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NATIONAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION—AUTHORIZATION AND OVERSIGHT

GOVERNMENT

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HEARINGS

BEFORE THE

SUBCOMMITTEE ON CONSUMER PROTECTION
AND FINANCE

OF THE

COMMITTEE ON

INTERSTATE AND FOREIGN COMMERCE

HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

FIRST SESSION

ON

H.R. 2585

A BILL TO AMEND THE NATIONAL TRAFFIC AND MOTOR
VEHICLE SAFETY ACT OF 1966 AND THE MOTOR VEHICLE
INFORMATION AND COST SAVINGS ACT TO AUTHORIZE AP-
PROPRIATIONS FOR FISCAL YEARS 1980 AND 1981

FEBRUARY 26, AND MARCH 28, 1979

Serial No. 96-68

Printed for the use of the
Committee on Interstate and Foreign Commerce



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JOHN PETER McLAUGHLIN, *Counsel*

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Meyer, Barry, vice president of government relations.

Steel, John S., chairman, Automotive and Truck Committee.

Davidson Rubber Co.:

Ferrari, Richard, vice president for engineering.

Hopkins, Jon, marketing manager for bumpers.

Weller, A. P., director of product engineering.

Houdaille Industries, Inc.:

Cantrell, Ronald.

Copaken, Richard, counsel.

Norton, Thomas A., group executive, automotive division.

O'Reilly, Philip, executive vice president.

Pechan, Edward, mathematician.

Roth, H. Daniel, Ph. D., statistical consultant.

Stull, Franklin, member, Local 3739, and the wage policy committee, International Union of Steelworkers.

Surgeon, George, president, Local 1395, International Association of Machinists.

Wise, David A., economist consultant.

Insurance Institute for Highway Safety:

Kelley, Ben, senior vice president.

O'Neill, Brian, vice president for research.

State Farm Automobile Insurance Co.:

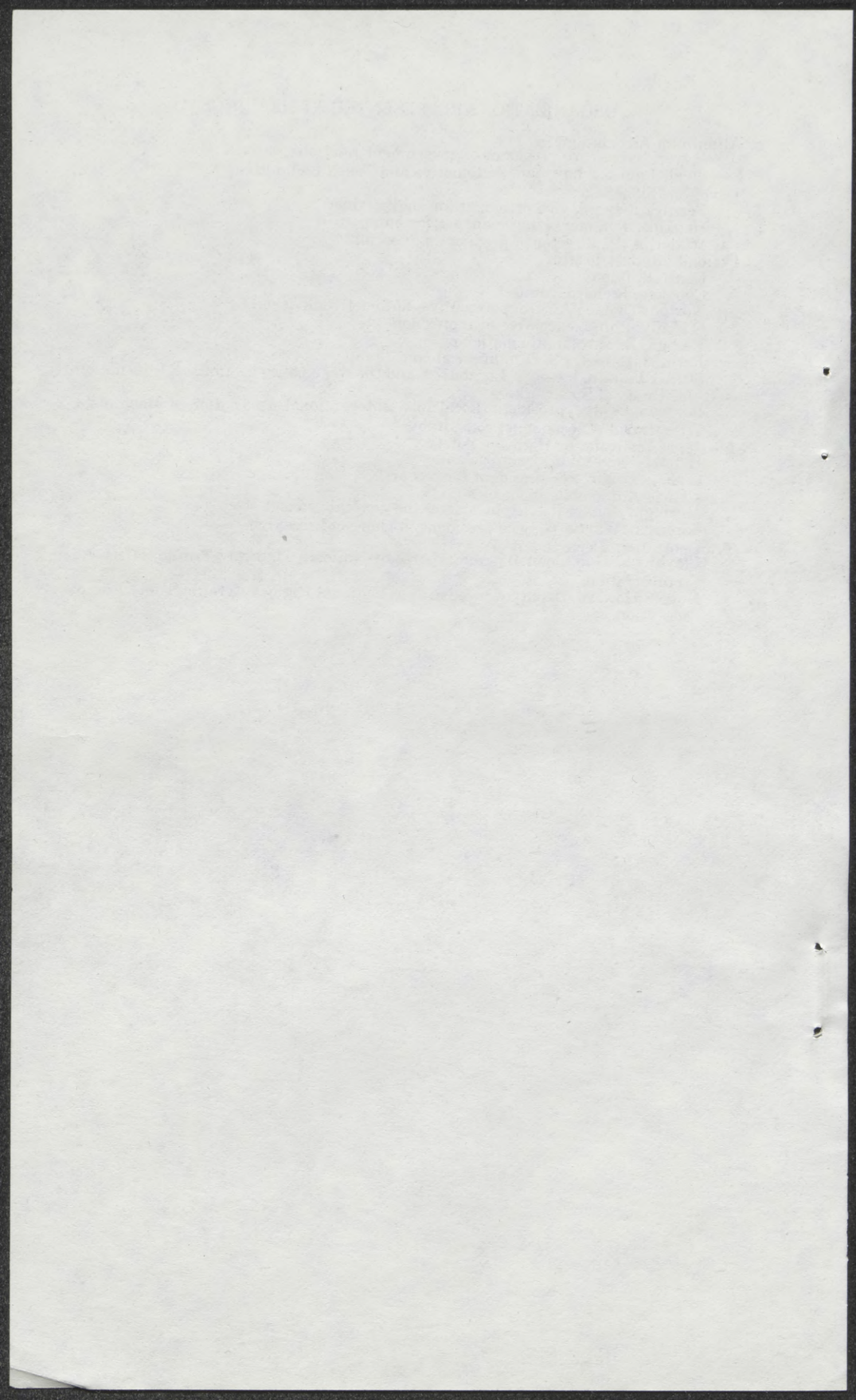
McHugh, Donald P., vice president and general counsel.

Sorenson, Wayne W., vice president in charge of research.

Transportation, Department of:

Claybrook, Hon. Joan B., Administrator, National Highway Traffic Safety Administration.

Dugoff, Howard, Deputy Administrator, National Highway Traffic Safety Administration.



NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION—AUTHORIZATION AND OVERSIGHT

MONDAY, FEBRUARY 26, 1979

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON CONSUMER PROTECTION AND FINANCE,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to notice, in room 2322, Rayburn House Office Building, Hon. James H. Scheuer, chairman, presiding.

Mr. SCHEUER. This meeting of the Subcommittee on Consumer Protection and Finance will commence hearings on the National Highway Traffic Safety Administration authorization bill.

This is a 2-year bill which simply authorizes the amounts which we voted to authorize for the fiscal years last year, fiscal 1980 and 1981 which failed to pass in the final rush of the year end business in 1978, the end of the 95th Congress. So we are here to authorize the appropriations for the National Traffic and Motor Vehicle Safety Act of 1966 and the Motor Vehicle Information and Cost Saving Act of 1972.

There are a number of questions on this act that we hope we will get some information on. The Motor Vehicle Information and Cost Savings Act was passed in 1972 to promote competition among motor vehicle manufacturers in the design and protection of passenger motor vehicles.

I guess the principle was that through some Federal regulation and a mixture of better competition and more sophisticated buying habits due to the availability of information that the market forces would combine with some Federal regulations to stimulate production of motor vehicles that would have greater resistance to damage, greater crash worthiness, and be more susceptible to develop cheap and cost effective repairs.

We would like to know to what extent this has happened or to what extent it has not happened. In title II of the bill the Secretary of Transportation was required to compile and publish information comparing different makes and models of cars in terms of their relative damage susceptibility, their crash worthiness, and their ease of diagnosis and repair and again the idea was that the availability of information on this subject would make it easier to help prospective automobile purchasers in their purchase decisions and by means of promoting competition among the manufacturers to improve vehicles in all these respects.

We would like to know the extent to which that has happened. We would like to know the extent to which the relative ease and

diagnosis of repairs has been facilitated by the activities of your agency and the degree to which consumers are getting the information they need on safety, on repairability in order to make these rational decisions.

I would like to know whether a problem may not be that the industry is producing cars that are cost effective from the industry's point of view where their main game is to produce the cars as cost effectively as possible and whether this may not mean that in the design of these cars, repairs have been made very difficult, very time consuming.

To replace the little light bulb above the license plate—first of all the bulb could be built with the kinds of filaments and ought to be expected to last 5 years. But since the manufacturer only has a very short-term interest in the car after sale, they put in a bulb that has the expectancy of lasting 1 year so it has to be removed far earlier than normal and it may be that because the manufacturer has little interest in the ease of repair once the car is on the road and in operation that you have to take off the rear bumper in order to screw in that little light bulb.

So a part of the problem of the frequency of repair and the fact that parts burn out or wear out may be in design. It may be in specs. It may be in the calculus of the automobile manufacturer he has made exactly the right decision for the manufacturer's profit center but very much of a wrong decision when the interests of the consumer are weighed.

I would like to have your thoughts on whether we might help create a different cost benefit calculation by laying on the manufacturer perhaps the cost of routine and predictable ordinary repair and maintenance for the first 3, 4 or 5 years of the car's life so that when that car is originally made available to the consumer, it will predictably have a light bulb that will be specified and expected to last for 5 years to save the manufacturer the cost of hassling with it.

And in the design of that car it will be possible to screw out that little bulb and replace another without taking off the fender since it would be the manufacturer in that case who had to undergo that expense. These are all some of the questions that we would like to ask you as you get into your testimony.

Madam, you have been responsible for some very great steps forward. You are responsible for the seat belts in our cars and I was happy that several years ago I had the opportunity to testify before Secretary Coleman. As matter of fact I think I was the only Member of Congress who went down that day, and as fate would have it, I end up in the driver's seat here today and it is a matter of great satisfaction to me.

You pioneered the collapsible steering column, the windshields that do not snap across an occupant's neck and recently the passive restraint standard.

I know you are thinking about additional work on side impact protection, pedestrian protection, removing unnecessary decor, logos on the outside of the car that cut and slash. You are also bent on improving the dummies used in crash testing. You are involved in the dissemination of consumer information on diagnosis and repair as I mentioned.

I have had the pleasure of knowing you over quite a period of years and I watched your performance with great admiration and respect and I look forward very much to working with you and to listening to you testify this morning.

Without objection the text of H.R. 2585 will be printed at this point in the record.

[The text of H.R. 2585 follows:]

96TH CONGRESS
1ST SESSION

H. R. 2585

To amend the National Traffic and Motor Vehicle Safety Act of 1966 and the Motor Vehicle Information and Cost Savings Act to authorize appropriations for fiscal years 1980 and 1981.

IN THE HOUSE OF REPRESENTATIVES

MARCH 1, 1979

Mr. STAGGERS introduced the following bill; which was referred to the Committee on Interstate and Foreign Commerce

A BILL

To amend the National Traffic and Motor Vehicle Safety Act of 1966 and the Motor Vehicle Information and Cost Savings Act to authorize appropriations for fiscal years 1980 and 1981.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*

3

SHORT TITLE

4 SECTION 1. This Act may be cited as the "National
5 Traffic and Motor Vehicle Information and Cost Savings Au-
6 thorizations Act".

1 TITLE I—TRAFFIC AND MOTOR VEHICLE
2 SAFETY

3 AUTHORIZATION OF APPROPRIATIONS

4 SEC. 101. Section 121 of the National Traffic and
5 Motor Vehicle Safety Act of 1966 (15 U.S.C. 1409) is
6 amended to read as follows:

7 "SEC. 121. There are authorized to be appropriated for
8 the purpose of carrying out this Act \$60,000,000 for fiscal
9 year 1980 and \$70,000,000 for fiscal year 1981."

10 TITLE II—MOTOR VEHICLE INFORMATION AND
11 COST SAVINGS

12 BUMPER STANDARDS

13 SEC. 201. Section 111 of the Motor Vehicle Information
14 and Cost Savings Act (15 U.S.C. 1921) is amended by
15 adding at the end thereof the following new sentence: "There
16 are authorized to be appropriated to carry out this title
17 \$400,000 for fiscal year 1980 and \$450,000 for fiscal year
18 1981."

19 AUTOMOBILE CONSUMER INFORMATION STUDY

20 SEC. 202. Section 209 of the Motor Vehicle Information
21 and Cost Savings Act (15 U.S.C. 1949) is amended by
22 adding at the end thereof the following new sentence: "There
23 are authorized to be appropriated to carry out this title
24 \$2,400,000 for fiscal year 1980 and \$3,000,000 for fiscal
25 year 1981."

1 DIAGNOSTIC INSPECTION DEMONSTRATION PROJECTS

2 SEC. 203. Section 321 of the Motor Vehicle Information
3 and Cost Savings Act (15 U.S.C. 1964) is amended by in-
4 serting after the first sentence thereof the following new sen-
5 tence: "There are authorized to be appropriated to carry out
6 this title \$1,400,000 for fiscal year 1980 and \$1,800,000 for
7 fiscal year 1981.".

8 ODOMETER REQUIREMENTS

9 SEC. 204. Section 417 of the Motor Vehicle Information
10 and Cost Savings Act (15 U.S.C. 1990g) is amended by
11 adding at the end thereof the following new sentence: "There
12 are authorized to be appropriated to carry out this title
13 \$300,000 for fiscal year 1980 and \$360,000 for fiscal year
14 1981.".

Mr. SCHEUER. My distinguished colleague and long-time friend, Jim Broyhill—I look forward to working with you, Jim, on this distinguished committee and I welcome you to make any opening remarks.

Mr. BROYHILL. I do not have a prepared statement. I appreciate the remarks you have made. Of course, these are areas in which I have worked for some years and I am just delighted to have you working in this area, Mr. Chairman. I am also delighted to have Ms. Claybrook before the committee.

Mr. SCHEUER. Thank you, Jim. Our distinguished colleague from North Carolina, Richardson Preyer, do you have any opening remarks you would like to make?

Mr. PREYER. I am glad to be on this committee for the first time and look forward to hearing from Ms. Claybrook.

Mr. SCHEUER. We are delighted to have you as an active participating member. Ms. Claybrook, we will be happy to have you proceed.

**STATEMENT OF HON. JOAN B. CLAYBROOK, ADMINISTRATOR,
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, DE-
PARTMENT OF TRANSPORTATION, ACCOMPANIED BY HOW-
ARD DUGOFF, DEPUTY ADMINISTRATOR**

Ms. CLAYBROOK. Thank you, Mr. Chairman. I am pleased to appear before the subcommittee today to discuss authorizations for

the National Highway Traffic Safety Administration, our performance over the last year and our plans for the future. I would first like to congratulate you, Mr. Chairman, on your election to head this important consumer subcommittee. With me today is Howard Dugoff, Deputy Administrator of the NHTSA.

With automobiles the basic transportation system of this country, the public needs and wants cars to be efficient, available and not unnecessarily harmful. In a survey carried out for the Department last May by Peter D. Hart Research Associates, we found that nearly three out of four people rate safety and safety features as being of major importance to them in deciding what car to buy. Interest in safety, 72 percent, was topped only by cost, 85 percent, gas mileage, 77 percent, and repair record, 75 percent. These important consumer issues are high priorities for the agency.

[Summary Report of "Public Attitudes Toward Passive Restraint Systems," Peter D. Hart Research Associates (August 1978), Summary of "1978 Survey of Public Perceptions on Highway Safety," Teknekron, Inc., HS-6-01424 (November 1978); and Gallup Poll on Public Attitudes on Passive Restraint Systems (July 1977) may be found in subcommittee files.]

In any society one of the basic tasks of government and the legal system is to protect the public from hazards over which they have no effective control. In our society, where the sanctity of human life has the highest value, we have countered the inherent hazards of automobiles with safety performance standards, defect recall responsibilities, and grant programs to make the highways and drivers safer as well.

Motor vehicle crashes are the greatest killer of young people in this country, the largest single cause of paraplegia and epilepsy, and are conservatively estimated to cost the public 40-plus billion dollars a year. Although the GAO has estimated that motor vehicle safety standards through 1974 have saved at least 28,000 lives, a figure that would now total about 55,000 lives, we have seen the rate of fatalities per million miles grow between 1977 and 1978 for the first time since the inception of the Federal auto safety program in 1966. Fatalities have increased in 1978 to 50,145 from 47,876 in 1977. Increased use of motorcycles without helmets, the sharp increase in light trucks and vans which do not incorporate many safety features, and some increase in the speeds traveled on the highway are among the principal causes underlying this tragic reversal of trend. We are vigorously pursuing programs designed to counteract it, including an extension of the applicability of passenger-car safety standards to light trucks and vans.

In accordance with the President's Executive Order 12044, we have been closely scrutinizing our regulatory activities to catalogue their benefits and thoroughly analyze costs. The foresight of Congress in 1966 was clear in calling for analysis of our rulemaking as a decisionmaking tool. Since the beginning of our program, we have addressed those areas where the standards would have the greatest benefit, and our standards have in fact had substantial payoff. Of course, it remains immensely difficult to put a price tag on the benefits of motor vehicle safety regulation, most importantly the value of human life. Our approach is to quantify to the

extent possible the economic and other consequences of our standards, both costs and benefits—as a decisionmaking tool.

[Preliminary report on "The Contributions of Automobile Regulations" (June 1978), may be found in subcommittee files.]

Of the \$60 million in authorizations we are seeking for 1980, one of the major items is the National Center for Statistics and Analysis which is designed to provide us, as well as the industry and the public, with a statistically sound projection of the extent and nature of highway accidents. Much of this information is used to evaluate and to substantiate the benefits and costs of safety standards. Sixty percent of this program is funded under the Vehicle Safety Act. The pilot phase of the Center's national accident sampling system is complete and we are expanding our data collection teams from 10 to 20 in fiscal year 1980. This system will provide us for the first time with a nationally representative, statistically valid measure of highway accidents over a range of crash severities. Such information is critical to choosing the most beneficial performance standards.

Secretary Adams has underlined the importance of basic motor vehicle research in a recent challenge to the industry, academic community, and the Government research establishments to take major steps in automobile innovation by the turn of the century. Refinement of existing and commercially utilized technologies will bring us the "socially responsible" automobile of the 1980's. What concerns the Department of Transportation is generation of the new innovations in technology that will allow us to have the personal mobility of private automobiles for the foreseeable future without unacceptable burdens of safety hazards, pollution and excessive fuel consumption which increases costs as the price of gasoline rises.

We have therefore opened a dialog with the automotive research community on new propulsion, powertrain and fuel systems, and on vehicle structures and materials to advance the Nation's policy of reducing dependence on imported petroleum, consistent with improved highway safety and air quality, and continuing freedom of personal mobility at reasonable cost. Our first meeting, held in Boston 2 weeks ago, made clear that these subjects must be pursued to fulfill our transportation needs for the 1985-2000 period. Secretary Adams concluded, after hearing three panels of experts, that mileage in the range of 40- to 50-miles per gallon is realistic and that the effort should be made to accomplish this goal.

At this time the Government's long-range basic research effort is based primarily in the Department of Energy, where about \$100 million is spent annually on advanced automotive propulsion systems. While impressive, this funding will not do the job alone, and industry and the academic communities must make contributions to achieve our goal.

To advance the state-of-the-art for production through the 1980's, the Department of Transportation is spending from \$4 to \$6 million annually on a research safety vehicle program. Four and a half million would be spent in fiscal year 1980. Begun in 1974, this research program has resulted in several vehicle designs, which should be finished this spring and demonstrated worldwide to encourage advanced technology in mass-produced vehicles.

The large research safety vehicle concept incorporates state-of-the-art features that could be adopted by the industry today, resulting in a safer, more fuel-efficient, full-size sedan than is presently mass produced. This large research safety vehicle should provide 27.5 mpg, along with crash protection and emissions levels that meet or exceed all standards on the books for the 1980's. The smaller Calspan research safety vehicle provides equally impressive features which are adaptable immediately to mass production techniques, including fuel economy of 28- to 30-miles-per gallon. The Minicars research safety vehicle is a more advanced design, that is constructed to crash safely up to 50 mph and achieve a fuel economy of 32 to 34 miles per gallon.

[A fact sheet on the Minicars contract follows:]

fact sheet

U.S. Department
of Transportation
Office of Public Affairs
Washington, D.C.
20590



The information contained in this fact sheet has been checked for accuracy and corrected as of the date shown below. The Office of Public Affairs should be contacted if further information is required.

Subject: Large Research Safety Vehicle (LRSV)
Operational mockup developed under a \$250,000 contract by Minicars, Inc. of Goleta, California, for evaluation and demonstration by Department of Transportation's National Highway Traffic Safety Administration

Date: April 20, 1978

Phone: 202-426-4832

Objective: Demonstrate that good fuel economy, enhanced safety, and low emissions can all be achieved in a comfortable six-passenger car. More specifically, demonstrate that a family-sized car downsized for fuel economy can also have improved safety. Investigate and demonstrate how advanced vehicle technology as developed in the compact-sized Research Safety Vehicle Program can be applied to full sized, six passenger, family sedans to increase their fuel economy and improve their crash-worthiness.

The LRSV operational mockup is the first step in the evolutionary development of a full-sized six-passenger sedan that provides Level II crashworthiness (equivalent to 40 mph frontal barrier crash passive protection), 30 mph side protection, and offers 27.5 miles per gallon on the combined EPA driving cycles. This is to be achieved while maintaining as "research goals" emissions of less than 0.41 grams per mile (gpm) hydrocarbons (HC), 3.4 gpm of carbon monoxide (CO), 0.4 gpm of oxides of nitrogen (NOX) and an acceleration of 0-60 mph in less than 13.5 seconds. (These emissions are the "research goals" established by the Clean Air Act Amendment of 1977).

Safety Features: Crashworthiness - The LRSV structure and restraint systems are designed for improved crashworthiness. The LRSV is designed to meet Federal Motor Vehicle Safety Standard 208 for 40 mph frontal and frontal oblique impacts, 30 mph side impacts and rollover with the occupants experiencing injury levels of less than 1,000 on the Head Injury Criteria (HIC) scale, peak chest G's (gravity force) of less than 60 and femur loads of less than 2,250 pounds.

Structure: The LRSV has an integrated structure comprised of body gage sheet steel with tubular members. The passenger compartment is reinforced with internal box section sills and lateral box crossmembers, all of which are filled with 2 lb/cu ft. urethane foam. The rear fenders are also foam filled. The four doors are reinforced with a tubular upper door beam and a foam-filled lower section. The fuel storage cell is mounted against the rear compartment firewall.

- Restraint System:** The occupant restraint system includes air cushion restraints for all front seat passengers. Protection in a 40 mph head on barrier crash is the design goal. Force-limited lap belts are provided for all six occupant positions. In addition, foam-filled side impact padding is mounted on the doors and pillar sections in the hip and shoulder target areas.
- Engine:** Development of the LRSV engine has been undertaken by the Product Planning group at Volvo of America. The LRSV is presently powered with a preliminary version of the Volvo Lambda-Sond engine.
- Fuel Economy:** The fuel economy objective of the LRSV is 27.5 miles/gallon for combined EPA city and highway driving cycle. The fuel economy performance will be determined according to 1978 EPA fuel economy test procedures.
- Acceleration:** The design objective for acceleration is from 0 to 60 mph in not more than 13.5 seconds.
- Exhaust Emission:** HC 0.41 gpm; CO 3.4 gpm; NOX 0.4 gpm. This emission level is the goal set by Congress for future vehicles.
- Damageability:** The front and rear bumpers are molded of flexible urethane facias designed to insure no front damage in collisions up to 10 mph, no rear damage in collisions up to 5 mph. The front bumper is backed up by a 15 mph damage isolation module.

General Specifications:

-Vehicle-

- Seating Capacity 6 passengers
- Body Type 4 door Sedan
- Volume Passenger Compartment 122 cu. ft.
Luggage Compartment 24 cu. ft.
- Propulsion Front Wheel drive
Transverse Engine
- Suspension 4 wheel independent suspension
- Wheelbase 115.0 inches
- Overall Length 213.0 inches
- Overall Width 76.0 inches
- Overall Height 59.0 inches
- Curb Weight 2,850 pounds

-ENGINE-POWER TRAIN-

- | | |
|--------------------------|--|
| ● Type | Cylinder in-line with cast iron block; light alloy cylinder head of cross flow design; belt driven overhead camshaft. |
| ● Displacement | Nominally 1900 cc to 2300 cc |
| ● Bore | Nominally 3.62" (92 mm). |
| ● Stroke | Nominally 3.15" (80 mm). |
| ● Compression Ratio | Nominally 8.5:1. |
| ● Maximum Output | Estimated SAE Net H.P.: 140 @ 5,200 RPM. |
| ● Torque | Estimated 150 ft. lbs. max. |
| ● Fuel Requirements | 91 RON unleaded gasoline |
| ● Fuel Handling/Emission | Manifold fuel injection (Bosch C.I.) with oxygen sensing, feed-back loop controlled mixture correction and 3-way catalyst; with exhaust gas driven turbocharger incorporating boost pressure control and other detonation limiting controls. |
| ● Transmission | 5-speed Manual Transmission |

Ms. CLAYBROOK. Our request for \$60 million in fiscal year 1980 will also permit us to develop important new safety standards for side-impact and pedestrian protection and extend other standards to cover light trucks and vans. The upgrading of Standard No. 208 for passive restraints is proceeding on schedule. The Secretary's rule issued in June 1977 has been reviewed by the U.S. Court of Appeals for the District of Columbia Circuit and upheld in every respect.

We have remained in close communications with the automobile manufacturers and suppliers, reviewing their development efforts in upgrading occupant restraints. Passive belt systems already in mass production have been providing great life-saving performance, and we expect to see some air bag equipped 1980-model, full-size sedans even before the rule takes effect.

Mr. SCHEUER. Do you have any statistics or studies that you can give us on the great life-saving performance of passive seat belts?

Ms. CLAYBROOK. Yes, I would like to submit the full report for the record but we did a study through the fatal accident reporting system which gets reports from every State in the country, compared to the V.W. Rabbits with passive belts and without passive belts—that is with active belts—to see if there was a difference in life-saving records between the two.

The cars are identical; the only difference would be whether people are wearing restraint systems.

[“Assessing Field Performance of VW Rabbit Passive Belt Knee Bolster System” (and latest update); “Passive vs. Active Safety Belt Systems in Volkswagen Rabbits: A comparison of Owner Use Habits and Attitudes,” NHTSA Technical Report HS-5-01039 (August 1976) (Summary Report); Summary Report of “An Examination of the Comfort and Convenience of 1979 Safety Belt Systems”, Verve Research Corp.; “Safety Belt Usage: Survey of Cars in the Traffic Population (November 1977–June 1978)”, Opinion Research Corp. (December 1978); and Summary of “Development of Specifications for Passive Belt Systems,” ManFactors Inc., DOT HS-7-01617 (December 1978) may be found in subcommittee files.]

Mr. SCHEUER. The only difference is an active belt in one and a passive belt in the other.

Ms. CLAYBROOK. Yes; which means the people in the passive belt car are wearing the system and in the others they are not.

Mr. SCHEUER. In the Rabbit, how can they not be wearing them?

Ms. CLAYBROOK. They can disconnect the system. The findings are that the people in the active belt Rabbits suffer twice the death rate that people in the passive belt Rabbits did. We attribute that to the difference in the use of the belt system. With the passive belt, people are more likely to be wearing them.

Our survey shows between 30 and 35 percent of the people in Rabbits were wearing active belts and more than 70 percent were wearing passive belts.

Mr. SCHEUER. Do you mean more than 40 percent of them have disconnected them?

Ms. CLAYBROOK. About 70 to 80 percent in the passive belt cars had them connected.

Mr. SCHEUER. And upward of 20 percent then under the passive belt system would have disconnected the passive belt.

Ms. CLAYBROOK. That is correct.

Mr. SCHEUER. When they do away with the passive belt, do they cut it out of the car or do they put it in back of them and sit on it or is it permanent removal?

Ms. CLAYBROOK. There is a button that can release and disconnect it. That is important for exit purposes in emergency situations. As I understand, what is done is they release that button and disconnect the belt.

Judicial review of standard No. 121, air brake systems, was completed in October, 1978 and two major requirements were set aside: the 60-mile-per-hour stopping distance for trucks and the no lockup requirement for trucks and trailers. Secretary Adams and I have decided to initiate rulemaking toward a new standard to replace the remaining requirements of the existing one.

An advance notice of proposed rulemaking was published February 15 soliciting views on this approach, and a public meeting was held in Ann Arbor, Mich. last week. This rulemaking will be promulgated only after planned testing and after obtaining and considering the views of all interested parties on what would be appropriate requirements.

A second ANPRM will follow shortly that would separately outline any longer-range initiative that might be appropriate for more advanced technology such as antilock systems and automatic brake adjusters. We do not expect this action to be completed in the near future.

Our 5-year plan, first published last March, to afford both industry and the public a view of our priorities and obtain their reactions, is a continually evolving document. It will be periodically revised based on public comment and in response to continual changes in the motor vehicle safety field. For instance, we have added a motorcycle priority area to try and stem the alarming increase in motorcycle fatalities. We intend to issue the revised plan shortly. As already indicated, our major safety priorities are for side-impact and pedestrian protection, extensions of requirements to light trucks and vans, and braking.

["The Effect of Motorcycle Helmet Usage on Head Injuries, and the Effect of Usage Laws on Helmet Wearing Rates—A Preliminary Report," HS-803-791—January 1979—may be found in subcommittee files.]

The authorizations will also permit continuation of our valuable defect recall program. Mr. Chairman, I would like now to stop and show you some work we have done on restraint systems and on our research safety vehicles.

Mr. Dugoff will narrate the film.

Mr. DUGOFF. This is a series of tests which illustrate the life-saving benefits of restraint systems. The first is a 30-mile-per-hour collision into a rigid wall showing an unrestrained dummy and the violent and potentially lethal motions that are experienced in such a collision.

This is a shot of the same test, at slightly higher projection speed. It gives a better feel for the impact.

Now, here is the same test condition with a dummy restrained by a lapbelt. It is clear that the lapbelt does its job and that protective restraint is obtained for the lower portion of the body.

However, the upper body is still thrown forward, which exposes it to risk.

Now a shot, same conditions, but with both lap and shoulder belts. Here the dummy is fully restrained and is protected with contact from either the windshield or the instrument panel.

In spite of the life-saving protection offered by belts, less than one in five Americans bother to buckle up.

The passive belt system is available on the V.W. Rabbit. This is the system the effectiveness of which was being discussed earlier. This belt requires no action by the occupant to buckle.

An alternative and more comfortable passive restraint is the airbag system. This car contains an airbag in the hub of the steering wheel. The restraint system consists of a knee bolster and the bag. Here the system is being tested at 30 miles per hour and in slow motion we can see the bag deploying. A crash sensor triggers the airbag. The dummy's head and chest are cushioned by the airbag and its lower limbs are protected by the padded knee bolster at the bottom of the dashboard.

This sequence shows what can happen with an airbag, with lap and shoulder harness protection, and with a lapbelt only. Substantially less protection. And this is an unrestrained occupant, all the same crash.

This is a shot of the research safety vehicle mentioned earlier. It is being developed for us by the Calspan Corp. in conjunction with Chrysler Corp. This vehicle illustrates how manufacturers can achieve significant improvements in safety using current state of the art technology.

The stylish front of the vehicle contains unique features for both pedestrian protection and damage reduction. Here is a 7-mile-per-hour barrier test in which the plastic foam filled bumper absorbs the impact energy and returns to its original shape completely undamaged.

Here is a front-to-rear vehicle collision at 21 miles per hour between two of these RSV's. Again, no damage occurs because of the elastic foam-filled bumper and body structure. Reduction in pedestrian death and injury is one of our major goals.

This film shows a driver's view of a pedestrian dummy test. Each year 100,000 drivers in this country experience scenes like this as pedestrians are being killed or injured on our highways. Each year over over 7,000 pedestrians are killed. Many of these fatalities are children. The soft front end on this research vehicle is designed to mitigate pedestrian injuries.

This is a test sequence illustrating our work to improve side impact protection. That was a 30-mile-per-hour test crash of a full size Plymouth into a subcompact Honda and you can see from this overhead shot that the side of the Honda offers virtually no resistance to the Plymouth.

Mr. SCHEUER. Would the side of the Plymouth offer as little resistance to the Honda?

Mr. DUGOFF. It would do better because the Plymouth is much heavier. Here is the dummy receiving a severe impact by the front of the Plymouth which actually intrudes into the occupant space. The Plymouth is virtually undamaged by this test, which shows that the impact energy was absorbed almost entirely by the Honda.

Mr. SCHEUER. Is that because of the way the car is structured?

Mr. DUGOFF. The weight and the structure of the car. This depicts the same Plymouth crashing into the research vehicle that we saw shots of earlier. That vehicle's special side structure permits it to resist the penetration of the incoming heavy vehicle and you will note in a moment that the front of the Plymouth in this instance does a lot of crushing, which shows that the energy is being absorbed equally between the two vehicles. That is as a result of the side structure configuration in the experimental vehicle.

Mr. SCHEUER. It is not purely a factor of weight?

Mr. DUGOFF. This demonstrates that structure can be employed to compensate for unequal weight balance.

This is the second research vehicle that was mentioned. It is a more innovative approach being developed by the Mini-Cars Corp. of Goleta, Calif. The vehicle features, as you can see, outstanding visibility, a tremendous amount of glass and wide gull-wing door for ease of entry and exit both in front and rear. Gull-wing doors are not critical for the safety design of this vehicle but are incorporated to enhance convenience of the motorist and to stimulate public interest.

You will see that with the gull-wing doors that access is possible even in cramped quarters. That was 16 inches. The interior of this very small car is almost as large as a current midsize car. All four seats are equipped with transparent head restraints for improved visibility.

The driver and front seat passenger are protected by advanced airbags. The RSV front structure is designed for low cost repair. The section shown in yellow can be unbolted and replaced after a low-speed accident. The front bumper is covered with resilient plastic, and similar damage resistant components are used for all four fenders and the hood. This is a test of the front bumper at 10 miles per hour and that bumper is undamaged. At 20 miles per hour some damage does occur, but it is limited to the bottom section, which can be easily replaced.

The most beneficial feature of the RSV from a safety standpoint is its excellent crash protection. In this scene the basic vehicle structure and the occupant protection system are being run in a 50-mile-per-hour barrier test. Note the controlled crush of the structure and the airbags providing the needed protection even in this very severe crash. These airbags are advanced technology and are a significant advance in restraint performance.

The results of this experimental car are so encouraging that we are now trying those same airbags on production Volvo cars in car-to-car crash tests. This film shows a series of crash tests of the Volvos equipped with the new airbags. Closing velocities are in the neighborhood of 80 miles per hour, both oblique and frontal crashes.

These tests demonstrated that airbags installed in even a conventional car will protect occupants in a variety of frontal crash modes and at speeds well above those required by our current occupant protection standards.

Mr. SCHEUER. Which do I find is the safer configuration, the airbag or the seatbelt and shoulder harness?

Mr. DUGOFF. In frontal collisions, the airbag. In the full gamut of crashes including rear, side collisions and rollovers, the best estimate is that airbags and shoulder harnesses perform approximately as well in conjunction with a lapbelt.

Mr. SCHEUER. How about using them both?

Ms. CLAYBROOK. We think passengers should wear the lapbelt with the airbag system. The lapbelt is important to protect in a rollover crash and in side-impact crashes. The airbags spread the crash forces over a larger portion of the body, which is better than the shoulder harness.

Mr. SCHEUER. If you have a seatbelt and an airbag, should you also wear a shoulder harness or should you simply have the seatbelt and the airbag?

Ms. CLAYBROOK. The airbag is designed to replace the shoulder harness.

The authorizations that we are seeking will permit us, Mr. Chairman, to continue the valuable safety defect recall program. In the largest cases we concluded this year, 7.5 million Firestone 500 tires still on the highway, out of a total 14.5 million produced, are being replaced due to thousands of accidents in which 41 people died and 125 were injured; 1½ million 1971 through 1976 Ford Pintos and 1975 and 1976 Mercury Bobcats are being recalled because of the vulnerability of their fuel tanks to rupture in rear collisions. Thirty-three fires, involving 31 fatalities and 25 injuries, were associated with this safety-related defect. Seventy-five thousand Toyotas have been recalled for heater hose replacement due to 17 injuries in which hose ruptures released scalding water into the passenger compartment; 133,000 AMC vehicles were recalled because the power steering hose was routed too close to the exhaust manifold and 22 fires resulted when the hose burned through.

Substantial funds are necessary to discover defects and then compile the comprehensive evidence we need to carry a case all the way through court, when necessary. We spend \$1.7 million for automobile defect testing, field investigations and surveys, and for surveillance of manufacturers' recall campaigns.

Americans not only expect and want their automobiles to be safe but also efficient, comparatively inexpensive to operate, and resistant to unnecessary damage. The automobile is the second largest investment most families make and costs the average carowner nearly \$2,000 a year to own and operate. The Motor Vehicle Information and Cost Savings Act has advanced the consumer's valid expectation for a car that is worth its price.

The 1981 through 1984 passenger car fuel economy standards, in conjunction with the congressionally mandated 27.5-mile-per-gallon standard for 1985 and thereafter, will mean that consumers will enjoy up to a \$500 net cost savings over the life of their cars, light trucks, and vans. The fuel economy standards will further aid the consumer by relieving inflationary pressures on the dollar abroad due to the trade imbalances induced by petroleum imports. Currently it is estimated that these standards will significantly reduce demand for gasoline, by 15 percent in 1985, for example.

We have three major fuel economy issues now pending before us. They are, one, whether to slightly lower model year 1981 standards

already in place for light trucks and vans in response to a Chrysler petition; two, whether to revise either up or down the passenger car standards already in place through 1985; and three, what the standards should be for light trucks and vans in model years 1982 and thereafter. As Secretary Adams said in Boston, the loss of the Iranian oil supply is a graphic reminder that energy supplies are not assured and that increasing fuel prices will make these standards increasingly more beneficial. He stressed, of course, that a final decision on our response to the outstanding light-truck petitions must await full consideration of the comments received. We are expecting to issue a decision in that matter in March.

The U.S. Court of Appeals for the Sixth Circuit has affirmed for the second time the Uniform Tire Quality Grading Standards we issued in 1975. This means that the consumer will have comparative traction, treadwear and temperature resistance grades on all bias tires manufactured after April 1, 1979, and all bias-belted tires manufactured after October 1, 1979. We shortly expect to establish an effective date for radial tires as well. Cutting through the jungle of confusing claims and puffery in tire merchandizing should significantly improve the consumer's ability to obtain value for the price paid and cut into price increases for tires generally. This can only help to hold down inflationary effects on the retail market.

We are working to make the consumer ratings provision of the Cost Savings Act a reality, an issue which you raised in your opening remarks.

Mr. SCHEUER. Can you give us a progress report on that?

Ms. CLAYBROOK. Why don't I read my testimony on that and then I will comment further.

We have appointed new personnel to the effort who are attuned to obtaining useful, attainable ratings on crash worthiness and repairability, rather than the more esoteric research-oriented goals pursued in the past. We know that meaningful ratings are difficult to generate, but expenditure of more of our attention and funds, while focusing our efforts narrowly, promises a real potential payoff.

The prior administration, Mr. Chairman, took a stab at trying to issue the ratings. They looked at predictive ratings—trying to predict ahead of time the performance of vehicles but abandoned that effort in the middle of 1976. Secretary Adams and I decided we should try once again to pursue this program, that the intent of Congress was evident, and that it would have great meaning to the consumer to know differences between makes and models by these various characteristics.

So, last year we initiated an effort to pursue this, primarily from the point of view of historical ratings that look at how cars already produced actually are performing. Then, after we are able to do that, then we would move further and see whether we can develop predictive ratings.

Essentially the predictive ratings were beyond the state of the art at the time they were tried.

Mr. SCHEUER. The consumers unions get hold of cars early on, I suppose, or maybe even before they are offered to the public and do certain kinds of tests and then issue ratings on those cars. They have actually made ratings on the actual production line.

Ms. CLAYBROOK. That is correct.

Mr. SCHEUER. They are predicting how those cars will function after 50,000 miles, 100,000 miles or whatever. Are they the kind of predictive results you talk about?

Ms. CLAYBROOK. Not exactly. Consumers Union looks at such things as tires, comfort and convenience, and steering ability. They try and look at the quality built into that car, and how it handles and runs in short-term tests.

What we are attempting to do first is a crash survivability rating, which is much more difficult—after a crash of the vehicle, to assess whether or not it was better or worse than some other vehicle.

Mr. SCHEUER. Then that is not predictive. That is on the production car.

Ms. CLAYBROOK. Right. We have to try and develop a system that gives a base of information—because cars do not change every year—so we have a base on which to make any assessments of such cars. We will try and develop, probably through computer simulation crash tests to give us the ability to rate the cars for crash survivability. It is a tough thing to do.

Mr. SCHEUER. Has Consumers Union been widely criticized for the unreliability of their predictive ratings of cars? They have been doing it for a long time.

Ms. CLAYBROOK. Not as far as I know. They tell you if it is difficult to repair a particular part of the car. They do not give you any information on what that car is likely to do 50,000 miles hence. They tell you what that car is like when it comes off the production line.

Reparability is a relatively easy thing to do. You can tell people how easy it is to repair any given part of the car. In England there is an insurance group that does this. They take the cars and they help the insurance industry set rates for those cars based on their reparability.

Mr. SCHEUER. Can you make a projection of the likely cost of repair over 2, 3, 4, or 5 years based on the car's specification, the performance specs that have been designed into the car?

Ms. CLAYBROOK. That is maintainability. That is harder than reparability. You have to try and predict if a car is run 50,000 miles what kind of condition it is going to be in. We are just beginning to work on that, and the work is not sufficiently far along for me to tell you if we will be successful.

Mr. SCHEUER. On maintainability you can—right when the car is first sold—you could put out an advisory saying if you have to repair the little bulb over the license plate, you have to take the bumper off and that will cost you \$50 in labor.

Ms. CLAYBROOK. That is reparability. That is a structural issue. That is a design issue. We could do that immediately.

Mr. SCHEUER. Is that kind of information on the design characteristics of a car which is going to add to the cost of maintenance clearly predictable ascertainable? Is that kind of information being made available to the public now?

Ms. CLAYBROOK. No, it is not.

Mr. SCHEUER. Why isn't that being made available to the public now?

Ms. CLAYBROOK. By the Department or the industry?

Mr. SCHEUER. Either or both.

Ms. CLAYBROOK. You have to ask the industry why they do not make it available. As far as the Department is concerned, we are trying to pursue that as the short-term goal that we have with this program and I would like to see us do that relatively quickly. But we have not done that yet.

Mr. SCHEUER. Wasn't that in your original charge, I think in title II?

Ms. CLAYBROOK. In title II as it was enacted in 1972.

Mr. SCHEUER. Why hasn't that been done?

Ms. CLAYBROOK. The last administration abandoned that program. We started it up again in late 1977. We had no budget for it. A small amount of money was added to the fiscal 1978 budget. It was reprogramed by us because it was not actually appropriated. We set up a new office, hired new people to manage that office and we have begun work on it.

Mr. SCHEUER. How long do you think it will take you to get that kind of information?

Ms. CLAYBROOK. To do the reparability—about a year or year and a half to do some of it. There is a huge number of makes and models on the highway—more than 300-plus—and we have taken the position we should do it with all cars, not just a small number.

Mr. SCHEUER. Why do you say that? Why wouldn't it help to do it for the top models of the big three let us say which is probably 75 percent of your consumer decisionmaking?

Ms. CLAYBROOK. At Thatham, England, they do the 10 most popular models, and that is still a lot of work to do accurately. It will be used in advertizing and by consumers. It is important that it be accurate. I am concerned if we do something in a big rush and not well, that might harm the program.

Mr. SCHEUER. Nobody is suggesting you should not do it well. What we are suggesting is to have it done quickly. I am not laying on you the problem of prior administrations not doing it but this whole business of repairs is something that is costing the American consumer billions of dollars.

I have an excellent car myself. I have a Volvo and I take it up to a repair station on Wisconsin Avenue. No matter how insignificant the problem for which I bring that car into the station, it seems to be a physical impossibility for me to get out of there for less than \$110 or \$115. It is almost as if some computer is instructed to zap you for \$120 because he can afford it.

That is what happens with clock-like predictable regularity and it bugs me. The labor costs for installing the mirrors, little trivia in the car or repairing the trivia, the labor cost of disassembling that whole portion of the car is absolutely mindboggling.

I am impressed with Volvo; it is a very safe car and members of my family have been in collisions with Volvos—we own several of them—that they walked away from and you wouldn't believe it to look at the condition of the car. So in terms of safety it is a terrific car but in terms of reparability or maintainability the design characteristics of that car make it quite predictable that the cost of repairing or replacing insignificant items is off the chart and off

the wall and I cannot believe that other cars are a heck of a lot different.

This is a common complaint. I would think on a cost-benefit basis, the benefits to the American consumer in making intelligent decisions on maintainability and reparability would be astronomical compared to the additional injections of resources that you might need to do that in a timely fashion.

Do you feel you would like to have an additional appropriation to get on with this particular job with a little bit shorter time frame than what you seem to be describing?

Ms. CLAYBROOK. Part of it has to do with the physical ability to do it. We have requested a little over \$1 million for this program—\$1.2 million in 1980—and I think that is about as much money this year as we can spend.

Mr. SCHEUER. You are aware, of course, that you asked this year for less than you were appropriated last year. You were appropriated \$1.486 million and you asked for \$1.2 million.

Ms. CLAYBROOK. That is correct.

Mr. SCHEUER. Why did you reduce your request below what you were actually appropriated last year?

Ms. CLAYBROOK. I believe that happened in ZZB.

Mr. SCHEUER. The what?

Ms. CLAYBROOK. Zero based budget, that work that goes on in the Office of Management and Budget. It is fairly close, a difference of \$200,000.

Mr. SCHEUER. We are talking about almost 10 percent, 7 or 8 percent. That is a big difference.

Ms. CLAYBROOK. I am not sure we are going to spend every penny we have in this fiscal year. The Appropriations Committee gave us more than we asked for last year in this program, and I think that is part of the explanation.

Mr. SCHEUER. To my mind it is a very minor program that would have a terrific positive fallout.

Ms. CLAYBROOK. I agree.

Mr. SCHEUER. Any time you talk about less than \$1½ million for Federal moneys to help consumers spend their dollars more cost-effectively, you talk about a pip-squeak program with an enormous payoff.

Ms. CLAYBROOK. That is correct.

Mr. SCHEUER. So this is a little pip-squeak expenditure with a tremendous payoff. We talk about the cost of government regulations and when it passes beyond the point of diminishing returns—it seems to me you are way at the peak of the cost-benefit thing here.

Ms. CLAYBROOK. That is right. Not only that but I think, if we get these ratings out on reparability, the manufacturers will take a look at not only how they produce that car and design it for producibility but also how they design it for reparability.

Mr. SCHEUER. This is the whole point I am making. A pitiful little expenditure by you is going to help concentrate a lot of minds out there in the engineering offices of the people who make these cars and they are going to balance more intelligently, from the consumer point of view, factors of maintenance and reparability as against initial production costs so this pitiful little expenditure is

going to have an enormous fallout from the point of view of the guy who is buying the car.

That information he is going to get there not only helps him buy more intelligently but it will change the design of the cars in the future.

What I would like to know is why you did not ask for the same amount you got last year or—what did you ask for before it? You were given \$1.486 million last year. What did you ask for this year?

Ms. CLAYBROOK. I will have to submit that for the record. I did not bring that with me but I think it was larger.

Mr. SCHEUER. I think it was larger than \$1.486.

Ms. CLAYBROOK. I think so.

Mr. SCHEUER. I would be interested to find out and I would be interested to find out when that—whatever the figure is—was reduced to \$1.2 million by OMB, what their cost-benefit justification for that reduction was.

Ms. CLAYBROOK. We will submit that for the record.

[The following information was received for the record:]

TITLE II APPROPRIATION REQUESTS (FISCAL YEAR 1979)

Our fiscal year 1980 request to OMB to cover the staff and contractual costs of the Automobile Rating System amounted to \$1,486,000, the same level as appropriated for fiscal year 1979. The amount requested provided for the completion of the pilot effort to develop historical automobile ratings for crashworthiness, and maintainability; the initiation of preparatory work on historical damageability rating; and the development of some predictive models for crashworthiness.

OMB reduced the request to \$1,202,000. The reduction of \$284,000 served to defer the initiation of work on damageability until consumer reaction to historical ratings on crashworthiness and maintainability had been assessed. Should the consumer reaction to those ratings be favorable, we believe OMB would be agreeable to the use of any available balance to pursue work on damageability.

Mr. SCHEUER. Please proceed.

Ms. CLAYBROOK. This committee's hearings on auto repair and our study of the subject have made clear that expense and waste attend automotive maintenance and repair.

Mr. SCHEUER. Do you have any idea whether OMB in reducing your request from whatever level to \$1.2 million takes into account that the information you would be making available to consumers both its impact on their decisionmaking and its impact on corporations, on automotive design decisionmaking, might have a substantial impact on saving a good hunk of that \$20 billion a year in unnecessary costs of repair and maintenance?

You would certainly be talking about \$1 billion. How many billion I do not know but it would be in the magnitude of billions of dollars. I cannot believe if consumers had that information and if the automobile design decisionmakers knew that consumers had that information there would not be a minimum 5 percent saving.

So, you are talking about billions of dollars saved in the marketplace. Do you happen to know if OMB factored that into their decisionmaking?

Ms. CLAYBROOK. No, I do not. Our estimate on the part that is due to bad design is in the nature of about \$2 to \$3 billion a year. I think that is low by the way.

Mr. SCHEUER. Maybe you would give us a statement of what you really think it is and then you will also, as you have indicated, give us a statement as to what you originally asked last year over and

above the \$1.2 million to which you were reduced by OMB and then perhaps could I request OMB through you to give us a statement of what their cost-benefit calculus was for reducing you from whatever figure to \$1.2 million in terms of the multi-billion-dollar savings that seem to be there available for the asking were this information made available both to the automobile consumers and to the automobile designers.

Ms. CLAYBROOK. Yes.

We issued a study in May 1978 that estimates \$2 billion in unnecessary costs occur annually. This is bound to fuel inflation. Part is due to bad design in the first place, and part of the responsibility is the consumer's for neglecting or overdoing maintenance requirements. Part of the loss is attributable to the repair industry for performing unneeded, inadequate, or faulty repairs.

[The following material was received for the record:]

CONSUMER LOSSES DUE TO POOR DESIGN OF AUTOMOBILES

The NHTSA Technical Report, "Auto Repair and Maintenance" (May 1978) estimates that \$2 billion was lost as a result of vehicle design requiring use of overly modularized parts, highly non-standard parts, and excessively laborious repair techniques. This estimate (and the total amount of waste estimated in automotive repair and maintenance) does not include costs incurred in connection with repair or replacement of body parts after automobile accidents. Therefore, to the degree that body parts are designed in a fashion that unnecessarily increase their cost to replace or repair following a crash, the consumer suffers losses that exceed the \$2 billion in waste detailed in the study. A fact sheet summarizing the study is attached, in addition to the report itself.

[The attachments may be found in the subcommittee's files.]

Mr. SCHEUER. What I perceive you to be saying is if this information that you would be accruing through this expenditure of \$1.2 million or a little more were available, it would have an impact on all three of these, all three aspects of the problem, both the bad design and the consumer facing up to repair and maintenance because it would be similar and it would be more predictable.

It would be within some kind of a budget and I suppose to the repair industry too because—

Ms. CLAYBROOK. If repairs are easier to make, the repair industry has an easier time.

Mr. SCHEUER. And it would be still easier to make if there were redesign due to this information you would be producing, so I see improvement in all three of these areas.

Ms. CLAYBROOK. I think primarily in design, but in the others there are some as well.

Based on our title III experience, one remedy that meets this problem head on is periodic motor vehicle diagnostic inspection. Diagnostic inspection programs are feasible, effective, and publicly acceptable.

Mr. SCHEUER. Would you tell us who would do what with what?

Ms. CLAYBROOK. There are several options. Now we have several models. The Missouri Auto Club has a diagnostic center in St. Louis and another in Kansas City. They have two levels of inspection. One is that the State motor vehicle inspection program, a very minimal level of inspection which they conduct as do other people in other repair places in Missouri.

Additionally, though, what they offer and others do not is that you can get up to 500 parts of your car inspected for about \$25 or \$30. When you take it there for your periodic inspection, if you pay this additional fee, you can get this much larger amount done.

They will give you a computer printout with problems of your car. They will alert you to things wearing down like brake pads that do not need replacing, but will in 5,000 miles. You can take the car any place you want to obtain repairs. For a dollar you can get it reinspected to see if they properly repaired the car.

That kind of a system is very useful. We had a demonstration program under title III which is now completed. It had five diagnostic centers, one in Tennessee, one in Arizona, the District of Columbia, Puerto Rico, and Alabama. They attempted to assess the consumer acceptance of diagnostic inspection, enthusiasm for it, and whether we got a savings in safety and fuel economy, emissions and so on.

My feeling is, with the expensive items built into the car initially, that consumers get much better payoff overall over the life of their cars if there is a diagnostic inspection available to consumers so they themselves can keep their car in good shape and know what needs to be done.

That leads to fewer and cheaper repairs. You do not do unnecessary repairs. It is a counterbalancing force to the repair industry, to the extent they are tempted to commit fraud or other such practices. If you have a diagnostic system in place, it operates as a counterbalancing force and keeps the consumer informed and removes excuses he might have not to get the car repaired. Thus, there are a great number of advantages.

The biggest issue is whether or not the States are interested and willing to make the kind of investment that would be necessary to have such a system nationwide. We were instructed by this committee last year to take a look at this. We have a study underway attempting to assess what should be the relationship of diagnostic equipment, in the diagnostic facility on the one hand, and built into the car on the other.

We were asked to look at the financing of diagnostic centers by the States. There are some experiments now going on with mobile diagnostic vehicles that diagnose your car while you are at work. We are pursuing all of these things at the present time.

Mr. SCHEUER. What has been the degree of consumer acceptance?

Ms. CLAYBROOK. It was relatively high. It takes a while for the consumer to find out the value of a diagnostic center. The one in D.C. I remember was very popular and a lot of people called and were mad when it closed down. But it was an experimental project and could not be kept going under the funding.

Mr. SCHEUER. When will these studies be finished and available?

Ms. CLAYBROOK. They are fiscal 1979 studies so we hope they will be finished next fall.

Mr. SCHEUER. This fall?

Ms. CLAYBROOK. This coming fall.

The successful Missouri Auto Club program is now being duplicated by Pennsylvania's Keystone Auto Club. The costs of automobile operation can be reduced significantly by a properly conducted diagnostic program. We found in our title III demonstration

inspection projects that inspected vehicles have better safety equipment, deliver better mileage, and emit fewer pollutants.

Together with the FTC we are managing a contract to make a more accurate determination of the unnecessary and inappropriate repairs discovered in our demonstration project.

