included for debugging purposes; A tabular summary of the important physical variables such as geometric configuration, velocities, accelerations, and forces conclude the test case. These quantities are plotted in graphical form using the PLOT subroutine. The test case is concluded by the output of a subroutine called STYX which provides the outline of a stick figure representation of the occupant as a visual aid in data interpretation.

by D. Robbins; R. O. Bennet; J. Becker  
Michigan Univ , Ann Arbor, Hwy. Safety Res. Inst.  
FH-11-6962  
1969 ; 58p  
Availability: Corporate author

HS-700 517

**DEVELOPMENT AND USE OF SAFETY FACTORS  
AT INDIANAPOLIS "500"**

Mechanical developments of vehicles, such as, more powerful engines, brakes, improved shock absorbers, suspension, bucket seats, and tires are listed. Safety improvements in the racing plant are discussed. Custom seat fitting, seat belt and double shoulder harness, roll bars, safety helmets, flameproof clothing, and stiff physical exams for driver protection are reviewed.

by T. A. Hanna  
Indianapolis Motor Speedway  
1964 ; 3p  
Presented at the American Assoc. for Automotive Medicine  
annual meeting, Louisville, 26 Oct 1964.  
Availability: Reference copy only

HS-700 523

**AUTO INDUSTRY RESEARCH IN SAFETY TODAY  
AND TOMORROW**

Over 70% of all accident victims suffer head injury. Investigations of actual accidents and impact tests suggest that head and chest injuries can be prevented by vehicle design improvements such as headrests; interlocking door latches; seat back latches; improved door locks and seat anchorages; and energy absorbing steering columns, seats, instrument panels, ashtrays, sun visors, knobs, door handles, and gear shift levers. Head and chest injuries can also be prevented by use of three point restraint systems. It is suggested that seat belt usage must be increased not by means of legislation but through voluntary cooperation of motorists

by R. Haeusler  
Chrysler Corp.  
Publ: Proceedings of the 1967 Convention of the Canadian  
1967  
Availability: Reference copy only

HS-800 393

**APPLICATION OF RESTRAINT SYSTEMS TO USED  
CARS. FINAL REPORT. VOL. 1. SUMMARY**

The study of seat belt-shoulder belt anchorages for used cars is primarily directed toward those domestic passenger vehicles that are not provided with factory installed anchor points and/or have experienced some degree of deterioration. Other types of passenger vehicles such as compact and foreign are included in the study. The program consisted of field inspections to develop the criteria for used cars of the 1960-69 vintage from which the anchorage design was accomplished. The program actually resulted in two final anchors: the large area washer type and the rivnut type for blind attachment or installation access from only the inside of the passenger compartment. Lap and shoulder belt kits were developed and implemented using both types of end fittings. Seat belt load tests on salvaged vehicles resulted in a recommendation that a proof-load pull test is not as feasible as a compliance test because of the resulting damage to the owner's car. This report described sample kits which can be used to retrofit seat belts into used cars.

by G. J. Overby; C. R. Ursell  
FH-11-7306  
1970 ; 136p  
Availability: NTIS

HS-800 394

**APPLICATION OF RESTRAINT SYSTEMS TO USED  
CARS. FINAL REPORT. VOL. 2 EXHIBITS AND  
DRAWINGS**

This volume of the study of seat belt/Shoulderbelt anchorages for used cars contains individual exhibits and drawings referenced in Volume 1. Of primary interest are an exhibit containing the installation instructions for the belt kits recommended as a result of this study and an exhibit presenting inspection procedures that will lead to selection of suitable restraint kit.

by G. J. Overby; C. R. Ursell  
FH-11-7307  
1970 ; 434p  
Availability: NTIS

HS-800 441

**PATHOMECHANICS OF AUTOMOTIVE  
RESTRAINT-SYSTEM INJURIES**

Deceleration test results for restraint systems and seat positions are reported. Baboons were used as subjects. Seat positions included front facing, side facing, and rear facing. Systems tested were: lap belts; diagonal belts, three point, full torso, inverted Y yoke double shoulder harness, and air bag. Deceleration tolerance was lowest for side facing seats. Grave effects that may not be correlated with degree of tissue disruption are reported, fetal death and pancreatic involvement being cited. Evidence indicates that loose-high lap belts contribute to more severe injuries than those snugly fitted and worn over the abdomen. The two experimental devices, Y yoke with iner-