We concluded that the Federal Government can best assist consumers by providing them and their State and local governments with the tools to effectively represent their own interests. Also, we see a Federal role in suggesting means for States and localities to find the capital to put diagnostic inspection stations in place. There is, of course, already a way to establish pilot efforts beyond title III, under section 210 of the Clean Air Act, authorizing grants to develop and maintain emission inspection programs, and our Highway Safety Act, for similar grants for safety inspection purposes. These approaches all fall within existing authorization and budget arrangements and thus have a good chance of realization.

Odometer fraud in the United States continues to be a multimillion dollar ripoff of the consumer. In a significant number of used car sales, the seller unfairly overcharges the buyer by underrepresenting the vehicle's mileage. Title IV addresses the problem by requiring the transferor of a vehicle to disclose what he or she knows of the vehicle's true mileage to the transferee. New requirements and simplified forms have been put in place to improve the program. For instance, we have adopted a shortened form so the States can include it in their titling documents. Auto dealers now have to retain the statement for 4 years so that there is a record on which to base enforcement actions.

Our two investigators have uncovered widespread violations of the odometer law along the east coast. Guilty pleas and convictions have resulted from enforcement actions taken by States and the Department of Justice in the Northeast. We expect that our small staff will be able to increase the effectiveness of title IV by continuing to bring patterns of significant violations to the attention of consumer fraud and other sections of State and local enforcement agencies.

In addition, the private right-of-action is being used by injured individuals to collect treble damages independent of any governmental enforcement action.

Mr. SCHEUER. How is the information your investigators pick up made available to State and local agencies and to injured individuals?

Ms. CLAYBROOK. As to State and local agencies, once we pick up information that looks like it contains a violation, we then go and approach the State and local agencies. If it is a relatively local problem, we will bring it to the attention of a local agency. If it is statewide or interstate, we bring it to the attention of one or more State agencies.

Mr. SCHEUER. What has been your experience in how eagerly they pick this up?

Ms. CLAYBROOK. They have been very responsive. For major large interstate operations, for example, discount dealers and so on, we usually will go to the Department of Justice. But for ones that are primarily State, we go to State agencies.

As to the consumer, we receive letters of inquiry from consumers all the time. If we have relevant knowledge we get that to them. We also encourage the State agencies to publish information on any convictions that are found.

The consumer bumper standard went into effect last September. Phase I prohibits any damage to the vehicle, other than the bumper itself, in 5-mile-per-hour barrier and pendulum impacts front and rear. Phase II comes into effect next September and will limit damage to the bumper to small amounts that most consumers would choose not to repair. As a result, the cost and inconvenience of repair should be spared the consumer for low-speed impacts.

At the direction of the Senate Appropriations Committee, we performed a re-evaluation of the appropriateness of our standard in relation to other damage or impact levels that might save the consumer even more.

In late January, we sent a preliminary report to the Senate Appropriations Committee members which indicated that, with any of the technologies chosen—that would be steel, plastic, or aluminum—the performance requirements provide substantial net benefits to consumers over the lifetime of a vehicle. At the same time, it is not at all clear that the 5-mile-per-hour standard results in greater net benefits to the consumer than a lower speed standard. We are now issuing a Federal Register notice requesting comment on our analysis, on Houdaille Industries' study on the same issue, and on related studies in the field. We are also conducting crash testing that will better quantify the damage that occurs and is mitigated employing a variety of bumper designs and materials.

[“Analysis of the Bumper Standard—National Highway Traffic Safety Administration” (January 1979), and “Calculations and Supporting Material for the Preliminary Analysis of the Bumper Standard” (February 1979), may be found in the subcommittee files.]

Before we make specific changes, the statute dictates that we be certain of the safety, for pedestrians as an example, and other consequences of any change. Also, the effectiveness of bumper standards are greatly dependent on the bumper design chosen by the manufacturers. We intend to finish that assessment by the early part of the summer.

Mr. SCHEUER. You are aware the Houdaille people are here and will testify and they are very much exercised about this standard and feel they will have to go out of business if it is not changed. I take it you have some sense of reasonableness as to their position and that you are not all wedded to the 5-mile-an-hour standard.

Ms. CLAYBROOK. We have a sense of reasonableness about it. We want to make an assessment that everyone has a chance to participate in. For that reason we are putting out the advanced notice of rulemaking to allow all interested parties a chance to comment on the way we meet our calculations, to criticize or support them.

Mr. SCHEUER. How about the time frame? How soon will they know whether they have to close down their plants and add to the economic problems of Huntington, W. Va., or whether they can go to the 2½-mile standard, which they are very eager to do? How soon will they be able to—

Ms. CLAYBROOK. In terms of our activity we will give a 60-day notice period for comment, which is a relatively short one considering there are foreign manufacturers who have to have translations and so on. This means we should have our assessment finished by early June.

An issue also relevant to that is whether the manufacturers continue to buy the Houdaille bumper. That is an issue over which I have no control.

In addition to these substantive accomplishments, we have improved the consumer participation process at NHTSA. Our hotline and our town meetings throughout the United States have been a great success, letting us know better what truly concerns consumers about automobiles and informing us of specific problems and defects being found by the driving public. In Oregon, for example, a resident pointed out a safety defect that resulted in a recall.

Financial assistance to individuals and groups that are otherwise unable to participate in our administrative proceedings has also proven a real advantage to the agency. We are obtaining a wide range of views on our rulemaking, for example, that were never as well documented before. In our child restraint rulemaking we funded the Action for Child Transportation Safety group and obtained extremely useful recommendations from the ultimate consumers of these devices. We expect to continue this beneficial program in more proceedings to further involve the public.

The purpose of Federal motor vehicle performance standards is to assure the production of vehicles that embody socially desirable attributes such as safety, fuel efficiency, clean exhausts, and damage resistance. The standards we issue are explicitly designed to achieve the highest payoff to these ends. But the standards produce other benefits as well. They have helped increase the competitive position of U.S.-made cars in the domestic and overseas markets. Regulatory programs have also spurred the development of many new industries that have contributed to the GNP and to employment.

The regulations I have discussed also contribute to the long-term control of inflation by curbing economic expenditure that makes no contribution to our social and economic well-being. Repairing people and cars that have been unnecessarily injured or damaged in crashes contributes to inflation. Importing excessive amounts of petroleum degrades our international balance of payments, leading to devaluation of the dollar that further feeds inflation. Thus, our regulations help to reduce significantly energy and hospital costs, two of the four most significant factors in the inflation fight.

Every gallon of gasoline saved in motor vehicle transportation reduces the pressure to import petroleum. By 1985, passenger car and light truck fuel economy standards now on the books will save more than 15 billion gallons of gasoline annually as reported in our recent annual report to Congress on title V.

Thus, we remain firmly convinced that the statutory directives set forth in the Vehicle Safety and Cost Savings Acts contribute vitally to the safety, health, and well-being of Americans and deserve to be pursued with as much support in the future as they have been to date.

This completes my prepared statement. I and my colleagues would be pleased to answer any questions you may have.

Ms. SCHEUER. I am very grateful to you for your excellent statement and I will have some questions, but I did interject from time to time and I got some of them off my mind. So, why don't I ask the distinguished minority leader of this committee, Jim Broyhill, if he has any questions.

Mr. BROYHILL. You have already asked a number of the questions I had on my mind, and I think you have added to the record in that respect. Let me just ask a couple of other questions to clarify my own thinking.

In regard to the consumer ratings, it is my understanding that you have a two-pronged study going on, one you are analyzing the automobiles from the standpoint of the historical rating of the models that are already on the road; is that correct?

Ms. CLAYBROOK. That is correct.

Mr. BROYHILL. That study is about to be issued.

Ms. CLAYBROOK. No. This will take another 1½ or 2 years. It is very complicated because we look at insurance data which, of course, does deal not only with cars but with the drivers of those cars as well. It is hard to separate out what accident factors were relevant to the driver versus what factors were relevant to the car's construction.

Mr. SCHEUER. You have access, do you not, to Allstate's records.

Ms. CLAYBROOK. Yes.

Mr. SCHEUER. If you have easy access to those records, why would it take you 1½ years to sort of organize in a solely constructive way?

Ms. CLAYBROOK. We are not going to just use these records. It is more complicated than that. We have accident investigation studies we have carried out. We also analyze to do testing to show the characteristics purely of the vehicle as separate from the interaction or the driver with the vehicle. So, it is much more work than that.

Mr. BROYHILL. Now, you were also trying to come up with a rating so that you can predict the cost of repairing an automobile for, a new model that comes on the market this year. That is an entirely different project.

Ms. CLAYBROOK. That is right. The crash survivability portion will take longer. For the reparability portion we may be able to do it quickly. We are hoping so.

Mr. SCHEUER. What is the timeframe for the reparability?

Ms. CLAYBROOK. I hope 1½ years, but I cannot tell you for a fact at this moment but I hope it will be. What I should do is submit a written statement for the record that lays out the different programs and each part, that is the historical and predictive for each of the three characteristics, crash survivability, reparability and maintainability.

[The following information was received for the record:]

TIMETABLE FOR ANALYSES OF CRASHWORTHINESS, REPAIR/MAINTAINABILITY, AND
DAMAGE SUSCEPTIBILITY RATINGS SYSTEMS

The feasibility studies of both historic and predictive crashworthiness ratings and underway and should permit a judgment on generation of rudimentary ratings for a limited number of vehicle makes and models during the first few months of

fiscal year 1980. After experience with such limited ratings, the NHTSA will be able to judge the ultimate feasibility of rating all models on a predictive or historical basis.

Studies of repairability/maintainability ratings are also underway and results should be available in November 1979 that would permit a judgment of feasibility. At this time, the NHTSA does not envision maintainability ratings based on predictive methods. Accordingly, emphasis has been on historically based ratings for both repairability and maintainability.

Damage susceptibility ratings of the insurance companies, based on claims experience, are being evaluated by NHTSA to see whether these data can be manipulated to eliminate driver effects and the absence of crash severity data to permit the assignment of meaningful ratings of the automobile itself. This effort should be complete by the end of 1979.

Because the insurance companies already plan to establish their rates based on their ratings, the NHTSA has made damage susceptibility ratings a third priority behind crashworthiness and repairability/maintainability. At this time, predictive damage susceptibility ratings are not being pursued.

Mr. BROYHILL. Are the insurance companies doing work in this area? Have they done cooperative studies of this kind?

Ms. CLAYBROOK. They have and they have been generous to us with the information that they have. The Insurance Institute for Highway Safety has an institute which collects insurance statistics and they collect them for a variety of companies. Then there are the individual insurance companies themselves which collect information, Allstate being one of the main ones.

Mr. BROYHILL. Maybe I should ask the question of them but what have they done with this information; that is, have they gone to the automobile manufacturers and attempted to get changes made in design?

Ms. CLAYBROOK. I think the one example that I can remember—think you should ask the insurance companies to submit something more specific to you—is in the area of theft protection. I remember Allstate raised an issue about the ease of breaking into Ford Motor Company vehicles and they raised the rates on them on that basis and then Ford made some changes and the rates were reduced again.

Mr. BROYHILL. Have the insurance companies raised or lowered rates of respective various automobiles when they make a determination they are either more expensive to repair or less expensive to repair?

Ms. CLAYBROOK. I do not think they have gotten that far in their work. When they do that they have to be able to prove their contentions and they want to be sure that what they have done is accurate, but I think you should ask the insurance industry directly.

Mr. BROYHILL. It would seem to me they have all the information already.

Ms. CLAYBROOK. They deal primarily in crash repair, not just in maintainability and the normal kinds of daily repairs that people have, but they primarily have information on a car involved in a crash. They have done a lot of work with the Federal Trade Commission on monopoly auto parts costs. They have done work there—State Farm I believe has done that—but I do not believe that they have worked on maintainability. I do not believe they have that information.

Mr. BROYHILL. In regard to the bumper standard I was a member of this committee when that was put into the law and, of course, it

does seem reasonable, Mr. Chairman, think that a 5-mile-per-hour bumper standard would mean more protection than a 2½-mile-per-hour standard. But, of course, I realize that you have to take into consideration the total costs, that is that the total cost of repairs and so forth might be far more to the consumers with the higher standard and that the total cost to the consumers would be less with the lower standard.

Now, it is my understanding you have this analysis going on and you have already responded to the chairman in regard to that analysis. Now, you have some preliminary figures that you have given to the committee in response to the Senate committee request last year.

Ms. CLAYBROOK. That is right.

Mr. BROYHILL. However, this apparently is completely different than the information that is being given to us by a prominent member of the industry that manufactures this—

Ms. CLAYBROOK. It is not completely different. There is some similarity. We say the bumper standard as issued is very cost effective. The question that Houdaille Industries has raised is whether a lower bumper standard would be more cost effective than the one that is now on the books.

Mr. BROYHILL. Are you not analyzing it from the same standpoint?

Ms. CLAYBROOK. Yes, we are. What we said is that our preliminary estimates told us the 5-mile-an-hour bumper is very cost effective. We could not say at this stage it was more cost effective than a 2½-mile-per-hour bumper. That is as far as we could go based on the preliminary work.

We are publishing all the assumptions this week and asking for the comment of all the different companies and industries that are concerned and interested in this, as well as consumers.

Mr. BROYHILL. I think this is only a question of the cost of repairs, reparability and not safety, either to passengers in the vehicle or pedestrians. It is just the nuts and bolts.

Ms. CLAYBROOK. It is a cost comparison.

Mr. SCHEUER. Cost comparison of reparability?

Ms. CLAYBROOK. Of the original manufacturing cost. On the one hand, the 5-mile-an-hour bumper costs more to manufacture originally. Then compare that to the cost of repairs as we can best estimate them, also taking a look at differences in fuel economy, because the 5-mile-an-hour bumper is a heavier bumper in the steel version for example.

Mr. BROYHILL. You have to take into consideration also the cost of replacing the more expensive bumper in the event of an accident at higher speeds.

Ms. CLAYBROOK. That is correct.

Mr. BROYHILL. The 50-mile-an-hour crash.

Ms. CLAYBROOK. That is correct.

Mr. BROYHILL. What we are really doing is talking about evaluating and analyzing the economic impact of these regulations.

Ms. CLAYBROOK. That is correct.

Mr. BROYHILL. It is too bad we have not done this sooner in these instances.

Ms. CLAYBROOK. We have attempted to. We had not done the kind of analysis Houdaille raised, which is comparative cost of the 5-mile-an-hour bumper versus different speeds. We selected the 5-mile-an-hour bumper for a variety of reasons, a lot based on congressional testimony which led to enactment of the law.

That was not a bad decision in my view. The data we have suggest it has been very cost effective; it has been easier to make that assessment after we had the standard out there and can make measurements of what has been produced.

The other issue to remember is that the cost effectiveness depends a great deal on the designs the manufacturer chooses to use. What the standard states is, it has to have x amount of no-damage performance at 5 miles an hour. A manufacturer can choose any variety of designs and materials in order to comply with the standard. If they happen to choose one that costs more, then that is going to perhaps show a less cost-beneficial relationship than for a manufacturer who chooses one that is more cost beneficial. So we are limited by the innovation of the manufacturers as well.

Mr. BROYHILL. Do you feel it would be helpful to your agency with respect to some of these decisions that you have to make, to actually put into the law a provision saying that you should have the responsibility to evaluate and analyze the economic impact in connection with these regulations and thus to not only have the congressional mandate from one standpoint, but also from the standpoint of staff in order to be able to carry out that evaluation?

Ms. CLAYBROOK. The law does have a very specific provision in it for the bumpers. It says:

We shall seek to obtain the maximum feasible reduction of costs to the public and the consumer taking into account the cost of implementing the standard and the benefits attainable; the effect of implementation of the standard on cost of insurance and prospective legal fees and costs; savings in terms of consumer time and inconvenience; and considerations of health and safety, including emission standards.

We have a very large amount of——

Mr. BROYHILL. I was thinking of a general mandate from the Congress that these analyses and evaluations be a continuing process and that that might even help you as far as getting appropriations and getting support from OMB, Mr. Chairman, to have the staff that you might need.

Ms. CLAYBROOK. In that area OMB does not give us too much resistance. They have been fairly generous in helping us to do the cost effectiveness evaluations and we have tried to do just that. First of all, in conformance with the President's Executive order and, second, because we realize it is important before we issue any kind of standard to do an economic impact statement, and we do that with each and every standard that we issue.

I think the statute itself is comprehensive in requiring us to do these kinds of assessments already.

Mr. BROYHILL. I am going to go back and read the statute myself to satisfy myself from that standpoint and to see how broad it is from that standpoint. I will be consulting with your staff and our staff on this at a later time. Thank you very much.

Mr. SCHEUER. Thank you.

Congressman Preyer.

Mr. PREYER. Thank you, Mr. Chairman.

I enjoyed your testimony and this has been a learning experience for me. I was surprised to see that fatalities on the highways have increased in the past 2 years. In the Health Committee we have heard a lot of testimony to the effect that the 55-mile-an-hour speed limit has done more to save lives and improve the health of the American people than any medical development in recent years.

Do you attribute this increase to the public's getting used to the 55-mile-an-hour speed limit and so beginning to disobey it or do you put substantial weight on the increased use of light vans and trucks?

Ms. CLAYBROOK. We think there are three major factors: the motorcycle, lack of use of motorcycle helmets because a number of States have revoked their helmet use laws. Twenty-six States have revoked those laws since 1978. Also the increase in the use of light trucks and vans. They are selling at rapid rates and they have increased over the past 5 or 6 years. They do not incorporate most of the safety standards.

Also, a slight increase in the speed traveled. When the 55-mile-an-hour speed limit came into effect in 1974, there was an immediate reduction of some 9,000 deaths that year. And the best estimate we are able to make at the present time is that we can attribute something like 4,500 reductions to the 55-mile-an-hour speed limit. We have attempted to look and see whether or not the speeds have increased enough to make a difference. When you compare the reduction in death rate on those highways that previously were below 55 miles an hour, that is, roads that had 45-, 50-, and even 55-mile-an-hour speed limits prior to 1975, compared to those that had a higher speed, you see the greatest reduction initially on those highways where the speed went down to 55 miles an hour. You see some of those speeds creeping back up.

So, to the best we can estimate, not complying with 55 is adding to the increase. I could submit for the record a comparison of exactly how much we estimate the effect of noncompliance with 55 compares to vans and light trucks, but clearly both are significant factors.

[The following information was received for the record:]

EFFECT ON NONCOMPLIANCE WITH 55-MPH SPEED LIMIT AND INCREASED LIGHT
TRUCK AND VAN SALES ON INCREASED FATALITIES

Data are not available to determine with precision the proportion of the highway fatality increase in 1977 and 1978 that is attributable to increases in speeds in excess of 55-mph speed limit, compared to the increase attributable to the increasing proportion of light trucks and vans in the fleet.

There are several indications that increased speeds are a major contributor to the rising death toll. Since 1976, deaths increased over 20 percent on roads posted at 55-mph, but less than one percent on roads posted at lower speeds. Of the total increase in fatalities since 1976 (4,622), 95 percent has been on these high-speed roads.

In 1977, the fatality rate per-vehicle-mile-traveled on interstate highways increased 14 percent after years of constant reduction in the rate. Increases in fatalities have been primarily in the West and Southwest region of the country, where compliance with the 55-mph speed limit is estimated to be lower than in other regions. Since 1976, fatalities in the West/Southwest have increased 24 percent, representing 69 percent of the increased fatalities for the nation as a whole.

Light truck and van fatalities are increasing, one of the factors being the increasing sales and use of these vehicles for personal transportation. It is the agency's viewpoint that the occupants of these vehicles should be provided the same protections as those provided in conventional passenger cars through the safety standards.

Ms. CLAYBROOK. I will say that our best estimate is that the extent to which people violate the 55-mile-an-hour speed limit is the same that is used to violate the 65-mile-an-hour speed. It is 50 percent. When you look at 60 miles an hour, we find only 30 percent of the population go over 60 miles an hour, and I think the reason for that is traditionally police do not arrest people within plus or minus 5 miles an hour—both because of difference in speedometers and difficulty of making a case within that 5 mile an hour range. So the 55-mile-an-hour speed limit is still having big payoff but less so than it did originally.

Mr. PREYER. As to the vans which have become very popular these days, how long will it take to put the sort of safety equipment that is in automobiles into light vans?

Ms. CLAYBROOK. Until the mid-1980's. Some of the companies are doing it voluntarily. Ford has put several of the standards into effect. They did in 1975 when they redesigned their vehicles, their trucks. We have been asking General Motors to do the same because they are going to do a face lift on their 1980 model and they have agreed to put in several of the things they previously did not incorporate.

I am delighted with that. They agreed to do that faster than we could issue a standard. We have some proposals for rulemaking on collapsible steering assemblies and padded dash board and so on. Those will take effect as soon as we can get them issued.

Mr. PREYER. Are the safety features of an automobile automatically transferrable to a light van or pickup truck?

Ms. CLAYBROOK. Not in every case but in many cases. The design of some vans that are called forward control vehicles, the vans that do not have any front fender and hood and so on are the most difficult ones for us to deal with. Most of the others are relatively easily transferrable.

But for the forward control vans it is difficult because they have no crush distance between the front of the vehicle and the driver or the passengers in the front seat.

Mr. PREYER. There is just one other question in another area. How do you insure that motor vehicle manufacturers are complying with your safety standards? To take a specific example, you mentioned the Pinto fuel tank which did not meet the standards. How did you find out that it was not complying?

Ms. CLAYBROOK. Actually, that was not a standard violation. That was a defect. We did not have a standard on fuel tank rear impact until 1977. The Pinto came to our attention through appeals that were made to the agency from the public. When we started taking a look at it and did crash tests with the vehicle, we saw the filler neck was very short. There is a hole in the tank that the filler neck goes into and it was only in a short amount inside, so when a rear crash occurred the filler neck pulled out and gasoline poured out of that hole.

That is unnecessary. All they had to do is make the filler neck longer and it would not happen. In addition, some of the under

body parts of the vehicle rammed into the gas tank and those stiff structures punched holes in it.

What Ford did was to put a plastic shield in front of the tank so when the rear crash occurred, the gas tank skid up over the differential and comes back down after the crash is over. In terms of finding compliance with safety standards themselves, first the manufacturers have a responsibility under the statute to certify that their vehicles do comply. Second, we have a compliance testing program where we select on a random sample basis a number of different makes and models of vehicles and test them according to the different standards. If we find a violation, we contact the manufacturer; we allow them the opportunity to disagree with us. If we nevertheless believe that the vehicle is in violation of the standard and should be recalled, we order the manufacturer to do that.

We have not yet had a situation where the manufacturer has not ended up doing that voluntarily. We never had to sue a manufacturer for that.

Mr. PREYER. Thank you, Mr. Chairman.

Mr. SCHEUER. Ms. Claybrook, how much of your \$60 million requested authorization do you plan to spend on analyzing the effects of your agency's regulations?

Ms. CLAYBROOK. \$1 million approximately was spent on evaluation each year. We attempt to look at the more important standards. We have been looking, for example, at the side impact standard. We have been looking at bumper standards. We started that evaluation 2 years ago. That may be a little high. I could submit an exact figure for the record but we attempt to do evaluations of those standards on a routine basis because we need to know if they have a payoff.

[The following material was received for the record:]

ANNUAL NHTSA EXPENDITURES ON EVALUATION OF ITS REGULATIONS

The NHTSA has been funding evaluations at a level of \$1.2 million for several years. In 1976 we began the program to systematically evaluate our regulations. The objective of this program is to find out how effective safety and fuel economy regulations are under normal, in-use conditions. The results of such analyses are one basis for upgrading, modifying or eliminating standards, and also serve to explore new areas for rulemaking.

Rigorous evaluations of existing standards take time to complete since sufficient accident data must be available to yield statistically significant results. We also took into account the costs, initial estimates of benefits, and public and congressional concern, as we establish priorities among standards for evaluation.

Since past efforts at evaluation often came up with results that were less than definitive, largely because of design problems and the lack of appropriate data, we developed a number of methodologies for evaluation. These were completed last year, under contract, and included alternative ways for evaluating 13 safety standards including: FMVSS 214 (Side-Door Strength), 215 (Exterior Protection), 301 (Fuel System Integrity), 208 (Occupant Protection), 105 (Hydraulic Brakes), 108 (Lighting Systems), 202 (Head Restraints), 207, (Seating Systems), 213 (Child Restraints), 122 (Motorcycle Brakes), and 220, 221, 222 (School Bus Standards).

The following highlights portray the status and uses of the program:

An evaluation of Standard 214 (Side Door Strength) is nearing completion. Preliminary results support the need for upgrading the standard, but at the same time the analyses show that it is effective in reducing fatalities and injuries in single vehicle side door collisions. In multi-vehicle accidents, results are not definitive. Further analysis, with additional cases is planned for later this year.

A report of the actual cost of four safety standards (FMVSS 214, 215, 301, 203) is complete. Cost for side door protection (214) were used in the evaluation for cost effectiveness of this standard.

A preliminary evaluation of Standard 301 (Fuel System Integrity) is scheduled for completion in April 1979. It is designed to establish the degree of effectiveness of the present standards. The results will be used to decide whether to amend the standard. The collection of data on vehicle fires due to accidents will continue since the relatively small number of incidents made it particularly difficult to obtain sufficient data for proper statistical treatment.

A driver survey on unreported and small damage accidents as part of an evaluation to determine the effectiveness of the bumper standard (FMVSS 215 and Title I) will begin in March 1979. This is a pilot test followed by a full survey with 13,000 respondents required to obtain statistically significant results. The survey will be completed in October 1979.

The evaluation of fuel economy standards will begin in March 1979 with a pre-test involving 1000 DOT employees selected at random. The purpose is to test methods and procedures for obtaining sufficiently accurate miles per gallon measures. Upon completion of the pre-test, scheduled for June 1979, a survey involving 13,000 respondents will be started and will include drivers of passenger cars and light trucks (model years 1977, 1978 and 1979). It will be completed in June 1980.

Several standards are in the early stages of evaluation with data collection underway, followed by analysis. These include:

- FMVSS 105 (Hydraulic Brakes)
- 108 (High Intensity Head Lamps and Side Lamps)
- 202 (Head Restraints)
- 207 (Seating Systems)
- 213 (Child Restraints)
- 222 (School Bus Seating and Crash Protection)
- 203 (Steering Wheel Impact Protection)
- 204 (Steering Control Rearward Displacement)
- 212 (Windshield Mounting)

Preliminary results are scheduled for most of these beginning in December 1979.

Ms. CLAYBROOK. GAO has also done evaluations for us which we found helpful and useful so it is not just ourselves that conduct evaluations. From time to time, manufacturers will come in and say the standard is not working the way we thought it would and we recommend these changes in it.

Mr. SCHEUER. We had a dramatic example of that this morning with the Houdaille people coming in.

Ms. CLAYBROOK. It is important to point out, Mr. Chairman, that part of the bumper issue has to do with the desire of manufacturers to have lighter weight systems. It is not just the bumper standard. It is also the fact that the manufacturers are selecting lighter weight materials for the bumpers they are buying for fuel economy reasons. It is a bit more complicated than just the bumper standard itself.

Mr. SCHEUER. That is an area where you have to get into the act too because, as you get pushed toward this 27½-mile-an-hour—27½-mile-per-gallon standard that you have to reach by 1985, we want to make sure that in doing that we do not make an unacceptable compromise either with safety or with maintenance and repairability.

Ms. CLAYBROOK. That is correct. It is a very tough issue. In addition of course, relevant to bumpers is pedestrian safety. Pedestrians are better off usually if you have a more energy-absorbing system.

Mr. BROYHILL. Mr. Chairman, if you would yield, the point I was trying to make and I am not sure I got it across to you well is that perhaps if we had had some congressional mandate for the early analysis and evaluation of these standards we would not have to be

doing this here at the last minute when we have an industry that is just liable to have to close before you can get the analysis made.

In other words, we do want to make these judgments based on some fair analysis of the facts and it seems to me that this is a classic case of where, if we had required this of the agency earlier and not only required it in this particular instance but on an across-the-board basis, this decision could have been made 2 or 3 years ago and I would not be having to make this decision in some state of an emergency.

Ms. CLAYBROOK. I would like to comment on that because I think it is a very important point. One of the key ways that we can make assessments of what is going to have payoff in our standards is through the work of our data center; that is, through gathering of statistics, analysis, and accident investigations.

The data center was first set up in 1975 and is a major expenditure of the agency. We put a lot of our resources into that area. I think it is terribly important to Mr. Broyhill to do those economic impact statements, which we do attempt to do before we issue a standard as best we can on a predictive basis, that is, before the system is actually in effect.

But we also do evaluations afterward because conditions do change. The systems that the manufacturers put out may not be what we had anticipated they would choose. Sometimes conditions change during the course of rulemaking and implementation.

For example, the fuel economy law was not enacted until the end of 1975 and did not take effect until 1978. So that kind of changing conditions warrant our evaluation after the fact as well as before the fact.

But I have no disagreement with you on the importance of doing that, so that we make wise decisions. There is no question about that, and I wanted to elaborate a little in terms of the expenditure for evaluations. The money I was referring to is for after the fact evaluations. But we also, of course, have the data center which as it improves—it will take 2 or 3 more years before it is collecting the data we anticipate it can in any 1 year—will constitute a rather significant and major expenditure of the agency.

Mr. SCHEUER. I say the system is working fairly well, I must say, and the self-corrective built in features are functioning. This is what today's hearing is all about. Houdaille is making serious objections. They have done their homework in a rather intelligent way it seems to me, and they seem to have very professional witnesses lined up who have done their own cost effectiveness studies.

You, in turn, seem to be responding to those studies in an open-handed and forthcoming way and they are about to get their 60 days' notice and people will react and it seems to me you are reacting to the new information they have found and the position they are taking in a forthcoming way.

I think the system is working rather well and that your testimony and their testimony and their witnesses are eloquent testimony to that.

Rich, is there anything else?

Mr. PREYER. No, Mr. Chairman.

Mr. SCHEUER. Thank you very much Madam Administrator. We very much appreciate your testimony.

[The following letter was received for the record:]



U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

WASHINGTON, D.C. 20590

March 26, 1979

THE ADMINISTRATOR

REC'D CP&F SUB.
MAR 28 1979

Honorable James H. Scheuer
House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

It is my understanding that in testimony before your Subcommittee on February 26, 1979, representatives of Houdaille Industries, Inc., suggested that the Department has not fulfilled a promise to Senator Robert Byrd and a direction by the Senate Appropriations Committee that we prepare a study of the relative cost/benefit of our bumper standard compared to various other possible standards.

I would like to set the record straight. In late April 1978, Secretary Adams and I met with representatives of Houdaille in Senator Byrd's office at their request to discuss Houdaille's desire that the bumper study be conducted. They indicated that it had to be done immediately because if the standard were not changed, they might not receive any future orders from the automobile manufacturers. Senator Byrd indicated he wanted the study completed by December 31, 1978. I stated that it would be difficult to complete the study in such a short time but that we would certainly do the best job we could. I made it clear that there was an absence of significant information for a definitive study. For example, since the existing bumper standard did not take effect until 1979 model cars, there was no field data then available on the performance characteristics of complying bumpers. Senator Byrd asked me if we would change the standard if the study indicated that a different standard would be more cost beneficial. I told him we would certainly initiate rulemaking if we made such a finding.

Senator Byrd subsequently put the following language in our Senate Appropriations Committee report:

"Within the amount appropriated for NHTSA research and development, \$300,000, including the authority to hire consultants, is provided for studies and analysis to

assure that the Secretary's obligations to 'seek to obtain the maximum feasible reduction of costs to the public and to the consumer ***' in setting bumper standards in accordance with Section 102(b) of the Motor Vehicle Information Cost Savings Act are fulfilled through consideration and evaluation of a range of possible standards -- that is, speed of impact and extent of damage requirements -- to determine to the maximum extent feasible the standard that is most cost beneficial to the public and the consumer, that is, where marginal benefits equal marginal costs. Such a study is to be completed by December 31, 1978. NHTSA shall modify its bumper standard to reflect the results of this study."

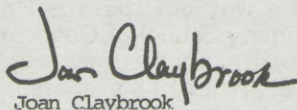
Houdaille witnesses have alleged to your Committee that the National Highway Traffic Safety Administration "...did not comply with the law." The basis for this allegation is the submission of our study in a preliminary form to the Appropriations Committee on January 26, 1979, instead of December 31, 1978. The study concluded: "These results indicate that with any of the technologies chosen, the present performance requirements provide substantial net benefits to consumers over the lifetime of a vehicle. At the same time, it is not at all clear that the 5-mph standard results in the greatest net benefits to the consumer."

Contrary to the Houdaille allegations, I would like to suggest that the Department has been exceptionally responsive to the Congress. First, the funds which Senator Byrd indicated would be appropriated to do this work were not appropriated. Rather, the agency was instructed to use funds already requested to pursue other matters concerning bumpers, such as bumper standards for vans and light trucks, and uniform bumper heights for these vehicles and passenger cars. Thus, these other items have been laid aside for this fiscal year. Second, based on all the existing information we could find, we prepared a preliminary report which has been submitted to your Committee. While it was 26 days late, I would like to point out that on December 21 I sent a letter to all interested Members of Congress and informed them the preliminary study would be submitted in mid-January when the Congress returned rather than on December 31, and our staff discussed this matter with Senator Byrd's staff prior to sending the letter and was informed the arrangement was agreeable. Third, on February 26 we initiated rulemaking to give all interested parties an opportunity to review the studies which have been prepared and to comment on all relevant matters. Only sixty days have been allowed for comment so that we can expeditiously consider the issues. Fourth, we have initiated a crash test program in Phoenix, Arizona, to acquire some empirical data previously not available.

As Houdaille Industries testified before your Committee, they would like the bumper standard changed to 2-1/2 mph. While we are obviously concerned about the capability of any company to comply with the standard, there are many parties concerned with this rule and the agency has a responsibility to give them all a fair opportunity to present their views and evidence.

I trust this letter fully responds to the allegations about the Department's performance in this matter. Please let me know if you desire any additional information.

Sincerely,


Joan Claybrook

Mr. SCHEUER. Now we will hear from Thomas A. Norton, an automotive group executive of Houdaille Industries of Huntington, W. Va., and his group.

Mr. Norton, you heard the testimony and the colloquy that has taken place here. I think you have done a very constructive job in producing the evidence that you have and in having these cost-benefit analyses made and we are impressed with the fact that the system is apparently responding to you very well and in the next couple of months, there will be some kind of a decision made on the position that you have taken and the information you have announced.

It was evident to me that the administrator was quite open-minded and forthcoming on the objections that you made to the 5-mile-an-hour standard and in effect she admitted here in her testimony that they had no particular reason to believe that their standard was more cost effective than a 2½-mile an hour standard and without in any way anticipating events in an improper way, it seems to me the system is working toward a conclusion that you will find satisfactory.

Now, we have your full testimony and we have all read it and that will be printed in its entirety in the record.

We start legislation at noon. Why don't you take the remaining 18 or 20 minutes, divide it up anyway you want and I am sure we will have a question or two but I really think you almost have won the ball game before you got into the ball park, and with that in mind, you might speak informally for 5 or 6 minutes and each of you might speak but divide up the time in the next 20 minutes in any way you wish and we welcome any informal comments you care to make.

Identify your colleagues for the record.

STATEMENT OF THOMAS A. NORTON, GROUP EXECUTIVE, AUTOMOTIVE DIVISION, HOUDAILLE INDUSTRIES, INC., ACCOMPANIED BY RICHARD COPAKEN, COUNSEL; FRANKLIN STULL, MEMBER OF LOCAL 3739 AND THE WAGE POLICY COMMITTEE FOR INTERNATIONAL UNION OF STEELWORKERS OF AMERICA; GEORGE SURGEON, PRESIDENT, LOCAL 1395, INTERNATIONAL ASSOCIATION OF MACHINISTS; H. DANIEL ROTH, PH. D. STATISTICAL CONSULTANT; AND DAVID A. WISE, ECONOMIST CONSULTANT

Mr. NORTON. Thank you for your kind remarks. I would like to introduce on my far left Mr. Frank Stull, who is a member of local 3739 and a member of the Wage Policy Committee for the International Union of Steelworkers of America. Next left is our attorney, Richard Copaken of Covington & Burling and on my right here is George Surgeon, president of local 1395 of the International Association of Machinists.

They are both steelworkers and machinists in our plants in Huntington, W. Va. On my far right is Dr. Neil Roth, who is a mathematician that we have employed in this cost-benefit analysis, and a way out there is Prof. David Wise, who is with the John F. Kennedy School of Government, an economist at Harvard.

[Testimony resumes on p. 57.]

[Mr. NORTON's prepared statement and attachments follow:]

STATEMENT OF THOMAS NORTON

GROUP EXECUTIVE

AUTOMOTIVE DIVISION

HOUDAILLE INDUSTRIES, INC

900 Ninth Avenue West

P.O. Box 2986

Huntington, West Virginia 25721

before the

SUBCOMMITTEE ON CONSUMER PROTECTION AND FINANCE

HOUSE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

hearing on

The Authorization Bill for the National
Highway Traffic Safety Administration

Room 2322, Rayburn House Office Building

February 26, 1979

My name is Thomas Norton. I serve as Automotive Group Executive of Houdaille Industries, Inc. Our company has operated a steel bumper fabricating plant in Huntington, West Virginia, for thirty-four years. For the past six years I have had major responsibility for this plant. With me today are two representatives of organized labor who are very concerned about the jobs that will be lost in Huntington if the current federal bumper standard is not changed and our bumper plant is forced to close. They are Mr. George Surgeon, President of Local 1395 of the International Association of Machinists and Mr. Franklin Stull, Member of Local 3739 and Member of the Wage Policy Committee for the International Union of Steelworkers of America.

I also have with me today Mr. Richard Copaken of Covington & Burling, our legal counsel; Professor David Wise, an economist at Harvard University's John F. Kennedy School of Government retained by Covington & Burling to assist us in evaluating alternative bumper standards; and Dr. Neil Roth, a mathematical consultant retained by Houdaille to assist in this task.

Conscious of the limited time available to this Subcommittee, I have asked Mr. Surgeon, Mr. Stull, Professor Wise and Dr. Roth to prepare brief written statements which I would like to submit to the Subcommittee for the record. Last week our counsel transmitted to the Subcommittee under cover letter of February 21, 1979, copies of our extensive

report dated December 27, 1978, and supplementary materials prepared since then. We would appreciate it if all of these materials also would be made part of the Subcommittee's official Hearing record. I shall attempt to provide the Subcommittee in my oral presentation this morning with a brief summary of our views. Our experts, of course, will be available to answer whatever questions the Subcommittee may wish to pursue.

Houdaille Industries employs more than 550 workers at its steel bumper manufacturing plant in Huntington. However, the continued existence of this plant and the welfare of Houdaille's 550 employees and their families are in a precarious position owing to the combined impact of federal automobile bumper regulations and fuel efficiency regulations. We believe fuel efficiency requirements are proper and we recognize that they are here to stay. We have no quarrel with them and we are confident our steel bumpers can continue to compete successfully in a market that is defined by fuel efficiency requirements provided federal bumper regulations do not force the most cost beneficial bumpers out of the market.

Unfortunately, the current 5 mile-per-hour federal bumper standard is having precisely this unintended result. The concurrent requirements of 5 mile-per-hour bumpers and greater fuel efficiency is forcing auto makers to opt for bumper materials that are far more costly than steel for

their 1981 model lines. The tragedy of this situation, for the public at large as well as Houdaille, is that the federal bumper regulations that are supposed to save consumers money in fact needlessly add hundreds of millions of dollars to the cost burden borne by American consumers every model year. At most road crash speeds all bumpers fail. More expensive bumpers mean higher initial costs, higher replacement costs, and higher fuel costs for consumers without compensating benefits. Our studies and figures published last month by the National Highway Traffic Safety Administration confirm that if a 2.5 mile-per-hour bumper standard were substituted for the current 5 mile-per-hour standard, American consumers would be freed of this wasteful and senseless cost burden, and Houdaille could continue to operate its Huntington manufacturing plant.

Title I of the Motor Vehicle Information and Cost Savings Act of 1972 directs the Secretary of Transportation to "seek to obtain the maximum feasible reduction of costs to the public and to the consumer . . ." in developing bumper standards. As Administrator Claybrook has candidly admitted in a letter to our counsel, Mr. Copaken, dated November 1, 1978, the current 5 mile-per-hour standard was not chosen on this basis but instead was a prejudged result in search of a justification. Houdaille was never enthusiastic about the current bumper standard that was arbitrarily selected

without any regard to the goal of saving consumers money despite the clear directions in the statute under which it was set. But like most other companies, Houdaille was not eager to challenge the federal government so long as it could live with the regulation. Certainly steel bumpers could be designed and manufactured to meet the 5 mile-per-hour standard. And we did. The introduction of fuel efficiency regulations, however, made steel noncompetitive under the arbitrary 5 mile-per-hour bumper standard even though steel would be highly competitive under any bumper standard that was chosen to save consumers money. In short, the imposition of fuel efficiency regulations seriously aggravated the costs to consumers of a bumper standard that was already needlessly costing consumers money instead of saving them money as Congress intended.

Early last year when it confronted the hard economic reality that it would have to close its doors to 550 skilled and loyal employees because of a federal regulatory bumper standard that had never been determined by anyone to be the most cost beneficial standard possible, the company balked. We simply could not in good conscience take such an action on the basis of what might be nothing more than federal whimsy. Houdaille will not capitulate and devastate the entire economy of the Huntington area until it is persuaded that such action is in fact justified.

Accordingly, in April of last year, Houdaille commissioned the first objective cost benefit study to determine for itself what bumper standard really is most cost beneficial to consumers. This study, completed on December 27 of last year, cost Houdaille Industries \$188,589.20. We are continuing to absorb significant expenses in efforts to refine our analysis.

I might add at this point that Houdaille feels a very deep commitment to the Huntington, West Virginia, area. This is not the first time it has dedicated significant corporate resources in furtherance of this commitment. In 1975, at very considerable expense, Houdaille preserved its Huntington plant against another misguided regulatory scheme and saved the day for American consumers by demonstrating to the complete satisfaction of the National Highway Traffic Safety Administration that its then-proposed bumper damageability standard of 1/100 of an inch was ridiculously below the threshold of consumer perception and would cost rather than save consumers money. More recently, Houdaille has transferred several bumper contracts from its plant in Oshua, Ontario, Canada, to Huntington. These transfers have added 211 employees to the payroll in Huntington. Unfortunately, all of this bumper business will disappear shortly unless the current federal 5 mile-per-hour bumper standard is changed immediately to the much more cost beneficial standard of 2.5 miles per hour.

Houdaille began its bumper study by seeking out a cost benefit expert of unimpeachable reputation who had never had any prior involvement with the automotive industry. Professor David Wise, an economist at Harvard University's John F. Kennedy School of Government, was retained by our counsel, Covington & Burling, to provide a conceptual approach for this analysis. We asked him to determine the truth whether that truth put us out of business for good or obliged us to fight on to save our Huntington plant. The National Highway Traffic Safety Administration approved Professor Wise's conceptual paper.

We also retained Dr. Neil Roth, a mathematical consultant, to devise a computer program capable of implementing Professor Wise's conceptual approach and to assist us with other technical aspects of this analysis. In addition, Houdaille commissioned the first crash tests ever conducted to isolate and evaluate the real world impact of the federal bumper regulation. These tests were conducted by Calspan Advance Technology Center in Buffalo, New York, an independent testing laboratory that does a great deal of work for the National Highway Traffic Safety Administration among others. We compared the bumper system currently used in the United States on Chrysler's Volare/Aspen, which must conform to the federal Part 581, Phase I, 5 mile-per-hour bumper standard, with the bumper system Chrysler manufactured for the otherwise identical model automobile sold in Mexico. Chrysler is not subject to any bumper regulation in Mexico

and the Mexican version of the Volare/Aspen bumper approximates the level of protection that would be provided under a 2.5 mile-per-hour barrier only standard. This cost benefit study of the Volare/Aspen revealed that the current 5 mile-per-hour federal bumper standard costs American consumers \$70 per car more in 1978 dollars than the benefits it provides. This waste includes the cost of 55 extra gallons of gasoline over the lifetime of each car.

If the cost benefit results of the Houdaille study are characteristic of the entire 11 million vehicle per year automobile market and proper adjustment is made for inflation, a total yearly consumer savings of \$814 million in 1979 dollars would result by substituting a 2.5 mile-per-hour barrier standard for the current 5 mile-per-hour standard. The adoption of the 2.5 mile-per-hour standard would not only save dollars but would also conserve approximately 605 million gallons of fuel -- representing refinery gasoline output from some 28.8 million barrels of ever more precious crude oil -- per model year.

After reviewing all available studies and Dr. Roth's analysis, Professor Wise concluded: "I believe the weight of evidence is that substituting the 2.5 mile-per-hour Volare/Aspen bumper for the 5 mile-per-hour American version would provide significant net benefits to the consumer."

At the same time that Houdaille commenced its cost benefit analysis of bumper regulations, Congress appropriated \$300,000 to the National Highway Traffic Safety Administration

for the 1979 fiscal year for research and development of the most cost beneficial bumper standard. The Senate Report accompanying the Appropriations Act indicated that this amount was to be used

"for studies and analysis to assure that the Secretary's obligations to 'seek to obtain the maximum feasible reduction of cost to the public and to the consumer . . . ' in setting bumper standards in accordance with Section 102(b) of the Motor Vehicle Information Cost Savings Act are [sic] fulfilled through consideration and evaluation of a range of possible standards -- that is, speed of impact and extent of damage requirements -- to determine to the maximum extent feasible the standard that is most cost beneficial to the public and the consumer. . . . Such study is to be completed by December 31, 1978. NHTSA shall modify its bumper standard to reflect the results of this study."

Although NHTSA failed to complete its analysis of the bumper standard by the Congressionally specified December 31, 1978 deadline, it did issue a report on January 26, 1979. In this document, NHTSA compared the range of net benefits that would result under three possible standards -- 2.5 miles per hour, 5 miles per hour, and 7 miles per hour -- for the three major bumper systems -- steel, aluminum, and soft face. If one compares the means of the various ranges set forth in the NHTSA document, it is clear that in regard to each bumper system analyzed, a 2.5 mile-per-hour bumper standard is more cost beneficial than the current 5 mile-per-hour standard which, in turn, is more cost beneficial than a 7 mile-per-hour standard. In fact, if one accepts the NHTSA numbers at face value and simply develops an

average figure that is weighted to reflect the relative market share in calendar year 1978 of each of the three major bumper systems considered, the net benefit to consumers of changing the current 5 mile-per-hour standard to a 2.5 mile-per-hour standard would be \$16.16 per vehicle per model year in 1977 dollars.^{*/} Adjusting for inflation and assuming an average 11 million vehicle model year, this would amount to nearly \$200 million for the 1979 model year.

*/ This figure was calculated as follows: Market shares were taken from Wards Automotive Reports for calendar year 1978. It was assumed that the bumper system which was employed at the end of the calendar year was used throughout the calendar year. The approximate market shares thus derived were:

70.8% for steel
11.4% for aluminum
17.8% for plastic

The difference between (1) the mean of the range of greater net benefits of the 2.5 m.p.h. standard, and (2) the mean of the range of lesser net benefits of the 5 m.p.h. standard shown on page 5 of the NHTSA analysis is:

Mean of Range of Net Benefits of 2.5 m.p.h. Standard		Mean of Range of Net Benefits of 5 m.p.h. Standard	
\$180	-	\$170	= \$10 for steel
\$250	-	\$225	= \$25 for aluminum
\$250	-	\$215	= \$35 for soft-face

The market share weighted average for these three is:

\$10 x 70.8% = \$7.08
\$25 x 11.4% = \$2.85
\$35 x 17.8% = \$6.23

\$16.16

It should be noted that the Houdaille cost benefit study compared a steel bumper system roughly equivalent to a 2.5 m.p.h. barrier only standard with a steel bumper system optimized to meet the current 5 mile-per-hour federal standard. As I already stated, the study found that the 2.5 mile-per-hour steel system was far more cost beneficial than the 5 mile-per-hour steel system. In its January 26 report, NHTSA sought to evaluate the relative costs and benefits of aluminum and soft face systems as well as steel systems. NHTSA found that the benefits of substituting a 2.5 mile-per-hour standard for the current 5 mile-per-hour standard were even greater for aluminum and soft-face systems than they were for steel systems. Thus, Houdaille's estimate of the total cost to the consumer of maintaining the 5 mile-per-hour standard may be quite conservative since undoubtedly for design and other reasons a mix of the three bumper systems would continue to be offered under a 2.5 mile-per-hour regulation.

In addition to the Houdaille and NHTSA analyses, a recent preliminary report evaluating the costs and benefits of ten automotive regulations by an independent consulting firm based in Washington, concludes that of all the federal automotive regulations considered, the worst from a cost benefit standpoint was the current bumper standard. This draft report issued by Economics and Science Planning Inc. on November 13, 1978, declared that the 5 mile-per-hour bumper

standard costs consumers over \$144 per vehicle per year more than any benefits it confers.

The net costs of maintaining the 5 mile-per-hour system are borne by all those who buy and operate cars. However, the burden is probably greatest on the automobile owners who live outside the major urban areas. These drivers are less frequently involved in the type of low speed, parking lot accidents which are commonly associated with city driving. Thus, the additional weight and cost of the 5 mile-per-hour bumper imposes a particularly heavy cost burden on rural car owners. These rural dwellers buy nearly one-third of all the cars in the United States.

Despite all this evidence including its own study conclusions pointing to the fact that a 2.5 mile-per-hour bumper standard is more cost beneficial to consumers than the current 5 mile-per-hour bumper standard, NHTSA has not yet changed its regulation. Not only is the agency's delay costing the consumers millions of dollars, the agency's failure to alter the bumper standard represents a violation of Congressional will as evidenced by the Senate Report on the 1979 Appropriations Act which called for NHTSA to alter the bumper regulation to reflect the results of its December 31, 1978, study.

At the present time, the auto makers are completing their designs for the 1981 model bumpers based on the current

fuel efficiency requirements and the Part 581, Phase II 5 mile-per-hour Bumper Standard. The 1981 designs will be completed and released for competitive bids within the next three to five weeks, and the current 5 mile-per-hour regulation almost insures that none of these designs will specify steel bumpers. This, in turn, means that no new business will be available in July, 1980, for Houdaille's Huntington plant which will force the plant to shut down. Furthermore, a delay in changing the standard would mean that any cost and weight saving changes the auto makers might make in their 1980 models that could benefit car buyers this Fall would be impossible.

On the other hand, if the bumper regulation were changed to a 2.5 mile-per-hour barrier only standard in the next few weeks, the auto makers would have sufficient time to modify their 1981 designs and, more than likely, convert some 1980 models to the lighter and more cost beneficial 2.5 mile-per-hour systems.

The serious adverse economic impact on American consumers in general and upon Houdaille and the Tri-State area in particular as a result of the continued maintenance of the 5 mile-per-hour bumper standard can no longer be tolerated. The evidence has been presented, and every study including those by NHTSA, independent consulting firms, and by Houdaille itself, confirm that consumers will save hundreds of millions of dollars if a 2.5 mile-per-hour barrier only

standard is substituted for the current 5 mile-per-hour standard. No one will argue that the available evidence against the current 5 mile-per-hour bumper standard is far more definitive than any information that was ever sought, let alone obtained, at the time this standard was set. But to the people of Huntington, the federal government seems to be an incomprehensible one-way turnstyle. Every objective expert agrees we made a bad mistake when we set the 5 mile-per-hour standard, but NHTSA seems to be afraid to admit that the Emperor has no clothes. Instead, it seems intent on taxing everyone by delaying remedial action and searching far and wide in a vain effort to find someone who can comment appreciatively on the Emperor's non-existent finery. American consumers are getting pretty fed up with this. Unless NHTSA takes immediate steps to effect this change, Congress should come to the aid of the American consumers and the residents of Huntington, West Virginia, and, without further delay, enact a 2.5 mile-per-hour barrier only bumper standard as part of the 1980 Authorization Bill for the National Highway Traffic Safety Administration.

STATEMENT OF MR. GEORGE SURGEON
PRESIDENT OF LOCAL 1395
INTERNATIONAL ASSOCIATION OF MACHINISTS

and

STATEMENT OF MR. FRANKLIN STULL
MEMBER OF THE WAGE POLICY COMMITTEE
MEMBER OF LOCAL 3739
INTERNATIONAL UNION OF STEELWORKERS OF AMERICA

before the

SUBCOMMITTEE ON CONSUMER PROTECTION AND FINANCE
HOUSE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

hearing on

The Authorization Bill for the National
Highway Traffic Safety Administration
Room 2322, Rayburn House Office Building

February 26, 1979

We, the employees of Houdaille Industries, Inc., Huntington, West Virginia, are asking for your support in helping us to get the bumper standard changed from 5 m.p.h. to 2½ m.p.h. From the three studies that have been made, if the standard were changed it would save the consumer approximately \$770 million a year. This alone would fall into President Carter's idea of curbing inflation. Bumper standards are supposed to be the most cost effective -- Congress required it by law. Let's enforce it now. If the plant in Huntington were to close it would affect approximately 1200 jobs in this area. This would mean a lot of them would go on unemployment which would mean a gain of about 4% unemployment in Huntington which we do not want and can not afford. More than one-half of Houdaille's employees have thirty years or more seniority. Average age is 53 -- they cannot be recycled. NHTSA itself has stated that the 2½ m.p.h. standard is more cost beneficial to the consumer than the 5 m.p.h. standard. We, as union representatives, feel closing this plant in Huntington will do a great harm to the city as a whole, taxwise. Along the line everyone hurts. We do not believe that it is fair to deprive the consumers of the saving that the 2½ m.p.h. standard would save them. Since there have been three expensive studies made and they show that the 2½ mile standard is the best, it is wrong to put this many people out of work.

HARVARD UNIVERSITY
JOHN F. KENNEDY SCHOOL OF GOVERNMENT
79 BOYLSTON STREET
CAMBRIDGE, MASSACHUSETTS 02138

February 21, 1979

Congressman James H. Scheuer
Subcommittee on Consumer Protection & Finance
Room 3275, H.O.B. Annex II
2nd & D Streets, S.W.
Washington, DC 20515

Dear Congressman Scheuer:

As a consultant to the law firm of Covington and Burling, since April 1978 I have been closely involved in the efforts of Houdaille Industries, Inc. to compare the costs and benefits of alternative bumper standards. I prepared a conceptual paper that sets forth criteria and a procedure for choosing a bumper standard. I also worked closely with Dr. Neil Roth in the implementation of the conceptual approach in his analysis of the costs and benefits of the 2.5 versus the 5 mile-per-hour standard. In addition, I prepared a detailed critique of the NHTSA "Final Impact Assessment," that supported the Phase II over the Phase I standard.

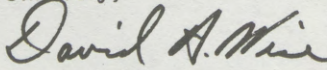
I was convinced from Dr. Roth's analysis and other information available to me that substitution of the 2.5 for the 5 mile-per-hour standard would provide significant net benefits to the consumer.

The most recent NHTSA analysis of the costs and benefits of the 2.5 and the 5 mile-per-hour standards also concludes that the consumer is better off with the 2.5 mile-per-hour standard. In addition to a comparison of steel bumpers--the major emphasis of Dr. Roth's analysis--the NHTSA analysis also includes comparisons for aluminum and soft-face bumpers. In all three instances, a comparison of the costs and benefits of the two standards to the consumer was found to favor the 2.5 mile-per-hour standard.

I have seen no defensible study that supports the 5 mile-per-hour standard.

Thus it is in my judgement indefensible that a standard intended by congressional mandate to benefit consumers was chosen and is maintained in the face of substantial evidence that the costs of the standard to the consumer are significantly greater than its benefits to the consumer.

Sincerely,



David A. Wise
Associate Professor

DAW:mc

H. DANIEL ROTH, Ph.D.
 STATISTICAL CONSULTANT
 10104 GRAYHORSE COURT
 POTOMAC, MARYLAND 20854

February 21, 1979

The Honorable James H. Scheuer
 Chairman Consumer Protection and Finance
 House Interstate and Foreign Commerce
 Room 3275
 House Office Building
 Annex II
 Washington DC

Dear Mr. Scheuer:

I am a mathematical consultant who has been retained by Houdaille Industries to conduct a cost-benefit analysis of alternative bumper systems. A major focus of my analysis consisted of comparing the bumper system on the 1978 Volare' / Aspen sold in the U.S. to the bumper system on the 1978 Volare' / Aspen sold in Mexico. This is an ideal comparison between a 2½ mph and a 5 mph bumper system, since the Mexican and the American Volare' / Aspens are identical except that the Mexican car is equipped with a bumper system that meets an approximate 2½ mph barrier standard and the American car is equipped with a bumper system that meets a 5 mph standard. My major findings from this analysis are as follows:

- Based on a comparison of the American and the Mexican Volare' / Aspen bumper systems, a bumper that meets a 2½ mph standard is more cost beneficial than one designed to meet the Part 581 5 mph standard (Phase I).
- In the Volare' / Aspen comparison my best estimate of the net benefit of the 2½ mph system over the 5 mph system is \$70 (this estimate includes fuel costs to support the heavier 5 mph system). Even under extreme assumptions favoring the 5 mph system on all variables considered, the 2½ mph system would still be at least \$34 more cost beneficial than the 5 mph system. Under another case in which assumptions favor the Mexican system on all variables considered the 2½ mph system would benefit consumers by \$136 more per vehicle than the 5 mph system.
- My best estimate is that a car equipped with the American 5 mph system would use 55 more gallons of gasoline over its lifetime than one equipped with the Mexican 2½ mph system. The possible range of fuel savings is 26 to 151 gallons per car.
- Given the real world option of no bumper standard, Chrysler Corporation decided against equipping the Mexican version of its Volare' / Aspen with an American bumper, and, instead, selected a bumper system that approximately meets a 2½ mph barrier only standard.

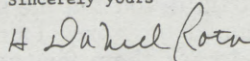
In addition to the above results I have also found that:

- Based on a NHTSA algorithm and the only good comparative data we could find on 1978 cars, steel bumper systems are more cost beneficial than comparable soft face systems.
- The protection offered by a bumper system could be enhanced in low speed crashes if the facebar were further extended from the body of the car.
- Analysis of barrier crash data show that increasing the distance between the car body and bumper facebar provides protection at speeds where current energy absorbers begin to fail.
- There is an extremely strong correlation between damage costs in barrier tests and damage costs in car-to-car collision tests, tests that are more likely to approximate real world accidents.

These findings are based on data obtained from a variety of sources, such as the automotive industry, the National Highway Traffic Safety Administration, the National Insurance Institute for Highway Safety, State Farm Insurance Company, Car Repair Guides, as well as from data generated by Houdaille itself.

The findings from my analyses are contained in the report entitled, "Cost-benefit Analysis of Bumper Standards" (December 27, 1978) and a letter I sent to Mr Richard Copaken on February 15, 1979 which was forwarded to NHTSA on the same day.

Sincerely yours



H. Daniel Roth

Mr. SCHEUER. I think in terms of the substantive implications of what needs to be done and who has plans to do it, the last two would be more relevant than the labor folks. We understand clearly the unhappy situation Huntington, W. Va. would find itself in and the unfortunate and really tragic impact on the families of the labor union's members who would be unemployed if you are not able to continue operation.

I think in terms of substance if we could hear from the last two gentlemen you mentioned who did some rather impressive work on this matter, I think that probably would be the most cost-beneficial use of our time.

Mr. NORTON. I would like to say at the beginning, though, that last April Joan Claybrook and Secretary Adams met with us in the majority leader's office, Senator Robert Byrd, and they did promise, Ms. Claybrook and Secretary Adams, that this study could be completed by the end of this, 1978 by December 31, 1978.

The reason it was so critical to us that this timing take place is because they are now designing the 1981 model bumpers and they will be placed to the lowest bidders as a rule and they will be placed by perhaps the end of April or maybe even March and really we cannot wait until June because we could be out of business the end of the 1980 model year and this was the urgency of it and Miss Claybrook and Secretary Brock Adams indicated they could have this study finished by the end of 1978.

Mr. SCHEUER. Apparently they have blown it, haven't they? They are not going to. They said that they would have it until approximately the first 10 days or so of June, as I recall. They are

publishing their materials this week or next week and I suppose that would be in around March 1, so they have to give 60 days for reply, that is May 1. And I suppose it will take them 30 days to get their act together and digest all the replies and I do not think that is a long period of time.

I can see a couple of weeks perhaps being possibly saved, but not much more than that. I think that is the condition that prevails. You are faced with not a theory but a condition as Grover Cleveland said about a hundred years ago and maybe you will have to delay that contracting period from March until June 15.

I wish it were not so and I did not know they had given you a commitment for having that study finished by the end of the year. Was that in your testimony?

Mr. NORTON. Yes, it was.

Mr. SCHEUER. I read all your testimony and I did not pay proper attention to that. I would have asked them the question as to why they did not make it because that undoubtedly has put you to unnecessary hardship and inconvenience and perhaps cost.

Should we ask them if there is something they can do to accelerate that? Is anybody here from NHTSA? They have all left.

Mr. NORTON. Our testimony implied that. It did not really say that but they did say it.

Mr. SCHEUER. If you tell me so I believe you and it is an unfortunate situation. I am sorry I did not know that and I would have been happy to ask them for the information, for an explanation as to why they did not make that date. It was obviously made in response to your plea to them that you needed it in timely fashion to complete your corporate decisionmaking and it is a shame that you do not have that information.

Mr. BROYHILL. Mr. Chairman, the reason I was pursuing that line of questioning with the administrator was that I knew there was some time constraint. I did not realize it was April and I was really bemoaning the fact that the agency had not done this work prior to this time, so we were not making these decisions on an emergency basis.

This should have been made a couple of years ago, not January 1 but sometime way back.

Mr. NORTON. I do not think they blew it. They were given \$300,000 that did not come immediately in April but some time later but I frankly think NHTSA believes the 2½-mile-an-hour standard is more cost beneficial to the consumer than the 5.

Mr. SCHEUER. They certainly did not take a very tough stand that the 5 was more cost-beneficial than the 2. To say the least, they are very openminded on the thing and think you are to be congratulated on that. When did they first have the benefit of the Houdaille study?

Mr. NORTON. December 27 we submitted it.

Mr. SCHEUER. Then it seems to me you should take some solace in the fact that they did wait and they cranked your information into their decisionmaking processes in a rather expeditious way. Perhaps if they had had your information earlier they could have stuck to their own timetable. I do not know and I do not want to get into the details of it. Time is running.

Take the next 10 or 12 minutes to make whatever informal statements you want. We would like to listen to your two experts briefly but it seems to me you pretty well won the ball game in the sense they are really reviewing that 5-mile standard and in an openhanded way.

As I say, I cannot prejudge what they are going to do but it seems to me you are in excellent shape. If I were you I would be willing to do a little risk taking when it comes to your contracting in March and I do not think it would be unreasonable for you to assume that things are going to work out well in May or June and perhaps anticipate that a little in March.

That is probably the most silly and dangerous statement any subcommittee chairman has made around here in years, is to advise a corporation in that kind of decisionmaking, but we never have perfect information when we make decisions, do we, in this life? We go on the best we have and if I had to put a value on the kinds of advice you just heard from Ms. Claybrook I would say you are in pretty good shape and I do not think you would be taking an undue risk in acting on that in March.

Anyway, that gratuitous statement aside, why don't you proceed.

Mr. NORTON. We certainly would take the risk and I concur with you, but it is the automakers that design these bumpers and we bid on them. This is the only role we play. By June we could win the battle and lose the war because we do not have enough business in the 1981 model year right now and if they design these bumpers out of oil-consuming urethane plastic or aluminum, which is much more costly, I think the consumer will suffer further.

I am not against aluminum. Aluminum will always make a lighter bumper than steel. It is one-third the weight of steel and it can be made in half the strength, so the net benefit will be a more costly bumper for the consumer and we could have won the battle and lost the war really.

I would like to take your advice and ask our professor, David Wise, to comment on the current standard, if you would, David.

Mr. WISE. I would take initially the conceptual approach for determining which standard would be most beneficial to the consumer. Neil Roth had implemented that conceptual approach in his analysis and he will say a few words about that. I was convinced by his analysis that the 2.5-mile-per-hour standard would be more beneficial than the 5-mile-per-hour standard.

More recently, I have seen the numbers that NTHSA came up with, although I have not looked at the documentation, but their numbers appear to be saying the same thing. In addition to looking at steel bumpers, they have apparently looked at aluminum and soft-faced bumpers as well, and their analysis says that in any of these cases, 2.5-mile-per-hour standard would be more beneficial to the consumer than the 5-mile standard.

Dr. Roth, maybe you want to add something.

Mr. ROTH. I would like to make two comments. First, David has mentioned there are two studies, namely, our own and NHTSA's, that show the 2.5-mile-an-hour standard is more cost beneficial than the 5, but there is also a third study done by economic analyses and those are the only three studies I know of looking at the cost benefit of bumper standards and all three come

out with the same basic result that a 2.5-mile-an-hour standard is more cost beneficial than a 5-mile-an-hour standard.

Second, as I understand it, we were supposed to work along with NHTSA on this cost-benefit analysis. We both began in June and, Mr. Chairman, you said that NHTSA blew it, but they were working along with this and, as I understand it, we were supposed to arrive at some result and whatever result the standard came up to be that is what we were supposed to live with.

We all came up with basically the same result. This is a hardship on the company itself. I do not know if it is my place to comment on that but it is, the result seems quite clear. Our analysis really took into account a wide range of data. It not only took into account data that we generated ourselves with our own test crashes; we also took advantage of all the Insurance Institute data that was available on bumper crash tests that the insurance companies have conducted back since 1969. It also took into account NHTSA's own analysis. NHTSA did analyses back in 1974, in which they developed an algorithm for looking at cost-benefit analysis for bumper standards.

Mr. SCHEUER. Can you tell me what an algorithm is?

Mr. ROTH. A method of calculating cost-benefit analyses. They developed this model back in 1974 in which they compared bumper standards at that time. We took those precise algorithms or their methods of calculations and we generated current bumper costs and current bumper replacement costs and current fuel efficiency costs, and what we found using their own methods of calculation was that the 2.5-mile-an-hour standard was more cost beneficial than the 5-mile-an-hour standard. And I see no evidence to the contrary even as you said, as you commented yourself, I didn't even see NHTSA's comment that the result is any different than what we are saying it is.

Mr. SCHEUER. They said openly they have no evidence that the 5-mile standard was more cost-beneficial than the 2.5-mile standard.

Mr. ROTH. What we are saying is you have three studies. Our study, by far the largest and more competitive, took into account all of NHTSA data, took into account NHTSA's method of calculation. It took into account all the data available to us from the National Institute for Highway Safety. We took into account everything that the Ford Motor Co. would give us, or State Farm or any information that was available to us.

In this time, we also acted on all NHTSA's critiques of our study and, if anything, we found our analysis was more conservative in estimating the benefits of the 2½-mile-an-hour standard.

It seems to me at this point it is an open-and-shut case and we have been speaking to the insurance people, the Insurance Institute people as well as State Farm people or anyone else we know that has an interest in this subject, and no one has critiqued us. Basically, they say our result is standard.

Mr. SCHEUER. I think most important, that is what NHTSA is thinking.

Mr. BROYHILL. Would the gentleman yield. Another study has been referred to. I had to step out of the room. Did that study indicate an even higher saving? The question I am asking is: Were they using the same data that you are using?

In other words, did they use just the top end of your figure and you used the average?

Mr. ROTH. No, there were three independent studies. They used different data. They did not consult us in doing the study, and we did not consult them. They did an independent analysis. What was interesting about their study was they looked both at the cost and the benefits. Not only are the costs greater for the more expensive bumper but they also found there was a disbenefit because of the point that you raised in earlier testimony.

You said in higher crashes at 50 miles an hour one would have—replacement cost for the more expensive bumper would be much more expensive than replacement for the other, so even the benefits—based on the point you raised they found even the benefit itself was was disbenefit.

In other words, really, what are you saving the consumer? Bumpers do not go at 50 miles an hour, they go at 10 miles an hour, so the current standard at 2½ miles an hour provides the bumper some protection beyond 2½ miles an hour, whatever that is.

The 5-mile-an-hour bumper does not provide much protection after 5 miles an hour so this more expensive bumper which in the case of the car we tested which was Chrysler Corp.'s car, amounted to something like \$60 more than the cheaper bumper that Chrysler has on their car. You are giving this extra money and you are only buying protection for a very limited range from 3 to 6 miles an hour. And that is really what makes the analysis stick.

Mr. BROYHILL. In your study you used an average to arrive at your conclusion. That is, you had a range of benefits there. You used an average. What about this other study, did they use an average?

Mr. ROTH. I do not really know. The results I have seen of their study they did not go into intensive explanation of what they did, and what I basically saw was just their results. However, we did not use an average in the normal sense. We used a range of values. What we said was the worst case estimate and the best case estimate.

On top of that, we took our best case estimate and we said assume all our figures were off by 25 percent against us, and we conducted—I forgot, something like 10 tests and we assumed each one was wrong by 25 percent. And even on using that very conservative assumption, we still came out ahead on all the counts. The 2½-mile-an-hour system was more cost beneficial.

Mr. BROYHILL. What approach do you recommend Congress take to deal with the matter?

Mr. ROTH. That is something I cannot address.

Mr. COPAKEN. I think that is really the key question. I think the data is quite clear and in fact I think NHTSA's data goes further than Administrator Claybrook's characterization of it this morning. They did publish a document on January 26, which has at page 5 numbers that show the range of cost benefits for the three different standards and the three different bumper systems and if you look at those and analyze those, it is clear 2.5 is not just equal to 5. It is considerably better than 5.

I think what is troublesome here is that we had a commitment in late April that they would carry out this study. The Senate

appropriated \$300,000 to help them carry out the study and mandated they complete that by December 31. We worked with them right along. We provided them with computer programs. We tried to assist them in every way possible. We got thinking they were not going to do the job, which is why we did this ourselves.

We could not wait to see if they would comply with the law and they did not comply with the law. This study they submitted was January 26 and we still do not have the back up data. I think the appropriate course under these circumstances—since it is costing consumers \$770 million a year for delay, and it is costing us something like 28.8 million barrels of oil—it is just wasted because of this one bumper standard being kept in place.

All the information is out and it is quite clear we are subjecting consumers to that kind of waste as well as putting the good people of Houdaille out of business. It would be appropriate for this committee to mark up this bill and by legislation make this decision that NHTSA has been sort of unable to come to grips with even though they had all that time and money to do it.

Mr. BROYHILL. What about the other alternative of extending the deadline from 1981 to 1982?

Mr. NORTON. I think we are below the break-even in the 1981 model year, would we choose to just stay in business at that rate or would we be out of business. We might win the battle but lose the war.

Mr. COPAKEN. I am not sure I understand your point about extending the deadline.

Mr. BROYHILL. They have a deadline of the 1981 model year to install this new bumper. We could extend that deadline.

Mr. SCHEUER. They want to do it sooner.

Mr. COPAKEN. The problem is the standard that is costing consumers \$770 million a year is a standard that is currently in effect. It will tighten up and probably cost considerably more beginning September 1, but our analysis was based on not only the even tougher standard that will come into effect in September, but the phase I standard that is currently in place and, of course, the automobile manufacturers are now getting ready to submit for bids their specifications for the 1981 model year which will take into account the tougher standard and they will probably rule out steel entirely because of the bumper standards to the greatest benefit of all American consumers, as well as the employees at Houdaille.

Mr. BROYHILL. Do you know if the insurance companies have done any work in the area, any analysis or evaluation from their records?

Mr. ROTH. Yes, they provided us with data all along and a great deal of our analysis is based on their data.

Mr. BROYHILL. Are they coming to the same conclusion you are?

Mr. ROTH. We have not heard anything from them. They called and asked us a number of questions, but they have not done any cost-benefit analysis themselves. I have not heard any critiques from them. We have acted on all critiques that were given to us. We have done our calculations some of which were extremely good points and we cranked them into our analysis.

But to answer your question directly, we have used all their data. They know what we are doing. They had it available for a few months now and we have not heard anything.

Mr. BROYHILL. What about the impact on the nonurban automobile owner? Did you make a separate analysis as to the impact on them?

I am particularly interested in that since my district is of that type.

Mr. ROTH. There was a point in the analysis—there was a question of what is the frequency of bumper type accidents, and we in our analysis, what we have used was data that was collected in urban areas where one would assume there is a greater frequency of bumper like accidents, particularly at parking lots and places of that nature.

We did our analysis on the basis of this more conservative type data and we still found that it came out with more cost-benefit to have a 2.5-mile-an-hour bumper than a 5-mile-an-hour bumper. If we were to re-do our analysis and adjust for the rural car owner, the bumper standards, the 2.5-mile-an-hour standard would not even earn much more cost-benefit than our cost analysis indicates.

Mr. SCHEUER. I can see your problem and I also understand NHTSA's problem but NHTSA's standard is a performance standard and they have no way of telling what the cost to the manufacturer is going to be to meet that performance standard.

Therefore, they cannot fine tune their cost-benefit calculations before the fact and now you are introducing information to them—you have written them a report; you had this cost-benefit analysis done and they are factoring it into their decisionmaking. And I think you will get the answers you are looking for.

Let me ask to what extent can the maximum potential benefits and the minimum necessary cost associated with the performance standards such as the one we are talking about be determined by a cost-benefit analysis of bumpers whose designs are wholly within the control of the auto manufacturers and whose not only designs but costs are within the control of the manufacturers?

Is there any way NHTSA could have done it ab initio?

Mr. COPAKEN. There are ways they could have done a better job ab initio. There is no question they could have done what we did. We started the same time, April of last year. What we did, Congressman, to meet your very point, is we took a very real world classic case study that isolated the impact of the Federal bumper standard.

Chrysler Corp. manufactures the Volari and Aspen in the United States. They sell and manufacture the identical car in Mexico with one exception. In Mexico there is no bumper standard at all. Therefore, they put on a bumper that is not reflective of the standard and that bumper is roughly the bumper one would get with a 2.5-mile-per-hour standard. So you have real world responses to a regulatory environment and nonregulatory environment.

We analyzed those cars and it turns out the Mexican version, which has no regulatory standards, saves the consumers in Mexico \$70 per vehicle over the life of the vehicle more than the American one which has the bumper built to a standard that is supposed to

have saved consumers money. They could have done that analysis. That is what our analysis is based on.

Mr. SCHEUER. The Houdaille analysis compared two bumper designs of the same manufacturer on a single model of automobile whereas your Mexican example, it was a totally different bumper design I presume.

Mr. COPAKEN. It was the same physical appearance, same stylistic design, but it was made out of a lighter gage steel and it did not have the energy-absorbing units that the identical model car sold in the United States had. So, it was a good test that compared a manufacturer's real world response to a Federal regulation in one context and no regulation in another context. It was the same car but for that, so it isolated that factor and gave us a good test.

Mr. SCHEUER. Have you made an effort to evaluate the cost-benefit ratio of alternative bumper technologies such as that that has been incorporated in the NHTSA experimental research safety vehicles or the TACO bumper system which has been demonstrated to withstand more severe impacts than called for under the standard and at a very low cost?

Mr. COPAKEN. We have, and I will turn this over to Dr. Roth to tell you about that.

Mr. ROTH. Our comparisons went beyond what Mr. Copaken was saying. We took a Chevy Monza. We wanted to test the plastics NHTSA suggested might be more cost-beneficial than steel. There is an American, 1978 Chevy Monza, and a 1979 Chevy Monza that comes in plastic version as well as in a steel version and we stripped the cars and we rated the bumpers and you asked us about costs of bumpers.

We asked the car manufacturers what was the difference in price, what was the cost of one bumper as opposed to the other? Then we collected their numbers by going back to manuals, to repair manuals, and actually checking out the costs themselves.

We found that the plastics which are the latest type bumpers are prohibitively expensive, more expensive than steel bumpers. The replacement costs—whereas steel bumpers could be rechromed, a plastic bumper has to be replaced from scratch and replacement costs run something like 4.5-fold higher than a bumper on a new car.

We also found that plastic bumpers deteriorate more rapidly. If you were to look at a 1979 Porche, a \$28,000 car—

Mr. SCHEUER. That is all I can afford to do is look at it.

Mr. ROTH. We did look at what was available and we checked our numbers as best we could and all this information was available to NHTSA, and we found that there is no question about it, the further you go to the more exotic systems, the least cost—the least cost-beneficial they are.

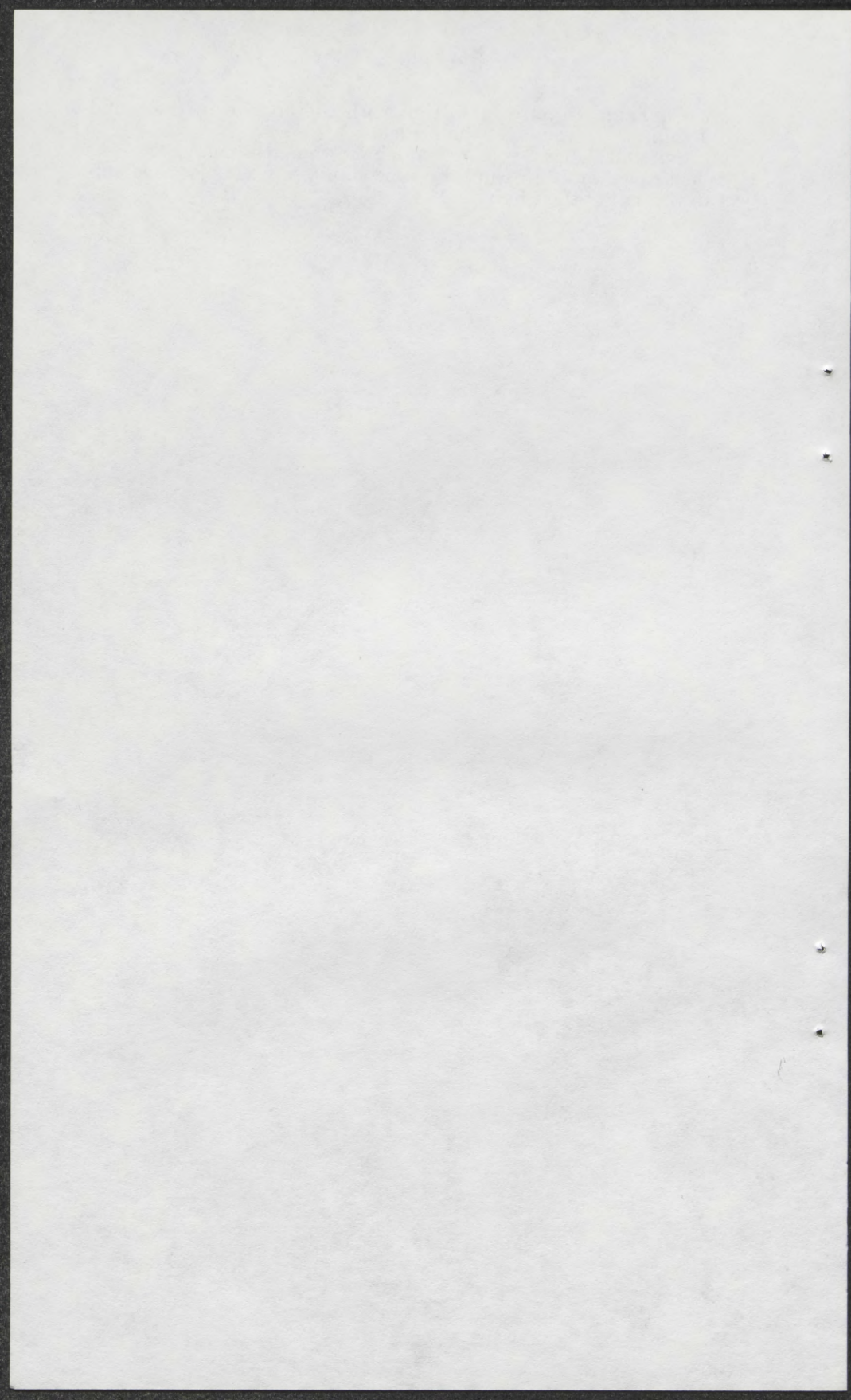
Mr. SCHEUER. I think one lesson here is NHTSA should have the capability of doing more ongoing analytical work than it has the staff to do and hopefully you would support us in petitioning OMB to give NHTSA the money to do the job that I am sure Mrs. Claybrook would like to do.

Mr. BROYHILL. One way we can do that is to mandate it by law, Mr. Chairman, and that will take care of it.

Mr. COPAKEN. If you couple that with the change in the standard, I think they would get the pledge.

Mr. SCHEUER. Thank you very much for your testimony.

[Whereupon, at 12:15 p.m., the subcommittee was adjourned subject to the call of the Chair.]



NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION—AUTHORIZATION AND OVERSIGHT

WEDNESDAY, MARCH 28, 1979

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON CONSUMER PROTECTION AND FINANCE,
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE,
Washington, D.C.

The committee met at 1:45 p.m., pursuant to notice, in room 2322, Rayburn House Office Building, Hon. James H. Scheuer, chairman, presiding.

Mr. SCHEUER. The Subcommittee on Consumer Protection and Finance will now commence its second day of hearings on bumper standards. This is part of our authorization hearings on H.R. 2585, which authorizes appropriations for the National Highway Traffic Safety Administration.

Now, a matter of a week or two ago, on the first day of our hearings, we focused on the agency's bumper standard. This day of hearings is designed to conclude that consideration. Perhaps a brief review of the bumper standard would be in order now. The original safety standards affecting bumpers, Federal Motor Vehicle Safety Standard No. (FMVSS) 215, first became effective in the 1973 model year. This standard was designed to protect safety-related items, actually, such as rear and front lights, exhaust systems, radiators, brakes, and so forth from any damage at an impact at speeds up to 5 miles an hour.

The standard had the collateral benefit of reducing other damage to the car, too, in low-speed collisions. When the Federal Motor Vehicle Safety Standard No. 215 became a standard, the new authority required that the bumper standard be based principally on economic considerations. The goal was mainly to provide the economy and cost effectiveness to the public and to the consumer, to the carowner. It provided that economy would include saving of time and inconvenience; health and safety issues; and out-of-pocket cost resulting from a low-speed accident at speeds up to 5 miles an hour.

In 1976 a new bumper standard was promulgated which became effective on September 1, 1978. It prohibited damage to any part of the body of the vehicle at a 5-mile-an-hour impact speed but allowed some damage to the bumper itself. All 1979 model year cars are subject to this bumper standard, which is a phase I standard. Phase II, which becomes effective in September of this year, will limit the damage that the bumper itself may sustain at 5 miles per hour to small dents. In his last appearance before this subcommittee, the representative of Houdaille Industries requested that we

legislatively roll back the bumper standards from 5 miles an hour to 2½ miles an hour. In connection with this request, they presented a study that raised real questions on the cost-effectiveness of the present bumper standard. At that time, the Houdaille study was the only available material on the subject. NHTSA, which promulgated the bumper standard, is still conducting a comprehensive cost-benefit analysis of the regulation. However, since our first day of hearings 10 days or so ago, several other groups have requested to be heard on the cost-effectiveness of the current 5-mile-an-hour standard. They have told us that they have information which bears directly on the question of whether this subcommittee should or should not change that standard.

It may be that one answer is for this committee to make a complete study de novo of the cost-effectiveness of this bumper standard in connection with future rulemaking. I have invited these gentlemen and these groups to appear before us today. I have also invited Houdaille Industries to come back and respond to what they say.

So what we are going to do is have a panel here composed of four gentlemen who, I think, will tend to support the present standard. We are going to have a representative of Houdaille Industries who will sit in on the panel and respond.

What we are going to do is ask these five people, then, to come to the table. Each of them will make a 10-minute presentation of his point of view.

Houdaille also will have 10 minutes to restate its point of view which was elaborated in extenso at our first day of hearings. They will also have a chance to comment on the testimony they hear. We will call you individually to come up and testify for 10 minutes: We will try to hold most of our questions, though perhaps not all. Thus, we will ask questions from time to time, I am sure, but we will try to keep many of our questions to the end. Then the Houdaille representatives will have a chance to state their case and also to respond to what they have heard. Let's hear first from Mr. Ben Kelley, senior vice president of the Insurance Institute for Highway Safety. Your remarks will be printed in their entirety in the record, Mr. Kelley.

Perhaps you would like to speak to us informally for 10 minutes, and any questions we ask you will not come out of your time. We will extend your time from that point. After all five witnesses have spoken, you will all have time to make additional remarks.

STATEMENT OF BEN KELLEY, SENIOR VICE PRESIDENT, INSURANCE INSTITUTE FOR HIGHWAY SAFETY, ACCOMPANIED BY BRIAN O'NEILL, VICE PRESIDENT FOR RESEARCH

Mr. KELLEY. Thank you, Mr. Chairman.

I am conscious of the 10 minutes and will stay within it, of course.

With me today is Brian O'Neill, our vice president for research of the Insurance Institute for Highway Safety.

I began my written testimony by pointing out that NHTSA recently has initiated a very broad-ranging quest for comment and data in this matter by issuing an advance notice of proposed rule-making. And now that we are only 7 months down the line with

the operation of the new part 581 bumper standard, NHTSA has quite appropriately decided to take a look at the various claims, assumptions, data, crash-test results, and views of the many parties to this in an effort to find out what is happening with that standard in the real world.

We have expressed problems in the past about the standard ourselves, not problems that Houdaille shares, perhaps, but problems with the inappropriateness of the test criteria that NHTSA has been using in the past. We have shown this subcommittee on numerous occasions films of some of the problems that remain in the real world with real world car designs, such as override and underide and, corner damage—the sorts of problems that we think the agency should be looking at on the basis of its own test work, and others, over the next months in an effort to make the standard a more effective one.

Although we don't agree with parts of the standard test criteria as they exist today, we would not for a minute presume to come before the subcommittee and suggest that you arbitrarily change the standard short of letting NHTSA do a very good, thorough job of analysis it has now embarked upon.

You wrote to us recently, Mr. Chairman, asking us for an extensive analysis of the Houdaille so-called cost-benefits study. I would not repeat, and indeed, time would not begin to allow me to repeat, the many, many problems we have with the Houdaille cost-benefit study, which we analyzed for you in our response. Our critique is attached to my testimony.

Suffice it to say that Houdaille's analysis was not in any way a cost-benefit analysis of the NHTSA bumper performance standard. Indeed, there can be no cost-benefit analysis of a performance standard. There can be cost-benefit analysis only of individual bumper systems. Houdaille chose to look at one bumper system, the Aspen-Volare bumper system, one of the heaviest and poorest performing and most costly to replace on the road today. And they found that that bumper system, which I believe is made by their own company, does not do a good job in their kind of cost-benefit analysis at 5 miles an hour. They compared it with something they called a 2½-mile-an-hour bumper, one which, at is turned out, suffered more than \$100 worth of damage in their own 2½-mile-an-hour crash test.

We think the Houdaille cost-benefit analysis can simply not be taken seriously, and in many pages of analysis, we have explained why. I would point out that one of the many examples of the fatal flaws in the Houdaille analysis is that Houdaille used a mathematical procedure for predicting the intervehicular crash damage, the amounts of damage which might be sustained by the Aspen-Volare. That predictive procedure was so inaccurate it predicted a damage value of \$230 for the impacting car striking another in a front-to-rear crash. Actually, in the real world, in real front-to-rear crashes, we showed your subcommittee 2 years ago that the very same car sustained a damage of only \$130. Thus, Houdaille's procedure produced an estimate which was nearly 80 percent off what actually happened in a real crash test in the real world.

We have also looked at the NHTSA preliminary analysis, one which has been cited as a possible reason for rolling back the

present standard. NHTSA had a more acceptable methodology and did a more comprehensive look than Houdaille, but NHTSA's study collapses on a number of points.

The basic point—and this is a flaw shared both by the Houdaille and the NHTSA study—is that they were not looking at bumper systems under the part 581 standard. They were looking at bumpers systems under the earlier Federal Motor Vehicle Safety Standard No. 215. The part 581 standard, as I mentioned at the outset, has only been in effect for 7 months, and it is only now becoming possible to look at some of the early results from that standard.

In addition, in attempting to compute the weights and therefore the costs of 2½-mile-an-hour versus 5-mile-an-hour standards and bumpers under those standards, NHTSA used a rather simple-minded formula in which it said that a 2½-mile-an-hour bumper would equal a 5-mile-an-hour bumper without the energy absorbers. They forgot, however, that you have got to have something to hold the bumper on to the car, and that that something has got to be some sort of a reinforcing or rigid strut that supports the bumper, whether it is 2½ or 5 miles an hour. NHTSA forgot to add in weights, and therefore costs, for those components, and therefore its cost figures are simply invalid. We believe the agency itself recognizes the failure in the so-called preliminary analysis and intends to correct it in the future.

We have brought with us today a number of bumper systems to show you what really is going on in the real world and we will very briefly show those to you now.

As I mentioned, gentlemen, the Houdaille analysis is based upon this bumper system [indicating]. That is a 1978 Volare steel bumper system. The total weight of this system, with this backup bar and everything else, is 78 pounds. That meets the former Federal Motor Vehicle Safety Standard 215. We assume it meets the current standard but we don't know that from our own test work.

The energy absorbers for that system, as you can see and feel, are a pretty big hunk of metal. Alternatives available——

Mr. SCHEUER. How many of those are there on the car?

Mr. KELLEY. Four: two in the front and two in the back. Alternatives available in the real world but not looked at by Houdaille in its study——

Mr. SCHEUER. Norman, would you like to come up and join us? We would be happy to have you join us.

Mr. KELLEY [continuing]. Include in steel this [indicating], the front bumper system of a 1978 Oldsmobile Cutlass, the same size car, the same year, except this system weighs 49 pounds instead of 78 pounds for the Aspen-Volare. This is the bumper mount right here [indicating], which is about half the size of that you looked at a moment ago, and it does the job just as well as this bumper mount right here [indicating], which is about half the size of that you looked at a moment ago, and it does the job just as well. Moving to much more lightweight systems, the same size car, this is the AMC Concord bumper and it weighs a total of 25 pounds for the entire bumper system. The shock mount is this, which weighs even less than what we have looked at already.

Those are light weight bumper systems in the real world today which are doing a very, very efficient job.

Mr. SCHEUER. In terms of energy absorption, how does it compare on a cost basis and on a per-pound basis?

Mr. KELLEY. On the basis of our crash tests, looking at this car [indicating] compared to that one in earlier years [indicating], this [indicating] does a much better job. And we have tested it under a number of configurations.

Mr. SCHEUER. Per dollar and per pound?

Mr. KELLEY. Oh, yes, definitely per dollar and per pound. And I might add this [indicating] is by far a superior system. We have done a broader range of crash tests than Houdaille did. It simply did some front and rear barrier tests. We have done barriers, corners, intervehiculars, the whole range. And this [indicating] performs much better.

Mr. SCHEUER. It does better on all of them?

Mr. KELLEY. Yes, sir. And here is what could be on cars today, and that is an energy absorbing unit made by Tayco, Taylor Industries, a leading energy absorption equipment manufacturer. That is the energy absorber. It weighs 1 pound and 2 ounces. This is what holds it [indicating], and that weighs 2 pounds and half an ounce. That is a 5-mile bumper support.

Mr. SCHEUER. Two pounds and one-half ounce?

Mr. KELLEY. Yes.

Mr. O'NEILL. This piece must be there.

Mr. KELLEY. This is a 5-mile-an-hour bumper support right here. That is a 2½-mile-an-hour bumper support right there, a saving of only 1 pound times 2. This weighs even less. It is an experimental plastic model, that is 15 ounces, and that is full performance, exceeding today's Federal standard under phase 2 of the part 581 Federal standard, and that is what you can do in the marketplace with competition. We tested a few years ago, Mr. Chairman, a car, a standard AMC Gremlin, a 1977 model with a steel bumper. We wanted to know whether one really had to add a lot of weight to an existing bumper in order to get much better performance. So we asked Tayco, Taylor Corp., up in Tonawanda, N.Y., who design things like Polaris missile shock mounts and automotive shock absorbers, to modify an AMC Gremlin for us to substantially exceed the performance of today's bumper.

I would like to show you now the film, first shown to this subcommittee 2 years ago, of the results of that.

[The film is shown.]

Mr. KELLEY. We are looking now at the modified Gremlin bumper, with virtually no addition in weight to the bumper, perhaps one ounce. And we could have taken about 10 pounds out of the bumper if we had had more than 6 weeks to do this job, but that is all we had. It is going at not 5 but 7 miles an hour, front into barrier, a steel bumper. And there is zero dollars worth of damage.

Mr. BROYHILL. To the bumper or to the—

Mr. KELLEY. To the bumper and the entire car, sir; everything.

Here [indicating] is the standard 1977 Gremlin bumper, which we also tested, 5 miles an hour, front into an angle barrier test. This is a very demanding test. It isolates and concentrates the forces into one small area, and you see the result with the standard bumper. It is about average for the cars we tested, a little more

than \$230 in damage to the bumper and to the cosmetic grill and the surrounding sheet metal.

Finally, we will see our modified bumper, the same weight, but simply using better shock mounts, lighter weight shock absorbers. It goes in in the corner test, also concentrating the loadings on the corner, and here you see the bumper guards meeting the barrier and the bumper itself. Zero damage. Not one penny. It not only can be done and be done simply in the real world, but in the U.S. marketplace, and technological innovation in this country has shown for quite a while that it can be done and done much more cheaply, even, than the bumpers we had before any standard took effect.

That is the end of the film.

Mr. BROYHILL. Were these steel bumpers or a combination?

Mr. KELLEY. Steel, sir, at that time. Were we doing this today, we might look at a combination of materials, but those are steel bumpers. We have every reason to believe that steel bumpers are very competitive in the marketplace and will continue to be so.

Mr. Scheuer, I have been clockwatching, and that concludes 10 minutes exactly. I will therefore say we will be happy to answer any questions.

[Testimony resumes on p. 173.]

[Mr. Kelley's prepared statement and attachments follow:]

STATEMENT OF BEN KELLEY, SENIOR VICE PRESIDENT, INSURANCE INSTITUTE FOR
HIGHWAY SAFETY

In response to your invitation, we are appearing today to comment on the Part 581 bumper standard promulgated by the National Highway Traffic Safety Administration under Title I of the Motor Vehicle Information and Cost Savings Act of 1972, and in particular on recent developments involving the future of the standard.

On February 26 of this year, NHTSA issued a broad-ranging advance notice of proposed rulemaking inviting comments on a wide range of very important questions concerning its Part 581 standard, issued under the mandate of the 1972 Motor Vehicle Information and Cost Savings Act, to improve the damage-reducing performance of new-car bumpers.

On the basis of Institute crash test results and our analysis of technological information available in the real world, the Institute for some time has believed that NHTSA's present test criteria for the Part 581 bumper standard are in some respects inadequate and inappropriate -- for instance, to the extent that the present criteria continue to permit bumper override-underride, with resulting damage, in low-speed intervehicular crashes.

Nevertheless, we also believe that the standard -- which, after all, has been in effect for less than seven months -- should not be modified until NHTSA has had the opportunity to gather ample data on the performance of the scores of different current bumper systems chosen by manufacturers to meet the standard, as well as on present and future bumper design plans of automobile manufacturers and the true values of costs and consumer benefits associated with a broad range of bumper designs.

Thus, we welcome NHTSA's invitation for submission of data and comment on the Part 581 standard. The Institute will respond by conducting extensive crash tests involving a range of bumper systems and performance criteria, as

well as by analyzing real-world information on the performance of past and present bumper designs.

The need for good data on bumper designs in general and the effect of the current Part 581 standard in particular is sharply pointed up by two recently completed analyses that have been cited by Houdaille Industries, a manufacturer of steel bumpers, as claimed justification for an immediate rollback of the standard to one calling for only a 2½ mile an hour "direct barrier" impact to front and rear bumpers. Houdaille has attempted to justify its desired rollback -- which in effect would be an abandonment of any standard whatsoever, if Houdaille's request is taken literally -- on the basis of a so-called cost-benefit analysis prepared by Houdaille contractors and also on the basis of a preliminary analysis of the bumper standard recently published by NHTSA. The Houdaille analysis attempts to prove that the 2½ mile per hour standard sought by that company would be more cost beneficial to consumers than the present, 5 mile per hour standard. The NHTSA preliminary analysis finds that both the present 5 mile per hour standard and a 2½ mile per hour standard yield substantial net benefits to consumers.

Both analyses are fatally flawed, and if they were depended upon as a basis for short-circuiting NHTSA's current data-gathering process, could produce similarly flawed public policy.

The Houdaille Analysis: Recently the Institute was requested by your Subcommittee to comment on the Houdaille analysis. We responded with a full-scale evaluation of the analysis. Appendix A contains the evaluation and the extensive technical backup supporting it.

In summary, we found that Houdaille's analysis, despite its authors' claims, is not in any way a "cost benefit analysis" of either the present standard or a 2½ mile per hour standard. It is simply an attempt -- an

unsuccessful one, as it turns out -- to study the costs and benefits of the bumper systems on two versions of the 1978 Chrysler Aspen-Volare. Since the Aspen-Volare has one of the heaviest, least effective bumper systems available, its use to typify all bumpers on the road guarantees making the current standard look bad.

NHTSA's bumper standard sets criteria for performance, not design. Thus, it encourages manufacturers to choose from a wide range of designs and materials in meeting the standard. A competent cost-benefit analysis would have selected lighter-weight, lower cost, more damage resisting bumpers than the Aspen-Volare's.

As an illustration of its many fatal flaws, the Houdaille analysis, using limited barrier crash test results, attempts to project the cost of intervehicular crash damage for the Aspen-Volare. Its mathematical procedure for doing this is so inaccurate that it predicted a damage value of \$230 for the impacting Aspen-Volare in a 10 mile per hour front-to-rear crash. Actually, in a real 10 mile per hour front-to-rear crash test of the same car, carried out by the Institute two years ago, the damage to the impacting car was only \$130. Thus the Houdaille procedure produced an estimate that was nearly 80 percent off the mark -- in a direction that favored Houdaille's erroneous conclusions concerning the present bumper standard.

Valid conclusions as to the complete range of consumer benefits to be gained from any bumper system or systems being evaluated depend upon reliable, real-world information concerning crash frequency, repair frequency, average repair costs per crash for repaired vehicles, crash speeds and many other factors for all low speed crashes, including those not reported to either police or insurers for a wide variety of reasons, such as that the improved bumpers have so reduced damage that there is nothing to report. Real-world

data for at least some of the foregoing factors must be known or dependably estimated for the conclusions to be credible and relevant. No such data were used by Houdaille, which instead relied on unsubstantiated and undependable estimates in its study.

For these and the additional reasons discussed in full in Appendix A, the Houdaille "study" is without merit.

NHTSA's Preliminary Analysis: The Institute also has completed an evaluation of NHTSA's preliminary analysis, which is Appendix B to our testimony. The NHTSA study is much more comprehensive than the Houdaille study, since it covers not just one but a number of bumper systems, and also uses a sounder methodology.

Nonetheless, it is fatally flawed in its incorrect estimates of bumper costs and weights -- estimates which, had they been accurate, would have demonstrated a clear advantage in consumer benefits for bumpers of modern designs, whether of steel or other material, that meet the current standard over similar designs meeting a 2½ mph standard.

In attempting to assign weights, which it then translated directly into costs, for bumper systems meeting the present, 5 mile per hour standard, NHTSA made a number of mistakes. First, it used information for 1977 and 1978-model cars -- cars with outdated bumper systems -- rather than for cars of the current model year. The cars for which NHTSA used cost and weight information were actually certified as satisfying only the former FMVSS 215 safety bumper standard, not the present Part 581 property damage bumper standard. And, rather than fitting into the "aluminum" and "steel" categories set up by NHTSA's analysis, the metal bumpers cited by the agency actually were often hybrids -- steel systems with aluminum reinforcements or aluminum systems with steel energy absorbers and reinforcements. Thus, the distinctions between the categories are vague or non-existent, NHTSA's conclusions to the contrary.

Had NHTSA looked at current, 1979 models and planned 1980 models instead of obsolete bumpers on 1977-78 models, it would have come to quite different conclusions about costs and weights. It would have discovered that the weights of the newer bumper systems are being substantially reduced. For example, some use "dual phase" steel which doubles the bending strength of a bumper with no weight increase. Newer technologies can produce steel bumper systems that weigh one percent or less of the car's curb weight -- even though for cars cited in the NHTSA study, the best steel system still represented 2.5 percent of the curb weight. As for aluminum, Alcoa has recently developed a new aluminum alloy which can reduce the weight and cost of aluminum components by 20 percent while retaining the same performance levels.

Because NHTSA erroneously depended on weight information from the outmoded 1977 and 1978 systems, it concluded that a typical 5 mile per hour steel bumper would weigh 162 pounds, or 43 pounds more than a typical bumper in the 1970-71 model years, which preceded introduction of even the FMVSS 215 safety bumper standard. But the fact is that as a result of design and material improvements, some bumpers on 1979 and 1980 models are weighing substantially less than even bumpers from those early model years! These are, of course, design and material improvements available to any and all auto manufacturers who desire to give their customers the best bumpers possible under the new Part 581 standard.

The crux of NHTSA's finding of important weight differences between metal 2½ mile and 5 mile per hour bumper systems is the agency's assumption that the energy absorbers and reinforcements needed for a 5 mile per hour system would not be needed for a 2½ mile per hour system. Using this assumption in its cost estimates for 2½ mile per hour bumpers, NHTSA subtracted the weights of the energy absorbers -- which hold the bumpers to the cars -- used in the 1977

and 1978 models it surveyed. But it neglected to add into its resulting estimates for the 2½ mile per hour bumpers any weight or cost for brackets or supports to hold the bumper face bar onto the car, the energy absorbers having been removed!

In fact, in the cars looked at by NHTSA, steel support brackets for 1977-78 car bumpers that do not use energy absorbers range in weight from 10 to 21 pounds -- very little less, that is, than the 8 to 28 pounds of weight for bumper energy absorbers on cars of the same model years. By ignoring bracket and support weights, NHTSA substantially understated the weight, and therefore the resulting cost, of so-called 2½ mile per hour bumper systems.

NHTSA also made the unfounded assumption that, since crash forces increase proportionately to the square of crash speeds, bumper system weights must similarly increase as crash speeds increase. Thus it assumed that a 7½ mile per hour metal bumper system would have to weigh 2½ times as much as a 5 mile per hour bumper system.

But as earlier Institute crash tests results have shown, this is simply not the case. In 1977, at the Institute's request, Tayco Development Corp., a manufacturer of energy-absorbing systems for automotive and other applications, modified a 1977 AMC Gremlin's steel bumper system -- one certified as meeting only the FMVSS 215 bumper safety standard in effect at that time -- so that it was able to sustain a 7 mile per hour direct barrier impact with no damage whatsoever.

The modified bumper weighed virtually the same as the original, unmodified version. Scaled to the 3600 pound car assumed by NHTSA's study, it would weigh about 175 pounds per car -- or 189 pounds less than NHTSA's estimate of weight for a 7½ mile per hour steel bumper.

Here is a film of that bumper's performance -- both in the 7 mile per hour direct barrier impact test and in a demanding, 5 mile per hour angled barrier impact which concentrates force on the car's front corner:

(FILM HERE)

NHTSA's analysis contains yet other serious errors as to bumper costs and weights. For instance, it overstated the weights of soft faced bumper systems -- systems capable of meeting a 7½ mile per hour standard -- by dozens of pounds. And, it overlooks the fact that soft face systems may replace all or parts of fenders, quarter panels, grilles and other parts, thus replacing the weight and costs of those components as well. Here again, the analysis substantially overstates the costs to consumers of bumper systems able to provide consumers with substantial protection against damage in low-speed crashes at 5 or even 7½ miles per hour.

Mr. Chairman, we believe that NHTSA has shown good judgement in issuing its recent advance notice of proposed rulemaking and in seeking to gather a wide range of data, information and comment on present and future bumper standards. The agency's own study, as well as the Houdaille study, will be available as part of that process for analysis and comment by the many interests having a stake in the standard's effectiveness. In addition, we and others will be able to carry out crash testing and data evaluation in support of the agency's quest for information on the standard. If all interests are given fair and full hearing, the result should be a better, more effective standard in response to the mandate of the 1972 Act.

We will be happy to answer any questions.

APPENDIX A

Letter from William Haddon, Jr., M.D., President, Insurance Institute for Highway Safety, to the Honorable James H. Scheuer, Chairman, Subcommittee on Consumer Protection and Finance, March 19, 1979, with nine (9) attachments:

- I. Insurance Institute for Highway Safety. Analysis of the Comments of Houdaille Industries on the Bumper Standard in DOT HS-803-867, March 1979.
- IIA. O'Neill, Brian and Kelley, A. B. Costs, Benefits, Effectiveness and Safety: Setting the Record Straight, SAE Paper No. 740988, October 1974.
- IIB. O'Neill, Brian; Kelley, Albert Benjamin and Wong, Jackson. "Evaluating Motor Vehicle Safety Performance Standards," Proceedings of the Fourth International Congress on Automotive Safety, July 1975.
- III. The International Nickel Company, Inc. Excerpt: Table I: Summary - Bumper/Vehicle Cost & Weight from A Cost Weight Study on Production Bumper Systems, 1978.
- IV. United States Department of Labor. NEWS: Report on Quality Changes for 1979 Model Passenger Cars, November 3, 1978.
- V. Riffe, William J. No Damage Steel Bumpers - A New Approach, SAE Paper No. 770212, February 1977.
- VI. Kary, John J. Weight Reduction of Automobile Bumper Systems, SAE Paper No. 760012, February 1976.
- VII. Mantey, Harvey H. L. and Burton, Fred T. Dual Phase Steel Production Bumpers, SAE Paper No. 790281, February 1979.
- VIII. General Motors Corporation. Taxi Fleet Field Evaluation of the Soft Face Bumper System Concept, undated.
- IX. Motor Trend. "Bumpers That Flex," February 1978.

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March 19, 1979

Honorable James H. Scheuer, Chairman
Subcommittee on Consumer Protection and Finance
of the Committee on Interstate and Foreign Commerce
Room 3275
House Office Building Annex No. 2
Washington, D.C. 20515

Dear Chairman Scheuer:

I am responding to your letter of March 7 asking for this Institute's comments on the bumper standard presently in effect under Title I of the Motor Vehicle Information and Cost Savings Act of 1972, and also on the recent submissions of Houdaille Industries seeking to have the current standard weakened to require only a 2½ mile per hour "barrier only" test impact.

In response to your letter of March 7 we have carried out an analysis of the Houdaille submissions (Attachment I) and also have developed some observations on the present standard that we believe will be useful to the Subcommittee.

The Houdaille Study

The key to the Houdaille study is a series of front and rear barrier impact tests carried out by Houdaille's contractors on two versions of only one car model -- the U.S. and Mexican versions of the 1978 Chrysler Aspen-Volare. Houdaille states that the Mexican version has bumpers that "provide protection essentially equivalent to what would be required by a 2.5 mile per hour barrier-only standard."

The crash test performance of the "Mexican version" bumper thus is central to Houdaille's arguments for a lower standard. As discussed below, in one of Houdaille's 2.5 mile per hour tests this bumper sustained more than \$110 in damage -- which Houdaille referred to as "minor" -- in contrast to the U.S. version, which sustained no damage at all even in Houdaille's five mile per hour tests. Adding up the damage in all tests run for Houdaille -- 2.5, 5, 10 and 15 miles per hour -- the total damage to the Mexican version was \$277 more than to the U.S. version, or \$6227 compared to \$5950.

The Insurance Institute for Highway Safety is an independent, nonprofit, scientific and educational organization. It is dedicated to reducing the losses--deaths, injuries and property damage--resulting from crashes on the nation's highways. The Institute is supported by the American Insurance Highway Safety Association, the American Insurers Highway Safety Alliance, the National Association of Independent Insurers Safety Association and several individual insurance companies.

On the basis of these crash test results and its use of a completely inapplicable set of formulas and assumptions, the Houdaille study claims to have "isolated the real-world impact" of the federal Part 581 bumper standard, and it concludes that the standard is less cost-beneficial than its proposed 2½ mile per hour standard.

The study and its conclusions are preposterous and without credibility. As our analysis shows:

1. The Houdaille study, its claims to the contrary, cannot in any way be considered a "cost-benefit" analysis of the Part 581 bumper standard.

Indeed, cost-benefit analysis of the standard per se is impossible, since it is a performance standard giving wide latitude to auto manufacturers to choose from any number of designs and materials, each with different cost and benefit implications. Only these individual designs can be analysed from a cost-benefit standpoint. (See Attachment II.)

2. Phase I of the standard has been in effect for barely seven months and Phase II, extending the no-damage requirement to bumpers themselves, has yet to take effect. In other words, prior to September 1978, there was no federal bumper standard in effect specifically aimed at reducing property damage in low-speed crashes. Therefore, no adequate real-world data are yet available on how these scores of individual bumper designs, chosen by the U.S. and foreign manufacturers for their various makes and models to meet Phase I or Phase II, actually are performing in the real world.

Any offer, by Houdaille or anybody else, of purportedly "real world" information on the net benefits to consumers of such bumpers is patently without foundation.

3. Information on the actual cost of present-day bumper systems is exclusively within the control of the auto companies.

Only the manufacturer knows exactly how much of a new car's price is accounted for by the bumper system -- and cost figures quoted by the companies may have little relationship to the actual costs to the manufacturers of such systems in the first place. As for bumper replacement parts prices, best estimates are that these routinely are ten or more times greater than the estimated costs of the same parts to the manufacturers. Compare, for instance, the published replacement parts prices with estimated costs of selected bumper systems to manufacturers as listed in the International Nickel Co. study. (Attachment III.)

Also, in some cases the replacement parts price has remained identical even when a manufacturer has made substantial design and material changes in its bumper system from one model year to another.