June 1, 1979

HS-800 712

tia reel and the air, bag gave maximal protection to the occupant.

by J. W. Young; Richard G. Snyder; G. Townley Price  
Federal Aviation Admin., Oklahoma City, Okla.  
Publ: Accident Pathology. Proceedings of an Inter. Conf., 1968  
p68-89  
1968

Presented at an international conference held in Washington,  
D. C., 6-8 Jun 1968.

Availability: In HS-800 431

HS-800 528

### **DEVELOPMENT AND TESTING OF INTEGRATED SEAT RESTRAINT SYSTEMS. FINAL REPORT**

The objective of this research was to develop, fabricate, and test seat and restraint system combinations designed to offer a level of protection exceeding that found in current production seats and restraint systems. To accomplish this a series of analytical studies was carried out using two- and three-dimensional mathematical models of an automobile crash victim. These studies, in combination with a survey of the state of the art of seating and restraint systems, were used to formulate design concepts of integrated seat restraint systems. The most promising of the active systems was fabricated and subjected to front, oblique, side, and rear impact tests using anthropometric dummies. The results of these tests were compared with current production seating systems and with the initial predictions of the mathematical models. Recommendations are made concerning performance requirements and compliance procedures for integrated seat restraint systems and for passive front seat occupant restraint systems.

by D. H. Robbins; V. L. Roberts; A. W. Henke; D. F. Raney;  
R. O. Bennett; J. H. McElhanev  
Michigan Univ. Hwy. Safety Res. Inst.  
FH-11-6962  
1970 ; 78p

Report for 1 Jul 1968-30 Jun 1971.

Availability: NTIS

HS-800 533

### **LAP AND SHOULDER RESTRAINTS FOR PREGNANT WOMEN. FINAL REPORT**

A series of 24 pregnant baboons were impacted under similar conditions. The only major variable was the difference in maternal restraint. The fetal death rate of 8.3 percent (1/12) among maternal animals impacted with three-point restraint was significantly different from five fetal deaths among 10 maternal animals impacted under lap belt restraint alone. It is concluded that shoulder harness restraint should be recommended for use by pregnant women as being significantly more protective of fetal welfare when compared with lap belt restraint alone.

by Warren M. Crosby; Albert I. King  
Oklahoma Univ. Medical Center  
FH-11-6970  
1971 ; 65p

To be published in 15th Stapp Car Crash Conference Proceedings.

Availability: NTIS

HS-800 585

### **MOTIVATING FACTORS IN THE USE OF RESTRAINT SYSTEMS. FINAL REPORT**

This study has undertaken qualitative the quantitative inquiry among licensed automobile drivers to determine attitudes, behaviors, and rationales that are relevant to restraint systems use. Moreover, it has identified target groups of drivers, by attitudinal patterns and other less salient characteristics, to whom further educational and/or promotional efforts can be addressed most efficiently to increase the use of restraint systems. Finally, analysis of the study data has suggested some procedures for implementing its conclusions most effectively. Among the variables in restraint system usage are: trip length, educational level, personality pattern, driving experiences, attitudes toward driving skills. Multivariate factor analysis of interviews was used to study the data.

by Petterson Marzoni, Jr.  
National Analysts, Inc.

FH-11-7610

1971 ; 100p

Availability: NTIS

HS-800 619

### **DRIVER EYE POSITION AND CONTROL REACH ANTHROPOMETRICS. VOL. 2. DYNAMIC EYE POSITION STUDY. FINAL REPORT**

Cyclopean eye positions of drivers were measured relative to vehicle reference points during normal driving activities in late model vehicles. The measures were related to eye position measures made in static situations in the same vehicles and in laboratory studies employing vehicle mock-ups. Findings indicate that drivers exhibit substantial head tilt not observed in static situations; that shoulder belts restrict eye position excursions; that a large field of view periscopic-type mirror virtually eliminates eye position shifts and substantially reduces variability in eye position during freeway lane changes and merges; that combining within-driver eye position variability and between-driver variability results in eyellipses which are enlarged substantially only in the lateral dimension; and that there is no consistent change in dynamic eye position over extended driving or in different driving environments.

by W. E., Woodson  
Man Factors, Inc.