As to the actual cost of original-equipment bumpers, it is worth noting that for the 1979 model year -- the year in which Phase I of the Part 581 federal bumper standard took effect -- the Bureau of Labor Statistics has reported on the basis of industry-supplied data that manufacturer compliance with the

standard as well as with auto safety standards taking effect at the same time amounted to less than \$6 additional in the price of new cars. (Attachment IV.)

4. The Houdaille study is based on the bumper performance of only one car model in a limited number of barrier-only crash tests -- with no front-to-rear or other intervehicular crashes included.

The model is the Chrysler Aspen-Volare in its U.S. and Mexican versions, for which Houdaille supplies the bumper face bar. Institute data submitted to the Subcommittee at the December 4, 1978 hearing show that the bumper system on the U.S. version of the Aspen-Volare is considerably heavier, less damage resistant, and more costly to replace than bumpers on many other cars on the road today. By choosing this car, rather than one with a bumper system known to be lighter, more damage resistant and less costly to replace, the Houdaille study severely biased its results against the present standard.

For instance, had the study been based on a car with a better performing, lighter weight bumper, such as the AMC Concord or the Chrysler Omni-Horizon, the outcome would have been much more favorable to the present standard. Indeed, the Concord bumper, a five mile per hour design, weighs 38 pounds less than even the "Mexican" Aspen-Volare bumper, the 2.5 mph system being pushed by Houdaille as an example of more cost-beneficial design.

5. As mentioned above, a close examination of the data from the crash test program conducted for Houdaille reveals that in a 2.5 mile per hour "direct barrier" frontal impact, that car sustained more than \$110 in damage.

This is in contrast to the U.S.-model Aspen-Volare also crash tested for Houdaille. This car sustained no damage whatsoever in direct barrier impacts of five miles per hour, front and rear -- twice the speed at which the "Mexican" Aspen-Volare was damaged. (In the 5 mph tests, the "Mexican" Aspen-Volare sustained \$164 in frontal damage and \$104 in rear damage.)

In its December 27 "comments," Houdaille dismisses the damage to the "Mexican Aspen-Volare" in the 2.5 mph barrier test as "minor." Such "minor" damage, amounting to hundreds of dollars in parts, sales and labor both in 2.5 mph and 5 mph impacts, would be allowed to be designed into American cars of the future if Houdaille is able to persuade Congress or NHTSA to, in its words, "substitute a 2.5 mph barrier standard for the current 5 miles per hour bumper standard..."

Such delicateness would penalize all car-using Americans, but especially those in urban areas, since low speed impacts increase with vehicle density.

6. Houdaille's assumptions about what it calls the "real world" costs and benefits of present-day bumper systems are without justification.

In order to estimate damage costs over the lifetime of a vehicle, for each bumper design being evaluated the following data are required at a minimum -- none of which were available to or employed by Houdaille:

- Crash frequency
- Repair frequency
- Average repair costs per crash for vehicles that are repaired
- Average loss in vehicle value per crash for vehicles not repaired
- Average costs of damage to struck objects -- such as other cars
- Age of involved vehicles
- Impact point in any given crash
- Crash speed

7. Lacking all of the above data, the Houdaille study substituted an elaborate but invalid mathematical procedure riddled with guesses in place of information.

As a demonstration of the procedure's flaw, the Institute used one of Houdaille's equations to "predict" the front-end damage for a 1978 "U.S." Aspen-Volare in a 10 mph front-to-rear crash. The Houdaille equation produced a damage estimate of \$230. But in the real world -- that is, in a 10 mile per hour front-to-rear crash test actually carried out by the Institute two years ago and submitted in testimony to the Senate Consumer Subcommittee on March 22, 1978 -- the actual front end damage to the 1978 Aspen-Volare was only \$130. The Houdaille study's mathematical procedure, on which its cost-benefit conclusions and its condemnation of the present standard are based, produced an estimate that was nearly 80 percent off, and in a way that favored Houdaille's erroneous assertions.

These and other aspects of the Houdaille study are covered in Attachment I. The Houdaille study is so thoroughly flawed and limited that it proves nothing except that -- as was already well known from earlier Institute crash test results -- the Chrysler Aspen-Volare bumper, by the choice of the car's manufacturer and the bumper's designer, is one of the poorer on the market in terms of weight, performance and replacement cost.

In additional response to your request, the following are more general comments on the present bumper standard and the performance of bumpers in the real world.

1. The idea (implicit in the Houdaille study) that steel bumpers somehow are foreclosed a place in the market by the federal bumper standard, or by some combination of federal fuel economy and bumper performance requirements, is totally unfounded and disproved by relevant technical and trade literature.

More than two years ago, for instance, a U.S. Steel Corporation presentation to the Society of Automotive Engineers explained material and design approaches enabling the use of steel bumpers in compliance with Phase II of the federal bumper standard, and at weights even below those of aluminum bumpers! The presentation described in detail a steel bumper that would "pass the 1980 no damage criterion and maintain the weight of the bumper plus energy absorbers at less than one percent of the gross vehicle weight." (See Attachment V.) That is in striking contrast to the U.S. Aspen-Volare bumper tested by Houdaille, whose weight accounts for 4.5 percent of the car's curb weight.

Even earlier, in 1976, a General Motors presentation to SAE disclosed breakthroughs in the use of steel that allowed "weight reductions up to 36 pounds per vehicle" -- including, in one example shown by GM, a weight savings of 23.5 pounds by replacing an aluminum bumper with a steel one! (Attachment VI)

Most recently, another General Motors presentation to SAE described the use of higher strength "dual phase" steel as "an effective method of reducing bumper weight while meeting ever increasing government performance requirements." In a real-world example, that of the Cadillac Eldorado, the presentation noted that by using such steel and good design, the weight of the car's bumper for the 1979 model year was reduced so drastically that its weight ratio to the car's curb weight was below three percent, or as low as that of the car's bumpers prior to the adoption of the federal safety bumper standard in the 1973 model year! (Attachment VII)

(Houdaille's apparent inability to compete for bumper orders does not seem at all representative of the steel industry's experience generally, nor does it seem to reflect a willingness by Houdaille to itself use the technological progress of its field -- rather than government protection -- to remain competitive in the marketplace.)

2. To roll back the Part 581 bumper standard now would be to roll back the incentive it has created for materials and design innovations not only in steel, but also in aluminum and plastics as well -- not to speak of the investments that fabricators of these materials for bumper use may have made in response to the standard.

As the NHTSA's current Research Safety Vehicle (RSV) Program has shown, soft-faced bumpers using plastics already are easily capable of preventing damage to themselves and to cars impacted by them at barrier-equivalent test speeds even higher than those specified in the Part 581 standard. (The Institute introduced data and films of RSV soft-nosed bumper performance in crashes at a hearing before your Subcommittee on October 19, 1978.)

In the real world, a GM study of the performance in New York City of 1973-model taxis equipped with a GM-designed soft-nosed bumper (the only real-world evaluation to date of bumper performance, and one completely ignored by Houdaille in its study) found that the rate of damage-sustaining incidents for the soft-face vehicles was 34 percent less than such incidents for the standard bumpers. (Attachment VIII)

Also in the real world, the standard is encouraging soft-faced designs that will exceed even the RSV's performance. As Attachment IX indicates, one major manufacturer of flexible bumpers is predicting that its design eventually "will be able to absorb impacts up to 13 miles per hour without damage to the cars." To "roll back" the present Part 581 standard would be to remove the incentive for such progress.

3. Any weakening of the Part 581 property damage bumper standard will automatically mean a weakening of FMVSS 215 -- the motor vehicle safety standard adopted by NHTSA starting in the 1973 model year.

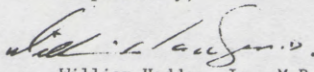
The standard requires that cars be designed to protect their safety-related components -- lights, brake lines, windshields, etc. -- from damage in five mile per hour barrier and other specified test crashes. Failure of such components in very low speed impacts means, of course, increased vulnerability of disabled vehicles to crashing, with resulting jeopardy to their occupants. Since the present Part 581 standard incorporates FMVSS 215, a weakening or virtual elimination of the former will have an identical effect on the latter -- something, incidentally, also not taken into account in any way in the Houdaille presentations.

* * *

Recently the National Highway Traffic Safety Administration (NHTSA) invited comment on a wide range of issues involving the current federal bumper standard and ways to improve it. The extensive data analysis and crash testing which the Institute must carry out in order to respond adequately to the NHTSA's request will not be completed for some months. We expect that when completed, this work, along with data and test results submitted by other parties to NHTSA's rulemaking, will enable the agency to develop an accurate, scientifically valid basis for modifying the standard toward encouraging auto manufacturers to provide their customers with bumper systems approaching the optimum in cost-benefit performance.

We will be happy to supply additional information and comment at the Subcommittee's request.

Respectfully,



William Haddon, Jr., M.D.
President

WH/cf

Attachments: (9)

Analysis of the Comments of Houdaille Industries
on the Bumper Standard in DOT HS-803-867

March 1979

Insurance Institute for Highway Safety
Washington, D.C. 20037

Introduction

Bumper standards issued under the 1972 Motor Vehicle Information and Cost Savings Act would appear at first impression to be ideal candidates for economic analyses since they are intended to reduce costs to the public and, because the expected benefits are primarily monetary, do not require controversial procedures such as assigning dollar values to life and limb.* Clearly, an optimum property damage bumper design would maximize the difference between the benefits it produced and the costs of compliance. Thus, the study of a number of alternative bumper designs with different performance levels to determine the one that is most cost beneficial would appear to be attractive.

It is important to recognize, however, that only specific bumper designs can be subjected to cost-benefit analyses; a performance standard, since it permits and indeed encourages a wide range of actual designs with corresponding differences in costs and in real world performance, cannot be evaluated in cost-benefit terms.**

DOT has the authority to issue only performance requirements for bumpers, thus enabling manufacturers to choose from a wide variety of alternative design approaches. Indeed, Congress gave DOT performance setting rather than design setting authority because by specifying performance rather than design requirements, design innovation on the part of the manufacturers is

*It is important to note, however, that the part 581 bumper standard issued under the Motor Vehicle Information and Cost Savings Act also incorporates the previously issued Federal Motor Vehicle Safety Standard (FMVSS) 215 which was justified as a safety standard, and that assessing it in cost-benefit terms would require assigning dollar values to life and limb.

**O'Neill, Brian and Kelley, Albert Benjamin. "Costs, Benefits, Effectiveness and Safety: Setting the Record Straight." Professional Safety, Vol. 20, No. 8 (August 1975), pp. 28-34.

encouraged. But, because this also means that different designs satisfying the same performance requirements can and do vary considerably in both their costs and real world performance, there must be some evidence that any particular bumper design chosen for study as indicative of the standard's effect is optimum with respect to the standard's performance requirements before any conclusions can be drawn concerning the bumper standard itself.

At the present time, there is no evidence that current bumper designs have been optimized.* For instance, for some years most manufacturers used relatively heavy and inefficient designs to satisfy DOT safety requirements for bumpers. Only in recent model years, when fuel economy requirements have prodded manufacturers to begin to emphasize weight-reduction designs, have lighter weight bumper systems been available.**

Bumper System Cost-Benefit Analysis

To perform cost-benefit analyses of bumper designs, it is necessary to have reliable information on the costs -- basically the initial cost and any increases or decreases in operating costs caused by the design -- and the benefits -- primarily reductions in the frequency of crashes and the amounts of resulting damage, but also including savings in time and inconvenience associated with getting crash damage repaired.

*Nor is there any evidence that the current DOT bumper performance requirements are themselves realistically related to real world crash damage. For many years now, the Insurance Institute for Highway Safety (IIHS) crash tests have shown huge amounts of unnecessary damage occurring in crash tests that are at the same or equivalent speeds to many of the crash tests specified in the performance requirements. It is quite apparent from the IIHS tests that many manufacturers have been designing bumper systems to meet the performance requirements of the DOT standard but with little or no consideration for real world performance.

**Kelley, Ben and O'Neill, Brian. Statement Before the House Committee on Interstate and Foreign Commerce, Subcommittee on Consumer Protection and Finance Hearing on Automobile Repairs, December 4, 1978. Washington: Insurance Institute for Highway Safety, 1978.

Bumper System Costs

Obtaining reliable cost information is very difficult. The manufacturers control virtually all of the information concerning the actual costs of a bumper design -- both the original manufacturing costs and the costs of replacement parts when repairs are necessary. The distinction between the costs to the manufacturer and the prices charged to the consumer is very important when assessing the costs and benefits of bumper systems. In the case of automobile replacement crash parts, it has been evident for some time both that the prices charged to the consumer are administered and that they bear little relationship, if any, to the costs to the manufacturer.*

Obviously manufacturers can significantly affect the conclusions of any cost-benefit analysis in which the parts prices charged to the consumer are used because such prices, particularly for replacement items, are not subject to competitive market forces and are arbitrarily manipulated. Thus, a manufacturer can produce any conclusion it desires by manipulating the obviously highly lucrative prices charged for bumper systems.

*Consider the following two examples:

Bumper face bar replacement prices for the 1978 and 1979 model AMC Concord are identical to the penny (\$116.07), yet the 1979 model face bar is made of aluminum and the 1978 model face bar is made of steel, Motor Crash Estimating Guide, Vol. 10, No. 11, November 1978.

Letter dated February 5, 1979 from Tayco to IIHS (attachment A) indicates that a supplier was prepared to sell bumper energy absorbers to the Chrysler Corporation at \$4.25 each for the Volare/Aspen. Yet the replacement price for a current Volare/Aspen energy absorber is \$59, a markup of over 1300 percent over the quoted cost to Chrysler!

Bumper System Benefits

The principal benefits expected from property damage bumper standards are reductions in the frequency of crashes and in the costs of the damage that would otherwise occur. Bumper standards are intended to provide protection in relatively low speed crashes -- crashes that, even lacking precise crash-speed data, are known to account generally for the bulk of dollars paid to repair crash damaged automobiles.

Cost-benefit analyses of bumper designs require estimates of crash frequencies and repair costs for ranges of crash speeds. The estimates used in the Houdaille study are rough approximations at best and unsubstantiated guesses at worst. None of the estimates used have been reliably validated. There is no reliable real world information on the distributions of crash speeds, particularly low speed crashes. In addition, there is no reliable source of information on the actual number of crashes occurring, in the real world -- again, especially the numbers of low speed crashes.

The reasons for the inadequacy of the available information relate to the nature of the sources of information on motor vehicle crashes, which are basically police departments and insurers. Police accident reports generally are not required in a crash unless the amount of damage exceeds some given threshold or a personal injury has occurred, and as a result most low speed crashes are not reported to the police. Similarly, first party insurance that provides coverage against damage to vehicles virtually always has deductibles; as a result, crashes below, and in many instances somewhat above, the deductible amounts are usually not reported to the insurers, since the repair work, if carried out, is paid for by the vehicle owner.

Unfortunately, crashes not reported to police and insurers are the most important ones to know about for evaluating bumper designs. In illustration, if two cars with good bumper systems collide, there may be little or no damage because of the bumpers; consequently the crash is unlikely to be reported to either police or insurers. However, if the cars have poor bumpers, the crash will result in significant amounts of property damage and will be much more likely to be reported.

Because of the major difficulties involved in obtaining useable information on crash speeds in the real world, the ideal study to assess the effects of a given bumper design is the type of study conducted by General Motors in 1973. In it, approximately half of a New York City fleet of vehicles was equipped with an experimental bumper system and the other half with a standard bumper system, and the resultant experience of the two groups of cars was compared.* (Because a fleet was involved it was possible to fully assess the total damage to each half of the fleet over a period of time.) At the present time this is the only type of study that can completely measure differences in real-world performance attributable to particular bumper designs.

Model Years Affected by Bumper Standards

Another reason that present attempts to perform cost-benefit analyses of bumper designs resulting from the federal property damage standard are

*This study compared the performance of two groups of taxis, one group equipped with "soft" front and rear ends and the other equipped with bumpers designed to satisfy the performance requirements of the federal safety bumper standard FMVSS 215. When the total amount of damage to each group was compared, the taxis with the soft face systems sustained 34 percent less damage per 10,000 miles than the standard taxis.

virtually impossible relates to the fact that various safety bumper performance standards have been in effect since 1972. Thus the most recent vehicles that were uninfluenced by any type of bumper standards were the 1971 models. Since there are significant demographic differences among the owners and use patterns of cars of different ages, attempts to compare the performance of 1971 model pre-standard cars with 1979 and 1980 models, the first models meeting a property damage bumper standard, are hopelessly confounded with other differences between the two model years that affect the frequency and severity of crashes.

The Houdaille Industries Cost-Benefit Analysis

The Houdaille analysis is not an analysis of the federal standard, as it claims. It is merely a comparison of two bumper designs used on the Chrysler Corporation 1978 model Volare and Aspen. The two bumper designs compared were on American Volare/Aspens meeting the FMVSS 215 safety standard and on Mexican versions of the Volare/Aspen which were equipped with what are termed "2.5 mph bumpers."* The choice of the Volare/Aspen, with a steel bumper system, was based in part on the repeated claims (both false) in the Houdaille analysis that aluminum bumper systems are not economically feasible and that the Volare/Aspen system is a typical steel system.

The Houdaille claims concerning aluminum designs can easily be refuted by comparisons of the prices and weights of a bumper face bar and associated energy absorbers for a 1979 AMC Concord, which uses an aluminum system, and a

*It is stated in the report that the bumper system used on the 1978 American version of the Volare/Aspen "... is built to conform to the current Part 581, 5 miles per hour damageability standard." The first phase of this property-damage standard however, was not applicable until the 1979 models, whereas the Volare/Aspens tested were 1978 models. Therefore, there is no assurance that the tested cars in fact did satisfy even the weak Phase I Part 581 requirements.

1979 Plymouth Volare. (See Table 1.) Both vehicles are in the same market class and approximate curb weight range, both meet the Phase I Part 581 bumper requirements, and the prices for both are within a few dollars -- but the aluminum system is substantially lower in weight than the steel system. And, the crash test performance of the Concord aluminum system is substantially better than that of the Volare/Aspen steel system. The overall crash test repair costs for the aluminum Concord system were nearly 20 percent lower than those for the steel Volare system, and in the 10 mph car-to-car crash tests -- which the Houdaille submissions claim are much more representative of the real-world than barrier crash tests -- the Concord repair costs were 76 percent lower than the Volare repair costs.

In fact, the Concord bumper system weight of 61 pounds is substantially lighter than even the Mexican Volare/Aspen steel bumper system, which weighs 99 pounds according to the Houdaille study. The Houdaille study furthermore, claims that the Mexican Volare/Aspen steel bumper system would be lighter than an American Volare/Aspen with an aluminum system which it claims would weigh 108 pounds!

Table II summarizes bumper system weights for the 1979 model year cars tested by IIHS; the Plymouth Volare has by far the heaviest bumper system.

The Volare/Aspen clearly has a very poor bumper design. It is unnecessarily heavy, performs poorly in a range of crash tests, and is more expensive than competing steel or aluminum systems. This fact by itself is sufficient reason to discount the Houdaille analysis.*

*In an addendum to the main study there is, according to Houdaille, also "... a cost benefit analysis of the only 1978 model car that we could find that comes in both a steel bumper system version and a soft face version: the Chevrolet Monza. The standard Monza is equipped with a steel system and the sports coupe is equipped with a soft face system." This statement is typical of the lack of technical knowledge demonstrated throughout the Houdaille document. The Monza sports coupe is not equipped with a soft face system. The bumper system has a metal "face bar" with hydraulic energy absorbers and the system is covered with a soft plastic face. Metal backup bars and energy absorbers are not used in true "soft face" bumper systems.

TABLE I

1979 Model Bumper System Prices, Weights and Crash Test Damage*

	<u>PLYMOUTH VOLARE</u>	<u>AMC CONCORD</u>
<u>WEIGHTS</u>		
Curb Weight	3223 lbs.	3135 lbs.
Bumper System Weight	146 lbs.	61 lbs.
Percent of Curb Weight	4.5%	1.9%
<u>REPLACEMENT PRICES</u>		
Face Bar	\$112.15	\$116.07
2 Energy Absorbers	<u>118.46</u>	<u>111.76</u>
TOTAL	\$230.61	\$227.83
<u>CRASH TEST RESULTS</u>		
5 mph Front-into-Angle Barrier	\$271	\$273
5 mph Rear-into-Pole	179	144
10 mph Front-into-Angle Barrier	795	750
10 mph Front-into-Rear:		
Front Damage	131	18
Rear Damage	142	48
Damage to Both	<u>273</u>	<u>66</u>
<u>TOTAL DAMAGE ALL TESTS</u>	\$1518	\$1233

*Source: Kelley, Ben and O'Neill, Brian. Statement Before the House Committee on Interstate and Foreign Commerce, Subcommittee on Consumer Protection and Finance Hearing on Automobile Repairs, December 4, 1978.
Washington: Insurance Institute for Highway Safety, 1978.

TABLE II
1979 Model Low Speed Crash Tests
Vehicle Bumper System Weights*

	Weight of Bumper System Including Mounting Hardware (Lbs.)			Car Curb Weight (lbs.)	Bumper System Weight as a Percent of Curb Weight
	Front	Rear	Total		
<u>SUBCOMPACTS</u>					
Plymouth Horizon	20	21	41	2265	1.8
AMC Spirit	29	33	62	2697	2.3
Ford Mustang III	58	48	106	2638	4.0
Volkswagen Rabbit	31	29	60	2029	3.0
Chevrolet Chevette	35	33	68	2139	3.2
Averages	35	33	67	2354	2.8
<u>COMPACTS</u>					
<u>AMC Concord</u>	<u>29</u>	<u>32</u>	<u>61</u>	<u>3135</u>	<u>1.9</u>
<u>Plymouth Volare</u>	<u>75**</u>	<u>71</u>	<u>146</u>	<u>3223</u>	<u>4.5</u>
Chevrolet Malibu	53	59	112	3158	3.6
Ford Fairmont	43	33	76	2882	2.6
Averages	50	49	99	3100	3.2
Overall Averages	41	40	81	2685	3.0

*Rounded to nearest pound.

**According to the Houdaille study the 1978 model front bumper system weighed 72.4 lbs.

However, even if the analysis had been based on a more efficient bumper design the results would still be worthless.

In order to estimate the damage costs over the lifetime of a vehicle, at a minimum the following information is required:

- ° Crash frequency
- ° Repair frequency
- ° Average repair costs per crash for vehicles that are repaired
- ° Average loss in vehicle values for vehicles that are not repaired
- ° Average costs of damage to objects struck.

The above data must be known by vehicle age. If these data are to be used in evaluating the effectiveness of a bumper system in reducing crash losses, then they must also be known by impact point and crash speed.

The Houdaille study was almost entirely based on data from 14 crash tests of Volare/Aspens, seven front-into-barrier and seven rear-into-barrier crash tests. These test data were then used in a mathematical model with no demonstrated relationships to the real world. Assumptions with no reliable foundations were used to estimate real-world crash frequencies by speed, and also to estimate the costs of repaired real-world crash damage.

The costs of real-world damage to objects struck, including other cars, were ignored!

In order to estimate relationships between repair costs and crash speeds an elaborate but invalid mathematical procedure was developed based entirely on crash test data. No real world data were used.

The Data

The Houdaille analysis employed three types of data:

- ° Repair costs for the American and Mexican versions of the Volare/Aspen in front-into-barrier and rear-into-barrier crash tests at 5, 10 and 15 mph, and in addition at 2.5 mph for the Mexican version.
- ° Estimates of the proportion of all crashes involving the front or rear bumpers. This proportion was assumed, without justification, not to depend on crash speed.
- ° The estimated coefficients of linear regression lines. Two of these related repair costs for the striking car in 10 mph front-into-side car-to-car crashes to repair costs in front-into-barrier crashes. Others related the repair costs for the striking car in 10 mph front-to-rear car-to-car crash tests to repair costs in front-to-barrier crash tests. These relationships were calculated from selections of IIHS crash test results.

The Scheme

In the Houdaille analysis average repair costs for a particular speed range (e.g. 2.5 mph - 5 mph) were estimated in four steps. First, barrier crash test repair costs were averaged for crash tests at speeds corresponding to the speed range endpoints (e.g. 2.5 mph and 5 mph). This was done separately for the front and rear barrier tests. Second, the front and rear estimates were then averaged using the presumed involvement proportions of the front and rear bumpers.

For the next step the Houdaille analysis assumed that crash test repair costs from front-to-side and front-to-rear crashes are more typical of real world crash repair costs than crash test repair costs from front and rear barrier tests. Consequently, to obtain average front and rear damage costs

for car-to-car tests, the weighted averages of front and rear damage costs for barrier tests for various speed ranges were substituted into the regression equations described above that were based only on frontal impact damage and 10 mph car-to-car tests. The result of substituting in the first regressions was supposed to transform average front and rear barrier crash test repair costs into front-to-side crash test repair costs. The result of the second substitution was supposed to produce similar front-to-rear crash test repair cost estimates. The results from these two substitutions were averaged yet once more to produce the figure that was described in the Houdaille submission as the "equivalent car-to-car accident damage costs" for the speed range. This four-step scheme was then repeated for the Mexican and the American Volare/Aspen vehicles in five separate speed ranges (0-2.5 mph, 2.5-5, 5-10, 10-15, greater than 15 mph).

The Errors

It is clear that the claim that these estimates represent real world crash data is preposterous. No real world crash data were used anywhere in the process!

The estimates do not even correctly represent car-to-car crash test repair costs. Estimates of car-to-car repair costs for the Volare/Aspen from barrier crash test damage costs were estimated from a statistical relationship between car-to-car and barrier crash test damage costs for a number of different vehicles. This scheme of "transforming" costs from one kind of crash test into another was clearly unnecessary since car-to-car crash tests of the Volare/Aspen could have been undertaken instead of the barrier crash tests that were conducted. Besides being unnecessary this scheme was also

incorrectly carried out and it produced a host of unneeded -- and unacknowledged -- uncertainties in the estimates.*

First, the regression lines used in the Houdaille analysis provide information about the relationships between car-to-car crash test damage costs and barrier crash test damage costs only for front impact damage and only for the test speed for which data were analyzed. These relationships were determined for car-to-car tests at 10 mph only. The implicit claim that the same relationships would hold for rear impact damage and at different car-to-car crash speeds is both completely unjustified and absurd. Despite this in the Houdaille analysis relationships that were determined from front impact damage only and car-to-car tests at 10 mph only were used to obtain estimates of both front and rear damage over the whole speed range.

Second, the statistical relationships between these two types of crash test damage costs left a large margin of uncertainty in the car-to-car crash test damage costs they purported to estimate. This uncertainty is measured by the residual error. If there is a lot of residual error in the statistical relationship between two quantities (e.g., weight and height for men), then the estimate for one of these quantities (e.g. weight) from the other (e.g. height) for a given pair of values (e.g. the estimate for the weight of a man from knowledge of his height) may be substantially incorrect. All that can be legitimately inferred from such statistical relationships is the percent of times the estimates (e.g. weights) are within a specified range given the value of the first variable (e.g. height).

*In fact, to illustrate the inherent errors in this process, IIHS used one of the Houdaille equations to predict the front end damage for an American Volare/Aspen in a 10 mph front-to-rear crash and obtained a value of \$230, whereas in an actual 10 mph front-to-rear test of a 1978 model Volare the actual front end damage was \$130. Thus the Houdaille procedure produced an estimate that was high by 77% -- not surprisingly, in Houdaille's favor.

As an example of this problem the regression lines employed in the Houdaille analysis had standard errors of the residual variation in car-to-car crash test damage costs of \$80 and \$88. To illustrate the effect of this, the Houdaille analysis used the regression equations with these errors to estimate crash damage costs for the Mexican Volare/Aspen of \$145 for the 5-10 mph range. Given the uncertainties due to the residual errors, all that could have been legitimately claimed was that these costs were likely to be somewhere in the \$0-\$313 range. It is clear that no valid comparisons can be based on estimates that may be off by more than a factor of two!

Conclusions

Despite the claims to the contrary, the Houdaille Industries comments do not include "... a cost-benefit study of bumper regulations." What they do represent is an absurd and fundamentally flawed study of the costs and benefits associated with a particularly poor bumper design chosen by one manufacturer for some of its 1978 models. Furthermore, the claim by Houdaille that this is "... the only study to our knowledge that has isolated the real world impact of the current federal bumper regulation" (emphasis added) is also untrue since its "study" is almost completely based on the results obtained from 14 crash tests and not real world data.

The conclusions of the Houdaille submission cannot be supported either quantitatively or qualitatively. The methodology employed is so fundamentally flawed that none of the conclusions concerning bumper standards, costs to consumers, or gasoline consumption can be supported by the analyses employed.

Jayco Developments, Inc.

February 5, 1979

200 Michigan Street
Tonawanda Island
North Tonawanda, New York 14120
Telephone: 716-694-0877

Mr. Jack Wong
Insurance Institute for Highway Safety
Watergate 600, Suite 300
Washington, D.C. 20037

Dear Jack:

The last contract in which we were involved with Rockwell International and Chrysler, the reported asking price was \$4.25 to Chrysler for a bumper shock made under our patents by Rockwell for Chrysler. According to Rockwell, we lost the contract by 2 cents. We believe with G.M.'s volume and tooling, it would not cost more than \$3.70 each or 50¢ under the larger more complicated G.M. design.

Incidentally, we believe our new design preferred by Chrysler engineering but ruled out by styling because a possible 1/4 inch of longitudinal positioning of the bumper (due to a Chrysler tolerance) should be less than \$3.50 out of aluminum.

As you know, we have been working on a plastic liquid spring bumper shock which could be as low as \$2.50 each based on our studies.

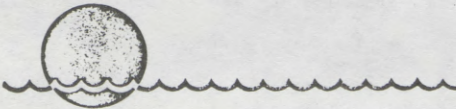
When you consider this price, remember it replaced a bracket on the car which costs at least 60-90¢ so you have to net out 60¢ from the bumper costs for a comparative price of a shockless system.

Further substantiation of the price is that DeLorean and Checker asked us to quote and we said what price do we have to beat from Delco. Both said \$4.20-\$4.25.

Yours very truly,

Paul H. Taylor
Paul H. Taylor
President

PHT/bjc



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**Costs, Benefits, Effectiveness
and Safety:
Setting The Record Straight**

Brian O'Neill and A. B. Kelley

Insurance Institute for Highway Safety

SOCIETY OF AUTOMOTIVE ENGINEERS

**Automobile Engineering Meeting
Toronto, Canada
October 21-25, 1974**

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Costs, Benefits, Effectiveness and Safety:

Setting the Record Straight

Brian O'Neill and A. B. Kelley

Insurance Institute for Highway Safety

INTRODUCTION

Society's goals for safer motor vehicles are expressed in two laws: the National Traffic and Motor Vehicle Safety Act of 1966 (1)* and the Motor Vehicle Information and Cost Savings Act of 1972 (2). These two laws direct the Federal government, through the National Highway Traffic Safety Administration (NHTSA), to translate motor vehicle safety goals into motor

vehicle safety standards. The standards are minimum performance (not design) criteria for new car safety.

The concepts of "cost-benefit" and "cost-effectiveness" are increasingly cropping up in debate over present and future motor vehicle standards. Often they are introduced to attack, or justify, a particular standard. Just as often, they are misunderstood and misused.

*Numbers in parentheses designate References at end of paper.

ABSTRACT

The concepts of "cost-benefit" and "cost-effectiveness" are increasingly cropping up in debate over present and future motor vehicle standards. Often they are introduced to attack, or justify, a particular standard. Just as often, they are misunderstood and misused.

Since a motor vehicle safety performance standard has no costs per se, it cannot be evaluated either in cost-benefit or cost-effectiveness terms. It is the particular design alternatives available to manufacturers to achieve the objectives of a standard that have societal costs. The various design alternatives can be evaluated.

Cost-effective designs should be

chosen to minimize societal costs, and until there is evidence that cost-effective designs have been chosen, cost-benefit studies are premature.

Even then, because of the major conceptual and methodological difficulties in the valuation of life and limb, cost-benefit studies will be appropriate only in the evaluation of designs not primarily intended to save lives and reduce injuries -- that is, vehicle designs to reduce property damage. Until manufacturers are forthcoming with accurate cost data, neither cost-effectiveness nor cost-benefit studies in this field can be relied upon. Pending legislation may resolve this.

The purpose of this paper is to define these two concepts of economic analysis, to show how very different one is from the other, and to provide discussion and examples of their growing misapplication in the area of motor vehicle safety standards development.

COST-BENEFIT ANALYSIS

Cost-benefit analysis measures a planned program's costs against its expected benefits, using identical monetary units of measurement -- most often dollars -- on both sides of the ledger. To oversimplify: the dam will cost \$10,000 (in manhours, materials, land, alternative land uses, displaced houses, etc.) to build. It will produce \$12,000 worth of benefits (hydroelectric power, arable land, flood reduction, increased recreation area, etc.).

Cost-benefit analysis can, in theory, be used to obtain socially efficient solutions to the resource allocation problems of an economy, and as such is an application of welfare economics. Such an analysis is concerned with the welfare of the complete economy, not any subset of it.

Cost-benefit analysis is based on the concept of the so-called "potential Pareto improvement," which is defined as a costless economic rearrangement in which the gains can be distributed so as to make everyone in the community better off (3).

In a cost-benefit analysis the present and future benefits and costs associated with the project under consideration are determined and compared. Future benefits and costs are usually discounted at some rate to reduce them to present values. In order to compare them, both the benefits and costs must be

expressed in common monetary units. They are usually compared either by computing the ratio of benefits to costs (the well known "benefit-cost ratio") or by subtracting costs from benefits (the net benefits). Benefit-cost ratios greater than one or positive net benefits are usually considered as economic justification for the adoption of the project under consideration.

There are no substantial theoretical or conceptual difficulties for cost-benefit analyses of projects in which the costs and benefits can reasonably be quantified in monetary units. If, however, the principal benefits anticipated are savings in lives and/or reductions in the frequency and severity of injuries which cannot be reasonably quantified in monetary units, serious theoretical and conceptual difficulties arise.

The same difficulties also arise where the costs of a project involve the loss of life and/or increases in the frequency and severity of injuries.

Virtually all cost-benefit studies involving the loss of life or limb have assigned fixed monetary values to human life and limb. Values for a life in such studies are typically obtained either by computing the discounted future income of individuals or by computing the discounted differences between future earnings and personal consumption. These concepts and approaches have been criticized on a number of grounds (4,5) and, in a detailed critique, Mishan (3) concluded that they are "economically irrelevant."

It is well worth noting that NHTSA has expressed a similar view. In its recent notice of proposed rulemaking concerning

school bus crashworthiness, the agency stated that it "has conducted conventional cost-benefit studies on school bus safety, but the normal valuation techniques evidently do not adequately reflect general public opinion on the importance of protecting children from death or injury. It is obvious from voluminous mail and Congressional interest that society places a much higher value on the safety of its children than a conventional cost-benefit analysis would indicate." (Emphasis added.) (6)

Goodwin (7) suggested that the criticisms of these "values of a life" can be avoided "only if it is clearly specified that the money value arrived at is a minimum that society would find it worthwhile spending in order to avoid a fatal accident." NHTSA (8) also emphasized "that placing a value on a human life can be nothing more than a play with figures. We have provided an estimate of some of the quantifiable losses in societal welfare resulting from a fatality and can only hope that this estimate is not construed as some type of basis for determining the 'optimal' (or even worse, the 'maximum') amount of expenditure to be allocated to saving lives."

Mishan (3) also concludes that other approaches as well are "economically irrelevant concepts." The only economically justifiable concept, he finds, is one based on the notion of "compensating variation," which is the amount each member of the community is willing to pay or to receive, in order to feel that his overall welfare is unchanged, in compensation for the estimated change in risk. But this approach, while justifiable economically, is not practical at the present time and may never be so, because of the fundamental

impossibility of accurately measuring each person's compensating variation.

It is clear from the preceding discussion that cost-benefit analyses involving the loss of life and limb are fraught with conceptual and methodological difficulties. Accepting the suggestion of Goodwin (7) and NHTSA (8) that the values conventionally used for a human life in cost-benefit analyses be considered as the minimum that society should find worthwhile spending in order to avoid a fatal accident leads to only minimum values for the benefit-cost ratios and the net benefits. There is no acceptable method for setting upper values. Thus, if validly interpreted, cost-benefit studies involving the loss of life and limb -- particularly those studies that have used unfavorable benefit-cost ratios to criticize motor vehicle safety standards, such as the RECAT report (9) and Lave and Weber (10) (studies with additional serious methodological deficiencies) -- can only yield very limited conclusions.* Furthermore, these shortcomings of method and approach could lead to the rejection of socially desirable solutions.

COST-EFFECTIVENESS ANALYSIS

Cost-effectiveness analysis compares the cost of alternative means for effectively achieving an agreed upon goal. The means

*Joksch (11) has presented a critical appraisal of the applicability of cost-benefit analysis to highway safety, highlighting a number of additional problems and difficulties associated with cost-benefit analyses applied to this area.

may be programs, technologies, devices, or combinations of approaches. The goals are often expressed in public policy as laws and standards.

Much of the philosophy and methodology of cost-effectiveness analysis was derived from cost-benefit analyses. As a result, there are many similarities in the techniques and many people confuse the two.

The three requirements of a cost-effectiveness analysis were outlined by Fabrycky and Thuesen (12) as follows:

First, the systems or projects being compared must have common goals or purposes. (The comparison of passenger car occupant protection devices with passenger car property damage protection devices would not be valid.)

Second, alternative means for meeting the goal must exist. (In the case of virtually all vehicle safety performance standards, such alternatives exist, whereas with design standards there would be no alternatives.)

Finally, the capability of measuring the cost and effectiveness of each system must exist.

One of the fundamental differences between the cost-benefit method and the cost-effectiveness method is contained in the first requirement. This simply states that the systems being compared must have common goals or purposes, which do not have to be expressed in monetary units. Thus, for example, an objective could be a target reduction in the annual number of motor vehicle occupant fatalities, with no requirement that this objective be translated into monetary units. In the cost-

benefit approach, both costs and benefits must be measured and compared in monetary units.

Clearly, since there are in general going to be several alternative designs and methods available for satisfying the objectives of a motor vehicle safety standard, a socially responsible manufacturer should choose the cost-effective design; that is, that design which satisfies the objectives of the standard with the lowest cost to society among the various alternatives.

DISCUSSION

The appropriate uses for cost-effectiveness methods and cost-benefit methods in motor vehicle safety improvement will be discussed in a moment. First, however, it is essential that one point be very clearly understood.

A motor vehicle safety performance standard has no costs per se and therefore it cannot be evaluated either in cost-benefit or cost-effectiveness terms. A performance standard is a minimum goal, and must not be confused with the means for achieving the goal.

It is the particular design chosen by a manufacturer to satisfy the objectives of the standard that has costs.* The

*It is important to note that standards do not always increase manufacturing costs, they have in some instances reduced costs. Furthermore, there are frequently significant cost increases or reductions to society in addition to those of manufacturing; these (sometimes referred to as indirect or spillover costs and/or benefits) must be considered in both cost-effectiveness and cost-benefit studies.

design alternatives, of course, can be evaluated.

Accepting the premise that the goals established by Congress are society's goals, it then becomes the manufacturer's obligation to society and government to demonstrate that his particular design choice for meeting the objectives of a particular standard is cost-effective. Until there is some convincing evidence that a cost-effective design has been chosen by the manufacturer, it is inappropriate and premature to undertake a cost-benefit study of designs that may be substantially more costly than is necessary.

Even then, because of the major conceptual and methodological difficulties in the valuation of life and limb, cost-benefit studies will be appropriate only in the decision-making processes involving standards not primarily intended to save lives and reduce injuries -- that is, vehicle safety standards to reduce property damage.

Congress recognized this distinction. Under Title I of the Motor Vehicle Information and Cost Savings Act (2) -- principally intended to reduce property damage losses resulting from low-speed crashes -- it included a mandatory requirement for the Department of Transportation (DOT) to consider both the costs and the benefits and to report to Congress the cost savings resulting from the administration of this title. However, in considering the National Traffic and Motor Vehicle Safety Act (1), which empowered DOT to set motor vehicle safety standards aimed at reducing deaths and injuries, Congress rejected draft language requiring such studies for safety standards. (13)

Since Congress itself recognized

the inappropriateness of applying cost-benefit criteria to developing motor vehicle standards for reducing death and injury, it is necessary to ask why so-called cost-benefit studies are increasingly being forced into the standards-making process, where they clearly do not belong. (Cost-benefit analysis does, however, have a legitimate place in the development of property damage standards under the Motor Vehicle Information and Cost Savings Act of 1972, but not before there is evidence that cost-effective designs have been or will be chosen and that their advantages have not been or will not be negated by the pricing policies of the manufacturer.)

Turning now to cost-effectiveness: this method is a useful tool for comparing alternative ways to achieve a predetermined vehicle safety objective and selecting the most desirable way. It does not appear, though, that cost-effectiveness techniques are being used very much for that purpose.

In illustration, consider Federal Motor Vehicle Safety Standard (FMVSS) 215 (14). This exterior protection standard was issued in April 1971 and was intended to provide protection, beginning with the 1973 models, against damage to a limited range of "safety related equipment" in low-speed crashes. Although this was a standard aimed at protecting safety related equipment, it was widely hoped that one of the principal benefits would be reduction in the amounts of property damage occurring in low-speed crashes. Thus, the designs chosen by the various manufacturers to satisfy the requirements of this standard have been used to estimate both the benefits and the costs in cost-benefit studies

(15, 16, 17, 18), including the mandated DOT study, to justify or refute the proposed motor vehicle standard issued under Title I of the Motor Vehicle Information and Cost Savings Act.*

There is no evidence that the designs chosen to meet the requirements of FMVSS 215 are cost-effective. On the contrary, there is considerable evidence to suggest that the designs chosen by certain manufacturers are far from cost-effective. Casassa, et. al. (20) have shown huge differences in the replacement prices** of bumper systems for seven domestic 1974 models; front bumper replacement prices range from \$111 to \$347 and rear bumper replacement prices range from \$80 to \$296. Comparing replacement prices for subcomponents among the same seven domestic 1974 models, the bumper energy absorbers range in replacement prices from \$13 to \$67, a more than fivefold difference. Such huge price ranges for designs intended to perform the

same function strongly suggest that cost-effectiveness has not been a concern of the manufacturers in meeting this standard.

The law leaves it entirely to the manufacturer to choose front and rear end designs that meet the minimum requirements of FMVSS 215. The manufacturer may under the standard develop, for instance, front and rear end designs with the following characteristics that would be costly to society:

--- A low performance level, so as to meet the standard yet permit sheet metal damage (not covered by the standard) at five miles per hour.

--- Ineffectiveness at higher speeds, so as to virtually guarantee costly damage -- and attendant sale of replacement and repair parts -- in impacts at speeds higher than five miles per hour.

--- Unnecessarily heavy components that increase fuel consumption.

--- Expensiveness of repair and/or replacement.

While such design choices would not be cost-effective to society, they could return substantial profits and also could create for the manufacturer large future sales of replacement and repair parts. It is also possible that the manufacturer could generate consumer hostility to the standard by choosing these unfavorable characteristics.

The manufacturer may, on the other hand, develop designs that seek to incorporate the following characteristics that should reduce society's costs:

--- Effectiveness in reducing

*At the present time there is no federal motor vehicle standard that is directed exclusively toward the reduction of property damage. Under Title I of the Motor Vehicle Information and Cost Savings Act, a proposed standard (19) is due to go into effect beginning with the 1976 model year. The cost-benefit analysis required by law under this Act has been based inappropriately and almost entirely on the performance of recent model year vehicles that conform with FMVSS 215 (16).

**It is important to note the distinction between cost, which is the real cost to the manufacturer, and the price which is that charged to the consumer. At the present time there is no reliable information publicly available, or available to the Federal government, concerning the relationship between prices and costs.

auto body damage both at and above the five mile an hour minimum requirements, so as to further reduce owner and insurer costs in crashes.

--- Easiness and inexpensiveness of repair and/or replacement.

--- Lightweight components that reduce fuel consumption.

The example of Standard No. 215 typifies the difference between the standard, which is an objective that cannot be measured in cost terms, and the alternative ways available to meet it, which can be subjected to cost-effectiveness evaluation.

The difference is also apparent in examining other standards. For instance, FMVSS 202 (21) requires the provision of protection against whiplash injuries in rear-end crashes. Manufacturers have chosen to meet the standard in a variety of ways, ranging from designs requiring considerable adjustment by the user, to designs that are so well integrated with the seat back that no adjustment whatsoever is required.

FMVSS 301 (22) requires, as another example, that new cars be able to withstand a 30 mile per hour front-into-barrier crash without hazardous loss of fuel. The range of options available to manufacturers for meeting this standard includes relocation of fuel tanks and fuel lines, use of bladder-inner tanks (as in the 1975 model Chevrolet Corvette), and a wide variety of additional design and manufacturing alternatives.

Motor vehicle safety standards do not necessarily increase the manufacturing costs. For example, FMVSS 211 (23), which precludes the use of wheel nuts, wheel discs and

hub caps that constitute a hazard to pedestrians and cyclists, has eliminated "scythe like" hub caps. These were presumably more costly to manufacture than less hazardous hub caps because they were invariably priced higher to the consumer; thus, in this instance costs were reduced as a result of a motor vehicle safety standard.

Consider, for another example of cost-reduction opportunities flowing from a still hypothetical standard (although one within the power of NHTSA to issue) limiting the maximum speed performance of new cars. A manufacturer could meet such a standard by adding a clumsy, inefficient "governor" device to its existing design for an overpowered automobile. But it also could meet the standard by redesigning the engine, power train and transmission to produce less horsepower, which would at the same time reduce the weight of the automobile and use less valuable metal and other resources, lower its fuel consumption, and lower its pollutant emissions, thereby substantially reducing both the direct and indirect costs to society.

(To say that a standard, as a goal, cannot per se be measured in cost-effectiveness terms is not, of course, to say that its effectiveness cannot be evaluated at all. On the contrary, safety standards must be subjected to continuing evaluation against the possibility that a standard's language may defeat its purpose. For example, recent studies (24, 25) have indicated that the wording of FMVSS 203 (26), requiring that steering assemblies be designed to absorb the driver's energy in a crash, may actually be precluding steering assembly designs that would perform better than those now available.)

It is clear that cost-effectiveness methods have a useful place in comparisons of alternative means for meeting the objectives of a motor vehicle safety standard, but not for assessing the standard itself.

It is also clear that cost-benefit analysis has a legitimate role in evaluating the desirability of a motor vehicle property damage standard once the most cost effective way to meet the standard is chosen, but does not have a legitimate role in evaluation of standards whose benefits are lives and health, not dollars and cents.

A closing note of caution: No cost-benefit or cost-effectiveness analysis can be performed if the costs of the system under scrutiny are unknown. For approaches to motor vehicle standards compliance, those costs are in fact largely unknown to all but the auto manufacturers themselves.

NHTSA has not made full use of its existing statutory power to obtain from the manufacturers detailed, reliable data as to the costs of alternative designs that meet particular safety standards. Nor have the manufacturers been forthcoming with any but vague and general information about costs.

The undependability of manufacturer-provided cost figures has been exemplified often. Recently the former director of General Motors Corporation's air bag project provided NHTSA with information on air bag system costs that was far more precise -- and far more encouraging for the public -- than the cost and price estimates that General Motors itself has released (27). After doing so, he stressed that his figures were "quite markedly different from possible other claims that you have

heard as to how much the air cushion should cost."

Earlier this year a European auto manufacturer told the General Accounting Office (GAO) of its belief that industry-generated cost information is not useful for valid cost-effectiveness measurement. "... the auto industry," Volvo told GAO, "has in some instances taken advantage of the lack of methodology and released biased material aimed purely at resisting regulation." (Volvo added its belief that cost-effectiveness should be an NHTSA consideration, "but not necessarily the overriding consideration, in establishing the need for regulation.") (28)

In its report on "benefit-cost analyses" issued in August, GAO itself was critical both of NHTSA's methods for collecting usable cost information involving standards, as well as the industry's reluctance to furnish such information. (29)

On October 11, 1974, the Senate passed a bill -- earlier agreed on in conference between the two houses -- which may hold the key to solving this problem (30). The bill provides that manufacturers opposing an NHTSA standard on the "ground of increased cost" be required to submit cost information -- "information with respect to alleged cost increases resulting from action by the Secretary, in such form as to permit the public and the secretary to make an informed judgment on the validity of the manufacturer's statements" including "both the manufacturer's cost and the cost to retail purchasers."

If the bill becomes law, and if NHTSA makes vigorous use of the bill's provision for acquiring

accurate cost data from manufacturers, cost-effectiveness and cost-benefit techniques can become

useful tools in the motor vehicle safety field -- so long as they are used appropriately.

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EVALUATING MOTOR VEHICLE SAFETY
PERFORMANCE STANDARDS

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ABSTRACT

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Federal motor vehicle safety standards must be specified in minimum performance and not design terms. Consequently, different individual designs and approaches can be and frequently are chosen by the various manufacturers to satisfy the minimum performance requirements of a federal motor vehicle safety standard. Using examples derived from present standards, basic rules for comprehensively evaluating these safety performance standards are developed.

The first stage of an evaluation of a federal motor vehicle safety standard should be a statistical comparison indicating whether or not the performance requirements of the standard, however implemented, are reducing the target damage to people and other associated societal losses. The second stage should be a more clinical and in-depth measurement of the performance, in reducing the target losses, of the various design alternatives chosen by the manufacturers to meet the standard under scrutiny, to determine whether some designs have more payoff than others. There can be no justification for weakening or revoking an existing standard unless there has been a full, comprehensive two-stage evaluation.

INTRODUCTION

Economic issues have tended to dominate recent debate over present and proposed federal motor vehicle safety standards.¹⁻⁴ Although there are legitimate economic issues that should be considered during federal rulemaking, in the case of federal motor vehicle safety standards issued under the National Traffic and Motor Vehicle Safety Act of 1966, economic arguments should not be allowed to obscure the basic purpose of the Act, which "is to reduce traffic accidents and deaths and injuries to persons resulting from traffic accidents."⁵

Despite claims to the contrary, the loss of life and limb cannot be definitively measured in dollars;⁶⁻⁸ consequently any attempts at such valuations will always be controversial and open to valid criticisms. Congress apparently recognized the arbitrary nature of such economic valuations when, during its consideration of the National Traffic and Motor Vehicle Safety Act of 1966, it rejected draft language that would have, in effect, required cost-benefit analyses before any federal motor vehicle safety standard could be promulgated.⁹

Even though cost-benefit analyses involving the loss of life and limb are fraught with conceptual and methodological difficulties, such analyses are increasingly cited by critics of the federal role to justify slowdowns in rulemaking and elimination of some existing standards.¹⁰⁻¹²

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The publicity surrounding such criticisms has led to the apparently widespread misunderstanding that the federal government is designing automobiles; this is, of course, incorrect. In fact, the House and Senate Conference Report on the 1966 Act stated clearly that the Secretary of Transportation "is not to become directly involved in questions of design."¹³ Federal motor vehicle safety standards must be specified in minimum performance and not design terms.

It is left up to each manufacturer to choose designs to satisfy the requirements of federal motor vehicle safety standards and also to set the price the public must pay; the federal government has no role in choosing either the design or the price. It does, however, have a role in evaluating and improving its vehicle safety standards, once they have been in effect for a reasonable length of time, on the basis of their performance, and specifically the performance of designs chosen by manufacturers to meet the standards, in reducing the target losses. Using examples derived from present federal motor vehicle safety standards, this paper presents some basic rules for comprehensively evaluating performance standards after they have been issued.

FEDERAL MOTOR VEHICLE SAFETY STANDARDS

Federal motor vehicle safety standards are minimum standards for motor vehicle performance,¹⁴ or motor vehicle equipment performance. A performance standard is a minimum goal, and must not be confused with the means for achieving the goal, which is the particular design chosen by a manufacturer to satisfy the objectives of the standard. They must also be "practicable" and be "stated in objective terms." Before a standard can be issued, unless there are exceptional circumstances, a Notice of Proposed Rulemaking must be published in the Federal Register describing the substance and terms of the proposed rule and all interested persons may file written comments on the proposal. In addition, informal nonadversary fact-finding hearings may also be held.¹⁵ Each proposed standard is intended to reduce certain types of damage to people as well as other associated societal losses and usually research on the subject has preceded the Notice of Proposed Rulemaking. Following consideration of the comments and any relevant research and other information the Administrator of the National Highway Traffic Safety Administration may adopt the standard.

Each standard specifies objective performance criteria that must be met, and tests for establishing compliance are usually specified as part of the standard. The compliance tests are intended, to the extent possible, to objectively measure the performance of designs that are chosen by the manufacturers to reduce the types of real-world losses at which the standard is directed. (It is essential that both the manufacturers and the federal government not lose sight of the fact that federal motor vehicle safety standards are intended to reduce real-world losses and that satisfying the requirements of compliance tests in a laboratory environment does not automatically ensure this.)

It is up to each manufacturer to choose vehicle designs that meet the compliance requirements of federal motor vehicle safety standards, and, although the fact apparently is not widely recognized, quite different designs frequently are chosen to satisfy the requirement of a particular standard.

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For example, FMVSS No. 105 "requires motor vehicles utilizing hydraulic brakes to have a split brake system, incorporating service and emergency features that are capable of stopping the vehicle under certain specified conditions...." Most domestic made cars typically use separate front and rear brake circuits¹⁶ such that if one system is lost only the front or rear brakes are operational resulting in a substantial degradation from the full system. Volvo, however, uses a split triangle design with each brake system operating both front wheels and one each of the rear wheels.¹⁷ With this design the performance when one system has failed is substantially better than most domestic vehicle braking designs when one circuit has failed.¹⁸

FMVSS No. 109 "specifies tire dimensions and laboratory test requirements for bead unseating resistance; strength, endurance, and high-speed performance; defines tire load rating; and specifies labeling requirements." Tire manufacturers are able to meet the requirements of this standard with, for example, bias ply, belted-bias ply, steel belted bias ply, radial ply, and steel belted radial ply tires.

FMVSS No. 202 "specifies requirements for head restraints to reduce the frequency and severity of 'whiplash' type and other neck injuries in rear-end and other collisions." In recent years "active" adjustable head restraints have been widely used in General Motors¹⁹ automobiles, whereas Ford,²⁰ Chrysler,²¹ and AMC²² have tended more often to use "passive" non-adjustable high seat backs in their small vehicles to satisfy the requirements of this standard. Volvo¹⁷ and Saab²³ have developed "passive" head restraints with open areas for visibility, and thus have essentially eliminated one of the criticisms directed at the head restraint standard, which is that it restricts visibility.

FMVSS No. 203 "specifies requirements for minimizing chest, neck, and facial injuries by providing steering systems that yield forward, cushioning the impact of the driver's chest and absorbing much of his impact energy in front-end crashes." Most present domestic automobiles satisfy the requirements of this standard by use of a so-called axial-collapse steering column, several designs of which are in use.²⁴ A smaller number of vehicles, however, have satisfied this standard by using an energy absorbing convoluted steel can mounted between a conventional rigid steering column and the steering wheel.²⁵⁻²⁶

FMVSS No. 205 "specifies requirements for all glazing materials used in windshields, windows, and interior partitions of motor vehicles. Its purpose is to reduce the likelihood of lacerations to the face, scalp, and neck, and to minimize the possibility of occupants penetrating the windshield in collisions." Most current domestic vehicles use a high penetration resistant glass with annealed inner and outer sheets of glass and an inner layer of plastic.²⁷ However, certain 1970 AMC models used a thinner tempered inner panel called "Chemicor," made by the Corning Glass Company, which it claimed would reduce lacerations to occupants and also to allow an impacting head to travel further, thus reducing the head decelerations.²⁸

FMVSS No. 208 specifies requirements for both "active" and "passive" occupant crash protection systems. At the present time it allows manufacturers to offer, for front seat outboard occupants, either full "passive" protection or "passive" protection in frontal crashes with lap belts for

protection in other crash modes, or three-point lap and shoulder belts with inertia reels. Although most manufacturers have chosen the third option, GM has offered air bags plus lap belts in certain luxury models,²⁹ and Volkswagen currently offers a "passive" belt system as an option on its Rabbit model.³⁰

FMVSS No. 209 "specifies requirements pertaining to the manufacture of seat belt assemblies. The requirements apply to straps, webbing or similar material, as well as to all necessary buckles and other fasteners." Manufacturers have met this standard in a variety of ways; some have used single belts that function as both the lap and upper torso restraint and others have used separate lap and upper torso belts attached at the latch intersection. Similarly, a variety of designs of emergency locking retractors required for the upper torso restraint has been used. Belt-sensitive retractors were used on 1974 Chrysler models,³¹ and vehicle-sensitive retractors were used by the other domestic manufacturers on their 1974 and 1975 models³²⁻³³ and by Chrysler on their 1975 models.³⁴ Combination vehicle- and belt-sensitive retractors have been used by Volvo¹⁷ and Volkswagen³⁵ and a vehicle-sensitive electro-mechanical retractor has been used by Toyota.³⁶

These are just a few examples of alternative designs used by vehicle manufacturers to satisfy particular federal motor vehicle safety standards. It is clear that design freedom is available and used by the manufacturers when satisfying the federal requirements.

MEASURING THE EFFECTIVENESS OF FEDERAL MOTOR VEHICLE SAFETY STANDARDS

Each federal motor vehicle safety standard is intended to reduce certain types of real-world damage to people and other associated societal losses. Many of the existing standards have been subjected to statistical evaluations to determine whether the losses that they were intended to reduce have, in fact, been affected by their implementation.* Although such studies are an essential first stage in the comprehensive evaluation of a performance standard, alone they cannot provide sufficient evidence to modify existing standards, because they usually fail to differentiate between different designs and approaches that, although satisfying the same performance requirements and compliance test criteria, may perform quite differently from each other in the real world. Statistical comparisons of the real-world losses associated with vehicles with, as against those without, designs satisfying the requirements of a particular standard (but as comparable as possible in all other respects) that do not consider individual design variations should be considered as only the first stage of an evaluation. Completion of this first stage can, however, provide no more than indications that the performance requirements and compliance test procedures of the standard, however implemented, are reducing the appropriate losses as anticipated during the research and rulemaking period preceding the issuance of the standard.

* Recently Griffin prepared a comprehensive review of a number of such statistical comparisons.³⁷

The second stage of an evaluation should be a more clinical and in-depth measurement of the performance, in reducing the target losses, of the various design alternatives being employed to meet the standard under scrutiny, to determine whether some have more payoff than others. Clearly with the considerable design freedom permitted by federal motor vehicle safety standards, it is possible that the real-world performance of different designs satisfying the same minimum performance requirements may vary considerably. Any major differences found between the effectiveness of alternative design approaches should logically lead to improvements in the standard, in the form of revised compliance tests, or revised performance requirements, or both.

Two-stage evaluations of the type described above do not necessarily have to be conducted separately; they can be conducted either in parallel or sequentially.

Standards can, of course, be upgraded if it becomes obvious that some classes of design approach can offer more protection than others even though comprehensive two-stage evaluations may not have been completed for each and every standard. For example, the first statistical evaluation of FMVSS No. 202, which specified requirements for head restraints, showed that the frequency of claimed head and neck injuries was significantly lower in cars in which head restraints were supplied as standard equipment than in the earlier year model cars in which head restraints were not supplied.³⁸ Although this study did not definitively differentiate between the real-world performance of different head restraint designs, it did present field survey information that "active" adjustable head restraints were frequently positioned incorrectly and were therefore unlikely to provide protection. The requirements of FMVSS No. 202 permit both "active" and "passive" head restraint designs, and survey information has repeatedly shown that "active" head restraints are often incorrectly positioned and therefore are not in a position to provide protection. Thus, there is justification for improving FMVSS No. 202 to eliminate "active" designs, even though a complete two-stage evaluation of the standard has not been conducted. (Appropriately, changes of this type have been proposed by the Agency.³⁹)

On the other hand, there can be no justification for weakening or revoking existing standards unless there has been a full, comprehensive two-stage evaluation. The reasons for this are fundamental. The research and rulemaking period preceding the issuance of the standard has presumably indicated the existence of a serious real-world problem. Thus, even if a first-stage statistical evaluation indicates that the losses are not being affected to any substantial degree, weakening or revoking the standard, which is a performance goal, would amount to an acceptance of such losses even though designs -- including ones subsequently developed -- may be available to reduce them. In fact, if a first-stage statistical evaluation indicates that a standard is having little effect on real-world losses, this should lead to an urgent second-stage, in-depth investigation of the alternative designs, together with a thorough review of the performance requirements and compliance tests, in order to try to determine why the target losses are not being reduced as anticipated.

An excellent example of a comprehensive evaluation of a federal motor vehicle safety standard is illustrated by considering FMVSS No. 203, which specifies requirements for energy absorbing steering assemblies. Although

first-stage statistical evaluations indicated that vehicles meeting this standard were as a group producing fewer serious and fatal driver injuries in crashes than vehicles without such assemblies,⁴⁰ a second-stage in-depth clinical evaluation showed that different designs were performing quite differently in the real world, and suggested that the compliance test should be modified.²⁵⁻²⁶ The in-depth study of steering assemblies showed that the axial-collapse columns, which perform very well in the compliance tests, were substantially inferior in their real-world performance to the self-aligning energy absorbing convoluted steel can designs, even though the latter design did not perform as well in the compliance tests. Thus, an inappropriate compliance test has tended to push designs in the wrong direction. (Recently in correspondence with Senator Vance Hartke the Administrator of the National Highway Traffic Safety Administration stated that appropriate new rulemaking on this standard should take place "within the next few months."⁴¹)

Differences in the real-world performance may be expected for varying designs used to satisfy federal motor vehicle safety standards, and it is essential that these design differences be recognized, analyzed and understood, as a basis for strengthening the performance standards and their compliance-test criteria.

CONCLUSIONS

Economic arguments are increasingly being cited by critics of federal motor vehicle safety standards in urging slowdowns in rulemaking and elimination of certain existing standards. These arguments frequently fail to recognize that design and pricing freedom is the prerogative of the manufacturers, not the government, in satisfying the federal requirements; and, in addition, they often rely inappropriately on economic analysis techniques. The appropriate use of commonly applied economic analysis techniques such as cost-benefit and cost-effectiveness analyses in these circumstances have been outlined elsewhere.⁶ However, in addition to the misapplication of economic analyses there is an absence of definitive two-stage evaluations of the sort necessary to justify modifying existing standards.

The first stage of an evaluation of a federal motor vehicle safety standard should be a statistical comparison indicating whether or not the performance requirements of the standard, however implemented, are reducing the target damage to people and other associated societal costs. The second stage should be a more clinical and in-depth measurement of the performance, in reducing the target losses, of the various design alternatives chosen by the manufacturers to meet the standard under scrutiny, to determine whether some designs have more payoff than others.

Standards can, of course, be upgraded if it becomes obvious that some classes of design approach can offer more protection than others even though comprehensive two-stage evaluations may not have been completed for each and every standard. For example, considerable evidence has now been accumulated concerning the overall superiority of "passive" approaches (i.e., that protect automatically) over "active" approaches (i.e., that require people to do something special such as fastening belts or adjusting head restraints), and where possible, federal motor vehicle safety standards should require "passive" design approaches in order to maximize the effectiveness.⁴²

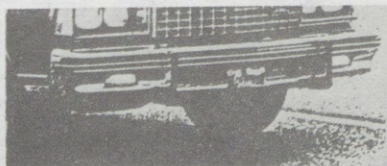
Although economic issues are tending to dominate the debate over federal motor vehicle safety standards, the necessary comprehensive evaluations of individual designs adopted have not usually been undertaken and therefore most of the criticism of federal motor vehicle safety standards is clearly premature and without justification.

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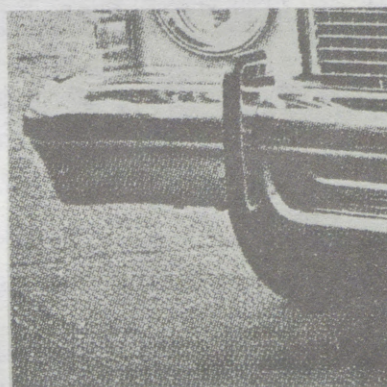
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A COST/WEIGHT STUDY ON PRODUCTION BUMPER SYSTEMS



THE INTERNATIONAL NICKEL COMPANY, INC.

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Immediate
Friday, November 3, 1978

REPORT ON QUALITY CHANGES FOR 1979 MODEL PASSENGER CARS

The value of quality changes for the 1979 model domestic passenger cars included in the Producer Price Index was estimated to average \$37.00 at manufacturer's prices and \$46.35 at retail, the Bureau of Labor Statistics of the U.S. Department of Labor reported today. This estimate represents about 15.4 percent of the average increase of \$300.30 in manufacturer's suggested retail prices on the 1979 model cars in the index.

These estimates are based on an evaluation by BLS of data for similarly equipped 1978 and 1979 model cars. The automobile companies supplied data for the 16 domestic cars priced for the Producer Price Index. Of these cars, 15 are also priced for the Consumer Price Index. These estimates of quality change are used in the Producer and Consumer Price Indexes for October when most of the new models are introduced into the indexes.

The \$46.35 estimated retail value of the quality changes can be broken down as follows:

---\$12.10 for redesign of emission control systems to meet current and anticipated HEV air quality standards.

→ ---\$5.75 for structural changes to meet current and anticipated safety standards. ←

---\$28.50 for other quality changes not related to air quality or safety standards, such as engine and chassis changes for improved vehicle performance and improved corrosion protection. In accordance with past practice, changes made to resize passenger cars were not treated explicitly as quality changes.



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No Damage Steel Bumpers— A New Approach

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Transportation Industries Market Development
U. S. Steel Corp.

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International Automotive Engineering
Congress and Exposition
Cobo Hall, Detroit
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No Damage Steel Bumpers— A New Approach

William J. Riffe

Transportation Industries Market Development
U. S. Steel Corp.

WHEN THE ARAB OIL EMBARGO focused the attention of the American Government on the fuel consumption of the automobile, the emphasis of automotive design shifted from what the customers wanted to what the designer could permit within the weight limitation imposed upon him by the demands of fuel consumption.

Today, the most widely conceived, prototyped, and tested component for minimum weight has been the bumper. This is natural since it is a discrete part subjected to well defined loads with minimal structural feedback from other parts of the car. In today's vehicles, there are seven basic bumper systems:

- . Plated Steel
- . Plated Aluminum
- . Anodized Aluminum
- . Painted Steel
- . Painted Aluminum
- . Steel Reinforcement for Massive Plastic Fascia
- . Aluminum Reinforcement for Massive Plastic Fascia

The questions often asked by the public are - "Who is right?" "Which is best?" Obviously, all of the systems meet the economic and structural requirements of the designers.

This report will not attempt to evaluate the various approaches to bumper materials but will concern itself with a steel design to meet the proposed standards for 1980. The remainder of this report will deal with investigations into dent resistance, a lightweight steel bumper design, welding, and corrosion, as they apply to the particular design of the bumper.

A LOOK AT THE FUTURE

On the drawing boards of each of the automobile manufacturers are bumper systems in steel, aluminum, and soft fascia. Each

offers the designer a specific look or property. Steel has the traditional polished chrome appearance. Aluminum, exhibiting a more matte anodized surface rather than bright chrome, offers light weight. Soft fascia units, being cast in a mold rather than formed from sheet material, create styling effects with sharp corners and intricate curves.

For NO DAMAGE, the plastic fascia system relies on the compliance of the soft fascia to return to its original contour after impact. Traditional approaches for aluminum and steel have dictated heavy face bar thicknesses to restrict the extent of denting.

This switch to alternate bumper materials is not being accepted with enthusiasm by the manufacturing operations. Their lack of familiarity with the materials as well as the new processing techniques required to implement the change are a source of unknown problems and hence, reluctance on the part of some manufacturing plants.

As with all new designs, the status of technology must be evaluated, new technology must be created, or existing technology must be modified to meet the current problem. A listing of the facets of technology which were reviewed is given in Table 1. The remainder of this report will describe the role of each of these factors in the final design of the bumper system.

DENT RESISTANCE

The Federal Motor Vehicle Safety Standard 215, Part 581, specifies that 1980 bumpers may exhibit no greater than a three-eighths inch deep permanent local dent or a three-quarter inch permanent gross deviation from the original position of the bumper after two longitudinal impacts of the pendulum at 5 mph, two corner impacts at 3 mph, and a

ABSTRACT

An approach to NO DAMAGE steel bumpers for 1980 vehicles is presented. Included in the study is consideration for dent resistance, materials, forming, joining, and corrosion. The design philosophy is carried

to prototype testing. The results indicate that a bumper system -- bumpers and energy absorbers -- may be designed in steel at 1% of the vehicle gross weight.

Table 1 - Technologies Reviewed

Dent Resistance

- Intrinsic Protection to Face
- Support from rear of face
- Redirection of Impact

Materials

- Hot Rolled HSLA
- Cold Rolled HSLA
- Cold Rolled Low Carbon

Forming

- Conventional Stamping
- Continuous Roll Forming

Joining of Face Bar and Reinforcement

- Mechanical Fasteners
- Spot Welding
- Fillet Welding

Corrosion

- Back-up Materials Coating
- Effect of Welding on Corrosion

barrier impact at 5 mph. It is this Standard, designated NO-DAMAGE by the industry, that has caused the most concern in the bumper industry.

There are several excellent papers on dent resistance. Perhaps the most useful is DiCello and George (1)*. They show that equal dent resistance is given by:

$$\sigma y_2 = \sigma y_1 \left(t_1/t_2 \right)^2 \sqrt{(E_2/E_1)} \left(t_2/t_1 \right)^N$$

Without going into the derivation of the equation or the value of "N", it can be shown that dent resistance is favored by a material having high yield strength, more thickness, and/or a low modulus of elasticity. Unfortunately, for steel, when weight is of concern, aluminum is favored by the last two criteria while steel better meets the yield strength criteria. Thus, design of a steel bumper should take advantage of its property of high strength. To use the equation properly, the yield strength at the strain rate of denting should be used.

Data on high strain rate yielding of steel and aluminum are available in Chatfield

*Numbers in parentheses designate References at end of paper.

and Rote (2), Chang and Justusson (3), and research done for AISI by Mindlin and Malik at Battelle (4). All of these have shown that steel, having a static yield strength of about 30-45 ksi (207-310 MPa), exhibits an apparent increase in yield strength of about 20 ksi (138 MPa) when loaded at about 5 mph. For steels with static yield strengths of about 45 ksi (310 MPa), the increase is about 15 ksi (103 MPa). These data are valid only for conventional and micro-alloyed steels and do not necessarily represent the behavior of steels which acquire their yield strength through heat treatment. For aluminum, no appreciable change in yield strength has been shown for strain rates up to 5 mph.

It is unfortunate that bumper cross section configurations do not respond to the DiCello and George equations. Several small test sections were fabricated and dented with a section representing a portion of the bumper pendulum. The results are shown in Figure 1. The material in each case was USS PAR TEN 55 with a nominal static yield strength of 60 ksi (414 MPa) and a thickness of 0.075". All tests were made with the sample inclined 5° from the horizontal to represent the peaked condition of bumper styling. Strain rates were comparable to static conditions.

The experimental data in Figure 1 shows the ranking of cross sections to be 5, 4, 2, 7, 6 while the ranking of stiffness according to the DiCello-George criterion is 2, 5, 6, 4, 7. Thus, the statement earlier that bumper sections do not respond to the criterion.

For the sections tested, dent resistance appears to depend more upon the proximity of the straight leg sections to the point of loading than the configuration of the face.

In another approach to dent resistance, foam backed steel was tried. Olson Cup samples of three different grades of steel—inclusion shape control (ISC), SAE 950, and renitrogenized (ReN)—were made with 1" cup heights. Each of these samples was backed

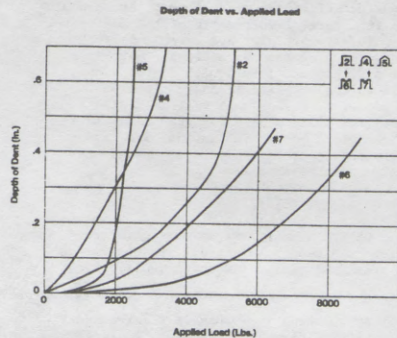


Fig. 1 - Depth of dent versus applied load

with urethane foam of nominal density 5, 10, 20 pcf.

Dent resistance was measured as the amount of dent resulting from an impact with a semi-circular indenter carrying 500 ft. lbs. of energy. A plot of the data is shown in Figure 2. It is seen that each steel gives a different slope of dent vs. foam density.

It may be concluded that the addition of a minimum of 5 pcf of foam will increase the dent resistance. The benefits of foam are not without consequence, however. For the foam to be effective, it must be restrained by full support behind it to prevent decohesion and falling away from the section. This entails weight and cost beyond that of the foam itself.

LIMITED ACCESS BUMPER

There are two ways to approach the design of bumpers to achieve dent resistance. The traditional approach is to thicken the face bar and raise its yield strength such that the combination of these properties will provide the desired dent resistance. While weight then becomes a problem, styling is also compromised and shapes achievable are limited by the lesser formability of the stronger steels.

In contrast to the traditional approach, a design was conceived and tested which uses the Limited Access philosophy. This approach states that "denting can be minimized by restricting contact of the pendulum with the bumper to specific locations where accommodation for impact loading has been made."

Figure 3 shows how this is applied to the vehicles of today and tomorrow. In Figure 3.a, all frontal pendulum impacts are borne by one or both bumperettes. Judicious placement of these bumperettes can guarantee this situation for small cars. The lower energy corner impacts are then absorbed by the face bar with full access by the pendulum.

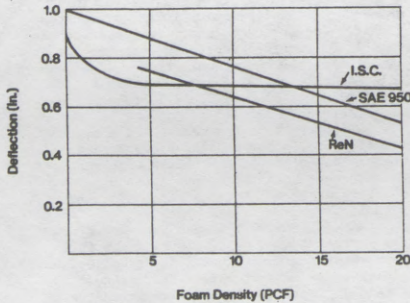


Fig. 2 - Depth of dent versus form density

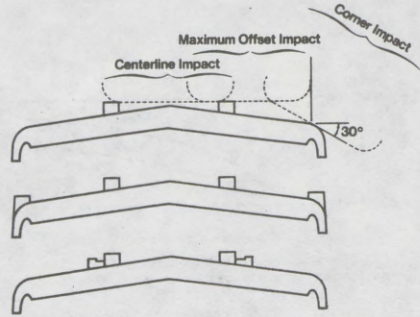


Fig. 3 - Limited access bumper philosophy

In Figure 3.b, the same philosophy can protect larger cars by the use of bumperettes at the corners similar to the corner pod approach used today on bumpers. This corner bumperette can take almost any configuration to complement the styling.

Some vehicles will not require the approach shown in Figure 3.b but are yet too large for the scheme of Figure 3.a. Figure 3.c offers an alternative.

The benefit of this approach on bumper strength requirements is shown as follows. Consider the bumper of Figure 4 with bumper-

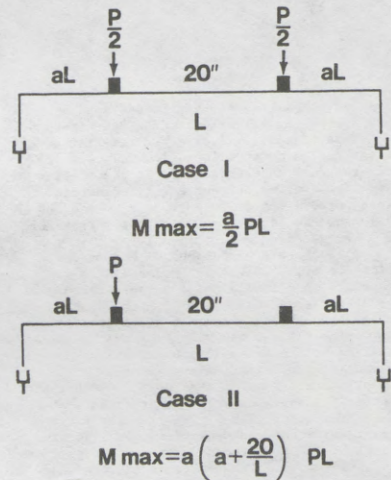


Fig. 4 - Limited access bumper geometry

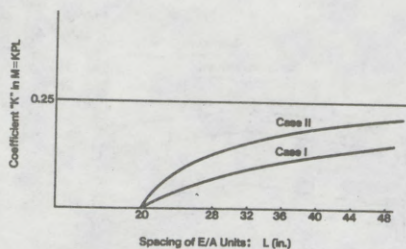


Fig. 5 - Effect of energy absorber spacing on bumper strength requirements

ette spacing of 20". For Case I, the pendulum strikes both bumperettes and the resulting bending moment is given by

$$M_{\max} = \frac{a}{2} PL$$

For Case II, the pendulum impacts but one bumperette and the bending moment is given by

$$M_{\max} = a \left(\frac{a+20}{L} \right) PL$$

For the unprotected bumper, the bending moment is given by

$$M_{\max} = 0.25 PL$$

These equations may now be plotted as

$M_{\max} = k PL$ for all values of L (See Figure 5).

Thus, for all values of L , the limited access design demands less flexural capacity than the full access design. In the smaller cars with spacing between energy absorbers close to 28", the difference is close to 50% while for the larger cars with spacing nearer 40", the difference is only 33%.

To test this philosophy, a bumper was built for a 1976 Chevrolet Monza 2+2 to replace the soft fascia and aluminum system. The steel design used 0.075" thick USS PAR TEN 55 throughout. Figure 6 gives details of the design. The total weight of the bumper and mounting brackets was 31 pounds, which compares to the 41 pound existing system.

The bumper was mounted on a 3200# car and tested in accordance with the proposed 1980 Bumper Standard, (See Figure 7). The first impact was along the vehicle center line at a height of 20" from ground. The two bumperettes caught the full 5 mph impact of the pendulum with but a 1/16" deep depression in the face of the bumperettes. With the pendulum at the 20"

ALL MATERIAL 0.075" THICK, 55 ksi YIELD STRENGTH.

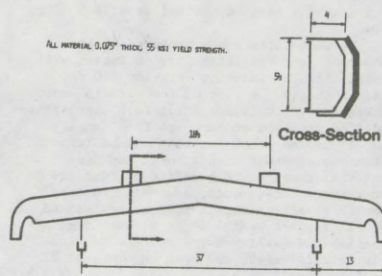
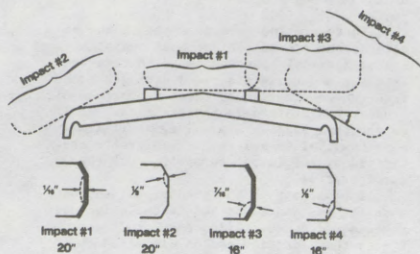


Fig. 6 - Original test bumper



Test Results - Original Bumper

Fig. 7 - Test results - original bumper

height, the corner was impacted next at 3 mph. The resulting depression was less than 1/8" deep. The pendulum was then lowered to 16" and a frontal impact was absorbed with the maximum outward excursion of the pendulum. One edge of the bumperette took the entire 5 mph impact and deformed about 7/16" in so doing. The final pendulum impact was at the corner, also at 16" height. The dent was less than 1/16" but the bumper did override the pendulum at the end of the stroke. The vehicle was then run against a barrier at 4.89 and 4.99 mph. No noticeable increase in damage was observed.

While the existing design did not pass the Standard, minor modifications regarding the styling slope at the bottom of the bumper will correct both the bumperette and corner override problem. This correction can be made with little or no weight penalty.

In addition, weight can be removed from the current design by eliminating the full rear reinforcement to bring the total weight closer to 25 or 26 pounds. If this goal is attained, it is highly conceivable that a total system weight of 35#, -- bumpers and energy absorbers -- which represents 1.10% of

the total vehicle weight (based on 3200# car), can be achieved.

To date, this limited access system represents the best steel design known to achieve the NO DAMAGE criteria.

MATERIALS/DESIGN IMPLICATIONS

The selection of steel materials for 1980 bumper systems is a function of design philosophy, strength requirements, availability of material, manufacturing considerations, and surface for plating. These criteria are inter-related and none of them may be used as the sole basis for selection.

The limited access philosophy, by its very nature, leads to the use of high strength steels that are thinner than those currently being used for bumpers. The steels would now fall into the cold rolled thickness range. As the required yield strength for these steels is increased to values close to 80 ksi, their availability may be limited.

For conventionally styled face bars, large draw dies are required. These dictate that the material have sufficient formability to achieve the desired shape. For yield strengths of 50 ksi and above, high-strength low-alloy (HSLA) steels likely will be used. The steel industry currently offers both hot and cold rolled HSLA steels at the 50/60 ksi yield strength level and is working on the same type of availability for these steels close to 80 ksi yield strength. These steels offer the greatest styling flexibility.

For simpler bumper configurations, roll-forming can be used, which may broaden the choice of materials somewhat. Here, cold rolled low carbon steel sheet or strip in the full-hard condition may offer some possibilities. This material has a yield strength of approximately 80 ksi with elongations of several percent. If styling effects such as center peaks or integral wings are desired, additional operations will have to be performed on the roll-formed shape.

WELDING

Examination of existing bumper systems where the face bar and reinforcement are joined by bolts has shown that when failure occurs, the reinforcement will fail in tension around the bolt holes. Elimination of these holes would solve that problem but present another one - that of welding the face to the reinforcements.

Two alternatives for welding exist. First, the two-pieces can be joined prior to plating. This creates a metal finishing problem. Second, the face bar and reinforcement can be joined after the face bar has been plated. The problem is now the integrity of the weld and the possible discoloration and/or damage to the chrome in the vicinity of the weld. This second approach was chosen as the more likely to achieve solution.

The first system investigated was Union Carbide's Ultrapulse. This is a capacitor discharge projection weld system. There were two major concerns to be overcome with this system. In order to achieve a blemish-free face bar, the projection was put into the hard reinforcement which then had to be forced into the softer face bar. Several projection designs were investigated with a punched and extruded hole projection providing the minimum surface distortion. The other concern was damage to the chrome due to the ultra high electrical power discharge from the chromed face to the electrode. Direct projection spot welding proved unsuitable but indirect spot welding gave acceptable appearance. With the technical problems solved, the economics of the welding system were investigated. It was then discovered that the capitalized equipment expense was too great and the production rate too low to be of value in this application. For non-bumper applications, the welding system could be very useful.

The second system investigated was a non-vacuum electron beam (NVEB) system at Leybold-Heraeus. This system was used to lay a fillet weld between the chromed face bar and the reinforcement. Using a 35 KVA power source, a successful weld was made at 180 ipm with a wire feed of approximately 340 ipm. No discoloration of the chrome was observed nor was there any flaking or physical damage to the chrome. It was estimated that a production system could be built to produce a weld at 300 ipm from the same basic equipment.

The success of the NVEB welding system led to the fabrication and testing of one completely welded bumper. The Chevrolet Monza Town Coupe system was chosen due to its design which is readily adaptable to welding. The bumper was judged to have performed as well as the bolted system and no stress was noticed in any of the welded areas.

It therefore seems feasible to create bumper systems where the reinforcement is welded to the chromed face bar. Non-vacuum electron beam welding is one system which has been shown to be technically acceptable.

CORROSION

One of the prime concerns with reduced thickness in bumpers is the effect of corrosion. For the face bar, the chrome plating should offer sufficient protection to satisfy the requirements for that component. The reinforcement has, in the past, been a painted part. Because of its environment, protected from gravel pecking, there is no reason to change this treatment. Greater protection can be achieved using a galvanized coating on the reinforcement.

The non-vacuum electron beam weld joining the chromed face bar and the coated reinforcement burns away very little of the coating. Thus, the galvanized coating would provide some additional protection beyond the

simple barrier that a paint system would provide.

CONCLUSIONS

Using the limited access philosophy of bumper design, it is possible to fabricate a bumper from steel to pass the 1980 NO DAMAGE criterion and maintain the weight of the bumper plus energy absorbers at less than 1% of the gross vehicle weight. Additional prototypes would help define the limits of the technology used and the extent that limited access philosophy is applicable.

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Weight Reduction of Automobile Bumper Systems

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SOCIETY OF AUTOMOTIVE ENGINEERS

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Weight Reduction of Automobile Bumper Systems

John J. Kary

Chevrolet Motor Div., General Motors Corp.

THE WEIGHT REDUCTION of the automobile bumper system was approached by a three-fold program:

1. Use of higher yield strength renitrogenized steel in place of SAE 945 steel for bumper reinforcements.

2. Use of higher yield strength Inclusion Shape Control steel for Bumper Face Bars.

3. Alteration of bumper system designs to reduce or eliminate reinforcements.

Fig. 1 shows a cross-section of a conventional bumper system. The bumper reinforcement is made of .156" gauge SAE 945 steel and the bumper face bar is made of .120" gauge 35,000 KSI minimum yield steel.

The weight reduction program was started by substituting .120" gauge renitrogenized steel for .156" gauge SAE 945 steel in the bumper reinforcements. A weight savings of 30 lb was accomplished by this change in a 4,000 lb vehicle without affecting its impact strength.

Renitrogenized steel is essentially C-1008 or C-1010 steel with an addition of .010 to .018% nitrogen. The advantage of renitrogenized steel is that it has the ability to produce marked increase in yield strength upon straining and aging and yet has fairly good forming properties. This higher yield strength by working or straining and aging allows for a reduction in gauge without lowering the strength of the finished part.

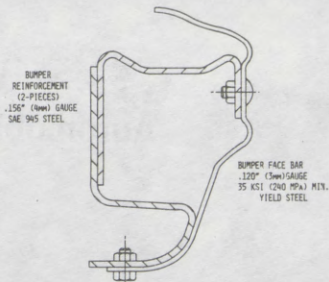


Fig. 1-Cross-section of conventional bumper assembly

Fig. 2 shows the effect of strain or work hardening on renitrogenized steel as compared to other types of steel. The renitrogenized steel shows a much faster and higher increase in yield strength from equal straining and aging.

Fig. 3 shows the effect of variations in

ABSTRACT

Weight reductions in automobile bumper systems were achieved by means of a three phase program:

1. Reduction of bumper reinforcement gauge by use of work hardening renitrogenized steel.

2. Reduction of bumper face bar gauge

by use of high formability, high yield strength, inclusion shape control steel.

3. Design changes to minimize or eliminate bumper reinforcements.

The weight reductions were achieved without reducing the impact strength of the bumper systems.

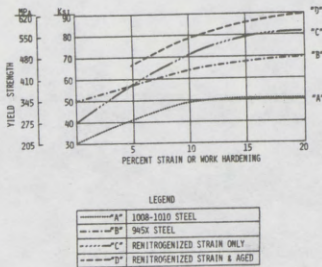


Fig. 2-Increase in yield strength by strain of work hardening on various types of steel

analysis of renitrogenized steel on its ability to increase in yield strength by straining and aging. The most significant element that affects this increase in yield strength seems to be percent of nitrogen. Variations in the other elements appear to be secondary.

Fig. 4 shows the effect of an increase in yield strength by artificial aging of a 10% strained renitrogenized steel versus room temperature aging. Seven days of natural room temperature aging of this steel is equivalent to an artificial aging treatment of 350°F for 15 min.

Fig. 5 shows that there is a direct relationship between hardness and yield strength. This indicates that a simple hardness check on this material may be translated to a yield strength.

The second phase of our weight reduction program consisted of substituting lower gauge, higher yield strength Inclusion Shape Control steel for our regular production 35,000 yield strength bumper face bar steel which requires a good surface condition for plating. The key to this change was to markedly increase the yield strength of this steel without reducing the elongation or formability appreciably. This was accomplished by the micro-addition of certain elements for maximum strengthening and the control of inclusion content, shape and size.

Three different and separate elements were added in micro proportions:

1. Zirconium
2. Titanium
3. Cerium

The mechanism of inclusion shape control by the addition of these elements results in uniform physical properties in all directions because of the reduction in number, fluidity and the isotropic orientation of the inclusions. This results in uniform elongation or formability in all directions and eliminates directionality, woody fracture and lack of drawability or formability in the transverse direction which is the cause of most breakage during bumper forming.

The control of inclusion content, shape and size by the micro-addition of the alloying elements noted is illustrated in Fig. 6.

The minimum yield strength of our bumper face bar steel can be increased from 35,000 minimum yield to 55,000 minimum yield without reducing the elongation below 25% in any direction. This allows us to reduce the metal gauge thickness on our Bumper Face Bars without reducing the impact strength.

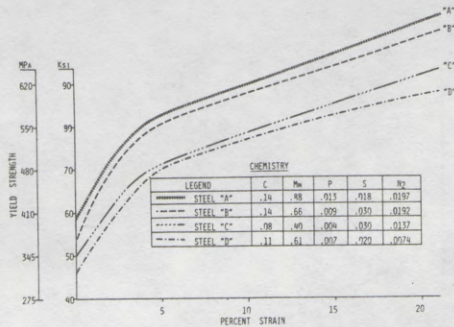


Fig. 3-Rentrogenized steel-effect of nitrogen content on increase in yield strength after strain and aging

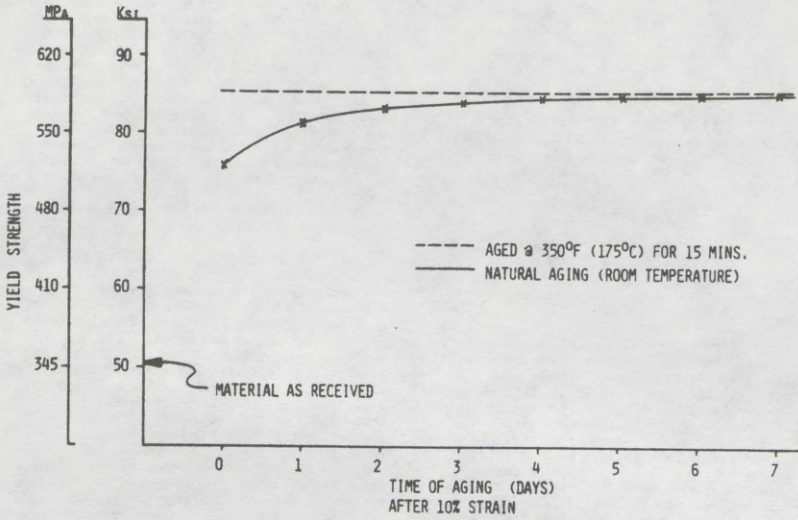


Fig. 4-Renitrogenized steel-effect of artificial aging versus room temperature aging on increase in yield strength after 10% straining

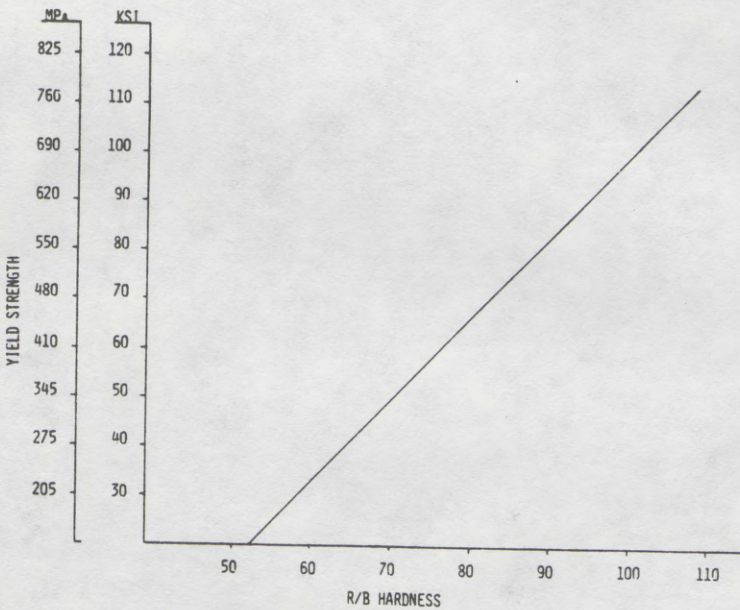


Fig. 5-Relationship of steel hardness to yield strength

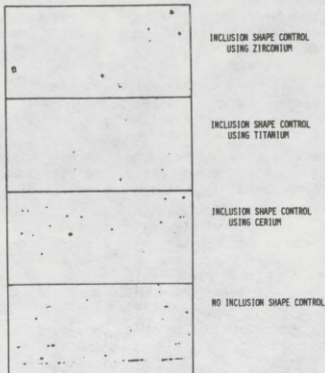


Fig. 6-Photomicrographs showing effect of micro alloying on inclusion shape control (unetched magnification 100X, reduced 55%)

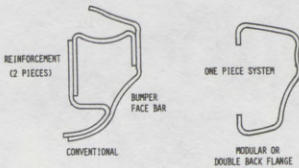


Fig. 7-Alteration of part design incorporating the use of a "double-back flange" to combine the bumper face bar and reinforcement into a 1-pc. design (using inclusion shape control steel for strength and drawability)

The third approach to our Bumper system weight reduction program was to eliminate or reduce the bumper reinforcement by putting a double back flange or a modular design on the Bumper Face Bar itself with the use of high strength Inclusion Shape Control Steel.

Fig. 7 shows a cross-section of a conventional Bumper system with a bumper reinforcement and a bumper face bar. It also shows an alternate design with a double back flange or a modular design.

Fig. 8 illustrates how a modular designed bumper face bar using high strength inclusion shape control steel replaced an aluminum bumper with a spring steel reinforcement with a net savings of 23 1/2 lb on a 2,500 lb vehicle.

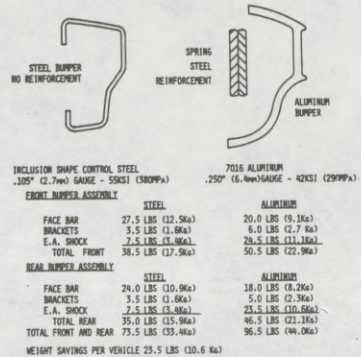


Fig. 8-Bumper system on 2500 lb (1135 kg) vehicle steel versus aluminum

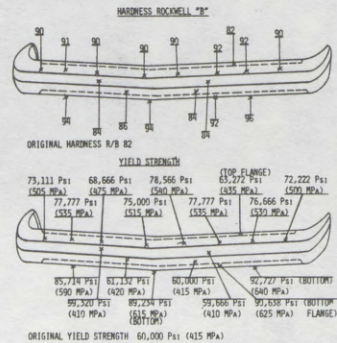


Fig. 9-Modular bumper on 2500 lb (1135 kg) vehicle hardness and yield strength of inclusion shape control steel after forming

Fig. 9 shows the hardness and yield strength increase of a modular bumper made of Inclusion Shape Control Steel before and after forming. Note the differences in hardness and yield strength because of the degree of working during forming.

Fig. 10 shows a cross-section of modular bumper showing the affect of drawing or forming of different bumper steels on the same cross-section. Note the softer SAE 950 steel has the greatest tendency to work harden although there

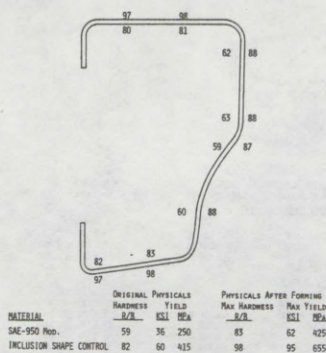


Fig. 10-Modular bumper on a 2500 lb (1135 kg) vehicle cross-section showing increase in hardness and yield strength using different steels

is also a rather large increase in the yield strength of the Inclusion Shape control steel. It appears that the final bumper section design has a marked effect on the final strength of the bumper itself.

To date, we have had very good production performance with very low breakage on our substitution of renitrogenized steel for SAE 945 steel for bumper reinforcements.

We also have had very good success in forming and plating our bumper face bars using high strength inclusion shape control steel.

We have experienced little to no problems in our polishing and plating operations in comparison to our regular lower strength bumper steel. We have experienced a little more spring back on the higher yield Inclusion Shape Control Steel during forming and we have made die changes to compensate for this.

Weight reductions up to 36 lb/vehicle have been accomplished by the application of the three phases of our Bumper System weight reduction program as noted.

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**Dual Phase Steel
Production Bumpers**

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Cadillac Motor Car Div.,
General Motors Corp.

Congress and Exposition
Cobo Hall, Detroit
February 26-March 2, 1979

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Dual Phase Steel Production Bumpers

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General Motors Corp.

IMPROVING FUEL ECONOMY THROUGH VEHICLE WEIGHT REDUCTION is currently a high priority activity in the automotive industry.

The bumper system, which took on a significant weight increase in 1973 (Fig. 1) as a result of the MVSS 215 Bumper Standard, was a good candidate for weight reduction. The bumper system weight is a function of the performance requirements, design, and material selection.

The choice of material is dependent on styling, appearance, weight, and cost. Today's bumpers are most often made of HSLA steel, aluminum, elastomers, or a combination of these materials. This paper evaluates the use of a dual phase HSLA steel for bumper face bars.

Higher strength steels can significantly reduce bumper weight, as shown in Fig. 2. Changing the face bar steel from a mild steel to SAE 980, while maintaining equal bumper performance with a corresponding gage reduction from .120" to .080", reduces the weight by 33%. The problem with current SAE 980 steel is that it has an elongation of only 18% and will not form the bumper shapes currently used at Cadillac.

Generally, an SAE 950 steel modified for increased formability and inclusion shape control, with elongations of 27-30% (referred to as SAE 950-M), was the highest strength steel that would form 1978 Cadillac bumpers.

In 1976 Dr. M. S. Rashid of G. M. Research reported the development of a new dual phase HSLA steel referred to as G. M. 980X steel. This steel, assigned the number G. M. 6187-M, has mechanical properties listed in Fig. 3 and shown on the stress-strain curve. At 0.2% offset the yield strength is 55 ksi maximum; at 3.0% offset the yield strength is 70 ksi minimum. The tensile strength is 90 ksi minimum and the elongation is 27% minimum.

This steel is basically an annealed vanadium strengthened SAE 980 steel.

Fig. 4 compares the stress-strain curves of G. M. 6187-M, SAE 980, SAE 950-M, and plain carbon steel. When G. M. 6187-M steel is strained greater than three percent in the forming process, the yield strength is increased to 70-90 ksi, or about the same as SAE 980. G. M. 6187-M dual phase steel has a stress-strain character-

ABSTRACT

The use of HSLA dual phase steel is an effective method of reducing bumper weight while meeting ever increasing government performance requirements. A paper analysis, followed by a hardware evaluation, successfully substituted "dual phase" for conventional HSLA steel at a reduced thickness. Bumpers for the all-new 1979 Cadillac Eldorado were designed and released using dual phase steel with yield strengths of 70-80 ksi for the face bars. Production problems were overcome by modifications

of mechanical properties and increased development experience with this steel. To achieve the full work-hardening potential of dual phase steel, bumper sections and draw dies must be designed for a uniform strain greater than three percent.

Future dual phase steel for bumpers in the 80-120 ksi range is desirable, but further improvements in steel-making technology and part and die design techniques are required to achieve this goal.

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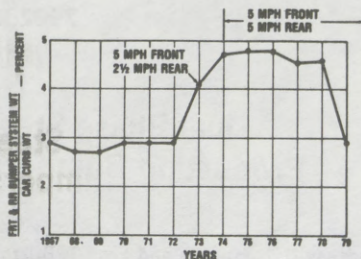


Fig. 1 - Eldorado front & rear bumper system weight as a percent of curb weight vs. years

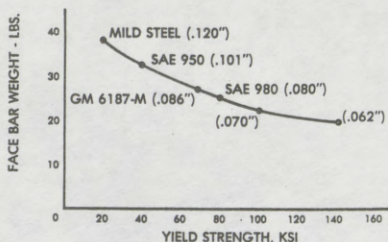


Fig. 2 - Bumper face bar weight vs. yield strength - 4,000 lb. car

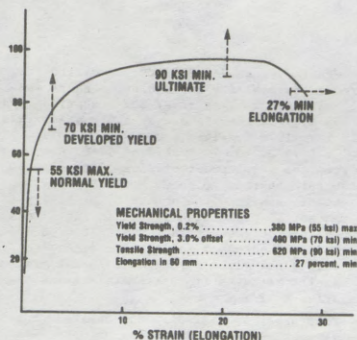


Fig. 3 - G. M. 6187-M mechanical properties and stress-strain curve

istic showing no yield point elongation which enhances formability.

These characteristics should provide the properties to form today's bumpers with good potential for gage and weight reduction. Several SAE papers have been presented describing the characteristics of G. M. 6187-M dual phase steel as listed in the references. This paper will describe Cadillac's experience as an end user.

ANALYSIS

Many steels were analyzed using a hypothetical bumper with equal bumper performance. A chart was compiled (Fig. 5) comparing the essen-

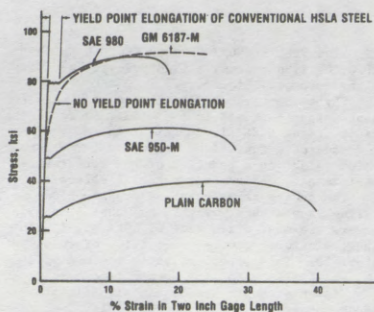


Fig. 4 - Stress-strain curves for plain carbon, SAE 950-M, SAE 980, and G. M. 6187-M steels

tial characteristics of some of these steels to SAE 950-M. G. M. 6187-M steel compared most favorably to the SAE 950-M steel and had the additional potential of reduced gage if the steel was strained greater than three percent in the manufacturing process. Based on this data, a hardware evaluation was initiated.

TRIAL RUN

A 1978 Eldorado rear bumper, made of SAE 950-M steel, was selected as the candidate for the G. M. 6187 tryout (Fig. 6). The gage was reduced from .111" to .101", and parts were made on production tools. These bumper bars were again evaluated for essential characteristics,

MATERIAL	ESSENTIAL CHARACTERISTICS							
	FORMABILITY — HALF FORM EXTERIOR BUMPERS	FORMING... SCRAP AND REPAIR RATE — EQUAL ON L&S	PLAT FINISHING — EQUAL ON L&S	WELDING — EQUAL ON L&S	PLATING QUALITY — EQUAL ON L&S	MATERIAL COST — EQUAL ON L&S	PAINT WEIGHT — EQUAL ON L&S	FINAL ASSEMBLY — EQUAL ON L&S
SAE 950	— BASELINE —							
SAE 960			X	X	X	X	X	5
SAE 980				X	X	X	X	4
GM 6187-M	X	X	X	X	X	X	X	7
MILD STEEL	X	X	X	X	X	X		6

Fig. 5 - Essential characteristics of a hypothetical bumper with various bumper steels compared to SAE 950

as shown in Fig. 7, line A. All of these characteristics were considered equal to the SAE 950-M material while achieving the desired weight reduction.

Although the surface of the formed parts appeared rougher than SAE 950-M, the chrome-plated parts had a quality appearance equal to SAE 950-M steel with the Cadillac plating system, which includes a copper plate and buff. Without the leveling contribution of the copper plate, the plating appearance of G. M. 6187-M was judged inferior to SAE 950-M steel. The bumper met all the requirements of Part 581 Bumper Standard. The yield strength of these bars is shown in Fig. 8. The upper surface yield strength was 89.3 ksi; however, the yield strength on the face ranged from 62.9 to 83.9 ksi. The section strength varied because of the bar shape and the conventional draw die design, as shown in Fig. 9. The front face of the bar was locked to the punch; consequently, most of the stretch occurred on the upper surface.

Material cost was a standoff with gage reduction from .111" to .101". The bar weight was reduced by 2.2 pounds. Since this trial run was considered successful by all concerned, G. M. 6187-M was released for mid-model production for the 1978 Eldorado rear bumper.

PRODUCTION RUN

With production lifts of steel, minor crack problems were observed in the area shown in Fig. 10. With the trimline modified, as shown by the dotted line in Fig. 10, production ran with acceptable scrap rates. This successful produc-

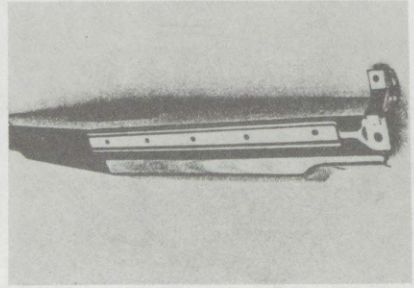


Fig. 6 - 1978 Eldorado rear bumper

BUMPER	ESSENTIAL CHARACTERISTICS							
	FORMABILITY — HALF FORM EXTERIOR BUMPERS	FORMING... SCRAP AND REPAIR RATE — EQUAL ON L&S	PLAT FINISHING — EQUAL ON L&S	WELDING — EQUAL ON L&S	PLATING QUALITY — EQUAL ON L&S	MATERIAL COST — EQUAL ON L&S	PAINT WEIGHT — EQUAL ON L&S	FINAL ASSEMBLY — EQUAL ON L&S
1978 AND 1979 ELDOORDO BUMPERS BASE FROM SAE 950-M STEEL	— BASELINE —							
A 1978 ELDOORDO TRIAL RUN ON GM 6187-M STEEL	X	X	X	X	X	X	X	7
B 1978 ELDOORDO PRODUCTION RUN ON GM 6187-M STEEL	X	X	X	X	X	X	X	6
C 1978 ELDOORDO PROTOTYPE BUMPERS MADE ON GM 6187-M STEEL	X	X	X	X	X	X	X	6
D 1978 ELDOORDO PRODUCTION BUMPERS MADE WITH GM 6187-M ORIGINAL SPEC	X	X	X	X	X	X	X	6
E 1978 ELDOORDO PRODUCTION BUMPERS MADE WITH GM 6187-M MODIFIED SPEC	X	X	X	X	X	X	X	7

*WITH CADILLAC PLATING SYSTEM

Fig. 7 - Summary of essential characteristics of 1978 and 1979 Eldorado bumpers comparing SAE 950 to G. M. 6187-M

tion run gave Cadillac greater confidence for expanded use of G. M. 6187-M for other bumpers. After the production tryouts, the chart of essential characteristics was updated to reflect the results of this run (Fig. 7, line B). This chart shows that G. M. 6187-M was judged slightly less formable than SAE 950-M because of the higher frequency of splits during forming.

The 1979 Eldorado was designed for the 4,000 pound EPA weight class for a 23% weight reduction from 1978. The 1979 front and rear bumper system weights were targeted for 118 pounds for a weight reduction of 52%. To achieve the 52% bumper weight reduction new technology and new materials were required. The 1979 Eldorado bumper design basically included a G. M. 6187-M steel face bar, a 7021 aluminum reinforcement, hydraulic energy absorbers, and bumper guards to provide a four-point barrier



Fig. 8 - Yield strength of 1978 Eldorado rear bumper after forming with G. M. 6187-M steel

contact to minimize the bar bending moments (Fig. 11).

Preliminary stress analysis indicated that with G. M. 6187-M steel, a face bar thickness of .080" front and .087" rear was required. The bars were to be one piece, but after several unsuccessful die design attempts to achieve styling crispness on the outer ends, the bars were made in three pieces and welded together, as shown in Fig. 12.

The yield strengths of the prototype bars, shown in Fig. 13, were not uniform across the section. The top and lower surfaces achieved yield strengths of 101 and 97 ksi, respectively. The face yield strengths ranged from 57 to 84 ksi. With this section design the front surface becomes locked to the draw die punch (Fig. 14) causing the nonuniform stretch. As will be shown later, in order for G. M. 6187-M dual phase steel to achieve its full work-hardening potential either the part section design or the draw die design must provide for a uniform and adequate stretch.

The 1979 prototype bars were evaluated for essential characteristics, with results as shown in Fig. 7, line C.

The formability was judged slightly less formable than SAE 950, while the remaining characteristics remained equal or better than SAE 950. The bumpers met Part 581 bumper requirements with the calculated gages.

Fig. 15 shows the 1978 and 1979 Eldorado weight comparisons. The 1979 front and rear bumper system weights were 111 pounds, 7 pounds under target. At 111 pounds, the 1979 Eldorado bumpers accounted for 2.9% of the total car weight, a significant improvement over the corresponding 4.8% figure in the 1978 Eldorado.

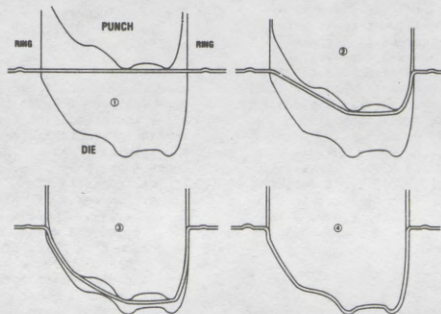


Fig. 9 - 1978 Eldorado rear bumper showing draw operation

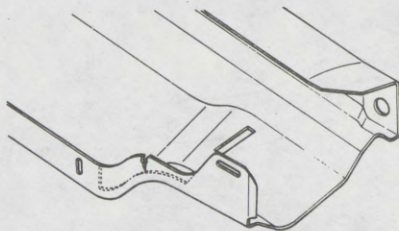


Fig. 10 - 1978 Eldorado rear bumper crack and trimline revisions

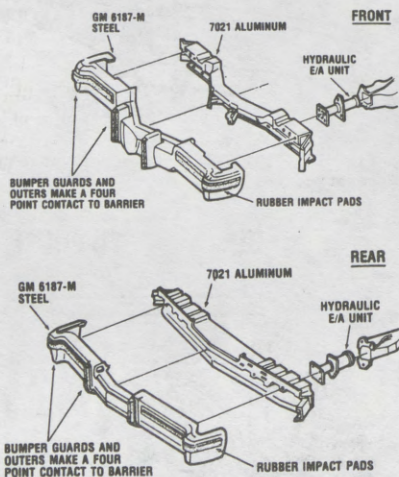


Fig. 11 - 1979 Eldorado bumper system design

Fig. 16 shows the bumper system weight versus vehicle weight on various 1979 cars. The bumper system weights are plotted corresponding to the most common material selection; i.e., all steel, all aluminum, and a combination of steel and aluminum. The 1979 Eldorado bumper weights, which represent a combination of steel and aluminum, are significantly below bumpers of similar construction.

A detailed weight analysis of the 1979 Eldorado bumper system is shown in Fig. 17. With this successful development program completed, G. M. 6187-M steel was released for 1979 production.