FH-11-7619

1971 ; 125p

Report for 1 Jul 1970-31 Oct 1971. Subcontracted to Dunlap and Associates, Inc.

Availability: NTIS

HS-800 712

### **IMPROVED AIR BAG RESTRAINTS FOR FRONT SEAT COMPACT CAR OCCUPANTS. VOL.2. FINAL PROGRAM REPORT**

This report summarizes the effort to develop an improved passive restraint. The objective was to apply maximum tolerable deceleration to the occupant so as to achieve the highest possible safe vehicle crash velocity for future crashworthiness-modified compact cars. The result of the work was the advanced development of a passive (non-air bag type) restraint such that at a complexity level equivalent to three seat buckles

and belts, a door hinge and latching mechanism, some foam and appropriate structural attachments, controlled deceleration of front seat occupants within acceptable injury criteria limits can be provided in 40 to 45 mph impacts, and with some increase in complexity level, the occupant can be similarly protected at any speed for which compartment intrusion can be reasonably controlled. Based on this effort, and results of 140 sled tests and two full-scale crash tests, it is concluded that passive restraints can be effective in meeting safety standard injury at speeds to 40 mph.

by D. Friedman; H. A. Wilcox; A. Jordan; N. DiNapoli  
Minicars, Inc.  
DOT-HS-113-1-163  
1972 ; 183p  
Report for 26 June 1971- 31 July 1972.  
Availability: NTIS

HS-800 717

### SAFETY BELT INSTRUCTIONAL BOOKLET

This programmed instructional text for children beings with a pre-program attitude survey, presents questions on safety belts, describes types of safety belts and how to use them, and safety devices for children, and concludes with a post-program attitude survey.

by B.E. Haughey; P.A. Alter; H.H. Shettel  
American Institutes for Res.  
FH-11-7522  
1972 ; 27p  
Availability: GPO \$0.20

HS-800 748

### CHILD RESTRAINT DEVELOPMENT. FINAL REPORT

Two child seats were designed and constructed which gave superior impact protection over those which are available commercially. Performance standards and a compliance test procedure for the evaluation of child seating systems were developed. Test results are presented in graphs.

by V. L. Roberts  
Michigan Univ. Hwy. Safety Res. Inst.  
DOT-HS-031-1-180  
1972 ; 133p  
Report for 1 Jul 1971 - 28 Aug 1972.  
Availability: NTIS

HS-800 849

### HSRI TWO-DIMENSIONAL CRASH VICTIM SIMULATOR: ANALYSIS, VERIFICATION, AND USERS' MANUAL. REVISION NO. 1. FINAL REPORT

A mathematical model was developed and used for the simulation of automobile occupant kinematics in a collision. This model was developed as a tool to study advanced concepts and designs of seat restraint systems from the viewpoint of occupant protection. After a discussion of the state of the art of mathematical modeling of the crash victim, an analytical description of the Highway Safety Research Institute Two-Dimensional Crash Victim Simulator is presented. This model consists of a segmented, eight-mass dynamic model of a

human interacting with the vehicle interior in a symmetric frontal or rear crash. The degree to which predictions of the model agree with experimental impact sled test data is presented, followed by a detailed Users' Manual for those individuals desiring to exercise the model. Sample data sets, computer output, a description of the program including subroutine flow diagrams, and a program source listing are included.

by D. H. Robbins; R. O. Bennett; V. L. Roberts  
Michigan Univ., Ann Arbor  
DOT-HS-013-2-499  
1973 ; 540p  
Report for 5 Jul-4 Oct 1972.  
Availability: NTIS

HS-800 859

### EFFECTIVENESS OF SAFETY BELT WARNING AND INTERLOCK SYSTEMS. FINAL REPORT

Rental cars in Fayetteville, N. C., were equipped with four seat belt and warning systems: (Phase 1) detachable shoulder and lap belt, no warning system; (Phase 2) detachable shoulder and lap belt, warning system; (Phase 3) non-detachable shoulder and lap belt with inertia reel on shoulder belt, warning and logic system; and (Phase 4) non-detachable shoulder and lap belt with inertia reel on shoulder belt, warning, logic, and starter/interlock system. Counters were installed in the cars to measure restraint system usage. Interviews were conducted with the drivers to determine attitudes toward the four systems. A significant increase in measured use of seat belts was seen from Phase 1 to Phase 2,3, and 4, however there was no significant difference in the measured usage rates in the last three phases. Drivers in Phases 1 and 2 voiced more favorable attitudes toward the seat belt and warning systems than did respondents in Phases 3 and 4.

by J. B. Cohen; A. S. Brown  
National Analysts, Inc.  
1973 ; 78p  
Report for Jul 1972-Apr 1973.  
Availability: NTIS

HS-801 030

### SEAT/SAFETY BELTS

A special bibliography on seat belts and safety belts is presented, with documents dating from 1967 to October, 1973. Abstracts are included for each entry, and each citation has previously appeared in the NHTSA publication Highway Safety Literature. The documents cited are in the NHTSA Technical Reference Division.

National Hwy. Traffic Safety Administration, Washington, D. C.  
Rept. No. SB-2 ; 1973 ; 80p  
Availability: NHTSA

HS-801 031

### SHOULDER HARNESSSES

A special bibliography on shoulder harnesses is presented, with most of the cited documents, dated 1967 or later. The documents cited are in the NHTSA Technical Reference Divi-

June 1, 1979

HS-801 918

sion collection. Citations and abstracts have previously appeared in the NHTSA publication Highway Safety Literature.

National Hwy. Traffic Safety Administration, Washington, D. C.  
Rept. No. SB-3 ; 1973 ; 24p  
Availability: NHTSA

HS-801 121

### **IMPACT TEST OF A NEAR-PRODUCTION AIR CUSHION RESTRAINT. FINAL REPORT (SYNOPSIS)**

The impact protection efficacy of a production automobile air cushion restraint was tested under experimental conditions simulating an automotive barrier crash. The restraint was designed and fabricated by General Motors to provide passive restraint for the center and right front seat passengers during frontal impact. The impact tests were conducted on the Daisy Decelerator at Holloman Air Force Base, New Mexico. Composite acceleration profiles measured during automobile barrier crashes were used to design the deceleration patterns. The nominal peak accelerations varied from 10 to 22 g at velocities ranging from 16.1 to 31.1 mph. Results show that observed trauma on test volunteers was generally milder than in previous tests. The average Head Severity Index was 258.

by G. Mohr; J. Brinkley; H. Russell; S. Cooper; J. Shaffer  
Aerospace Medical Res. Lab. (6570th)  
DOT-HS-017-1-017  
1974 ; 17p  
Availability: NTIS

HS-801 224

### **1974 SAFETY BELT SURVEY. NHTSA/CU RESEARCH PROJECT. FINAL REPORT**

A NHTSA/Consumers Union study is described which is part of a program to evaluate the effectiveness of the 1974 safety belt interlock system in increasing belt usage, and to determine owner/driver acceptance of the system. A survey of Consumer Reports readers who own 1974 model cars was conducted to determine detailed information about their reactions to the 1974 interlock and warning system, malfunction/failure of the system, comfort and convenience data, and personal data pertaining to the driver's sex, height, weight, age and education. Results showed that: 95.4% claimed usage of the belts on average distance trips; 31% either defeated or circumvented the interlock system over 50% of the time; malfunction or failure was reported by 36.5%, although only 7.4% reported a problem that had to be repaired by a mechanic; of the people who wear the belt system, 90% wear the combination lap and shoulder belt correctly; two most common suggestions for improvement were for easier fastening and change in shoulder belt placement to avoid its cutting across the neck.

by R. L. Hix, Jr.; P. N. Ziegler  
National Hwy. Traf. Safety Administration, McDonnell Douglas Automation Co., Fal  
1974 ; 53p  
Rept. for Sep 1973-Jul 1974. Prepared in cooperation with Consumers Union.  
Availability: NTIS