As with any revolutionary material, start-up problems were anticipated. Although steel suppliers have tighter controls on G. M. 6187-M steel than on conventional HSLA steels, the

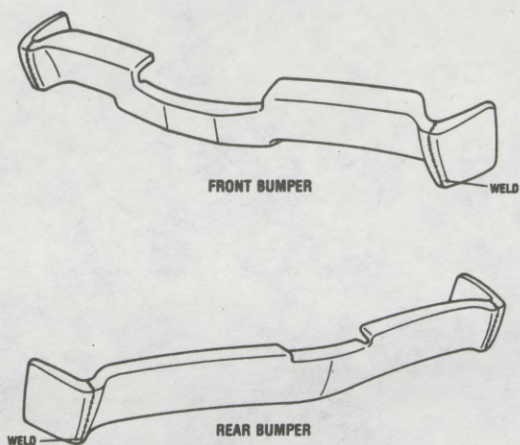


Fig. 12 - 1979 Eldorado bumper face bar construction

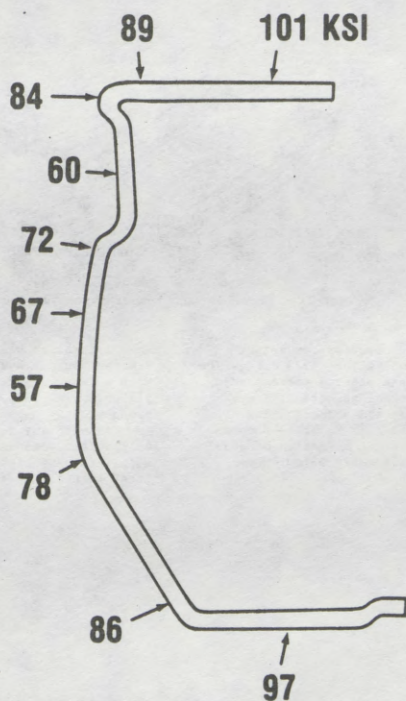


Fig. 13 - Yield strength on 1979 Eldorado prototype rear bumper section made from G. M. 6187-M steel

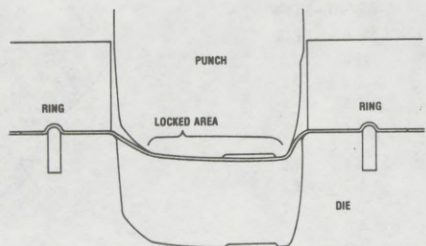


Fig. 14 - 1979 Eldorado rear bumper typical punch and die section

	1978 ELDORADO	1979 ELDORADO	1979 REDUCTION WEIGHT	%
TOTAL VEHICLE WEIGHT — LBS.	5062	3880	1181	23
FRONT BUMPER — LBS.	128	56	72	56
REAR BUMPER — LBS.	117	55	62	53
TOTAL FRONT & REAR	245	111	134	55

Fig. 15 - 1978 and 1979 Eldorado bumper system weight comparison

successful forming of this material requires good control of material properties, of lubrication, and of binder pressure; also, good die maintenance.

The strain values from the critical areas of the 1979 Eldorado rear bumper are plotted on a G. M. 6187-M forming limit diagram (Fig. 18). The strain values lie at or near a critical level of the curve. The bumper, from which these values were taken, had no indications of incipient failure; i.e., no necking, skin-splitting, etc. Any strain intensification or change in material properties, such as general lowering of the forming limit curve or anisotropic behavior caused by lack of inclusion shape or chemistry control, would move the press performance from the acceptable to the failure zone.

The chart in Fig. 19 shows the critical nature of the steel's mechanical properties to press performance during production runs of this material. The first run of bumpers, for all practical purposes, had no scrap.

The three percent strain yield strength and the tensile strength were below our original specifications. Bumper systems were validated for Part 581 Bumper Standard using this material.

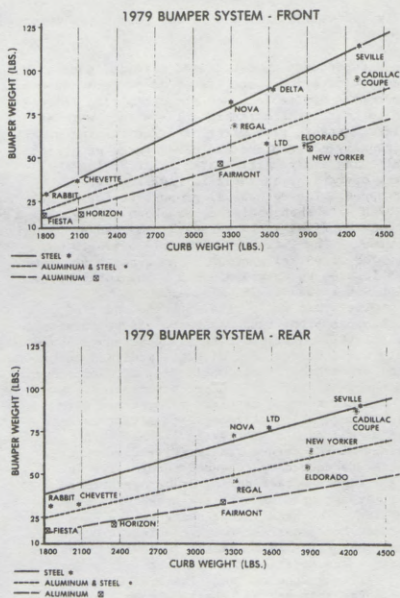


Fig. 16 - Bumper system weight vs. vehicle curb weight on 1979 cars

	WEIGHT — LBS.	
	FRONT	REAR
IMPACT BAR	23.4	24.8
REINF. IMPACT BAR	7.5	8.2
ESCUTCHEON	1.5	.8
BUMPER GUARD	2.7	—
BUMPER GUARD — REINF.	1.9	—
IMPACT PADS	4.1	4.6
EA UNIT	8.2	8.2
EA BRACKET	.8	.8
DOUBLER PLATE	1.8	—
CORNER BRACKETS	1.2	1.2
BULKHEADS	.5	—
JACKING RESTRICTOR	—	2.6
FASTENERS	2.6	3.3
TOTAL	56.2	54.5

Fig. 17 - 1979 Eldorado bumper weight analysis

Subsequent runs utilized material generally to specifications, but its press performance was much less desirable since the scrap rate increased to unacceptable levels. These runs were at times unstable with parts of lifts running with virtually no problems and other parts of a lift splitting every part. Parts split during the draw operation, as shown in Fig. 20, were scrapped. The mechanical properties for G. M. 6187-M were then modified, as shown in Fig. 21. The 0.2% offset yield strength remained at 55 ksi maximum. The three percent yield strength was lowered to 65 ksi minimum. The tensile strength was lowered to 85 ksi minimum. The total elongation was raised to 28% minimum.

The press scrap rate with the modified mechanical properties was decreased to an acceptable level. After-forming yield strength showed only a slight decrease with the modified mechanical properties, as shown in Fig. 22, and showed no change in Part 581 bumper performance.

Other forming problems encountered were back flange skin-splitting with a 2X thickness radius and edge splitting in license opening flange at the corner radius (Fig. 23). Each split was caused by consumed formability in areas highly worked during prior operations. The license opening cracks are repaired by welding. The back flange skin splits have been reduced to almost zero with the latest production run, due primarily to better inclusion shape control and modification of mechanical properties. Although the surface finish of G. M. 6187-M is poorer than SAE 950 steel, chrome plating quality was equal using the Cadillac plating system which has copper preplating.

Some problems were experienced with back-side plating adhesion. The backside did not

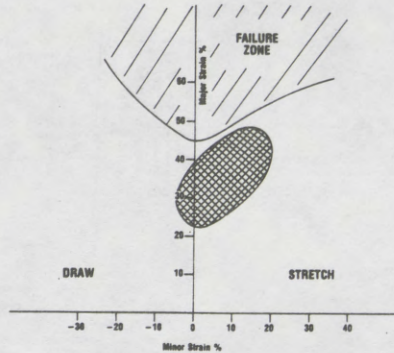


Fig. 18 - Strain values from critical areas of a 1979 Eldorado rear bumper plotted on a forming limit diagram for G. M. 6187-M steel

PROD. RUN	ORIGINAL SPEC	1ST RUN	2ND RUN	REVISED SPEC	3RD RUN
YIELD STRENGTH	55 MAX	—	45/50	55 MAX	41/49
0.2% OFFSET — KSI					
YIELD STRENGTH	70 MIN	67/68	72/78	65 MIN	65/73
3.5% OFFSET — KSI					
TENSILE STRENGTH	90 MIN	85/92	92/103	85 MIN	85/93
KSI					
TOTAL ELONGATION	27 MIN	29/32	25/30	28 MIN	29/32
%					
SCRAP	—	NIL	objectionable	—	acceptable

Fig. 19 - 1979 Eldorado rear bumper of G. M. 6187-M steel showing the effects of mechanical properties on scrap

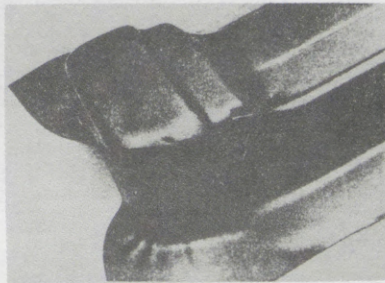


Fig. 20 - 1979 Eldorado bumper draw splits with out-of-spec. G. M. 6187-M steel

	ORIGINAL	REVISED
YIELD STRENGTH 0.2% OFFSET KSI	55 MAX	55 MAX
YIELD STRENGTH 3.0% OFFSET KSI	70 MIN	65 MIN
TENSILE STRENGTH KSI	90 MIN	85 MIN
TOTAL ELONGATION %	27 MIN	28 MIN

Fig. 21 - Mechanical properties of G. M. 6187-M original and modified

clean as thoroughly as other HSLA steels and resulted in a higher percentage of poor adhesion of the copper strike.

A more effective cleaning process was installed at Cadillac, and the steel supplied has an improved surface; consequently, this failure mode has been reduced to nil. Since the entire backside is 100 percent wax coated, the bumper has excellent corrosion protection.

Welding of G. M. 6187-M had no process related problems. Bumpers are welded using the MIG process with minor modifications for lighter gage steel. However, as the bumper gage is decreased, welding becomes more difficult.

The essential characteristic chart was updated to reflect the 1979 production runs (Fig. 7, line D and E). This chart shows that G. M. 6187-M steel with original mechanical properties is less formable than SAE 950-M steel, but has equal formability with revised mechanical properties. Other characteristics are the same.

More effective use of the work-hardening potential of G. M. 6187-M steel can be accomplished with better bumper or die designs. A section which provides for greater than three percent strain is essential. A computer program written to analyze the strain of bumper sections will provide the Design Staff Studio with design direction early in the styling phase. A modified bumper section is shown in Fig. 24 with design features to help avoid locking the bumper to the face of the punch and to provide for more uniform strain and higher yield strengths.

Techniques are possible in draw die design that can increase stretch and avoid locking the bumper to the punch face. One method is shown in Fig. 25. The bottom flange is opened permitting more stretch across the entire bumper section. This flange can be reformed in a subsequent operation. When designing dies for dual phase steel, uniform stretch must be a design requirement.

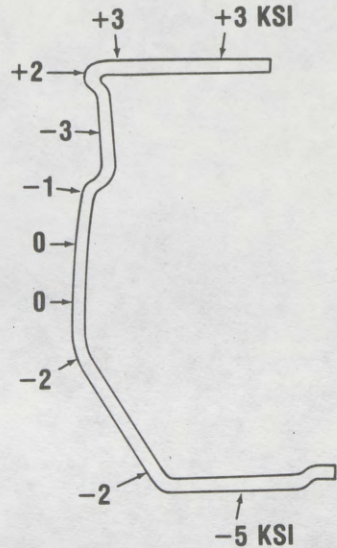


Fig. 22 - Yield strength change with modified as compared to original mechanical properties of G. M. 6187-M steel

FUTURE CONSIDERATIONS

What role will dual phase steel play in the future? There is still much to be learned about the steel-making process and the forming of this unique material. We have successfully made dual phase steel bumpers in the 80 ksi range; however, to achieve its full work-hardening potential, improvements in bumper and die design are required. The next step is to increase the three-to-five percent offset yield strength to the 80 to 120 ksi level. To accomplish this goal, the following objectives must be achieved:

From the steel mills -

- Eliminate inclusions or establish good distribution and shape control of inclusions.
- Optimize chemistry and processing.
- Provide good control and consistency of mechanical properties.

From the user -

- Design parts and dies to provide for strains between 5 and 15% in desired areas, but never exceed 25%.

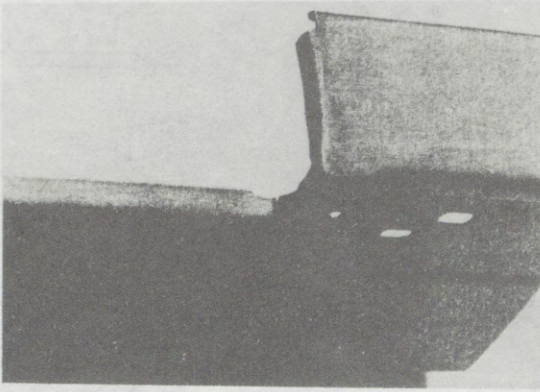


Fig. 23 - Edge splitting in license opening flange with G. M. 6187-M steel

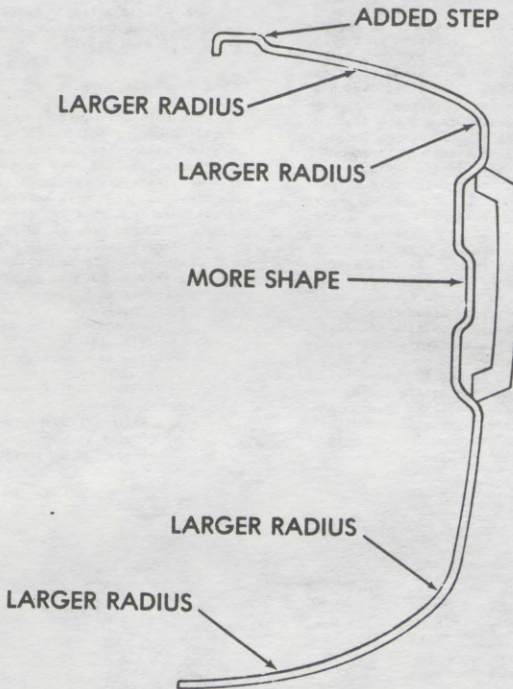


Fig. 24 - Bumper design modifications to increase yield strengths when forming dual phase steel

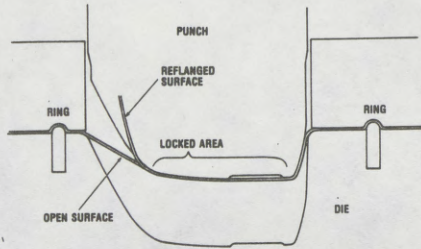


Fig. 25 - Proposed die change to increase strain when forming dual phase steel

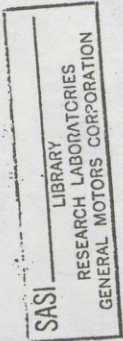
- Improve die lubricants.
- Provide good die maintenance.
- provide proper binder pressures.

With the attainment of these objectives, higher yield strength dual phase steel at thinner gages is possible for bumpers and other automotive parts. This is the type of development needed to provide the lighter weight cars that will help to meet the mandated fuel economies of the 1980's.

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TAXI FLEET FIELD EVALUATION OF THE
SOFT FACE BUMPER SYSTEM CONCEPT



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General Motors Technical Center
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INTRODUCTION

During the continuing research and development of vehicle exterior protection systems at General Motors, the soft face bumper system concept has emerged as one design approach that appears to have the potential of providing better real world damage protection than current bumper system designs. Although the materials and manufacturing technology required for large scale application of this concept is currently in its infancy, it appears likely that this supporting technology could be developed if the soft face concept proves to be a desirable alternative for some vehicles. Because laboratory testing cannot cost effectively duplicate the multitude of use situations found in field exposure, an experimental soft face bumper system design was installed on taxis in New York City. This field test program was designed to compare the performance of the soft face system and a current production bumper system in terms of repairability and damage resistance. Other important factors such as manufacturing, cost, and material availability are not considered in this report.

DISCUSSION

Bumper System Description - The basic components of the soft face bumper system that was used in this test program are shown in Figure 1. The fascia or flexible covering serves as a damage resistant interface between the vehicle and the environment, the energy management medium dissipates the kinetic energy of an impact through elastic and plastic deformation of a resilient material, and the backup beam transfers impact loads to the vehicle structure. Bumper systems, currently in production, that employ a flexible fascia that covers a load carrying beam mounted on hydraulic energy absorbing devices can achieve damage resistance performance comparable to soft face bumper system concepts. The front and rear soft face bumpers for the taxis were designed to withstand the 5 mph barrier and 5 mph pendulum impacts, specified in FMVSS 215, with no safety system damage. The front and rear soft face bumpers did contact plane A and B on the pendulum face during some impacts. The 1973 production bumper system was designed to withstand a 5 mph front barrier and a 2-1/2 mph rear barrier with no damage to safety systems.

Test Plan - To directly compare the real world damage protection of this soft face bumper system and a 1973 production bumper system, a field evaluation program was designed so that both systems were exposed to the same environment of potential damage producing impacts. This being the case, it was assumed that any measured difference in the performance of the bumper systems would be due to the bumper system design for that particular environment.

Arrangements were made with a cab company that maintains a fleet of 190, 1973 Chevrolet taxis in New York City. One hundred of the fleet vehicles were equipped with soft face front and rear bumper systems. The remaining 90 vehicles had production 1973 front and rear bumper systems.

The performance of the two bumper systems is compared in terms of the dollars that would be spent to repair all damage involving the front or rear bumper system. Only incidents of damage involving bumper system components were included in the test data. The minimum level of damage that was included was defined as any damage that a fastidious owner would have repaired if someone else were paying for it, and as a result many incidents of small levels of damage were included in the data. Incidents such as sideswipes, that possibly had an impact direction opposite to the bumper system design impact direction were included only if bumper system components were damaged.

Once every two weeks, a team of automobile collision damage estimators inspected all fleet vehicles and generated repair cost estimates on all observed vehicle damage that involved bumper system components. In the interim period between the bi-weekly inspections, one collision damage estimator reported to the fleet body shop on a daily basis to estimate repair costs for vehicles taken out of service for collision repairs. Records were maintained to insure that an incident of damage was not recorded twice.

Repair cost estimates for damage to production 1973 Chevrolet taxis were generated using published manufacturers' parts prices and flat rate labor schedules. For impact damages requiring replacement of the facebar, the cost of a new facebar, instead of a re-chromed facebar, was used in the repair estimate. Motors Insurance Corporation, GM Parts Division, and GM Service Research helped in developing parts prices, repair techniques and flat rate labor times for estimating crash damage to the soft face bumper system.

Summarized Test Results - Because of the number of soft face vehicles was larger than the number of production vehicles, total repair cost dollars could not be compared directly. To permit comparison, test results are reported in terms of repair cost per 10,000 miles. The taxi fleet office supplied the vehicle mileage information.

SOFT FACE BUMPER FIELD TEST DATA SUMMARY

<u>BUMPER SYSTEM</u>		<u>SOFT FACE</u>	<u>PRODUCTION</u>
o Miles		6,324,500	6,040,300
o Incidents of Damage	Front	544	867
	Rear	<u>563</u>	<u>395</u>
	Total	1,107	1,262
Per 10,000 Miles	Front	.86	1.44
	Rear	<u>.89</u>	<u>.65</u>
	Total	1.75	2.09
o Repair Cost Dollars	Front	49,561	82,286
	Rear	<u>27,147</u>	<u>28,844</u>
	Total	76,708	111,130
Per 10,000 Miles	Front	78.35	136.23
	Rear	<u>42.92</u>	<u>47.75</u>
	Total	121.27	183.98

The soft face front system sustained fewer incidents of damage and accumulated a lower repair cost than the production front system. Although the soft face rear system sustained more incidents of damage, the accumulated repair cost was lower than the production rear system. These test results are analyzed in greater detail in the following sections.

Frequency of Impacts for Front Systems - In Figure 2 the number of observed incidents of damage in each 25 dollar repair cost interval is shown for the production front and soft face front bumper system. If the two groups of vehicles in fact experienced the same environment of potential damage producing impacts, then differences in frequency and distribution of observed damages for the two systems was caused by the difference in damage resistance and repairability of the two bumper system designs. Throughout most of the repair cost intervals, the number of observed cases of damage on the front soft face system was lower than the production system. The large number of incidents of damage on production taxis with a \$75 to \$100 repair cost most likely involve replacement of the facebar. The most significant difference in performance between the soft face and production front system appears to be in the repair cost intervals between 0 and \$200.

The frequency of damage producing incidents measured during this test program is nearly 8 times higher than the frequency of impacts reported in other studies that attempted to measure reported and unreported cases of vehicle damage.

Distribution of Repair Costs for Front Bumper Systems - Further insight into the performance difference of the soft face and production systems can be gained by observing the distribution of repair cost dollars with respect to damage severity. In this analysis, all repair cost orders that fall in a given repair cost interval, for example \$100 - \$125, are summed together to get the total dollars in each interval. This sum represents the product of the frequency and average cost in each repair cost interval. A plot of cumulative dollars versus repair cost interval indicates the distribution of the repair cost dollars.

Figure 3 shows the cumulative total of repair cost dollars per 10,000 miles through all the \$25 repair cost intervals for the front soft face and production taxi. As would be expected after reviewing the damage frequency distribution of Figure 2, the large difference in total repair cost dollars between the two systems occurs primarily in the repair cost intervals under 300 dollars. In repair cost intervals higher than \$300, both systems accumulate repair cost dollars at about the same rate.

The distribution of repair cost dollars is largely a function of the impact environment. If these two groups of vehicles were operated in a rural area, the distribution of repair cost with respect to severity would be significantly different than the results measured in New York City.

Impact Frequency for Rear Bumper Systems - Figure 4 shows the frequency of observed damages in each repair cost interval for the rear soft face and production taxis. Assuming the same environment, the difference of the observed frequencies between the systems is probably due to the differences in the bumper system designs as was the case with the fronts. In the rear, this specific soft face design was vulnerable to light impacts in the corner areas. Also in the front, the soft face design had the advantage of eliminating easily damaged grilled components. Again, the measured frequency of damage producing incidents in New York City is significantly higher than the frequency of rear impacts reported in other studies.

Distribution of Repair Costs for Rear Systems - The distribution of repair costs for the rear production and soft face taxi rear bumper systems are plotted on Figure 5. The data indicates that the rear soft face system initially accumulates more repair cost dollars, as would be expected because the number of incidents of damages in the zero to \$50 repair cost range is greater than the production system. For incidents of damage greater than a \$50 repair cost, the soft face system typically has fewer

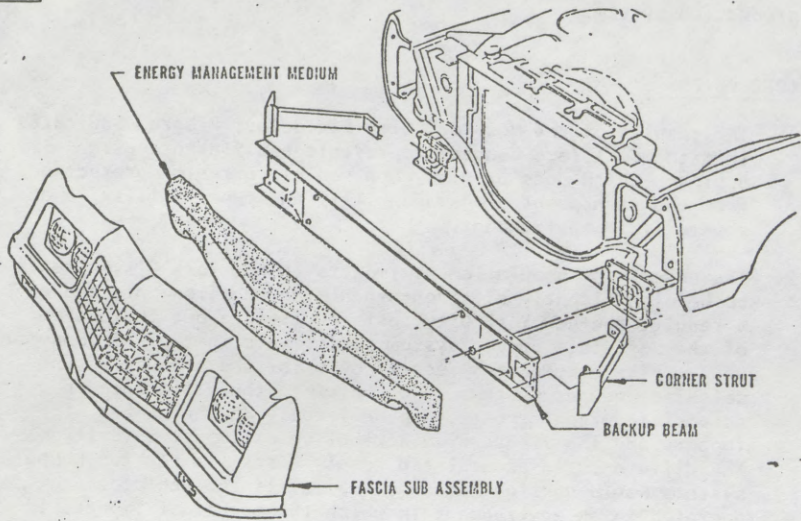
Incidents of damage than the production system and the total accumulated repair cost for the soft face system is less than the production system.

CONCLUSIONS

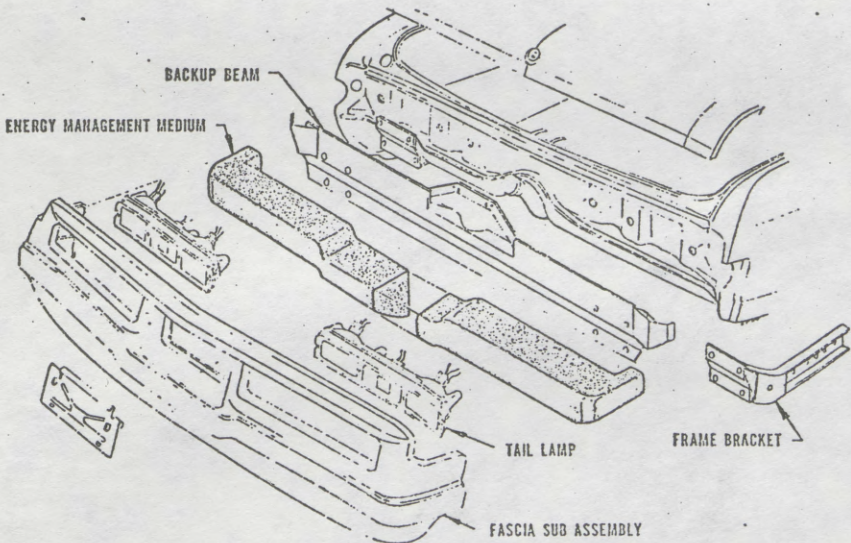
1. The results of the New York City Field Test Program indicates that the soft face concept represents a different design approach which does provide good vehicle exterior protection from the standpoint of damageability and repairability in a severe field environment.
2. The underlying population of impacts in New York City appears to be significantly different than other environments and as a result, the New York City test results are not indicative of the soft face bumper system performance in typical consumer usage. The accumulated repair costs for the production and soft face bumper systems, and therefore the difference in accumulated repair costs, depend largely on the number of impacts and the frequency distribution of impact severity. The difference in accumulated repair costs for the two bumper systems would be significantly smaller if the vehicles are operated in an environment in which the number of impacts is lower and the frequency distribution of impact severity is different.



GM SOFT FACE BUMPER CONCEPT



FRONT ASSEMBLY



IMPACTS PER CAR PER 10,000 MILES IN EACH REPAIR COST INTERVAL Front Impacts Only

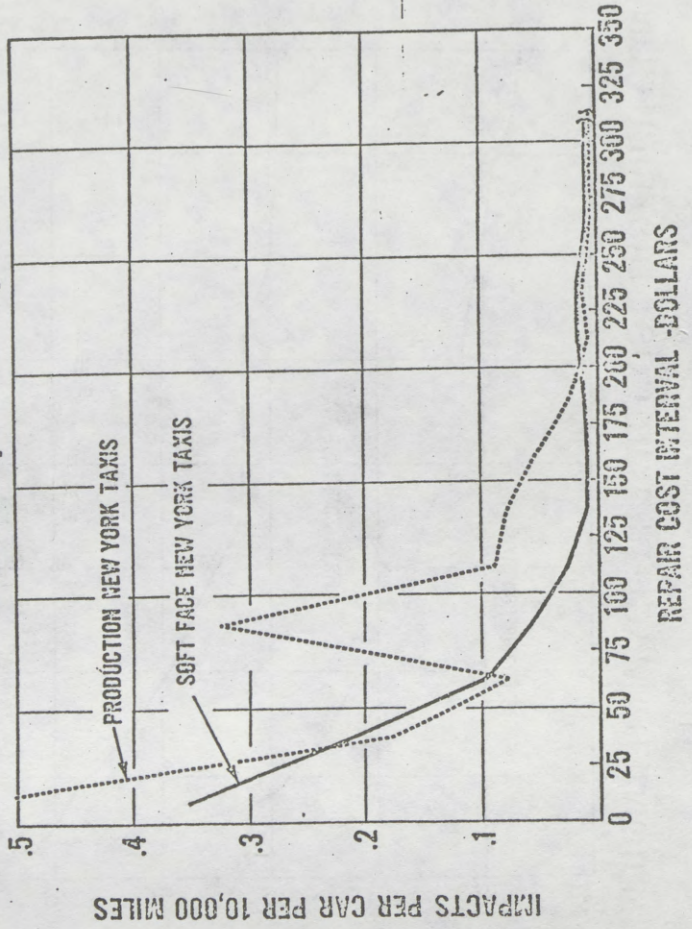


FIG. 2

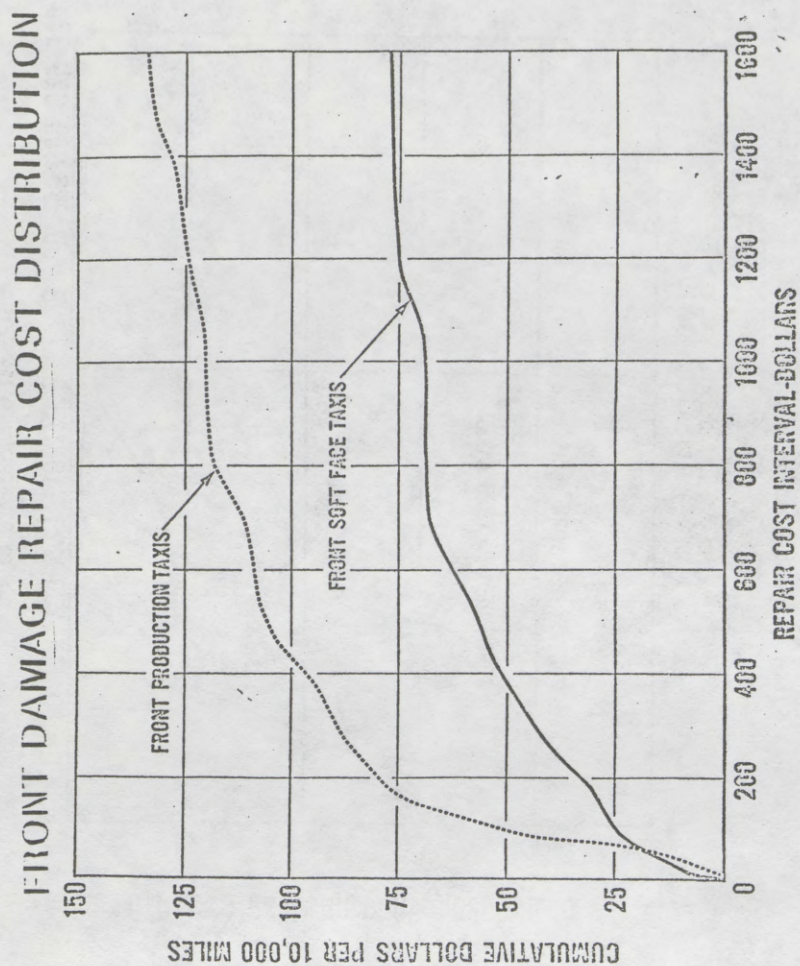


FIG. 3

IMPACTS PER CAR PER 10,000 MILES IN EACH REPAIR COST INTERVAL Rear Impacts Only

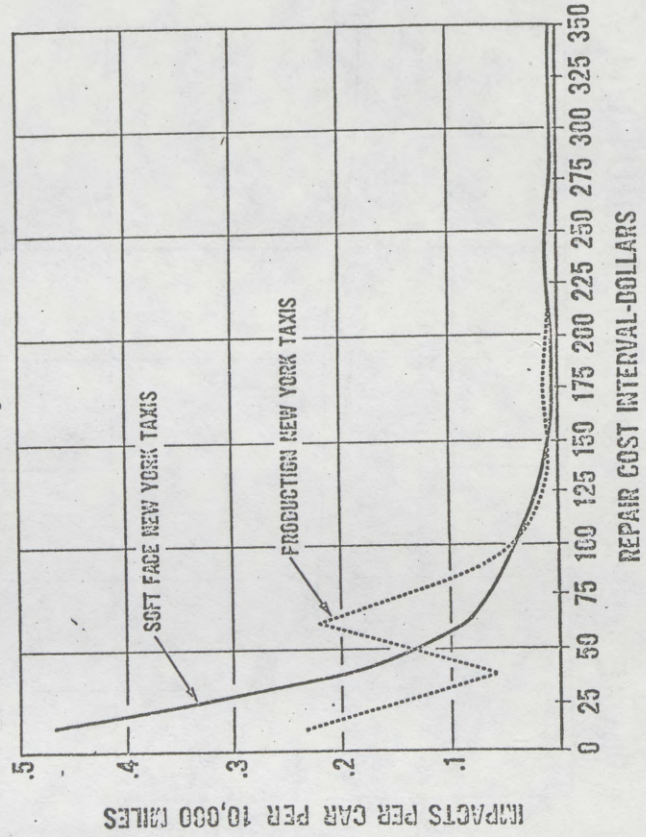
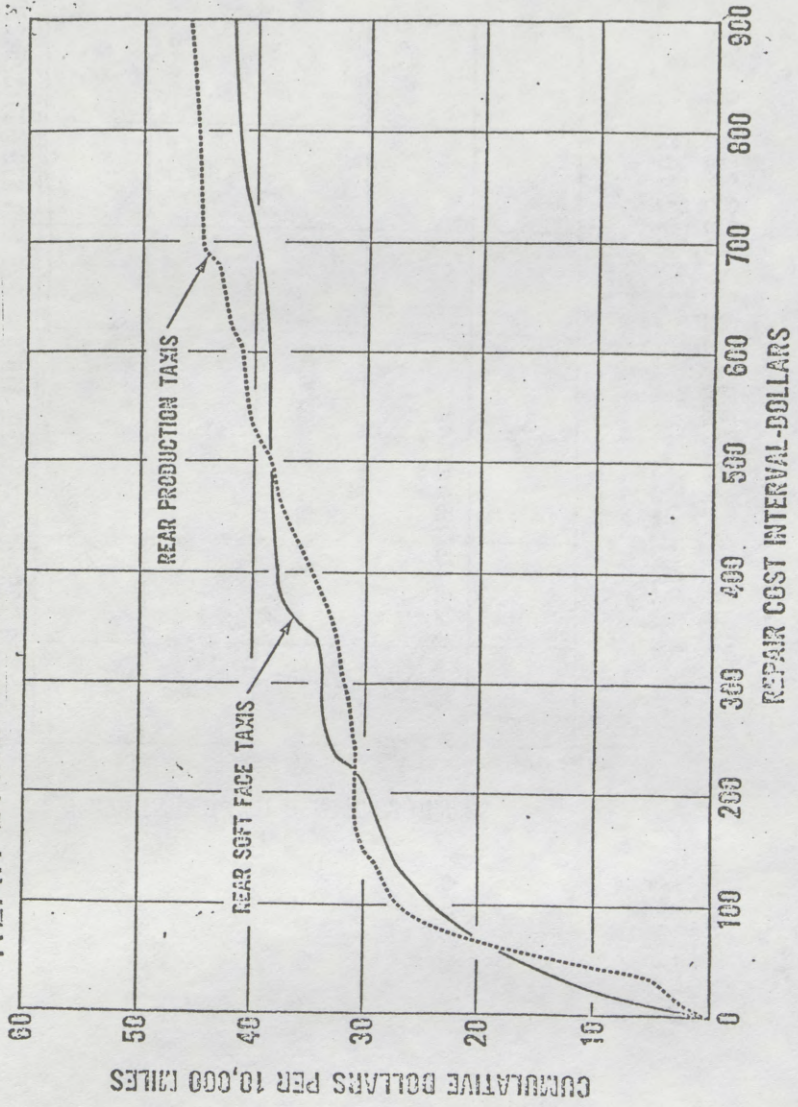


FIG. 4

REAR DAMAGE REPAIR COST DISTRIBUTION



BUMPERS THAT FLEX

The federal bumper "no-damage" standards for 1980 are going to persuade the auto makers to put flexible plastic bumpers on about 5 million cars a year in the next couple of years, in the opinion of McCord Corporation, a major supplier of these bumper systems.

Flexible bumpers are now on Corvette, Monte Carlo, Camaro, Monza, Grand-A, LeMans, Firebird, Starfire, Skyhawk and Mustang. Except for Mustang, all these cars have bumpers made by the reaction injection molding (RIM) process in which two chemicals are simultaneously poured into a mold. With little heat or pressure, an extremely tough, smooth and flexible urethane "skin" is produced in about two minutes. It's then filled with a urethane foam plastic and attached to a steel bumper beam or structure that's rigidly mounted to the car.

A more advanced and lighter flexible bumper system will be introduced on one or more 1979 cars. The current flexible bumpers are only compressed about 2½ in. on impact, with the remainder of the impacting energy being absorbed by mechanical shock absorbers. But the 1979 flexible bumpers, because of a change in the federal standard, will compress as much as 7 in., permitting elimination of the steel bumper beam and the shock absorbers. This bumper will contain up to 8 in. of urethane foam inside the flexible skin.

In 5-mph collisions, these bumpers compress and recover 95-99% of their original shape almost immediately. Ultimately, McCord engineers predict, these bumpers will be able to absorb impacts up to 13 mph without damage to the cars.

McCord claims these bumpers will be lighter, cheaper and more repairable, while providing much greater protection to pedestrians at impacts of up to 20 mph.

Motor Trend, February 1978, Page 4

APPENDIX B

Analysis of Calculations and Supporting Material
For the NHTSA Preliminary Analysis of the Bumper Standard
in DOT-HS-803-868

March 1979

Insurance Institute for Highway Safety
Washington, D.C. 20037

Introduction

The preliminary analysis of the bumper standard performed by the National Highway Traffic Safety Administration (NHTSA) is much more comprehensive and methodologically sound than the analysis conducted for Houdaille Industries, Inc. but despite this it contains fatal errors in its estimates of the costs and weights of alternative bumper designs -- errors that invalidate its conclusions.

The NHTSA study notes that a bumper performance standard permits manufacturers considerable latitude in choosing actual designs and that consequently, "... the role that manufacturers have in determining the amount of benefits that consumers actually achieve" is a large one. Recognizing that differences in designs will result in differences in costs and benefits to the consumer, the NHTSA analysis considered the costs and benefits of bumper designs utilizing three different materials -- steel, aluminum, and soft face -- each at three different performance levels -- 2½, 5 and 7½ mph.

Bumper Systems Studied

NHTSA attempted to compare the differences in costs and benefits it assigned to these bumpers with a 1970-71 model year steel "baseline" bumper, assumed to have a performance level of about 1.4 mph.

Unfortunately, even though it recognized that the design choices of the manufacturers significantly affect the costs and benefits to consumers, the NHTSA analysis considered only "average" and outdated systems and did not begin to explore the differences in net benefits to consumers resulting from good and bad designs.

The NHTSA analysis used information from a recent International Nickel Company (INCO) study of the weights and costs of a number of bumper designs

from 1977 and 1978 models. NHTSA incorrectly described these as 5 mph bumpers, whereas in fact they are bumpers certified as satisfying only the FMVSS 215 safety standard and may not necessarily satisfy even the weak Phase I performance requirements of the Part 581 property damage bumper standard, which became effective only beginning with the current model year.

Although NHTSA described the metal systems it studied as either steel or aluminum, in actual fact several of the steel systems had aluminum reinforcements and virtually all of the aluminum systems had steel energy absorbers and steel reinforcements. Consequently, the systems studied were really hybrid systems.

NHTSA used a sales weighted average of the cars in the INCO study to obtain its estimates of the weights of 5 mph steel and aluminum systems for a 3600 lb. car. Using these weight estimates NHTSA then estimated initial costs by multiplying each bumper system weight by the "consumer price per pound" for each material.

This attempt to define "average" bumper systems was inappropriate because many of the cars in the INCO study had technologically obsolete, unnecessarily heavy, and needlessly expensive bumper designs. What NHTSA should have done in its cost estimating was what it correctly did in its benefit calculations; it should have considered the best and the worst designs to obtain upper and lower estimates of the costs. It is particularly important to demonstrate this range because the particular designs used are chosen by the manufacturers and -- as NHTSA recognized -- these choices dramatically affect the benefits derived by consumers.

To illustrate this, the best steel system in the INCO study, when scaled to the 3600 lb. car used by NHTSA, would weigh about 90 lbs. -- that is, 72 lbs. less than the average steel system in the NHTSA analysis, and 99 lbs.

less than the worst steel system in the INCO study, which would weigh 189 lbs.! These weight differences, according to the NHTSA consumer price per pound, would translate into an initial cost difference of \$147 between the best and the worst 5 mph steel systems.

Another major error in the NHTSA weight estimates for 5 mph metal systems stems from the fact that the 1977 or 1978 bumper systems considered were far from optimum with respect to weight. According to the NHTSA estimates, a typical 5 mph steel system would weigh 162 lbs. and a typical 1970-71 model year steel "baseline" system 119 lbs. The weights of some 1979 and 1980 model bumper systems, however, have been substantially reduced by the use of improved materials, such as "dual phase" steel which doubles the bending strength of a bumper without any weight increase. As a result of improvements of this type some 1979 and 1980 steel bumper systems designed for 5 mph no damage performance will weigh substantially less even than 1970-71 steel systems, which had to meet no standard. Therefore, the NHTSA estimate that a 5 mph steel bumper would weight 43 lbs. more than a "baseline" 1970-71 model steel bumper is seriously in error.

The NHTSA cost and weight analysis also completely overlooks the newer designs being developed and increasingly used. For example, the best steel 5 mph system in the INCO study still represented 2.5 percent of the vehicle's curb weight, but the newer technologies can produce steel bumper systems weighing 1 percent or less of the curb weight.* Thus the best steel system in the INCO study, which weighed 90 lbs., could weigh less than 36 lbs. using

*Riffe, William J. (U.S. Steel), No Damage Steel Bumpers -- A New Approach. SAE Paper No. 770212. Presented at the International Automotive Engineering Congress and Exposition, Society of Automotive Engineers, February 28-March 4, 1977. Warrendale, Pa.: Society of Automotive Engineers, 1977.

more technologically modern approaches. Similarly, Alcoa has recently developed a new aluminum alloy which can reduce the weight and cost of aluminum components by twenty percent while retaining the same performance levels (Attachment A).

NHTSA used the weights and costs of the 1977 and 1978 bumper systems in the INCO study as a starting point to derive the weights and costs of 2½ and 7½ mph designs. The procedure used by NHTSA in this derivation, however, contained a number of assumptions that were incorrect.

2½ Mph Metal Bumper System Costs

For the steel and aluminum systems, NHTSA assumed that the difference between 5 mph and 2½ mph systems would be the elimination of energy absorbers and reinforcements for the lower speed designs. As a result of this procedure, NHTSA substantially overestimated the weight differences between 2½ and 5 mph metal bumper systems.

In estimating the weight reductions for 2½ mph metal systems compared with the corresponding 5 mph systems, NHTSA subtracted the weights of the energy absorber units from the 5 mph systems but did not include any weight for the necessary brackets or supports to hold a 2.5 mph bumper face bar to the car (a function performed by the energy absorbers in the 5 mile per hour systems used for comparison). Furthermore, the INCO study included the weights of steel support brackets for bumpers that do not utilize energy absorbers. These ranged in weight from 10 to 21 lbs. -- closely similar to the weights of energy absorbers, which ranged from 8 to 28 lbs. (It is interesting to note that at least one 1979 model, the AMC Concord, does not use energy absorbers on its rear bumper, and the support brackets used on this model to hold the face bar weigh almost the same as the front bumper energy

absorbers.) Thus NHTSA substantially overstated the possible weight savings by ignoring the support brackets needed to hold face bars to the car.

To illustrate the extent to which NHTSA overstated the weight savings associated with 2½ mph systems, consider its weight estimates for the 2½ and 5 mph steel systems. NHTSA estimated that a typical 5 mph steel system would weigh 162 lbs. and a typical 2½ mph system 78 lbs., resulting in a cost difference of \$124 between the two systems. However, in the Houdaille analysis of the 1978 Chrysler Corporation Aspen/Volare, which has a particularly heavy 5 mph steel system, the actual weight savings on the Mexican Aspen/Volare (which has a system approximating 2½ mph performance) compared with the American version was only 41.5 lbs. -- less than half the 84 lbs. savings estimated by NHTSA for two such systems.

7½ Mph Metal Bumper System Costs

NHTSA also made unreasonable assumptions to derive the weights of 7½ mph bumper systems. NHTSA assumed that bumper system weights are directly proportional to the square of the impact speed. Thus, they thought a 7½ mph metal bumper system would weigh 2.25 times as much as a 5 mph bumper system. This assumption is simply not correct, as was demonstrated by the Tayco modified 1977 model AMC Gremlin bumper that sustained no damage in a 7 mph barrier impact; the modified bumper weighed virtually the same as the corresponding 5 mph bumper.* The NHTSA assumption would only be credible if the distance available for energy absorption were fixed in both 5 and 7½ mph

*Kelley, Albert Benjamin and O'Neill, Brian. Statement Before the House Committee on Interstate and Foreign Commerce, Subcommittee on Consumer Protection and Finance Oversight Hearings on the Motor Vehicle Information and Cost Savings Act of 1972, May 6, 1977. Washington: Insurance Institute for Highway Safety, 1977.

systems. This is an artificial constraint that does not exist in the real world; higher speed performance can easily be obtained by using energy absorbers with slightly longer strokes and more efficient designs than those currently used.

Soft Face Bumper System Costs

NHTSA has also made a number of serious errors in its calculations of the weights of soft face systems. According to the NHTSA study, a 7½ mph soft face system for a 3600 lb. car would weigh 138 lbs., whereas the Calspan Research Safety Vehicle (RSV)* bumper, which is an 8 mph system, weighs only 52 lbs., which when scaled up for a 3600 lb. car actually translates into a 87 lb. bumper system, 51 lbs. less than the NHTSA estimate! Similarly, the Minicars RSV, which has a 10 mph front and a 5 mph rear bumper system, would weigh approximately 29 lbs.** on a 3600 lb. car -- again, substantially less than the NHTSA estimate of 138 lbs.

NHTSA has also overlooked the fact that soft face systems, depending on the design, replace all or parts of the fenders, quarter panels, grills, etc. since these components are incorporated in the soft face design. Consequently, the weights of soft face designs should not be compared against the costs and weights of metal bumper systems as was done in the NHTSA analysis, because the soft face systems may also incorporate other components with weight and cost. Nowhere in the NHTSA cost comparisons was this taken into consideration.

*Developed under NHTSA contracts.

**This does not include the weight of the cosmetic cover which in addition to covering the bumper incorporates the major front and rear end body components.

Conclusions

Clearly the NHTSA bumper system cost estimates are based on many erroneous assumptions. The principal effect of these various errors is to exaggerate the weight differences expected for different performance levels and consequently to also exaggerate the cost differences associated with different performance levels. Much more realistic assumptions based on the recent automotive engineering literature and on actual 1979 and 1980 model bumper designs demonstrate that NHTSA has seriously overestimated the weight differences and hence the differences in lifetime operating costs among the different performance levels.

With substantially smaller cost differences between the different performance levels, the net benefits to consumers will be much closer to the differences in consumer benefits shown in Table I of the NHTSA analysis. This shows substantial increases in benefits for the systems with higher performance levels.

Mr. SCHEUER. Do you have any questions you would like to ask now?

Mr. BROYHILL. What if NHTSA does find that the 5-mile-per-hour standard is not cost beneficial? What would you recommend then?

Mr. KELLEY. I think, Mr. Broyhill, that NHTSA must address first the question of whether actual bumpers in the real world under the standard are cost beneficial. The standard, after all, was drafted by Congress, and I think very wisely, as an extremely open ended performance standard. It gives absolutely no limitation to manufacturers on the types of material or designs or styling they must employ, other than that they must meet this straight-into-barrier test and a corner pendulum test at a lower speed.

That is all. So there is no way to assess the cost/benefit results of the standard per se. There are out in the real world, as we talked about here, bumpers that range from very heavy, very inefficient, to the very light and efficient. So NHTSA has the far more difficult job of looking in the real world at what the best bumpers under today's state of the art are that are being given to the American consumer, as well as the worst, and saying, "OK, here is what the standard can produce if manufacturers do the best job they can, here is what it will produce if they do the worst job they can, and here is the result of that analysis."

The agency is going to need a good deal more time than tomorrow morning, I am afraid, since the standard has just taken effect in this model year, to come up with those results. I know that it has currently completed the conducting of, I gather, the crashing of some 40 cars and is going to be crashing some more. We are going to be initiating another crash test program in response to the agency's invitation, and we will find out how the range of these bumpers are performing. We will also look at the possibilities for

even further improvements from soft-nosed bumpers, from experimental sorts of designs that the Government and industry have sponsored. We think it is just the beginning of tremendous progress toward designs that will reduce damage and protect pedestrians and will reduce costs and fuel use in cars.

Mr. BROYHILL. I think that what some of us might be concerned with as legislators is if the agency finds that the 5-mile-an-hour standard is not cost beneficial to consumers, it seems to me it would not be in the public interest to continue this. Apparently, from your testimony, you are convinced that they won't buy that.

Mr. KELLEY. No, sir, I am not. We are addressing those with the same sense of inquiry that we believe NHTSA is. We are going to use the 60-day comment period they have given us, which, frankly, is not a long time to crash a lot of cars and do a lot of data analysis. But we are going to use that to the best of our advantage to find out what the real world results of this new standard are.

If the results are not good in any direction, up, down or sideways—and by sideways I mean the specific test they are using rather than the speeds, since it may be it is not the speed but is one test or another—we are going to tell them so. And I don't think we are going to come out all four corners in agreement with their present standard for testing criteria.

But I would be presumptuous to sit here and predict where we are going to come out until we have done the extensive research required.

Mr. BROYHILL. Did I understand you were saying a few moments ago that in the study done by Houdaille and their research people, the facts that came out there may be accurate in and of themselves, but that study should in no way stand as a cost/benefit analysis of the bumper standards as applied to the total population of bumpers?

Mr. KELLEY. Well, even more than that, Mr. Chairman, even if their results were accurate specifically, you would be absolutely right. We do not believe those represent anything but results for one bumper. However, we have absolutely no reason to believe that their assumptions about the benefits to consumers from the performance of the Aspen/Volare bumper or another bumper are anything but their guesses.

They have no data. They have no real world data as to crash frequency, crash speeds, direction of crashes, age of vehicles, numbers of reported cars with damage, those unreported with damage. All of those are guesses by Houdaille based upon various assumptions within ranges that they thought, that they believed, coming from their position, were appropriate for their study. But they are not supported by the real world.

Mr. BROYHILL. Have you crash tested Volares?

Mr. KELLEY. Oh, yes, sir, we have.

Mr. BROYHILL. Did you come up with similar information?

Mr. KELLEY. No. In our front-to-rear crash tests of this car, the actual damage figure was 80 percent off of their estimate, using their formulas, and that was a real world crash.

Mr. BROYHILL. In other words, you are alleging that their costs were 80 percent higher than your estimates?

Mr. KELLEY. Eighty percent more damage. That is right, yes, sir.

Mr. BROYHILL. Thank you very much.

Mr. SCHEUER. Thank you very much.

If you will remain on tap, we will call you back after the other panel members finish. We are now going to call on Congressman Norman D'Amours—one of the most able, hardworking, and effective Members of Congress, and a valued friend of mine—to introduce the next witness.

STATEMENTS OF HON. NORMAN E. D'AMOURS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW HAMPSHIRE, AND RICHARD FERRARI, VICE PRESIDENT OF ENGINEERING, DAVIDSON RUBBER CO.; ACCOMPANIED BY JON HOPKINS, MARKETING MANAGER FOR BUMPERS, AND A. P. WELLER, DIRECTOR OF PRODUCT ENGINEERING

Mr. D'AMOURS. Thank you, Mr. Chairman. Your flattery will get you anywhere. Mr. Chairman and members of the subcommittee, it is a privilege to be here with you today to discuss the proper level of the safety standards for automobile bumpers under the Motor Vehicle Information and Cost Savings Act.

It is also an honor for me to present to the subcommittee three representatives of the Davidson Rubber Co., which has been in the forefront of efforts to develop safer, lighter, and easier to repair automobile bumpers. Accompanying me today from the Davidson Rubber Co., which has two plants in my congressional district employing over 1,000 men and women in the manufacturing of soft-face automobile bumpers, are Mr. Jon Hopkins, to my far left, the marketing manager for bumpers; Mr. P. A. (Tony) Weller, to my right, the director of product engineering; and Mr. Richard Ferrari, vice president of engineering, to my immediate left.

Mr. Chairman, this Congress has frequently been referred to as the oversight Congress, a Congress whose main purpose is to produce better legislation rather than simply more legislation, and to review and analyze the cost effectiveness of existing laws, rules and regulations. Your subcommittee is to be commended for taking such an early, aggressive role in this oversight process.

Last week, our former colleague and friend and present Secretary of Transportation, Brock Adams, called upon American industry to reinvent the automobile, to make the automobile of the 1980's lighter, safer, cleaner and easier to repair, and also more fuel efficient than its predecessor.

The employees of Davidson Rubber are ready, willing and able to meet that challenge, in part by designing and producing lighter, safer and easier to repair automobile bumpers.

Mr. Hopkins and his colleagues are going to demonstrate, in my opinion, to this committee that Davidson Rubber is already producing automobile bumpers which meet the 5-mile-per-hour National Highway Traffic Administration standard. They will also demonstrate the technology in this field is developing very rapidly, and that experimental bumpers which Davidson has designed and is currently testing can meet that 5-mile-per-hour standard while, at the same time, being lower in cost and weight than the current bumpers. Consequently, these newer lighter bumpers will also help manufacturers meet the future fuel efficiency standards.

Finally, Davidson representatives will express their serious concerns about the validity of the study being done by Professor Wise and Dr. Roth for Houdaille Industries, and the conclusions they have drawn that the 5-mile-per-hour standard should be lowered to 2½ miles per hour.

In light of the fact that bumpers which can meet the 5-mile-per-hour NHTSA standard are currently being produced, in light of the fact that still better bumpers are on their way and that these bumpers can significantly reduce repair costs after minor collisions and bumps, I would urge the subcommittee to recommend to NHTSA, to Joan Claybrook, that they continue the present study of bumper safety standards, and that you not take any precipitous action to weaken the 5-mile-per-hour standard.

Mr. Chairman, again I thank you for your very gracious and kind, if somewhat overstated, introduction. I am sure you will listen attentively to the representatives of Davidson Rubber.

Mr. SCHEUER. Indeed we will.

I have gotten a message which requires me to suspend for just a moment.

[Off the record.]

Mr. SCHEUER. Please proceed.

Mr. FERRARI. Thank you. I am Richard Ferrari. Thank you for allowing us the opportunity to testify today. We requested this opportunity because we are concerned that in the absence of sound field performance data, the value of the 5-mile-per-hour bumper standard is not recognized and unwarranted changes to it are being proposed.

Our position is that the current standard is of considerable benefit to the consumer. We also recognize that the limited actual data available does not clearly demonstrate that the standard is optimal from a cost/benefit point of view. But we do believe that neither the data analyzed by NHTSA nor the data presented by Houdaille at a 2½-mile-per-hour alternative is comprehensive enough or conclusive enough to warrant changing the standard now.

Bumper system technology has evolved dramatically in the past five or six years in response to the standard. The 1979 and 1980 bumpers are lighter and more efficient than earlier systems, and the bumpers currently being designed for 1981 and 1982 are still lighter and even more cost effective. To make a decision now to change the rules before the benefits of the new technology are fully available and understood would not be in the best interest of the consumer. Our main purpose is to ask that NHTSA be allowed to evaluate completely the cost effectiveness of current bumpers through their planned program of crash testing and public comment. This program should include both field performance data and the effect of the latest low-cost, low-weight bumper systems. We intend to participate in this evaluation.