HS-801 237

### **EJECTION RISK IN AUTOMOBILE ACCIDENTS. FINAL REPORT**

The influence of various accident parameters on the probability of occupant ejection and the relative risk of occupant ejection along a variety of ejection routes were examined. The relation between injury severity and ejection route was also studied. Data pertaining to one and two car collisions involving American make automobiles manufactured between 1968 and 1973 were used in this study. The probability of occupant ejection was found to be related to type of collision. Vehicles involved in rollover collisions were demonstrated as more likely to produce occupant ejection than non-rollover vehicles. For non-rollover collisions, the door was recorded as the primary ejection route (door window ranked second). For rollover collisions, the door window, was demonstrated as the primary ejection route (door ranked second). Rear seated occupant were found to be the least likely to experience ejection. Ejection injury was demonstrated more severe than non-ejection injury, and ejection route was found to have no influence on expected injury severity. Because of the effectiveness of the lap belt-shoulder harness restraint system in reducing occupant ejection, it was concluded that increased restraint utilization could provide as effective a means of reducing ejection as vehicle redesigns.

by T. E. Anderson  
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 19221  
DOT-HS-053-3-619  
1974 ; 45p  
Rept. for Jan-Dec 1973.  
Availability: NTIS

HS-801 374

### **SOURCES AND REMEDIES FOR RESTRAINT SYSTEM DISCOMFORT AND INCONVENIENCES. FINAL BRIEFING**

Restraint system design features that appear to create confusion, inconvenience, and discomfort for driver and passengers are identified and evaluated. The scope of the study is limited to seat belt/shoulder harness systems, with emphasis on the 1974 restraint systems. Potential systems under development, such as the passive belt (non-air bag) are also considered. Photographs and charts are included. A single, practical optimum design and installation configuration is identified and developed which fits the desired user population.

by B. F. Pierce  
Man Factors, Inc., San Diego, Calif.  
DOT-HS-230-3-674  
1974 ; 28p  
Availability: NHTSA

HS-801 918

### **MARYLAND MEDICAL-LEGAL FOUNDATION, INC., MULTIDISCIPLINARY ACCIDENT INVESTIGATION. VOL. 1. FINAL REPORT**

The methodology, results, conclusions, and recommendations pertaining to the investigation of 52 vehicular accidents occurring in Greater Baltimore metropolitan area are described. Twenty-six fatal and twenty-six nonfatal accidents were in-

vestigated. Particular emphasis was placed upon the human factors aspect of the vehicle accident. The investigations included vehicles and scene examination, autopsy findings on fatal victims, toxicological data and psychosocial evaluations of the "at fault" driver population. Alcohol and its effect upon the driver was considered a primary factor in the causation of 42% of the fatal accidents and 19% of the nonfatal accidents investigated. Excessive speed was considered responsible for 15% of the fatal accidents and 30% of the nonfatal accidents. In 23% of the nonfatal accidents, driver inattention was considered a primary causative factor. Recommendations include education and punitive measures to reduce the instances of driving under the influence of alcohol, enforcement of speed limits, and encouraging the use of seat belts and shoulder harnesses, as well as improved vehicular design, better designs for some traffic signals and parts of highways, and removal of roadside hazards.

by Russell S. Fisher; Irvin M. Sopher  
Maryland Medical-Legal Foundation, Inc., 111 Penn St.,  
Baltimore, Md., 21201  
DOT-HS-198-3-770  
1976 ; 201p 6refs  
Rept. for 28 Jun 1973-24 Jun 1974. Vol. 2 is HS-801 919.  
Availability: NTIS