Before we address two very important issues, first, the validity of the Houdaille report, and second, the current technology level of bumper systems as it relates to the 5-mile-per-hour standard, let me establish my company's credentials and provide some general marketing information.

Mr. SCHEUER. I tell you, we are very short on time. Maybe it would be better if you left that in the record. We are trying to

limit this to 10 minutes per witness; four of you are going to take up far more than 10 minutes. I would appreciate it if you would not restate such of your credentials as will appear in the record.

Mr. FERRARI. All right. I do want to point out, Mr. Chairman, that we have not had the benefit of previous contacts with these committees as Houdaille has, and our total presentation was planned for 17 minutes. I will leave that out, however.

Mr. SCHEUER. I am lumping the three of you plus your distinguished Congressman into one. After we have finished with all of the witnesses—to the extent that there have not been any rollcall votes—we can keep going. With any luck, we can go on after 3 o'clock and then you will have a chance to elaborate on your testimony. I would be happy to stay and listen.

Mr. FERRARI. I will go on, then. The one point I do want to make is that flexible bumpers and fascias will be on 25 percent of all cars in the 1980's. Three of Davidson's four manufacturing plants and 1,500 of our 4,000 employees are involved with the development of flexible bumpers and systems components. We are very concerned the changes made to the current bumper standards which are not soundly based will unnecessarily threaten the jobs of these people. Now we would like to comment on the study done for Houdaille by Professor Wise and Dr. Roth. In our opinion, the study is seriously flawed by an insufficient data base and a series of questionable assumptions. The result is erroneous and misleading conclusions. Furthermore, the resulting conclusions do not reflect the rapidly changing technology and capabilities of the automotive industry which provide today bumper systems which are far more effective in cost benefits and weight than the one studied. We have taken this position in part for the following reasons. The Houdaille reports are largely hypothetical in scope and content. Houdaille rejected real world analysis, which is a true test of a product's cost effectiveness, because of the cost to them. Regardless of the reason, this is a major flaw which casts serious doubt on the validity of the premises and conclusions made by Houdaille. Although their conclusions read like doctoral statements, the report is one of hypothetical premise laid upon hypothetical premise.

Two. Neither Professor Wise, an economist, nor Dr. Roth, a mathematician, have any engineering expertise in automotive technology. As a result, the whole report suffers from a lack of insight into the current ability of the industry to design and build cost-effective 5-mile-per-hour bumpers.

Three, the major flaw in the Houdaille report, in our view, is that the conclusions are based principally on the study of one bumper, the 1978 Aspen/Volare, which is obsolete by current technology standards. This system does not fairly represent and the cost and weight effectiveness of current systems. It is incorrect and misleading to generalize about the bumper population as a whole. We should explain why the Aspen/Volare system is obsolete by current standards. The 1978 model used technology similar to that used on the original 1976 Aspen. Normal design and tooling lead times predated this production by at least 1 and usually 2 to 3 years. So this 1978 bumper represents engineering state of the art existing in 1973 to 1975, at the latest. This is why the Aspen/Volare system does not incorporate the newer, lightweight, lower

cost absorbers and bracketry elements that are common in later systems.

Industry and technology has moved rapidly and successfully since then, but these results will only be seen if more recent and future models are analyzed.

Because of these factors, we believe a change in the 5-mile-an-hour standard at this time would be unwarranted. It really deserves better and more complete analysis.

Four. Another major flaw of the Houdaille position is the proposition for a 2½-mile-per-hour barrier only standard. It should be made very clear that this is really a no-standard proposition. Without a pendulum test, what will bring about bumpers that are resistant to the angle and pole-type impacts that occur in the majority of collisions?

Houdaille does not address minimum damage criteria at 2½ miles an hour such as exists with the 5-mile-per-hour standard. They could not because their case is based in part on a Mexican front bumper that failed at 2½ miles an hour and had to be replaced. What of damage restrictions to safety-related items? Houdaille doesn't address that need.

This proposition is really a return to a situation which was analyzed as a cost and quality of life problem for the American consumer before Government standards were introduced.

If a sound analysis of the 5-mile-an-hour standard does find it less effective than anticipated, the 2½-mile-per-hour no-standard proposition cannot be the only alternative. There must be a better alternative.

Mr. SCHEUER. What would be the elements of a better third alternative?

Mr. FERRARI. There are many possibilities. Later on we will get into one item. For instance, right now the cars are tested at maximum car weight for that car line, the heaviest model, the heaviest-weight model, which may be 10 percent or less of the car line. A better alternative might be to make the average weight of the car line the parameter for the tests rather than the heavy car line, and let the heavy go to, say, a 3-mile-an-hour standard.

Five. As the director said, with the limitations in scope and the lack of understanding of new technology in the Houdaille reports, two important fallacies developed. One, the conclusion that a bumper made to the 5-mile-per-hour standard is necessarily heavier and more costly than one made to the 2½-mile-per-hour level. This statement, though fallacious, is repeated frequently and passed off as fact. The NHTSA study, by the way, appears to suffer from the same questionable assumption. The data we will present today will show that current advance 5-mile-per-hour impact systems are essentially equivalent in cost and lower in weight to the more damageable 2½-mile-per-hour systems.

For example, that bumper system right there [indicating] is on the 1979 Firebird. That fascia you see and the 3½ pound energy absorber, which is black, plus the backup beam and the bracketry elements, are equivalent in cost and ten pounds lower in weight than the 2½-mile-per-hour Mexican bumper, yet it meets and goes beyond all the current bumper standards, the latest current bumper standards.

Six. A second fallacy that developed in the Houdaille work was the treatment of impacts above 5 miles an hour. They assigned average dollar values to damage costs for impacts between 5 and 10 miles per hour, but no impacts were run at this level. However, we have seen that on average, 5-mile-per-hour bumpers do provide protection at impact speeds significantly above 5 miles per hour.

This occurs because the 5-mile-per-hour standard is applied to the worst case, the heaviest car in each car line. Most cars have lower weight, and therefore bumper systems designed for, in effect, higher impact speeds. We believe a good average speed might be between 6 and 7 miles per hour. As a result, the dollar value assigned by Houdaille to repair damage in this category should be significantly reduced.

I am going to complete our analysis of the Houdaille report at this point. We have some additional comments in appendix 6 in our booklet. At this point I would like to ask Tony Weller, who is a recognized expert in bumper technology throughout the industry, to give you some concrete examples of current bumper technology.

Mr. SCHEUER. At the present time you are already over the 10 minutes. Please make your remarks very brief. I am sure we will have time to get back to you, but in terms of fairness to the other groups. I must ask you to be brief.

Mr. WELLER. All right. What I am going to address is the technology movement in bumper systems. You have already seen what is happening to metal bumpers in the table here. We can best illustrate what we are doing with regard to the bumpers that we are making.

If you look at your exhibit here, page 8, if you will turn to page 8 and look at exhibit 2, on the left side of the exhibit, the solid bars show the weight and cost of several of our front bumper systems, with the earliest at the far left, moving to the right in order of model year. So, as we go to the right, we are moving ahead in time. As a point of reference, the first bumper system at the far left is the 1975 Camaro metal system, which was replaced in 1978 with a soft system. The continuing reduction of cost, and particularly weight, is very apparent as we go from left to right. Notice particularly that the 1979 Firebird, which has been in production this past year, is already down to one-half the weight and cost of the 1975 and 1976 models.

Recently the bumper standard was improved in response to a General Motors petition to allow more pendulum contact in order to more fully use the advantage of soft systems. To fully utilize this improvement in the standard, we have developed and are offering to our customers a new generation of soft bumpers we call Davisorb SL, and these are identified by the three solid bars just to the right of the 1979 Firebird in the exhibit. Note that with this system we expect that weight will be reduced to about half that of the 1979 Firebird. The full benefits of this system will be realized when it is designed in conjunction with new vehicles. This is why we show several phases for the application.

On the right side of the exhibit there are three dashed bars shown for reference and showing the comparative weights and costs for several vehicles of interest. The first is the 1978 American Volare referenced in the Houdaille report. Notice that it is compa-

rable to, although higher in weight and cost than, the 1978 Camaro. Next is the Mexican Volare front bumper, also referenced in the Houdaille report, which, as we pointed out, fails even at 2½ miles per hour and is equivalent to no standard at all. Next is a prestandard front bumper of a 1968 Chevrolet. It is interesting to note the prestandard 1968 Chevrolet is of the same cost and weight as a 1978 no-standard Mexican bumper. Notice especially that the 1979 Firebird, which fully meets all the requirements of even phase II of the part 581 standard is 10 pounds lower in weight at the same cost as the Mexican Volare. No analysis is needed to conclude that the cost/benefits of the highly damage resistant 1979 Firebird are far greater than the Mexican Volare.

The new evolving soft and light technology of which Davisorb SL and the Chrysler CALSPAN research safety vehicle are examples, have the potential to be used for pedestrian protection applications as well. Further development is needed and the standard may have to be modified somewhat to reconcile it with such objective.

In closing we ask that this committee seriously consider the following conclusions and recommendations: one, that no change in the 5-mile-per-hour bumper standard be made at this time; two, that the Houdaille study be recognized as invalid based upon its limited scope and inaccurate data; three, that the alternatives beyond—

Mr. SCHEUER. Have you given us anything in your analysis that would buttress your conclusion that their data are inaccurate?

Mr. FERRARI. Yes. I think that appendix 6 is one.

Mr. SCHEUER. Is that a table?

Mr. FERRARI. No, it is text.

Mr. SCHEUER. It is a serious charge you have made. I think you ought to buttress it very carefully. If you feel you can improve on anything you have given us—

Mr. FERRARI. We would be glad to supply additional information.

Mr. SCHEUER. Yes, you might want to supply us with additional information.

Mr. FERRARI. Three, that alternatives beyond the Houdaille report be considered. We have mentioned there are other alternatives to be considered.

Mr. SCHEUER. What are they?

Mr. FERRARI. Well, I mentioned one, that the standard be applied against the average weight of the car line rather than the top weight. Another might be that some intermediate speed—

Mr. SCHEUER. 3.75 miles or something like that?

Mr. FERRARI. We have heard the number "4" represented by the insurance companies as perhaps a good cost-effective number. Our own opinion is that there is capability for 5 and better in the systems. But regardless of the fact of what is proposed, our point is that they have to be studied and evaluated and a rational, intelligent decision made.

Mr. SCHEUER. Do you feel that NHTSA is capable of making that evaluation?

Mr. Ferrari. Yes, I do. I think the evaluation, however, does not depend on NHTSA alone. It depends upon insurance and industry resources. It depends upon friends of the courts, so to speak, like our company, who are willing to work with NHTSA to provide

information to them. We have our own testing laboratories, impact testing laboratories, and we have done an extensive amount of testing in this area.

Mr. SCHEUER. Very good.

Mr. FERRARI. That the study now being made by NHTSA to determine the optimum bumper standard be expanded to include (a) field performance data so their findings may be validated; and (b) full consideration of the latest improvements in bumper technology.

Five, that the expanded NHTSA study be completed before any change to the standard is made.

In assessing these recommendations, please consider as well that too frequent changes in standards are disruptive and costly and do not allow for technology to respond to the new requirements.

The only other thing we have is a movie which shows these new soft Davisorb SL systems which have potential to be used not only for 5-mile-per-hour protection but pedestrian protection, as well, with further development, as Tony mentioned. It is a 4-minute movie. If you want to see it now, fine. If not, we will close.

[Testimony resumes on p. 225.]

[Mr. Ferrari's prepared statement and attachments follow:]

STATEMENT OF RICHARD FERRARI, VICE PRESIDENT FOR ENGINEERING,
DAVIDSON RUBBER CO.

Mr. Chairman and
Members of the Committee:

The Davidson Rubber Division¹ of Ex-Cell-O Corporation has asked to testify before this committee on the subject of bumper standards and whether they should be changed at this time. We requested this opportunity because we are very concerned that, in the absence of sound field performance data, the value of the 5 MPH bumper standard is not recognized and that unwarranted changes to it are being proposed. We believe that the proposed changes are not in the best interest of the American car buyer.

SUMMARY OF DAVIDSON'S POSITION

Our position is that the current standard, with its requirements for barrier and pendulum impact resistance and its strict no-damage regulations, is of considerable benefit to the consumer. We also recognize that the limited actual data available does not demonstrate that the standard is optimal from a cost benefit point of view. We do believe, however, that neither the data analyzed by NHTSA, nor the data presented by Houdaille on a 2.5 MPH alternative, is comprehensive enough or conclusive enough to warrant changing the standard now. Bumper system technology has evolved dramatically in the past five or six years in response to the standard. The 1979 and 1980 bumpers are lighter and more efficient than earlier systems, and the bumpers currently being designed for 1981 and 1982 are still lighter and will be even more cost effective. To make a decision now to change the rules, before the benefits of the new technology are fully available and understood, would not be in the best interest of the consumer.

Our main purpose is to ask that NHTSA be allowed to evaluate completely the cost effectiveness of current bumpers through their planned program of crash testing and public comment. This program should include both field performance data and the effect of the latest low cost, low weight bumper systems. We intend to participate, and I am sure that other interested parties in the affected industries and consumer organizations will, as well.

MARKET ANALYSIS

Before we address two very important issues, (1) the validity of the Houdaille report and (2) the current technology level of bumper systems as it relates to the 5 MPH standard, let me establish my company's credentials and provide some general marketing information.

¹ The Davidson Rubber Division of Ex-Cell-O Corporation is represented by:

Mr. Richard Ferrari - Vice-President, Engineering
Mr. P. A. Weller - Director, Product Engineering
Mr. Jon Hopkins - Marketing Manager, Bumpers and Fascia

Davidson Rubber Company is the largest supplier of flexible urethane soft face bumper and fascia to the auto industry. Our first soft fascia appeared in Model Year 1975, and for Model Year 1980 we will be producing over 2 million flexible bumpers and fascia for the industry. We have been leaders in the development of materials and manufacturing technology which have allowed the industry to provide lightweight, damage-resistant bumpers in response to the standard. Flexible bumpers and fascia will be on 25% of all the cars to be built in the 1980 model year. By 1983, we and other industry sources expect that 40 to 50 percent of all new cars will have damage-resistant, soft front and rear ends.

Three of Davidson's four manufacturing plants, and well over 1,500 of our 4,000 employees, are involved with the production and development of flexible bumpers and system components. We are very concerned that changes made to the current bumper standard which are not soundly-based will unnecessarily threaten the jobs of these people. Of course, we believe that this threat will go beyond Davidson to other industry supply sources, as well.

In any case, the main focus of this report will be on the merits of current bumper technology as it relates to the 5 MPH standard.

VALIDITY OF THE HOUDAILLE REPORT

Now, we would like to comment on the study done for Houdaille by Professor Wise and Dr. Roth. In our opinion, the study is seriously flawed by an insufficient data base and a set of questionable assumptions. The result is erroneous and misleading conclusions. Furthermore, the resulting conclusions do not reflect the rapidly changing technology and capabilities of the automotive industry which provide, *today*, bumper systems which are far more effective in cost benefits and weight than the ones studied.

We have taken this position, in part, for the following reasons:

1. The Houdaille reports are largely hypothetical in scope and content. They contain no real-world results which are the true test of product cost effectiveness.

On page Q0036 of their report, Houdaille considers and rejects a real-world analysis because of the cost to them. Regardless of the reason, this is a major flaw which casts serious doubt on the validity of the premises and conclusions made by Houdaille. Although their conclusions read like factual statements, the report is one of hypothetical premise laid on hypothetical premise.

The information needed for a more conclusive analysis could be made available through insurance industry resources. The NHTSA preliminary review, it should be noted, suffers from the same lack of real-world data.

2. Neither Professor Wise, an economist, nor Dr. Roth, a mathematician, have any engineering expertise in current automotive technology. As a result, their technical assessments are weak and the whole report suffers from a lack of insight into the current ability of the industry to design and build cost effective 5 MPH bumpers.
3. The major flaw in the Houdaille report is that the conclusions are based principally on a study of one bumper system, the 1978 Aspen/Volare, which is obsolete by current technology standards. This system does not fairly represent the cost and weight effectiveness of current systems. It is incorrect and misleading to generalize from it about the bumper population as a whole. Later in our presentation, we will discuss some examples of current technology.

We should explain why the Aspen/Volare system is obsolete by current technical standards. The 1978 model used technology similar to that used on the original 1976 Aspen design. Normal design and tooling lead times predate start of production by at least one and usually two-to-three years. So this 1978 bumper represents the engineering "state of the art" existing in 1973 to 1975 at the latest. This is why the Aspen/Volare system does not incorporate the newer, lightweight, lower cost absorbers and bracketry elements that are common in later systems.

Industry technology has moved rapidly and successfully, since then, to meet the dual challenges imposed by oil shortages and government legislation. But these results will only be seen if the more recent and future models are analyzed. Because of these factors, we believe a change in the 5 MPH standard, at this time, would be unwarranted. It deserves better and more complete analysis.

4. Another major flaw in the Houdaille position is the proposition for a 2.5 MPH barrier-only standard. It should be made very clear that this is really a no-standard proposition.

Houdaille suggests eliminating the pendulum test from the standard, as well. What, then, will bring about bumpers that are resistant to the angled and pole type impacts that occur in a majority of collisions? Houdaille does not address minimum damage criteria at 2.5 MPH such as exist with the current 5 MPH standard. They could not, because their case is based, in part, on a Mexican front bumper that failed at 2.5 MPH and had to be replaced. What of damage restrictions to safety-related items, such as lights, in the impact zone? The current standard prohibits such damage at 5 MPH. Houdaille does not address this need. So this proposition is, in essence, a return to a situation which was analyzed as a cost and quality-of-life problem for the American consumer before government standards were introduced.

If a sound analysis of the 5 MPH standard does find it is less effective than anticipated, the 2.5 MPH no-standard proposition cannot be the only alternative. There must be a better third alternative.

5. As a direct result of the limitations in scope and the lack of understanding of new technology in the Houdaille reports, two important fallacies developed. One is the conclusion that a bumper which is made to the 5 MPH standard is necessarily heavier and more costly than one made to the 2.5 MPH level. This statement, though fallacious, is repeated frequently and is passed off as fact. The NHTSA study appears to suffer from the same questionable assumption.

The data we will present today shows that current, advanced 5 MPH impact systems are essentially equivalent in cost and lower in weight to the more damageable 2.5 MPH systems.

For example, the 1979 Pontiac Firebird bumper is equivalent in cost and 10 pounds lower in weight than the 2.5 MPH Mexican bumper, yet it meets and goes beyond all the latest standards.

6. A second fallacy that developed in the Houdaille work was the treatment of impacts above 5 MPH. In Table B-6 (page Q0114), average dollar values were assigned to damage costs for impacts between 5 and 10 MPH. (The actual impact data is described in Table B-4, page Q0109.) No impacts were run at intermediate speeds between 5 and 10 MPH.

In fact, we have seen that, on average, 5 MPH bumpers do provide protection at impact speeds significantly above 5 MPH. This occurs because the 5 MPH standard is applied to the worst case (the heaviest car) in each car line. Most cars have lower weight and, therefore, a bumper system which is designed for, in effect, higher impact speeds. We believe that a good average speed might be between 6 and 7 MPH and that the dollar value assigned by Houdaille to repair damage in this category should be significantly reduced.

Note that this error did not occur in the analysis of the Mexican bumper because it was tested incrementally, at 2.5 MPH, between 0 and 5 MPH where it makes the transition from a non-damageable to a damageable system; thus, the comparative data is inconsistent.

CURRENT BUMPER TECHNOLOGY

As we have previously indicated, proper evaluation of the cost effectiveness of bumper standards is made extremely difficult by the four-year lag from the time bumper designs are committed to the time any appreciable field performance data becomes available. To further complicate the development of sound analysis, bumper technology is moving very rapidly and that's what we would like to review briefly with you now.

At the heart of the metal systems are the devices that are positioned between the bumper bar and the car. These absorb the impact energy.

Exhibit I shows the changes that have occurred in these devices. Notice, for example, that at Ford, the early absorber design weight 13 pounds while their current PGM or Polygel Mitigator absorber weighs 6 pounds. General Motors dropped an already lighter unit from 7.5 pounds to 4.5 pounds and Chrysler followed a similar course.

While we are not privy to the costs, we can assure you that for relatively simple mass produced devices such as these, costs are very closely related to weight. These devices have reached a level of weight and cost where they are very competitive with the fixed brackets that would be required to mount the bumper bar to the vehicle in 2.5 MPH systems.

With regard to the bumper bar itself, both the steel and aluminum producers have made, and are continuing to make, very significant improvements in the strength of their materials. For instance, many bumper bars are in production on the new vehicles with steels that are twice as strong as the bumpers on most of the cars on the road today and these steels are available at a surprisingly small increase in the price per pound. In our own bumper systems, we are now prototyping parts using steel that are almost five times as strong as ordinary steel at less than twice the per pound cost.

As manufacturers of soft bumper systems, we can best illustrate the changing technology by showing you the progress that has been made in the bumpers we make. On the upper part of Exhibit II, above the heavy horizontal line, we show the weight and cost for several of our front bumper systems with the earliest at the top and moving down in order of model year. As a point of reference, the first front bumper system at the top is the 1975 Camaro metal system which was replaced in 1978 with a soft system. Notice particularly that the 1979 Firebird, which has been in production this past year, is already down to one-half the weight and cost of the 1975 and 1976 models. Recently, the bumper standard was improved in response to a General Motors petition to allow more pendulum contact in order to more fully use the advantages of soft systems. To fully utilize this improvement in the standard, we have developed and are offering to our customers a new generation of soft bumpers we call Davisorb S/L. These are identified just above the heavy bar in Exhibit II. Notice that with this system, we expect the weight will again be reduced to about half that of the 1979 Firebird. The full benefits of this system will be realized when it is designed in conjunction with a new vehicle. This is why we show several phases for the Davisorb S/L product.

Below the heavy line in Exhibit II, we have shown, for reference, the comparative weights and costs for several vehicles of interest. First is the 1978 American Volare. Notice that it is comparable to, though somewhat higher in weight and cost than, the 1978 Camaro. Next is the Mexican Volare front bumper which, as we have pointed out, fails even at 2.5 MPH and is equivalent to no standard at all. Next is a prestandard front bumper of a 1968 Caprice. As you can see, the weight and cost are the same as the Mexican Volare. Note that the 1979 Firebird, which fully meets all the requirements of even Phase II of the Part 581 standard, is appreciably lower in weight at the same cost as the Mexican Volare. It is obvious that the cost benefits of the 1979 Firebird are greater than the Mexican Volare.

Let me reiterate that this kind of progress is not confined to the soft systems. The other systems have maintained a competitive position. Therefore, we expect that the product mix in coming years will continue to include cost effective steel, aluminum and soft systems.

In order to illustrate the function and benefits of our new Davisorb S/L system, we have put together a demonstration vehicle by converting the front end of a 1977 Firebird. This vehicle has been impact-tested at our laboratories in Dover, New Hampshire with a total of 10 MVSS impacts and six real-world impacts on the same set of bumper components. We would like to now show you a short film of some of these impacts which will describe this bumper far more vividly than we can in words.

A commentary on this film is given in Appendix II.

The new, evolving soft and light technology, of which Davisorb S/L and the Chrysler/Calspan Research Safety Vehicle (RSV) are examples, has the potential to be used for pedestrian protection applications. Further development is needed, however; and the standard may have to be amended to reconcile it with the new objectives.

CONCLUSIONS AND RECOMMENDATIONS

In closing, we ask that this committee seriously consider the following conclusions and recommendations:

1. That no change in the 5 MPH bumper standard be made at this time.
2. That the Houdaille study be recognized as invalid based on its limited scope.
3. That alternatives beyond the Houdaille report be considered.
4. That the study now being made by NHTSA to determine the optimum bumper standard be expanded to include:
 - (a) Field performance data, so that their findings may be validated.
 - (b) Full consideration of the latest improvements in bumper technology.
5. That this expanded NHTSA study be completed before any change to standard is considered.

In assessing these recommendations, please consider, as well, that too frequent changes in standards are disruptive and costly and do not allow for technology to respond to the new requirements.

EXHIBIT IEVOLUTION OF
ENERGY ABSORBING DEVICESWEIGHTFORD

OLD Rubber-In-Shear E/A	13.15 lbs.
NEW Polygel Mitigator	6.14 lbs.

Reduction - 53%

G.M.

OLD Delco Hydraulic E/A	7.50 lbs.
NEW Mini-Delco Hydraulic E/A	4.50 lbs.

Reduction - 40%

CHRYSLER

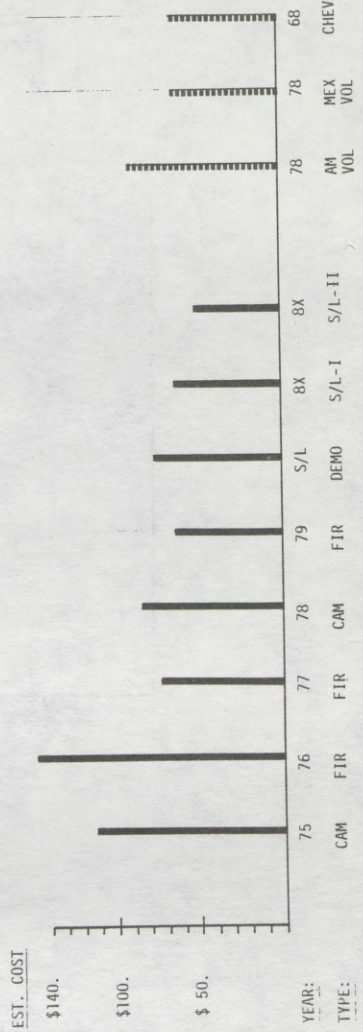
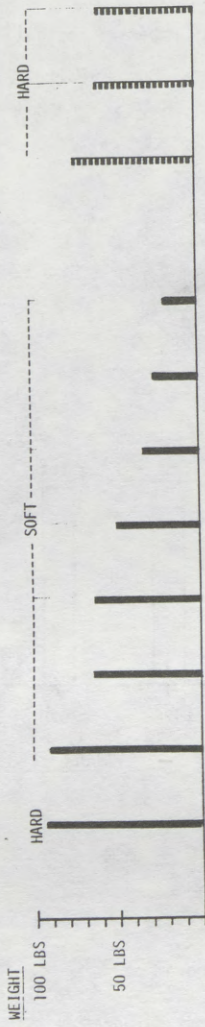
Prior to 1978 Hydraulic E/A	11.25 lbs.
1978 Aspen Hydraulic E/A	9.50 lbs.
1978 Omni Hydraulic E/A	4.30 lbs.

Reduction - 55 - 64%

EXHIBIT II
EVOLUTION OF LOW-COST, LOW-WEIGHT, FRONT BUMPER SYSTEMS

LEGEND

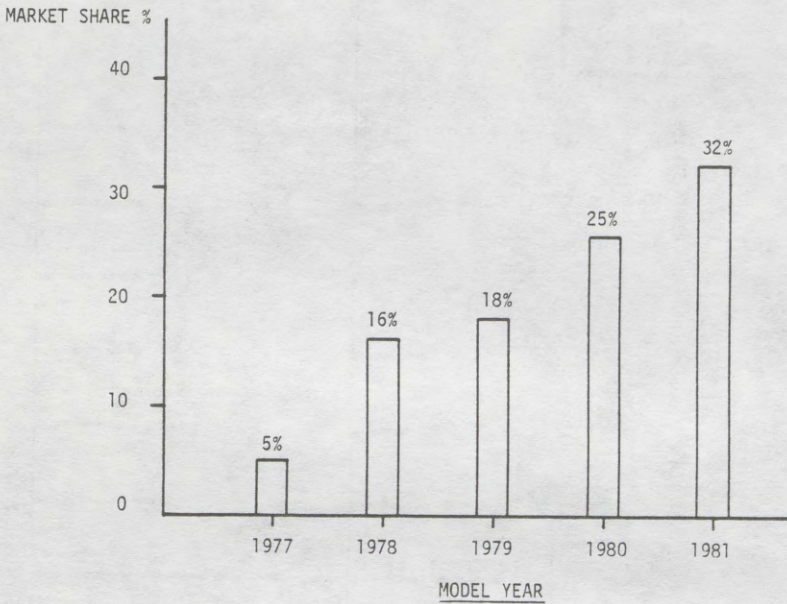
CAM ----- CAMARO
FIR ----- FIREIRD
VOL ----- VOLARE
CHEV ----- CHEVROLET
DAVISORB S/L - DEMONSTRATOR
- PHASE I
- PHASE II



APPENDIX IMarket Information

Elastomeric Bumpers & Fascias

Share of Total Bumper Market

MAJOR SUPPLIERS

Davidson Rubber Division - Ex-Cell-O Corporation	- Farminaton, NH
	- Americus, GA
Bailey Division - Emhart Corporation	- Seabrook, NH
	- Hopkinsville, KY
Guide Division - General Motors Corporation	- Anderson, IN
Utica Trim - Ford Motor Company	- Utica, MI

APPENDIX II

Description of Davisorb S/L Bumper & Film

1. Description of Davisorb S/L Bumper System:

The Davisorb S/L bumper system is one in which the impact energy is absorbed by compression of a very soft foam mounted behind a flexible urethane fascia. The system is unique in that the backup beam which normally supports the foam, such as in the '79 Firebird front bumper, has been eliminated. The foam, being greater in impact depth is mounted directly to the vehicle radiator support structure which must be accordingly slightly redesigned from current practice. Since the backup beam is normally the heaviest component, this new design results in a major weight and cost reduction. To meet the requirements of center pendulum impacts, reinforcement is molded into the foam across the center outer portion of the energy absorber.

2. Description of Demonstration Vehicle:

To demonstrate the function and performance of this advanced bumper system, we converted the front of a 1977 Firebird to incorporate this new energy management system behind the original 1977 fascia. The 1977 energy absorber, beam and brackets weighing 60lbs. were removed; the radiator support was removed, rebuilt with an addition of 3 lbs. and reinstalled; and the single piece reinforced S/L foam energy absorber weighing just 26lbs. mounted directly to the revised radiator support.

3. Description of Film:

A complete series of 10 MVSS tests and 6 real world tests were run and recorded on film. One set of energy management components were used for all of these tests. One fascia was used for fifteen of the tests and a second fascia was used for the 10 mph car to car test. (The use of a second fascia was the result of logistics only. Neither fascia was damaged.) Even after these repeated and vigorous tests, bumper system fully complied with all the damage criteria of Phase II of Bumper Standard Part 581.

Following is a list of the tests filmed:

A. MVSS Tests:

1. High Center Pendulum at . . 5.1 mph
2. Median Center Pendulum at . 5.1 mph
3. Low Center Pendulum at. . . 5.1 mph
4. High Outboard Pendulum at . 5.1 mph
5. Median Outboard Pendulum at 5.1 mph
6. Low Outboard Pendulum at. . 5.1 mph
7. High Corner Pendulum at . . 3.1 mph
8. Median Corner Pendulum . . 3.1 mph

A. (cont'd)

- 9. Low Corner Pendulum at 3.1 mph
- 10. Barrier at 5.1 mph (Appendix III A)

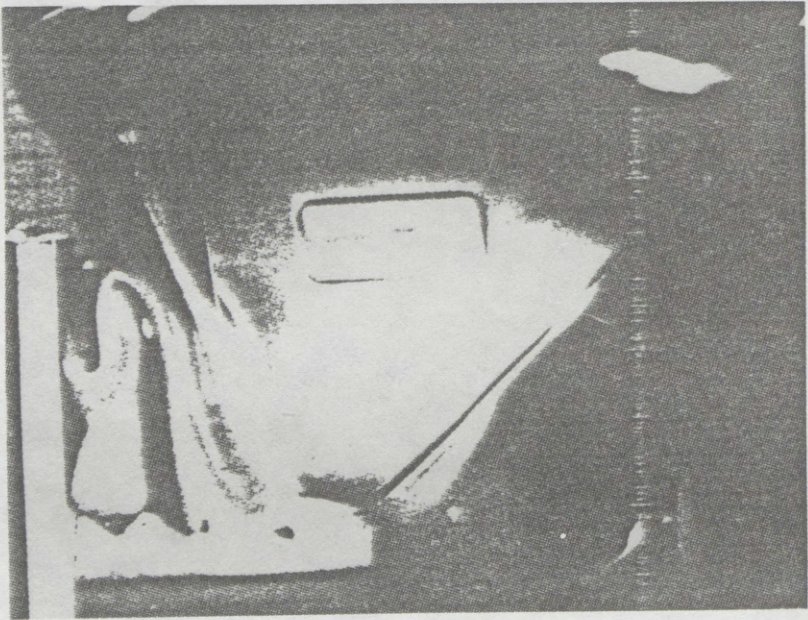
B. Real World Tests:

- 11. Into sand filled 55-gallon drum @ 5 mph
No damage to barrel or car (Appendix III B)
- 12. Into utility pole @ 5 mph
No damage to pole or car (Appendix III B)
- 13a. Perpendicular into side of '76
Aspen @ 6 mph (Appendix III C)
Firebird - No damage.
Aspen - Vehicle fully functional. Damage limited to distortion of door outer panels. No distortion of door structure, pillar post or rocker panel. Doors and windows functioning as normal. Appraisal \$389.
- 13b. '77 Aspen front (with typical steel bumper on hydraulic energy absorbers) perpendicular into side of '76 Aspen @ 6 mph (Appendix III D)
'77 Aspen Front - No damage.
'76 Aspen Side - Impacted side rendered non functional. Door panels, door structure, pillar post and rocker panel severely distorted. Doors and windows would not open. Appraisal \$634.
- 14. At 30° into corner of '76 Aspen Front @ 3.5 mph
No damage to Aspen or Firebird.
- 15. Head on into front of '76 Aspen. . . . @ 5.5 mph
No damage to either vehicle. Impact so soft that Aspen bumper did not stroke. All impact energy absorbed by Firebird.
- 16. Head on into front of '76 Aspen . . . @ 9.5 mph (Appendix III E)
Firebird - No damage.
Aspen - Two small cracks in grille bars caused by pressure of upper part of fascia against grille. Impact still so soft that Aspen bumper did not stroke. Based on this test, it is estimated that two like vehicles, each equipped with a Davisorb S/L bumper designed to meet the current Part 581 standard could impact each other front to front at a relative closing speed of 14 to 15 mph without damage to either vehicle.

Photographs of the various impacts appear in Appendix III.

APPENDIX III A

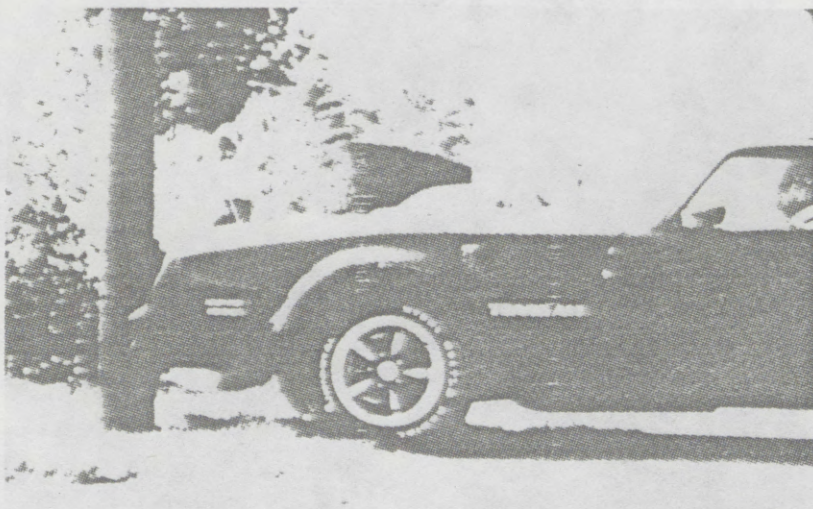
Davisorb S/L Demonstrator



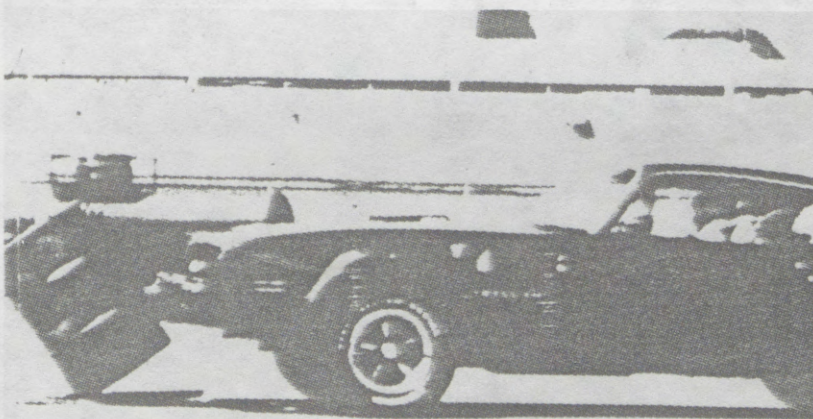
Front Bumper Under 5 MPH Impact.
No Damage.

APPENDIX III B

Davisorb S/L Demonstrator



5 MPH Pole Impact. No Damage.



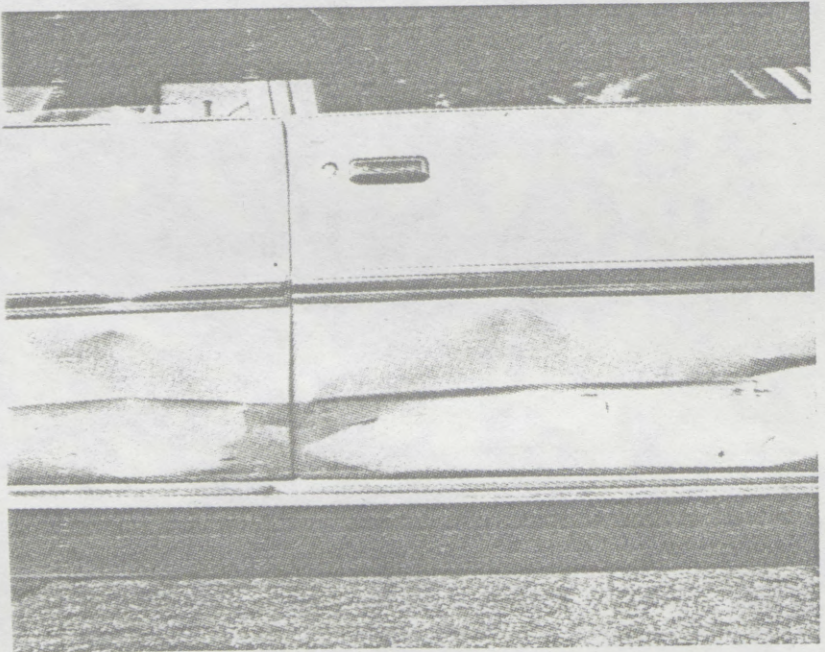
5 MPH Sand-Filled Barrel Impact. No Damage.

APPENDIX III C

Davisorb S/L Demonstrator



6 MPH Into Side of Dodge Aspen.
No Damage to Firebird.



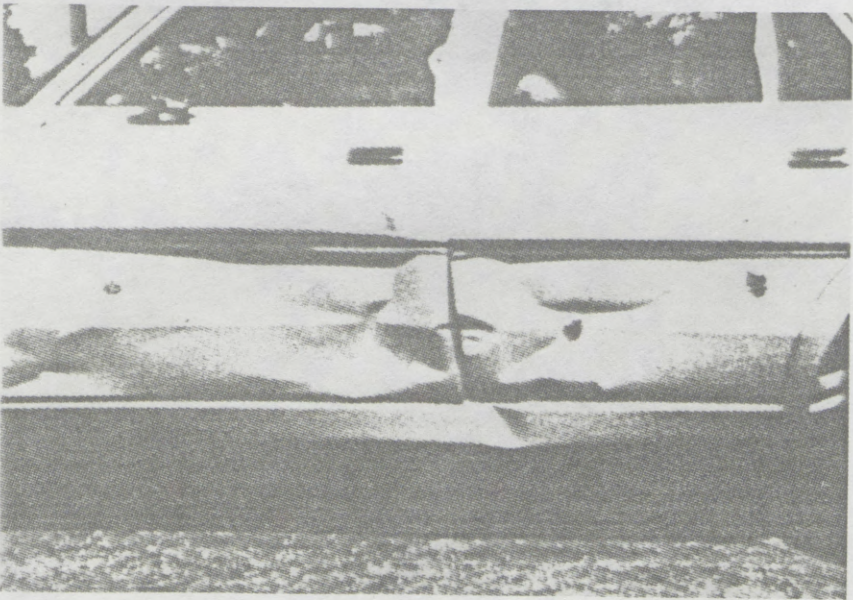
Limited Damage to Aspen in Above Impact.
Doors Functional. Damage Appraisal: \$389

APPENDIX III D

1977 Dodge Aspen Test



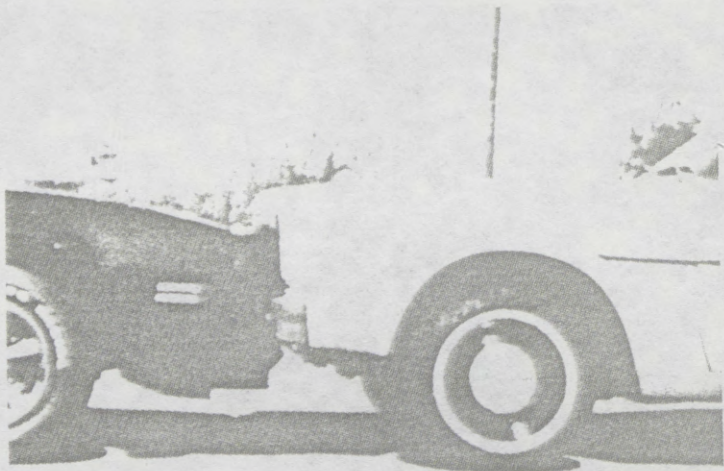
6 MPH Steel Bumper System Into Side of Dodge Aspen.
No Damage to Front Bumper.



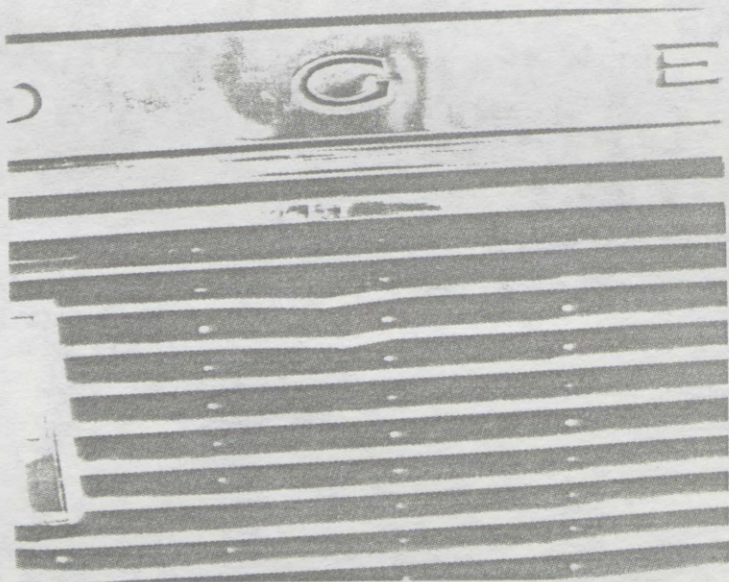
Extensive Damage to Aspen in Above Impact.
Doors Would Not Open. Damage Appraisal: \$634

APPENDIX III E

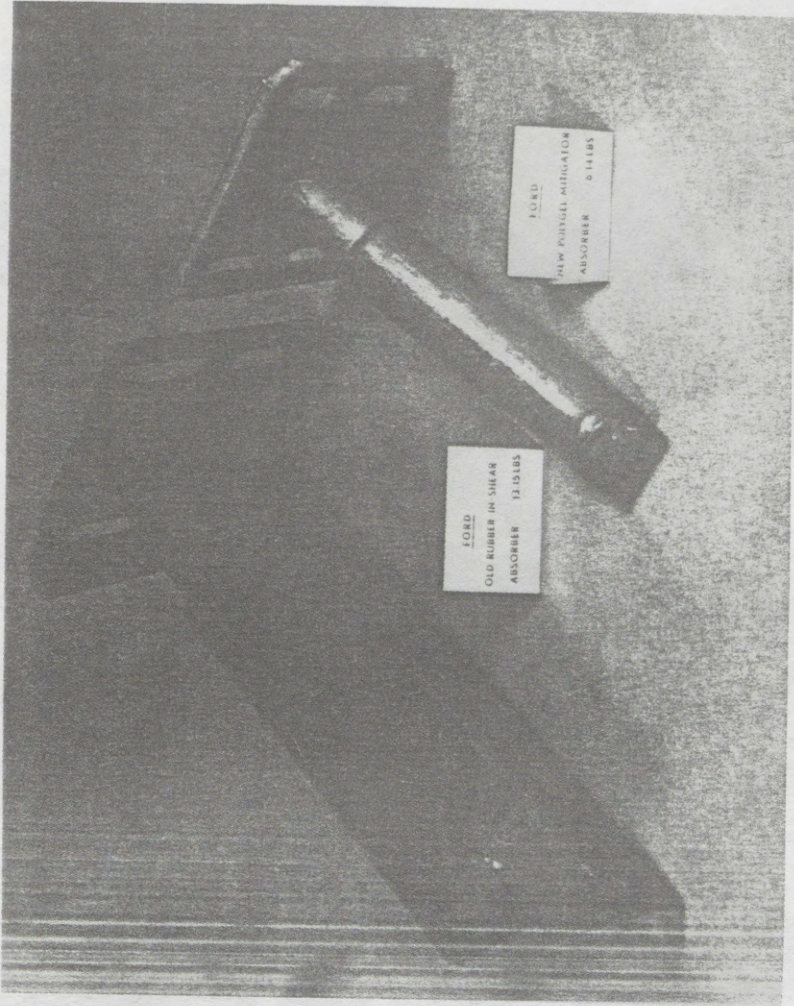
Davisorb S/L Demonstrator

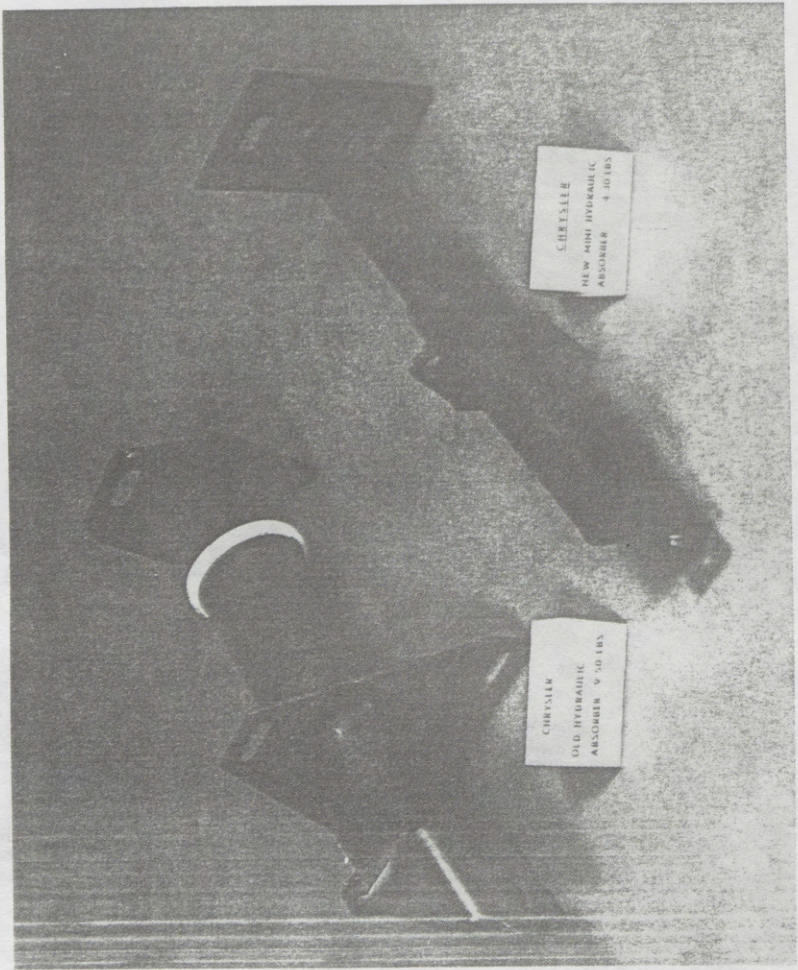


Demonstrator and Aspen Steel Bumper System. 9.5 MPH Head-On Impact.
No Damage to Davisorb S/L Front Bumper.



Non-Hostile Davisorb S/L Demonstrator Produced
Very Minor Damage to Aspen Grille in Above Collision.

APPENDIX IVFord Energy Absorbing Devices

APPENDIX VChrysler Energy Absorbing Devices

APPENDIX VIAdditional Comments on the 2.5 mph Mexican Volare Bumper

The Mexican Volare front bumper was damaged in the 2.5 mph barrier test. Houdaille has concluded that this bumper is acceptable to a 2.5 mph, barrier-only bumper standard. They imply, as well that it could be optimized to further reduce its cost and weight.

In fact, our analysis shows that the reverse is true. As a result, the cost-benefit analysis based on the Houdaille comparison is invalid.

The fact that the Mexican bumper does not provide damage protection at 2.5 mph and is probably no better than what we had prior to any standards is borne out by the tests conducted by Calspan for Houdaille.

Let's look first at the front bumper. The bumper is shaped in a V so that the center projects forward of the rest of the bumper. When this bumper runs into a barrier, all the force is concentrated on the center. Since the bumper is attached to the car towards the ends of the face bar, the tendency of the bar is to collapse in the center. The American bumper, having been made thicker and stronger, is designed to withstand these loads, which is demonstrated by the fact that in the Houdaille test at 5 mph, there was no damage. However, at 2.5 mph, the Mexican bumper failed just as we would expect and had to be replaced. And this does not take into account the fact that the Mexican bumper failed at a vehicle test weight of only 3,500 Lbs., whereas the American bumper is designed to function on the heaviest vehicle configuration in the Volare line which is over 4,000 Lbs. Thus, in order to meet even a 2.5 mph standard, the Mexican bumper must be considerably strengthened and increased in weight.

On the rear, there was no damage to the Mexican bumper at 2.5 mph. Here the vehicle configuration tells the story. In this case, the bumper is so flat that the impact forces are applied almost directly to the attachment brackets. The result is that the strength of the bumper is not really tested in a perpendicular barrier impact. So the test proved little about the ability of this bumper to protect the car. However, we can deduce from the performance of the front bumper that the rear is probably no better.

What we conclude is that in order to provide reasonable protection at 2.5 mph, the bumper bar itself must have strength comparable to that of the 5 mph bumper. The basic change then is replacement of the energy absorbers by rigidly attached brackets.

As we have pointed out in the commentary, an up-to-date hydraulic energy absorber such as this mini-Delco is probably as low in weight and cost as a bracket that might replace it. As near as we can estimate, the brackets on the Mexican Volare front bumper weigh more than the hydraulic energy absorbers they replace. Thus, the need to increase the strength and weight of the Mexican Volare bumper means that the cost-benefit analysis is incorrect.

APPENDIX VII

SAE Technical Paper Series



790335

1979 Firebird - An Advanced (Part 581) Soft Bumper System

J. V. Scrivo
Davidson Rubber Co., Inc.

Congress and Exposition
Cobo Hall, Detroit
February 26-March 2, 1979

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
400 COMMONWEALTH DRIVE
WARRENDALE, PENNSYLVANIA 15096

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1979 Firebird - An Advanced (Part 581) Soft Bumper System

J. V. Scrivo

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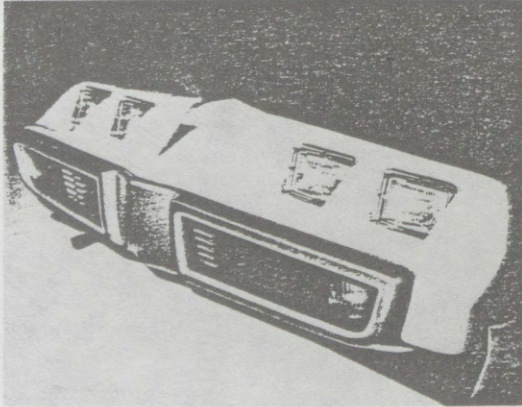


Fig. 1 - 1979 Firebird front styling

PONTIAC MOTOR DIVISION released the first production urethane automotive bumper on the 1968 GTO which was soon followed by a similar unit on the 1969 Firebird. In subsequent years, they have improved and upgraded urethane bumpers with a number of milestones having been achieved as follows:

- 1969 - First Firebird with Urethane "Endura" Bumper
- 1973 - First Energy Absorbing Urethane Bumper
- 1976 - First Urethane Bumper with Separate Energy Absorbing Element

ABSTRACT

Weight and performance characteristics of the 1979 Pontiac Firebird soft bumper system are compared to those for a typical new (1979) metal/hydraulic design to evaluate the effects of the new standard. This study demonstrates the

1977 - First Full Fascia/Separate Energy Absorber (DAVISORB) Bumper System

The 1979 Firebird front bumper is the latest product in this long line of bumper designs. It is unique in that it is the first elastomeric system designed specifically for the new tougher Part 581 Bumper Standard. The ability of this bumper to accommodate a dramatic new styling concept with lower forces and weights in the face of stringent damage requirements is the real achievement of Pontiac's latest effort. (Fig. 1)

changing competitive environment in the automotive bumper market due to the introduction of the Part 581 Standard. The deep soft bumper concept is also discussed including its potential for achieving weight reductions in future elastomeric bumper systems.

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PART 581 REQUIREMENTS

In 1976, NHTSA released a new tougher bumper Standard Part 581 which for the first time set damageability standards. (1)*The new standard was to take effect in two phases:

Phase I - No damage except unlimited damage to the bumper face bar - effective 9/1/78.

Phase II - No damage with limited damage (9.53 mm dent & 19.05 mm set) to the bumper face bar - effective 9/1/79.

Both phases allow plane A and B contact with a combined force limit of 8.9 kN.

In 1977 and 1978, NHTSA published amendments and interpretations related to the Part 581 Standard. (2 & 3) The net effect of these rulings was to alter the comparative requirements for hard and soft bumper systems. In the case of a hard system, additional strength is required in the face bar area to meet the denting limitations. The plane A and B contact allowances are inoperative unless large soft "filler" panels (which won't be damaged)

*Numbers in parentheses designate References at end of paper.

are used around the hard bumper. A hard bumper designed for Part 581 is, therefore, likely to weigh and cost more than one designed for the previous Standard 215. At best, cost and weight levels attained in the most recent designs might be maintained.

With soft systems, the dent limitation is overcome, since the material is elastic. The plane A and B contact allowances provide an opportunity to utilize longer strokes. (Fig. 2 & 3) These factors allow reductions in impact force levels and structural component weights.