HS-801 957

### SAFETY BELT INTERLOCK SYSTEM USAGE SURVEY. FINAL REPORT

Research was conducted to measure the effectiveness of various use-inducing systems in increasing safety belt usage. Three specific tasks were addressed: determine if the 1975 warning system issued in response to P.L. 93-492 is effective in increasing seat belt usage; ascertain drivers' reactions to this and other systems on 1975 model cars; and continue to monitor safety belt usage in the general traffic population. Methods used to carry out the research were an observation study in 19 U.S. cities to record safety belt usage among drivers and front outboard passengers in 1975, 1974 and 1973 private passenger cars; a telephone interview among owners/drivers of 1975 model cars from the observation study; and telephone interviews with a sample of spring-summer registered owners of 1975 model cars. The latter sample was required in order to obtain a sufficient number of interviews with owners of cars having the 1975 warning system. Results of the surveys show that the 1975 warning system (four to eight second light and buzzer) was not very effective as a use-inducing system. The most effective was a system that included a reminder light that went on and stayed on until the belt was fastened and a sequential logic circuit that required seating first and then buckling the belt. The second most effective 1975 use-inducing system was found to be the ignition interlock system, which prevented the car from being started when seat belts were not fastened. Drivers' attitudes toward the use of safety belts and perceived comfort of both the lap belt and shoulder harness were identified as key factors which correlate with usage. It was found, in general, that the more complex and sophisticated was the warning system, the more likely the system was to be defeated (disconnected) or circumvented. Drivers who reported that they circumvented the warning system, most commonly said that they buckled the belt behind their backs and left it that way, or hooked the belt on the door handle. It was found that, among owners/drivers of 1975 cars delivered with either a starter interlock or a continuous

buzzer, about one in ten reported a malfunction or mechanical failure in the system.

by Albert Westefeld; Benjamin M. Phillips  
Opinion Res. Corp., North Harrison St., Princeton, N.J. 08540  
DOT-HS-5-01039  
Rept. No. 51274 ; 1976 ; 74p  
Rept. for Sep 1974-May 1976.  
Availability: NTIS

HS-802 002

### LIFE SAVING POTENTIAL OF GREATER SAFETY BELT USAGE

A standardized procedure for examining the effect of safety-belt usage upon traffic fatalities in the U.S. is described and documented. Estimates for calendar year 1975 are made based on the procedure and on the NHTSA Fatal Accident Reporting System File (FARS). Data and results examining seat-belt usage and effectiveness are broken out by model year since at any given time, a sample of automobiles on the roads will include varying numbers of representatives of different model years, and different model years are equipped with different standard equipment. Seat belts were not mandatory in passenger cars prior to the 1964 model year. Beginning with the 1964 model, lap belts only were installed by mandate. In the 1968 model year, the shoulder belt for the front outboard position became an additional requirement to the lap belt. The 1973 model cars utilized a continuous buzzer that could only be deactivated by fastening the seat belt. In 1974 models, the continuous buzzer was replaced by the ignition interlock system. Also beginning in 1974, the shoulder harness was permanently fastened to the lap belt, forming a three-point system. The NHTSA's FARS currently contains information on approximately 90.9% of the fatal accidents which occurred in the U.S. in 1975. Of the 22,835 fatalities who were occupants of passenger cars, 20,976 were occupants of cars of model years 1964-1976, years in which seat belts were mandatory. This report focuses on the 20,976 fatalities among occupants of passenger cars for these model years. Tables presented describe: seat-belt usage in passenger cars in 1975; seat-belt effectiveness rates; a distribution of estimated actual traffic fatalities by model year 1975; assumed usage rates by model year and restraint type; estimated actual deaths to passenger vehicle occupants in 1975 versus those that would have occurred had there been no belt usage; hypothetical deaths to passenger vehicle occupants in 1975 at seat-belt usage zero versus 60%, 80%, and 100% usage rates; total deaths to passenger vehicle occupants in 1975 at seat belt usage zero, current seat belt usage, 80% seat belt usage, and 100% seat belt usage. The study concludes that in the year 1975, traffic fatalities would have been 12.88% higher had there been no seat-belt usage. In the year 1975, traffic fatalities could have been reduced from the number of estimated actual fatalities by 16.83% had there been 60% seat-belt usage. In the year 1975, traffic fatalities could have been reduced from the number of estimated actual fatalities by 26.68% had there been 80% seat-belt usage. In the year 1975, traffic fatalities could have been reduced from the number of estimated actual fatalities by 36.54% had there been 100% seat-belt usage. Programs are included which were used to compute data for tables.

by Kathy Pappas Jatras  
Office of Statistics and Analysis, National Hwy. Traffic  
Safety Administration  
1976 ; 33p 2refs  
Availability: NHTSA

HS-802 423

**PROMETHEUS 2 - A USER ORIENTED PROGRAM FOR HUMAN CRASH DYNAMICS. FINAL REPORT**

The PROMETHEUS 2 computer program, developed from the Office of Naval Research PROMETHEUS program, is an efficient user-oriented crash analysis program with interactive features. PROMETHEUS 2 simulates a pedestrian being struck in the side by the front of an automobile with a mathematical model composed of eleven linked rigid segments. A nonlinear finite element model of the vehicle structure is incorporated which interacts realistically with the victim. It is also possible to model a passenger inside a vehicle in certain crash environments. Various restraint systems can be simulated, including seat belt, shoulder harness and strap hangers. PROMETHEUS 2 input aids include free field data input and an on-line data edit capability. Output provides user selected time-history and occupant configuration plots as well as abbreviated output lists for a rapid scan of results. The program operates on the CDC 6600 computer in either a batch or interactive mode. A post processor is available which generates hard copy plots (Gerber or Stromberg-Carlson 4020) of PROMETHEUS 2 data. The post processor can also generate 16 mm motion pictures of the simulated accident. The user manual is arranged by synopsis of program input, program operation, preparation of input data, and a sample problem. Appendices present a strategy for belt force computation; a description of model and development of dynamic equations, a differential equation solver, and a cushion model.

by David W. Twigg  
Boeing Computer Services, Inc., Energy Technology  
Applications, P.O. Box 24346,  
DOT-HS-356-3-719  
Rept. No. BCS-G0802 ; 1977 ; 215p 12refs  
Rept. for Jun 1973-Aug 1976.  
Availability: NTIS

HS-803 210

**COMPUTER SIMULATION OF HUMAN THORACIC SKELETAL RESPONSE. FINAL REPORT. VOL. 2, THORAX PROGRAMMER'S AND USER'S MANUAL**

THE THORAX COMPUTER PROGRAM HAS BEEN DEMONSTRATED, BY FAVORABLE COMPARISON WITH EXPERIMENTAL DATA DEVELOPED ELSEWHERE, TO PREDICT DYNAMIC STRUCTURAL RESPONSES AND RIB FRACTURES FOR THE HUMAN CADAVER. TECHNIQUES ARE SELECTED TO SIMULATE RIB FRACTURE, RESTRAINT SYSTEMS, AND EXPERIMENTAL CONSTRAINTS AND FIVE SIMULATIONS ARE MADE OF ACTUAL CADAVER EXPERIMENTS: THREE WITH IMPACTORS, ONE WITH BELT RESTRAINTS, AND ONE WITH AN AIRBAG EQUIPPED, ENERGY ABSORBING STEERING COLUMN. DOCUMENTATION OF THE COMPUTER PROGRAM THORAX IS PROVIDED, INCLUDING FLOW CHARTS OUTLINING THE TWO MAJOR SUBROUTINES: INPUT, WHICH GENERATES THE NECESSARY GEOMETRIC DATA AND ELEMENT CONNECTIVITIES FOR THE SUBSEQUENT RUN OF DYNAMIC RESPONSES, AND ELPL, THE MAIN PROGRAM FOR PERFORMING DYNAMICAL ANALYSIS. THE USER'S INPUT MAP IS PROVIDED, WITH SAMPLE INPUTS AND CORRESPONDING OUTPUTS. THE PURPOSE AND FUNCTION OF THE LOGICAL UNITS ARE EXPLAINED AND ALL SUBROUTINES

LISTED. A SMALL COMPUTER PROGRAM, CONTACT, IS SHOWN FOR DETERMINING THE CONTACT NODES BETWEEN THORAX AND SHOULDER HARNESS.

by H. C. TSAI; M. M. REDDI  
FRANKLIN INST. RES. LABS., 20TH AND RACE  
STREETS, PHILADELPHIA, PA. 19103  
DOT-HS-5-01180  
1977 ; 581P  
Availability: NTIS

HS-810 305

**THE SNAIL'S PACE OF INNOVATION. REMARKS BEFORE THE AUTOMOTIVE NEWS WORLD CONGRESS, DETROIT, MICHIGAN, 13 JULY 1977**

THE AMERICAN PEOPLE HAVE THE RIGHT TO HAVE THE AUTO INDUSTRY'S MOST REASONABLE EFFORTS TO REDUCE THE HUMAN AND ECONOMIC COSTS ASSOCIATED WITH IMBALANCED ENGINEERING OF MOTOR VEHICLES. BESIDES THE EXISTING LAWS AND REGULATIONS REGARDING MOTOR VEHICLE SAFETY, THERE ARE NUMEROUS FORCES TO BE ENCOURAGED FOR THE "SOCIALY RESPONSIBLE" VEHICLE. THESE INCLUDE ASSEMBLY LINE WORKERS AND INSPECTORS WHO CAN CONTRIBUTE MORE OF THEIR KNOWLEDGE AND EXPERIENCE ABOUT VEHICLE DESIGN, DEFECTS, AND DETERIORATION AND THE ENGINEERING SOCIETIES WHOSE SCIENTISTS, ENGINEERS, AND TECHNICIANS CAN SHOW GREATER INITIATIVE INSIDE THEIR COMPANIES TO PROD MANAGEMENT TOWARD RENOVATION AND INNOVATION. IT IS IMPORTANT TO DISTINGUISH BETWEEN INNOVATION THAT IS NEEDED TO FULFILL THE CONSUMER HEALTH AND SAFETY RIGHTS AND THE KIND OF INNOVATION WHICH MERELY REFINES THE ENGINEERING OF THE HIGH COMPRESSION ENGINE. INNOVATION BECOMES MORE NECESSARY AS THE PASSING YEARS EXPAND THE GAP BETWEEN THE GROWTH OF PROBLEMS AND THE UNUSED ABILITY TO SOLVE THESE PROBLEMS. MS. CLAYBROOK CITES PAST EXAMPLES OF THE AUTO INDUSTRY'S UNWILLINGNESS TO DEVELOP CONSUMER-SENSITIVE ENGINEERING (E.G. THE SPAGHETTI SHOULDER HARNESS AND BUMPERS WEIGHING OVER A HUNDRED POUNDS). SHE CALLS UPON THE AUTO INDUSTRY TO PRODUCE AUTOMOBILES WHICH ARE SAFER, MORE FUEL EFFICIENT, AND EASIER TO REPAIR.

by JOAN CLAYBROOK  
NATIONAL HWY. TRAFFIC SAFETY  
ADMINISTRATION, WASHINGTON, D.C. 20590  
1977 ; 17P  
Availability: NHTSA

HS-820 226

**LAWS REQUIRING SEAT BELTS**

This commentary reviews state laws requiring motor vehicles to have seat belts in the context of comparable provisions in the Uniform Vehicle Code. It also discusses domestic and foreign laws requiring use of belts, civil court decisions on the effect of failing to use available belts, and the possible

preemption of state laws by federal motor vehicle safety standards.

National Com. on Uniform Traf. Laws and Ordinances  
DOT-HS-107-1-153  
Publ: Traffic Laws Commentary v1 n6 (Oct 1972)  
1972 ; 68p refs  
Availability: GPO \$1.25

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SEAT BELT INJURIES OF THE SPINE AND ABDOMEN

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June 1, 1979

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CED-76-121		SAE-710857	
	HS-019 228		HS-011 586
GM-Eng-Pub-4775		SAE-720430	
	HS-011 267		HS-011 897
NADC-75034-40		SAE-720434	
	HS-018 345		HS-011 774
Paper-13		SAE-720437	
	HS-018 851		HS-011 778
Paper-15		SAE-720974	
	HS-018 852		HS-012 396
Paper-5		SAE-730512	
	HS-018 843		HS-013 213
PB-169 175		SAE-740331	
	HS-010 102		HS-015 721
S-71-40		SAE-741181	
	HS-016 301		HS-016 022
SAE-670025		SAE-770094	
	HS-006 259		HS-021 775
SAE-670925		SAND75-0360	
	HS-000 577		HS-019 063
SAE-680776		SB-2	
	HS-004 435		HS-801 030

**SB-3**

HS-801 031

**TCREC 62-94**

HS-001 372

**UM-HSRI-78-22**

HS-023 421

**51274**

HS-801 957