CASE STUDIES - 1979 BUMPER SYSTEMS

The 1979 model year has seen the introduction of several all new bumpers. These were designed to meet both phases of the Part 581 Standard because they will be carryover hardware in the 1980 model year. This paper will use the new Pontiac Firebird and a new hard system as case studies to demonstrate that Part 581 has had the anticipated effects in the real world.

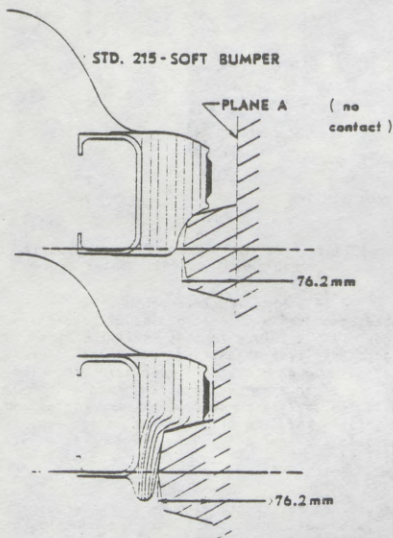


Fig. 2 - Standard 215 - stroke limitation

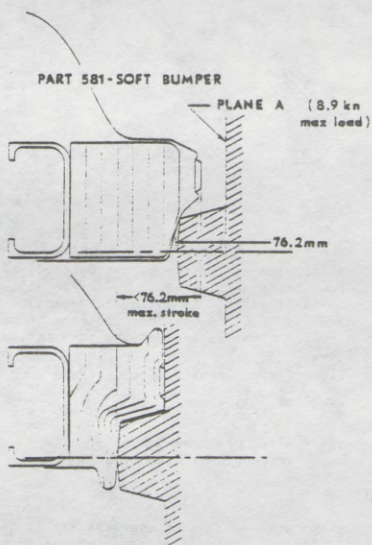


Fig. 3 - Standard Part 581 - stroke allowance

WHAT HAS BEEN ACHIEVED?

1978 VS 1979 FIREBIRD SOFT BUMPER - In keeping with Pontiac tradition, the 1979 Firebird incorporates a dramatic new styling concept which, while obviously a Firebird, is a totally new look significantly different from previous designs.

The main grille air intakes are totally located in the bumper's impact zone. Previous bumpers had incorporated air slots in this area to assist cooling, but these were only supplementary to the main grille area located above the bumper's impact zone. Large park and turn lamps are located at either end of the grille area directly in the bumper's impact zone. This feature has also been used before but on a more limited scale with the lamps recessed within the bumper's reinforcement beam out of the crush zone. These two major features combined to make development of a Part 581 bumper system difficult.

Initial reviews showed a need for a larger bumper reinforcement beam to accommodate the air intakes and a lack of space for elastomeric energy management material. It was feared that these problems would prevent the desired weight reduction in the 1979 system. However, after considerable design and development work, the 1979 bumper system achieved the substantial reductions in impact force levels (Table 1) through the allowance of plane A contact. The lower force, when combined with use of HSLA 980 material for the reinforcement beam, resulted in 40.5% reduction in beam weight and a 16% reduction in overall system weight. (Table 2)

Table 1 - Firebird Bumper System Impact Force Level Comparison

Impact Type	1978		1979	
	Impact Force	Plane A Force	Impact Force	Plane A Force
Barrier	108.7 KN		35.4 KN	
Center Pendulum	50.1	None	43.6	1.0 KN
Outboard Pendulum	64.1	None	58.0	2.5
Corner Pendulum	42.5	None	15.2	5.9

Table 2 - Firebird Front Assembly Weight Comparison

	1978	1979
Full Fascia with Grilles	5.7 Kg	5.9 Kg
Energy Absorber	2.3	2.3
Hanger Brackets*	7.7	7.7
Upper Support w/Headlamps	5.8	7.2
Reinforcement Beam	17.2	10.3
Miscellaneous Hardware	1.9	0.5
	47.3 Kg	34.7 Kg

*Hanger brackets are carryover items. No new tooling required.

1978 VS 1979 HARD BUMPER SYSTEM - For comparative purposes, an all new 1979 metal/hydraulic bumper system was selected. It is noted that this system has both steel and aluminum reinforcement beams for various carline applications. The aluminum reinforcement saves

9.3 Kg over the all steel system. This bumper system is used on a 1,814 Kg. weight class vehicle (same as the Firebird) and reflects a concentrated effort to develop a low weight bumper. For 1980, this bumper is projected to increase in weight to meet the 9.53 mm dent limitation which becomes effective in September 1979. (Table 3)

Table 3 - Front Assembly - Hard Bumper Weight Comparison

	1978	1979	1980
Grill Opening Panel w/Grilles	19.1 Kg	13.2 Kg	13.2 Kg
Sight Shields & End Caps		0.7	0.7
Hydraulic Shock Absorbers		5.8	5.8
Reinforcement Beam		9.7 (Alum)	9.2 (Alum)
Bumper Face Bar (Steel Chrome Plated)		13.0	15.4
Bumper Guards	49.0 Kg	2.6	2.6
Miscellaneous Hardware		1.1	1.1
Vehicle Weight:	68.1 Kg	43.1 Kg	47 Kg
% of Vehicle Weight:	2177 Kg	1814 Kg	1814 Kg
	3.1%	2.4%	2.6%

It can be seen that although total weight has been reduced compared to the earlier design, the actual face bar metal gage has to be increased to meet Part 581 Standards. Thus, the opportunity for further metal/hydraulic bumper weight reductions appears to be limited.

HARD VS SOFT PART 581 BUMPER - The data shown in Tables 2 and 3 has been retabulated in Table 4 to provide a simple comparison between 1980 hard and soft systems. For similar weight class vehicles, the soft system saved 12.4 Kg or 26% compared to the hard system. This is in spite of the use of an aluminum reinforcement beam in the hard system. An all steel hard system would be 10.0 Kg heavier. The soft system would then save 22.4 Kg or 39%. These case studies show that Part 581 provides new opportunities for weight reductions with soft bumper systems.

Table 4 - Part 581 Bumpers - Hard Vs Soft Front Assembly Weights

	1980 Hard System	1979-80 Firebird Soft System
Front End Panel (w/Headlamp & Grilles)	13.2 Kg	12.3 Kg
Energy Absorbers	5.8	2.3
Mounting Hardware	0.5	7.7
Bumper Face Bar (Steel Chrome Plated)	15.4	N.A.
Reinforcement Beam	9.2 (Alum)*	10.3 (Steel)
Bumper Guards	2.6	N.A.
Sight Shields & End Caps	0.7	N.A.
Miscellaneous Hardware	2.7 Kg	1.5
	47.1 Kg	34.7 Kg

*Weight of a steel reinforcement estimated to be 18.1 Kg.
(Total bumper weight 57.1 Kg)

DESIGN APPROACH (1979 FIREBIRD)

The first design objective was to develop a functional Part 581 bumper without altering the styling features. The approach chosen by Pontiac was to continue with a conventional soft bumper but to incorporate the latest technology to achieve the lowest possible weight without resorting to costly aluminum structural components.

DESIGNING "SOFT" FOR PART 581 (1979 FIRE-BIRD - Design Challenges - The unique styling of the 1979 Firebird front bumper presented a number of specific design challenges for the bumper engineers. These were as follows:

1. Provide a viable energy management system with minimal intrusion on the vehicle's air intake opening size.
2. Provide an adequate reinforcement beam which would accommodate the required large air intake passages while simultaneously reducing beam weight.
3. Provide adequate fascia support without using a proliferation of secondary components.
4. Provide grilles which could survive in the bumper's impact zone.

Upon detailed examination of the styling theme, it was apparent that the grille being in the impact zone had to be molded in a flexible damage resistant material such as TPU. With the flexible grilles and Part 581 provisions for plane A and B contact, the opportunity existed to substantially increase bumper system stroke over the 1977 design. By exploiting this opportunity, lower impact forces were achieved.

Thus, the design concept which evolved can be described as follows:

1. A minimal amount of Davidson's EM-1061 energy absorbing foam at an intermediate density (400.5 Kg/meter^3) could provide the necessary impact protection if strategically located.
2. Strategically located foam elements were tied together in a one piece molding with appropriate webs. These also served the added function of supporting the fascia and eliminated the need for separate support components.
3. Use of contoured foam to fit the styled surface allowed the reinforcement beam to be essentially straight eliminating the requirement for complex contours to fit the fascia.
4. The reinforcement beam weight was minimized by:
 - a. Strategically placing the energy absorbing elements to minimize beam bending moments.
 - b. HSLA 980 steel was used in a minimum gage using local gussets to strengthen high load points defined by the strategically located E/A elements.
 - c. Designing for increased impact stroke with plane A and B contact allowed lower forces and reduced beam strength requirements.

5. Use of the light reinforcement resulted in significant reinforcement deflection and energy absorption. This in turn reduced requirements for the urethane energy absorber element.
6. Carryover use of the 1979 hanger brackets, while not optimal in terms of component weight, substantially reduced tooling and changeover cost.
7. Protection for parking lamp mounting in the crush zone was initially provided by a bracket molded into the energy absorber element. This bracket was formed and shaped like an eyebrow, its function being to take any impactor contact and prevent contact with the lamp. Contact with the bracket caused compression of foam behind the bracket stroking the lamp. After impact, the foam rebounded returning the lamp to its original position.

STRATEGIC E/A FOAM FUNCTION - Initially, there was sufficient space for E/A foam at the center and corner positions, providing energy management for barrier, center pendulum, and corner impacts. The outboard pendulum would contact some of the E/A foam used to protect the bumper's center area, but not enough to provide adequate protection. To solve this problem, Pontiac provided space for a small secondary absorber adjacent to the parking lamp so that there would be enough foam for 457.2 mm and 508 mm outboard pendulum impacts. Even then, the sloped configuration of the grilles did not allow sufficient foam for a 406.4 mm impact in the outboard location.

This dilemma was resolved by placing a small solid bar of foam along the bottom edge of the grille.

Using these criteria, an energy absorber was designed and evaluated using Davidson's computerized design procedure. The design was based on the same material used in 1978. The density also turned out to be the same as for 1978. Forces were initially estimated to be similar to 1978 assuming similar vehicle and beam compliance values.

SYSTEM DEVELOPMENT

The initial designs showed the following weight breakdown compared to the 1977-78 base design.

Table 5 - Bumper System Weight

	Actual 1977-78	Initial Estimated 1979
Fascia	5.7 Kg	5.7 Kg
Energy Absorber	2.3	2.6
Reinforcement Beam	17.2	10.9
Hanger Brackets	7.7	7.7
Miscellaneous Hardware	1.0	1.0
	33.9 Kg	27.9 Kg

With this favorable projection, the go ahead for prototyping was given by Pontiac in early March 1977. An epoxy two piece energy absorber tool was constructed, and a two piece reinforcement beam was fabricated (Figure 4). Upon completion of the hardware, it was mounted on a 1977 Firebird Trans Am and impact tested at Davidson for design verification. (Fig. 5)

The test results were as follows:

Table 6 - Bumper System Performance

	Predicted		Impact Test Results	
	Force	Plane A	Force	Plane A
Barrier	97.9 KN		87.2 KN	
Center Pendulum	59.2	None	42.8	4.1 KN
Outboard Pendulum	59.2	None	34.3	3.2
Corner Pendulum	38.7	None	16.3	6.2

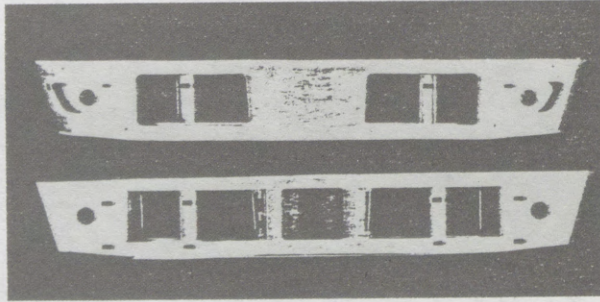


Fig. 4 - Initial prototype reinforcement beam

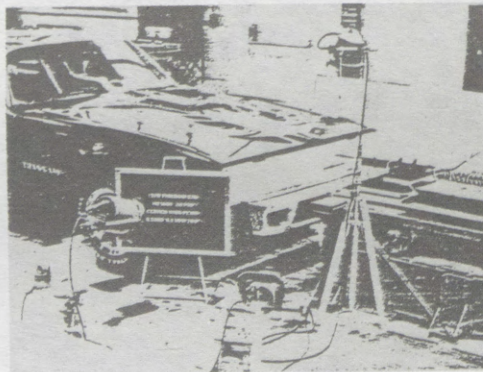


Fig. 5 - 1977 Firebird Trans Am test bed

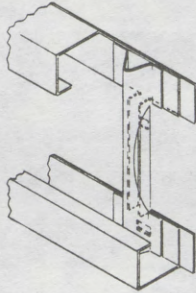
The lower test forces obtained were due to greater than anticipated deflections largely due to the lightweight beam design and the flexibility of its mounting. These secondary deflections were not included in the original calculations. However, since they could be accommodated within existing clearances, no effort was made to reduce them.

In this first test sequence, only two problems were observed:

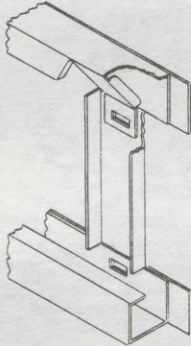
1. The high outboard impact tore the E/A in the web area adjacent to the main E/A. Even though this area is a non functional tie and would not consti-

tute failure of the Federal Standard, design modifications were undertaken. The E/A design was modified to strengthen the web area and updated to fit the latest fascia configuration. (Fig. 7)

2. The high outboard impact caused a 12.4 mm set at the upper hanger bracket attachment. This also is allowable within the requirements of Part 581. However, the two piece beam design was modified to add an integral reinforcement at the hanger bracket attachment. (Fig. 6)



INITIAL DESIGN



REVISED DESIGN

Fig. 6 - Reinforcement of beam at hanger bracket attachment

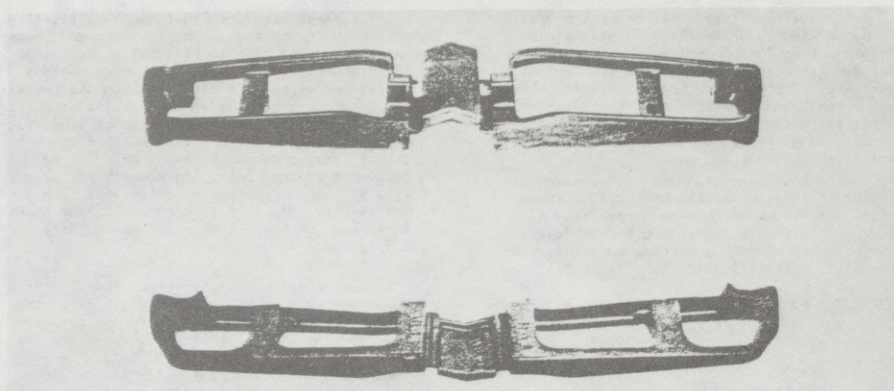


Fig. 7 - 1979 Firebird E/A configuration

Followup testing of these Phase II designs was completed in June at Davidson. The revised hardware had eliminated the earlier problems and demonstrated feasibility of mounting the park and turn lamp in the impact zone. A 7.6 mm dishing of the beam was noted behind the corner E/A, and a small tear occurred in the E/A at the park and turn lamp mounting. A set of Phase II hardware was delivered to Pontiac for their first test series. This test sequence consisted of eleven impacts and was very successful. No fascia or grilles were used for these tests because the parts were not yet available. The only discrepancies noted were minor tearing of the E/A in non functional areas. Also Pontiac

Engineers felt that the reinforcement beam design should be modified at the ends to make it more feasible for production.

Work was begun in early July to modify the E/A mold to a Phase III configuration for a good fit to the production fascia design. Further effort was also begun to reduce the beam weight by eliminating the back plate and substituting a series of bulk heads. This design was based on the lower forces obtained in early testing and was successful in reducing the beam weight to 9.0 Kg. The material used was again HSLA 980 @ 1.905 mm thickness. (Fig. 8)

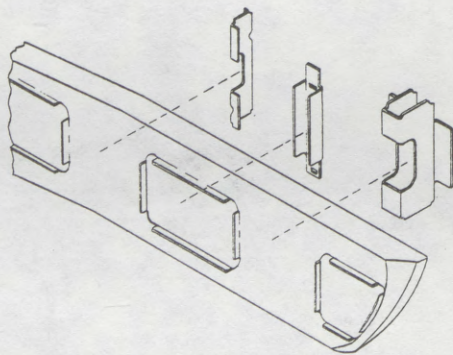


Fig. 8 - Phase III - lightweight beam concept

A successful test sequence of the Phase III hardware was run at Davidson in mid August. Park and turn lamp mounting in the crush zone was demonstrated with no damage to the lamp assembly. The mounting bracket itself, however, was slightly deformed, and further revisions were being evaluated. This was the final test sequence run at Davidson, the results of which are given in Table 1.

A complete set of Phase III hardware was tested at Pontiac in September 1977. These tests duplicated the Davidson results. No damage occurred to either the E/A or fascia. The park and turn lamp bracket bent away from the face of the E/A slightly. (Table 7)

Table 7 - Bumper System Performance (At Pontiac)

	<u>Force</u>
Barrier	86.7 KN
Center Pendulum	40.0
Outboard Pendulum	44.5
Corner Pendulum	11.1

At this point, the design was committed for production. To expedite the program, Pontiac developed a park and turn lamp mounting in the

reinforcement beam such that the lamp itself was not in the crush zone. The reinforcement beam design was also refined (Fig. 9) by adding jacking brackets, altering the bulk head designs, decreasing section heights by 32 mm and increasing metal gage to 2.337 mm. In spite of all the detailed design changes required for production release, Pontiac Engineering was able to maintain a final production weight only 1.3 Kg greater than the lowest achieved in the prototype series; a remarkable achievement. This was largely offset by elimination of the parking lamp mounting bracket from the E/A molding, a 0.9 Kg reduction.

During design finalization, Pontiac introduced a number of other detail changes in the energy absorber. The most important one was the addition of 7.62 mm foam depth at the outboard E/A location to support the grille and reduce plane A load. E/A material was also added to the back of the outboard support rib for better support of the jack adapter. Subsequent testing at Pontiac showed that impact performance was not significantly altered during design finalization. Figure 10 shows the complete energy management system as finalized for production.

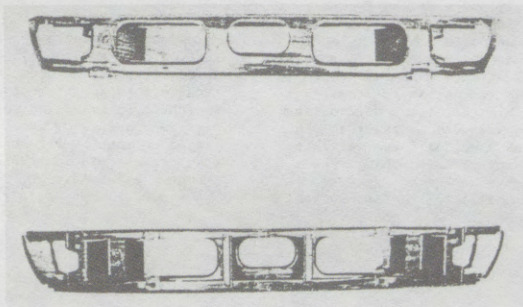


Fig. 9 - Final production beam design

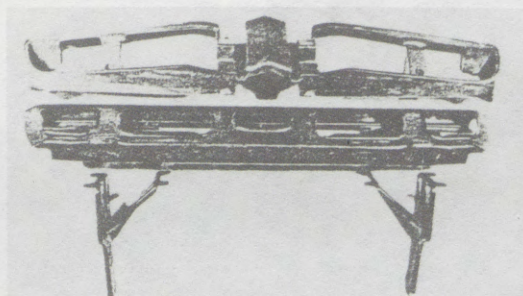


Fig. 10 - Final production energy management hardware

DEEP FOAM CONSIDERATION - 1979 FIREBIRD

In a paper presented to the 1976 SAE Congress (4), it was predicted that the application of soft bumpers under Standard Part 581 could be optimized by using softer low density foam in a deeper design having greater stroke than conventional designs. (Fig. 11) Such an approach was briefly considered in the 1979 Firebird program because it offered the possibility of eliminating the bumper's reinforcement beam (the heaviest component) by using reinforced body panels as the foam's mounting surface. (Fig. 12)

This approach was not pursued by Pontiac due to a number of unresolved developmental problems for which the lead time available was judged to be insufficient. One major problem area was to provide radiator clearance in a front bumper design. The deep foam concept, however, appears to be valid and could lead to significant further weight reductions in the next generation of soft bumper designs. Development work is proceeding on both NHTSA and industry funded projects. (5) (Fig. 13)

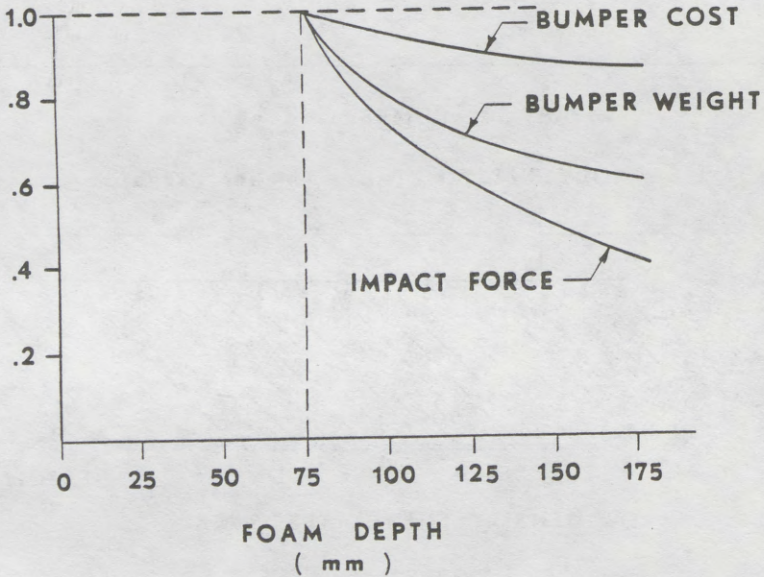


Fig. 11 - Bumper system performance vs. foam depth

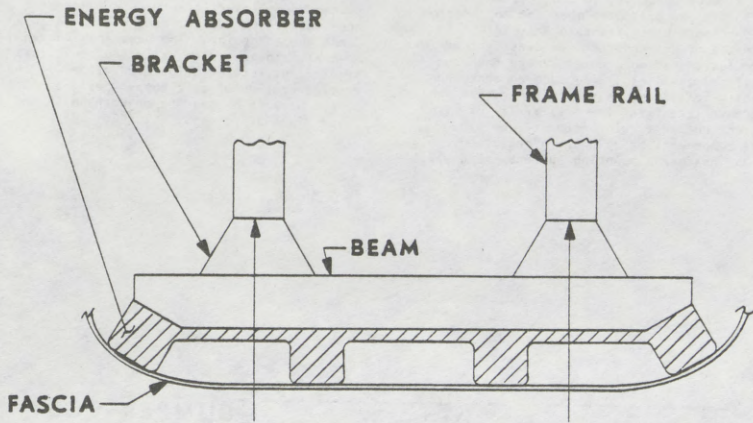
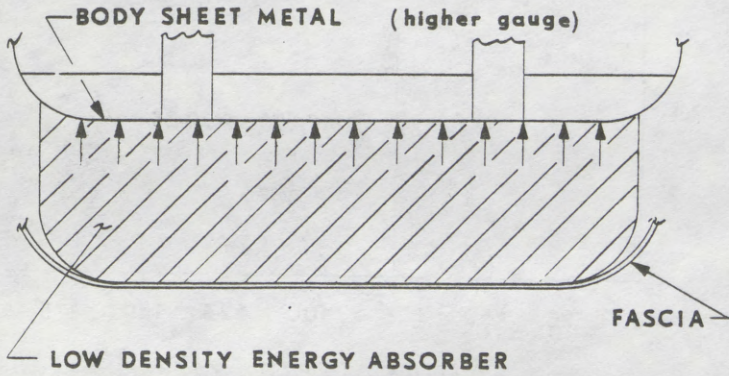
STANDARD 215-BUMPER**PART 581-BUMPER (deep foam)**

Fig. 12 - Deep foam vs. current designs

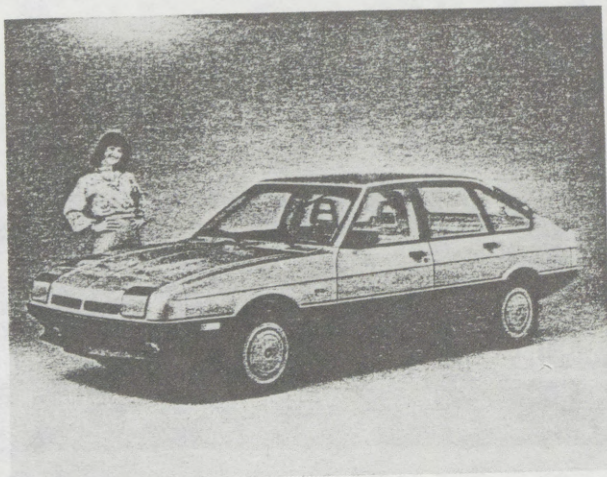


Fig. 13 - Phase III Calspan/Chrysler RSV

SUMMARY

Under Part 581 Standards, the competitive position of soft bumpers is improved relative to the traditional metal/hydraulic systems due to their inherent damage resistance and the allowance for greater soft bumper stroke.

Comparison of the 1979 Firebird elastomeric bumper and a typical new 1979 metal/hydraulic

bumper design demonstrates the anticipated performance improvement of "soft" system designs relative to the conventional "hard" bumper.

Future soft bumper designs will continue to improve in weight effectiveness by the successful development of the deep foam design concept.

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4. P. A. Weller & J. V. Scrivo, "Davisorb Bumpers Reduce Weight & Damage", Paper #770308, SAE International Automotive Congress & Exposition, Detroit, Michigan, 1976.
5. P. M. Miller, "A Status Report on the Calspan/Chrysler RSV", Sixth International ESV Conference, Arlington, Virginia, October 12-15, 1976.



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Davisorb Bumpers Reduce Weight and Damage

Peter A. Weller and Jerry V. Scrivo
Davidson Rubber Co., Inc.

Society of Automotive Engineers

International Automotive Engineering
Congress and Exposition
Cobo Hall, Detroit
February 28 - March 4, 1977

770308

Davisorb Bumpers Reduce Weight and Damage

Peter A. Weller and Jerry V. Scrivo
Davidson Rubber Co., Inc.

THE ORIGINAL INTRODUCTION of damage resistant urethane bumpers in 1968 was a natural market place response to a desire to provide something different on a specialty vehicle. The use of urethane bumpers saw steady growth such that in 1974, production was up to 800,000 units/year with a grand total of two million units produced through 1974 in the United States alone. Since then, several external influences have significantly spurred the development and production of soft, elastomeric, energy absorbing, damage resistant bumpers.*

1. The energy management requirements of Standard 215.

2. The damage resistance requirements of Standard Part 581.

3. The fuel economy requirements of the Energy Conservation & Oil Policy Act.

As developed, the soft bumper effectively manages the energy as required by Standard 215 with damage resistance exceeding the requirements of Standard Part 581 and with minimum

weight as required to optimize fuel economy. It does this with competitive costs and with materials that require low energy to manufacture.

HISTORY

The original urethane bumpers introduced in 1968 consisted of a thick (10 - 25 mm) coating of dense microcellular urethane molded directly to a steel insert which was rigidly mounted to the vehicle frame. The surface of the urethane was painted body color with a flexible urethane paint to provide a remarkably damage resistant surface for parking lot impacts up to about 2 1/2 mph.

Standard 215 introduced a requirement for significant energy management by imposing a requirement for 5 mph impacts. Since microcellular urethane foam can be formulated to be an effective energy management media, the first logical step in the development of soft systems was to thicken the foam at appropriate places on the front face of the bumper as exemplified on the 1973-75 Firebird bumpers. Subsequently, significant weight and cost savings were achieved by separating the skin and energy managing foams to optimize both the design

*Trade-named Davisorb by Davidson Rubber Co.

ABSTRACT

This paper describes the Davisorb bumper system which is a lightweight automotive bumper utilizing reaction injection molded urethane fascias, molded energy absorbers made of urethane foam and simple, low weight supporting structures. The

principal features such as improvement in damage resistance, weight reduction, styling freedom and reduction in component parts are described in detail. A design section provides information for application of urethane bumpers to specific vehicles.

and manufacture of each. The 1976 Firebird was a hybrid step wherein the energy management foam was separately molded and attached to the steel prior to molding the surface foam to the insert. The 1977 Firebird is the first system where the skin is separately molded as a thin RIM urethane part, while the foam energy absorber is separately molded and mechanically attached to the beam.

GENERAL DESCRIPTION

A Davisorb bumper consists of a thin, flexible, reaction injection molded urethane cover or fascia which forms the cosmetic exterior surface. An engineered urethane foam energy absorber is located directly under the fascia and is mounted to a beam or structure which is rigidly attached to the vehicle. (Figure 1) Under impact, the fascia deflects allowing the foam absorber to compress between the impacting device and the supporting vehicle structure, thereby, absorbing the impact energy. After impact, the fascia and energy absorber recover their original shape and position, ready to provide full protection for any subsequent impacts.

Within the general concept of a soft bumper, several specific variations can be identified and are described as follows: (See Figure 2)

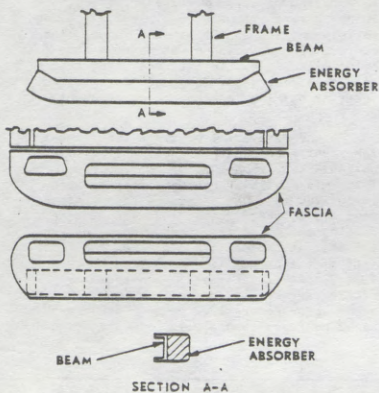


Fig. 1 - Typical soft bumper

Blade Type - The blade type bumper is a direct replacement for an existing metal bumper system. This type may have the same basic shape as a conventional bumper face bar, and can be used on a vehicle without alteration of the fenders, grille, hood or upper header panels. The bumper cover (fascia) is limited in extent to the area previously encompassed by the face bar, sight shield and end caps.

Partial Fascia Type - In this type, the bumper cover (fascia) encompasses a greater area than is involved in a blade type bumper. This type of bumper normally integrates adjacent body components such as the lower valance with the bumper cover to minimize components, simplify assembly, provide additional damage resistance or to achieve a unique styling "look".

Full Fascia Type - The full fascia concept involves a bumper cover which encompasses the entire front or rear body end panel in a single flexible component which also serves to cover the bumper system. This arrangement is the ultimate in terms of minimum components, simplified assembly, damage resistance and styling integration. Utilization of a full fascia will maximize the advantages of a soft bumper system. It is, therefore, the preferred configuration unless specific constraints in a given application dictate otherwise.

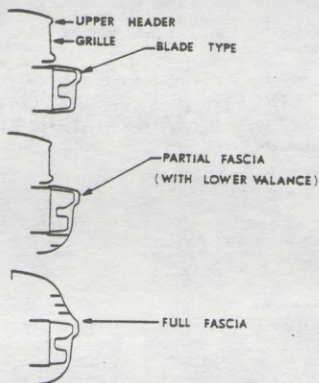


Fig. 2 - Types of soft bumpers

In discussing soft bumpers in the balance of this paper, it will be assumed that the configuration includes a full fascia bumper cover unless otherwise specified. The concepts involved will, however, generally be applicable to the more limited fascia types.

WEIGHT SAVINGS

Standard 215 places restrictions on the optimum design and application of soft systems. These restrictions are unique to the soft system and are largely the result of the shape and size of the test device and the test conditions. Referring to Figure 3, the upper section shows the typical bumper cross section with the pendulum positioned at the point of contact in the low position. Characteristically, the foam is compressed only under the impact ridge, the upper portion staying in position. Since Plane A cannot touch the bumper, the

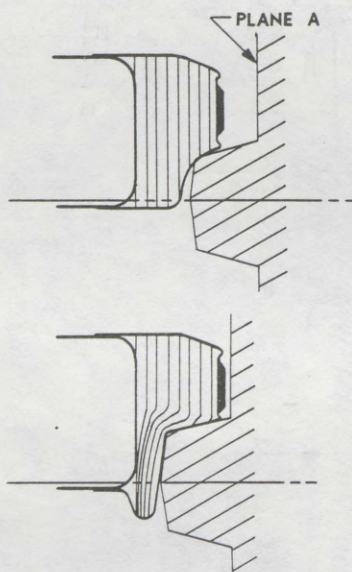


Fig. 3 - Standard 215 soft bumper

lower section shows the pendulum at the limit of its stroke. Obviously, the stroke is very short; and since the impact ridge projects only 3" from Plane A, the stroke cannot exceed about 2 3/4" under any circumstances. Thus, the stroke is limited, resulting in relatively high forces particularly on the heavier cars. In spite of these restrictions, significant weight savings can be achieved at competitive or lower cost when replacing a metal system with a soft system. Table 1 shows the comparison for several specific bumper systems designed for Standard 215. The savings are quite high when comparing with first generation metal systems as shown in Cases 1 and 2. However, they are still appreciable for the latest design metal systems as shown in Cases 4, 5 and 6.

Whereas in Standard 215, damage to the bumper is not limited, the new Standard Part 581 imposes stringent limits on bumper damage. Soft bumpers can meet the new requirement without modification, but metal systems must again increase in weight and cost. However, even more significant for soft systems is the allowance of Plane A contact in the new standard, whereby the stroke is no longer limited by the projection of the impact ridge of the pendulum. Figure 4 shows the effect of the new standard on stroke where Plane A is allowed to contact a portion of the bumper. Since energy is a function of force times stroke, as stroke is increased, force is decreased. Figure 5 is an approximate, generalized estimate of the effect of foam depth and stroke increase on force, weight and cost starting with current soft systems designed to Standard 215 as unity. Note the significant reduction in weight as the depth of foam and the stroke increase. As the foam depth increases, the foam volume increases; but the density decreases to reduce stiffness and allow greater stroke such that the net change in energy absorber weight is small. There is a small increase in the weight of the skin, which must be somewhat larger to encompass the larger energy absorber.

Table 1 - Comparison of Weight & Cost
Soft Bumpers/Striking Bumpers

Case No.	1	2	3	4	5	6
System Type:	Blade	Full	Blade	Blade	Blade	Full
Vehicle Weight:	4350	4200	3500	3000	2300	2600
Striking System Design:	Early	Mid	Early	Late	Late	Late
Striking System Wt., Lbs:	85	115	60	42	36	44
Soft System Weight, Lbs:	53	60	28	27	24	26
Weight Savings, Lbs:	36	55	32	15	12	18
Striking System, Cost:	\$56.	\$62.	\$30.	\$27.	\$23.	\$45.
Soft System, Cost:	\$46.	\$56.	\$29.	\$26.	\$25.	\$33.
Cost Savings:	\$10.	\$6.	\$1.	\$1.	--	\$12.

STRUCTURE DESIGN

The principal weight savings with a soft bumper is obtained in the structure required to support it. To illustrate this, a simple and straightforward comparison can best be made where a blade type soft bumper replaces a metal stroking bumper on an existing vehicle where both are designed to comply with Standard 215. Table 2 shows the weight comparative tabulation in two specific cases of this type. In Case 1, which is a relatively large, heavy car, the weight of the beam and brackets for the soft bumper at 34 Lbs. are significantly less than the combined face bar and reinforcement for the stroking system at 66 Lbs. Even for a very small vehicle with the latest high strength, unreinforced face bar as shown in Case 2, the soft bumper beam is

significantly lighter. This is accomplished in spite of the fact that with equal strokes, the forces are somewhat higher for the soft system than for the stroking system. Whereas, it might appear on the surface that the beam of a soft bumper should weigh about the same as the bar and reinforcement of a stroking system under comparable loads, there are several good reasons why it does in fact weigh significantly less.

1. Because the beam of a soft bumper is hidden behind the skin and energy absorbing foam, it can be designed as a "pure" structure, i.e. a rectangular open C section with a minimum of stabilizing elements, often perfectly straight from end to end - at most, a single V bend at the center.

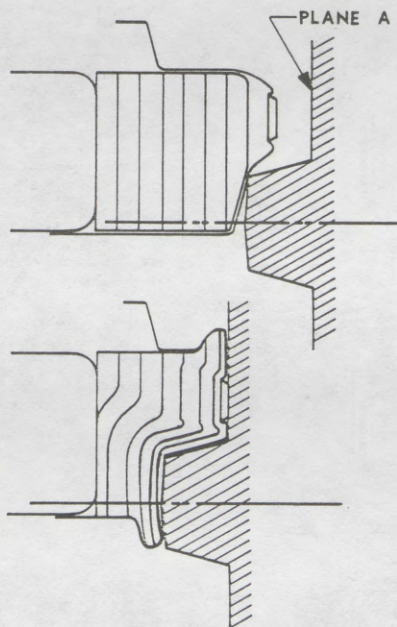


Fig. 4 - Part 581 soft bumper

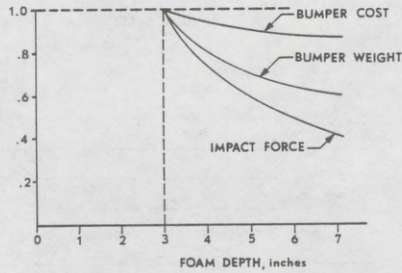


Fig. 5 - Effect of foam depth on cost and weight

2. Because the energy absorbers transfer the load to the beam as a distributed pressure rather than a point load, the metal gage can be minimized without concern for denting as required by a metal face bar.

3. Because the beam is rigidly attached to the frame, the attachment brackets can be designed in a truss arrangement, whereby the brackets contribute to the torsional and bending strength of the beam. The rigid attachment to the frame also contributes to the strength of the beam. Where a vehicle is designed from the start for a soft bumper, the rigidly mounted beam can eliminate the need for a front frame cross member, for additional weight savings.

4. By selective placement of the energy absorbing foam, the application of the loads to the beam are not only distributed but so located to assure that the maximum bending moment applied to the beam can be half or less than that of the stroking bar.

THE DEEP SOFT SYSTEM

As the foam depth increases and force decreases, the strength and thereby the weight of the beam can be reduced. Also, this increase in foam depth moves the in-board side of the foam towards the basic sheet metal and frame structure of the vehicle. Taken together, these two facts lead to a natural conclusion that the beam be eliminated with the deep foam supported directly on body end panel sheet metal. Thus, rather than high concentrated forces transferred to the frame at two local bracket attachment points, a much reduced total force is then applied by the foam to the

Table 2 - Weight Comparison
Major Bumper Components
(Pounds)

Case 1		
	Metal Stroking Bumper	Davisorb Bumper
Face Bar or Skin	28	9
Reinforcement or Beam*	38	34
Energy Absorbers	10	6
Case 2		
Skin	--	3.5
Bumper Bar or Beam*	25	18
Energy Absorbers	9.5	2.5

*Including Brackets

end panel of the vehicle as a distributed pressure as illustrated in Figure 6. The end panel structure will no doubt require reinforcement to prevent dishing and to provide load transfer to the frame structure without permanent deformation, but such reinforcement will weigh and cost considerably less than a separate beam with brackets. This concept has been identified as the Davisorb S/L system at Davidson Rubber Company and has been prototyped in the front bumper system designed by Calspan and Chrysler for their Research Safety Vehicle (See Figure 7). Table 3 gives the results of an analysis for a typical 3,000 lb. vehicle comparing the weight and cost of a Davisorb S/L front end with a conven-

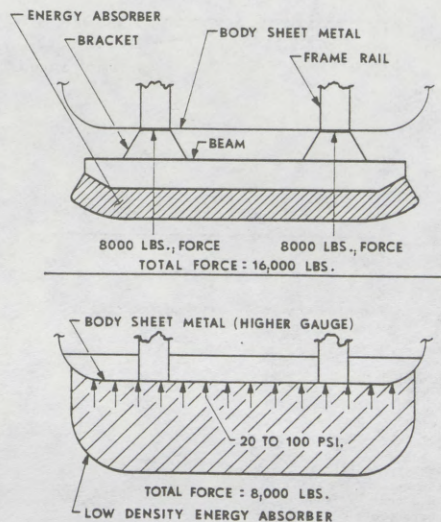


Fig. 6 - Standard 215 soft bumper (top) and Part 581 deep foam bumper - no beam - (bottom)

tional, hard, stroking front end which would meet the test and damage criteria of Standard Part 581.

Thus, three generations of soft systems can be defined, the first being under Standard 215, the second being with moderate to high strokes under Standard Part 581, and the third being the deep soft system with high strokes. Recognizing that every vehicle will have unique criteria that can significantly affect the weight of its specific bumper system, Table 4 lists the approximate average weight that may be expected for soft bumper systems for medium sized vehicles (3,000 - 3,500 Lbs.) expressed as a percent of vehicle weight.

It is important to recognize that Standard Part 581 still imposes restrictions on the design and application of soft bumpers due to the size and shape of the pendulum and the test limitation of 2,000 Lbs. force on Planes A and B. The result is that for moderate strokes, i.e. somewhat more than the pendulum impact ridge projection of 3", where the stiffness of the foam is only

slightly reduced from that required to meet Standard 215, the force on Plane A due to contact under a high or low pendulum as shown in Figure 4 is likely to exceed 2,000 Lbs., particularly on heavier vehicles but even on vehicles weighing under 3,000 Lbs. depending on the specific design criteria of the vehicle. As foam depth and stroke are further increased, the attendant reduction in foam stiffness will lower Plane A forces. The result is that within the spectrum of vehicle weights and impact strokes there will be (1) moderate strokes where soft designs may not be able to meet the Plane A force limit of the standard, and (2) a surrounding area where designs can be made within the standard but short of the optimum in performance, weight and cost that could be attained under a standard written specifically for soft systems.

DAMAGE RESISTANCE

The original introduction of urethane bumpers in 1968 was made to achieve a significant new level of damage resistance. Albeit they were relatively heavy and ex-



Fig. 7 - Calspan/Chrysler research safety vehicle

Table 3 - Comparison - Weight & Cost
Deep Soft System/
Hard Stroking System
Per Part 581 Bumper Standard
(3,000 Lb. Vehicle)

Weight Pounds	Conventional	61
	Davisorb S/L	24
	Savings	37
Cost (\$)	Conventional	\$47.
	Davisorb S/L	\$34.
	Savings	\$13.

pensive, these bumpers were capable of sustaining parking lot impacts up to about 2 1/2 mph without detectable damage and proved to be highly damage resistant to a host of real world situations. For instance, being elastomeric the skin material gives under the impingement of such things as gravel, thereby reducing the local contact forces and pressures to a level where damage is virtually eliminated.

With the progressive development of soft bumpers to meet Standard 215, the level of impact speed was increased to 5 mph, again with no detectable damage through all of the impact tests required by the standards including states barrier tests as well as under a host of real world situations. No change is needed to meet Standard Part 581, since they already more than meet the damage criteria of that standard.

In addition to being protective to the vehicle on which they are mounted and to themselves, they are protective of the objects they strike presenting a relatively soft surface to the environment. The principle effect of Standard Part 581 will be to allow an appreciable softening of that surface to the point that it can become

Table 4 - Soft Bumper System Weights
Percent of Vehicle Weight
(One Bumper) (3000-3500 Lb. Vehicle)*

Generation	Approx. Year of Application	MVSS Standard	Beam Material	Percent ^a	
				Blade Type	Full Fascia
1	1977-1978	215	Steel	1.00	1.35
2	1979-1980	Part 581	Aluminum	.85	1.00
3	1981+	Part 581	Steel	.85	1.20
			Aluminum	.55	.90
			None	--	.80

*For lighter vehicles, the percentage will be somewhat higher.
For heavier vehicles, the percentage will be somewhat lower.

**High strength FRP beams will be about the same weight as aluminum or slightly lower with a potential for lower cost.

more protective to other things. This effect has been graphically demonstrated by the front bumper system of the Research Safety Vehicle developed by Calspan and Chrysler. (References 1, 2 and 3)

OTHER ADVANTAGES

In addition to weight, cost, and damage resistance, the soft bumper systems bring with them several other advantages, some of which accrue to further cost savings.

One of these is the reduction in number of parts which can reduce cost in warehousing and inventory control as well as in final assembly labor. A typical metal stroking system front end can consist of as many as 13 parts not including attachment hardware as follows:

- Bumper Face Bar
- Reinforcement Bar
- Stroking Energy Absorbers (2)
- Brackets (2)
- Header Panel
- Grille

Lower Valance Panel

Rub Strip

Sight Shield

Corner Fillers (2)

By contrast, a soft front end can consist of at most seven parts,* in many cases only three parts, and in the ultimate, only one part. For instance, a front end with a blade type soft bumper would at most consist of the bumper (skin, energy absorber and beam pre-assembled), header panel, grille, lower valance, and two attachment brackets for a total of six parts. Preferably, the attachment brackets would be part of the beam and the lower valance, if needed, could be molded as part of the skin reducing the number of separate parts to three.

In the case of a full fascia soft system, the skin is attached to the body sheet metal rather than to the beam and the assembly will generally require a skin attachment and headlight support bracket resulting in at most a total of seven parts with the energy absorber, beam, attachment brackets, and grille. Or the brackets may be a part of the beam, the energy absorber may be pre-assembled to the beam and the grille may be molded integral with the skin reducing the number of separate parts to three.

In the case of the deep soft system, there are no brackets or beam, thereby, reducing the maximum number of parts to four. Molding the grille integral with the skin, and pre-assembling the skin, energy absorbers

and attachments can reduce the number of parts to be handled in the plant to one.

This arrangement is exemplified in the Calspan/Chrysler RSV shown in Figure 7. Figure 8 shows a rear view of this unique assembly of skin, energy absorbing foam filler and peripheral attachment strips that make up the complete one piece front end of this vehicle.

Another advantage is the basic corrosion resistance of the urethane components. The flexible urethane paint coatings for the skin are as resistant to the elements as the body sheet metal paint.

Although the reduction in highway speeds has somewhat reduced its significance, good aerodynamics can still result in a reduction in fuel consumption. The soft systems allow body lines to be smooth and continuous to the very ends of the car. Furthermore, because the skin can readily be molded in complex shapes, it is possible to incorporate special drag reducing shapes such as air dams and spoilers as an integral part of the skin molding.

ENERGY MANAGEMENT

With conventional metal stroking bumper systems, the bumper must project beyond the end of the vehicle by an amount equal to the stroke plus a margin. In order to maintain some semblance of integration between the bumper and the body, the stylists have placed the bumper designers under a great deal of pressure to maintain this projection as small as possible. This in turn requires that the shortest possible stroke be attained. Furthermore, long strokes accent the problems of tramping and pivoting that occur when a

*At the final assembly plant. A part as used in this section may be a subassembly.

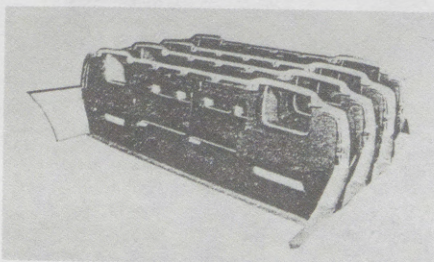


Fig. 8 - Research safety vehicle bumpers - rear view

conventional stroking system is impacted on one side only.

With soft systems, bumper designers are no longer under the restriction of designing for minimum stroke for two reasons. First, because the energy management system is covered by a flexible fascia that can be smoothly integrated with the body sheet metal, there is no visual bumper projection to break up the styling. Secondly, because the support structure is rigidly mounted, with the energy managed on the face of the bumper, long strokes which lower force and weight can be used without incurring problems with tramping and pivoting.

Whereas urethane foam materials have been developed, which give efficiencies up to 80% under a given impact condition such as experienced by a stroking hydraulic unit mounted behind the bumper bars, the overall system efficiency of bumpers where the energy is managed on the face of the bumper is reduced as a result of the specific test requirements of Standards 215 and Part 581. Although this results in somewhat longer strokes (at equal forces) than achievable with hydraulic energy absorbers, minimum stroke is not a controlling criteria when using full fascia soft systems, as indicated above.

In a conventional stroking system, there are just two energy absorbers located between the bumper bar and the frame of the vehicle. The load of an impact at any point along the bumper is transmitted by the bar to one or both of these two energy absorbers. Conversely, where the energy is absorbed on the face of the rigidly mounted bumper bar as in a soft system, the energy absorber in any given impact consists of the foam actually compressed in that impact. To understand the consequences of that action, the function of foam as an energy absorber can be characterized as follows:

$$E = AtZM \quad (1)$$

$$F = ARM \quad (2)$$

E = Energy Absorbed, In. Lbs.

A = Contact Area, Sq. In.

Z = Energy Factor (a function of foam strain)

t = Energy Absorber Thickness, In.

M = Compressive Modulus of Energy Absorber Foam, Lbs./Sq. In.

F = Force Observed at Point of Impact, Lb. Force

R = Load Factor (a function of foam strain)

Thus, the energy absorbed is a function of the foam volume ($A \times t$) compressed and its characteristics Z and M. The observed force is a function of the area of foam compressed (A) and the material characteristics R and M. The material characteristics R, Z, and M are either available from suppliers or can be determined from dynamic (5 mph) compression tests of cube specimens. (See Reference 4)

From the above equations, it is, however, apparent that both energy capacity and force level are a function of AM which is an expression of the stiffness of the energy absorbing foam compressed in a given impact. Since the energy to be absorbed in a barrier impact is approximately twice that to be absorbed in a pendulum impact, ideally, the value of AM should be twice as large for the barrier as it is for the pendulum. However, the specifications of the federal standards require high and low impacts by a relatively short pendulum, whereby, there is normally in the extreme pendulum positions only about one third vertical engagement of the pendulum with a portion of the foam on one side of the bumper. Except for extreme styling configurations, the barrier impact will engage all or a major portion of the total foam. The net result is an energy absorber for the barrier that is normally more than twice as stiff as that for the pendulum in the extreme position.

Thus, in an extreme position, the pendulum will normally have a longer stroke than the barrier. The barrier impact, having the shorter stroke and being applied equally to the rails will produce the highest rail forces.

DESIGNING URETHANE FOAM BUMPERS

The first step in designing an optimal urethane foam bumper system is to commit to such a system early in a vehicle's design life. While soft bumpers can be designed to directly replace conventional systems with savings in both weight and cost, such designs will seldom be optimized due to arbitrary design constraints carried over from the conventional system being replaced.

As previously stated, whereas barrier and pendulum force and stroke would be the same if AM for the barrier were twice that for the pendulum, the test requirements of

the standard result in an area ratio, R_A , that is appreciably more than two,

where: (3)

$$R_A = \frac{\text{Contact area in barrier impact}}{\text{Contact area in extreme pendulum position}}$$

The more R_A exceeds two, the more will be the amount by which the pendulum stroke exceeds the barrier stroke. Where an essentially flat rectangular block of foam is used over the full length of the bumper, R_A can be as high as given by equation (4).

$$R_A = \frac{L}{7} \quad (4)$$

where:

L = length of the foam block from corner to corner, in.

Obviously, large, wide cars with long bumpers will have an area ratio that is higher than small, narrow cars.

Lower values of R_A can be achieved by appropriate planforms and coring or placement of the foam in such a way as to reduce the foam impacted in the barrier relative to the foam impacted in the extreme pendulum position. By so doing, the amount that the pendulum stroke exceeds the barrier stroke can be reduced to values as low as 15% for subcompacts with narrow bumpers.

Having worked out a planform and arrangement of foam placement to minimize R_A , each impact situation for the design can be analyzed for stroke and force using equations (1) and (2) in combination with the characteristics R , Z and M for the particular foam under consideration.

The energy to be absorbed by the energy absorbing foam on the impact is given in equation (5).

$$E_B = .4 V^2 W (1-C) \quad (5)$$

where:

V = Impact Velocity, mph

W = Vehicle Test Weight, Lbs.

C = Vehicle Compliance

Vehicle compliance is that portion of the total energy absorbed by the vehicle components other than the bumper energy management system. The compliance normally in-

creases with increasing deceleration rate as shown in Figure 9. If the compliance of the vehicle is not known, Figure 9 can be used as a reasonable first approximation.

Combining equations (1) and (2) gives,

$$\frac{E}{F} = t \frac{Z}{R} \quad (6)$$

Given the maximum design rail force, F_R , and using E_B from equation (5),

$$t = \frac{R E_B}{Z \frac{F_R}{R}} \quad (7)$$

By inspection, it can be seen that t will be minimum when R/Z is minimum. From the characteristics R and Z versus e for the foam, R , Z and e can be obtained at the minimum R/Z . M can then be determined from equations (1) or (2).

Using the thickness, t , and modulus M thus determined, the force in the extreme pendulum position should be determined. If it results in a rail force that exceeds the design limit, thickness t must be increased sufficiently to lower it to the design limit. The force on Plane A can also be checked in the same way. If it exceeds the 2,000 Lb. limit and the contact cannot be relieved by design, it may be necessary to increase the thickness, t , further (with resulting reduced forces) in order to lower the modulus, M , required.

The design of the supporting structure can be optimized for minimum weight by taking into account the location and distribution of loads unique to the soft system such as enumerated under the section entitled "Structural Design".

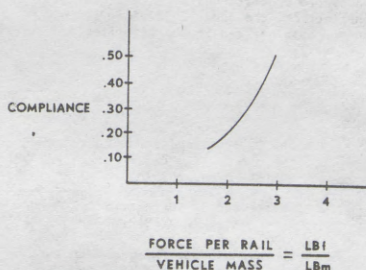


Fig. 9 - Typical vehicle compliance

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Mr. SCHEUER. Well, maybe we had better get through all of the witnesses before the bells start ringing, and after 3 o'clock if we have time.

Norman, would you like to see the movie now?

Mr. D'AMOURS. I would very much like to see it now, Mr. Chairman, because I have to leave.

Mr. SCHEUER. All right. Let's proceed with the movie. Thank you.

Mr. WELLER. This is a movie of a 1977 Firebird which was converted from the system you see on the table to our new Davisorb SL system. As you can see, it doesn't look any different from the outside. The change is in what is behind the fascia. There is a corner impact with no damage to other vehicle. That shows the fascia in detail following even the impacts that you will see later in the film.

Our laboratories are fully equipped to develop and serve bumpers. That was the barrier impact at 5 miles per hour. Here you will see a series of impacts of a pendulum required by the current standard. You can see that it does a tremendous job of assuring that the car is well protected across the full width, and assuring as well as possible protection against override and underide. There are nine of these pendulum impacts, followed by a barrier impact at 5 miles per hour.

Mr. FERRARI. These are all 5-miles-an-hour impacts, by the way.

Mr. WELLER. Then in the real world, 6 miles per hour into the side of an Aspen. You can see that the impact is not a very violent one. The softness of the system shows up in the fact that the outer sheet metal is dented but the doors and windows are fully functional, so the car's function has not been impaired in any way. Of course, there was no damage to the Firebird.

For a comparison, an impact on the other side with a standard metal system. Again, the energy absorbing qualities of the 5-mile-per-hour system have softened the impact, although not as much as the soft system.

Mr. FERRARI. Here the doors would not open.

Mr. WELLER. The Firebird, however, was not damaged in anyway. Typical of the barrels filled with sand we see along the highway at 5 miles per hour, an unexpected result was the catching of the fascia by the corner of the barrel, stretching it out. But even so, there was no damage to that Firebird.

This is into a utility pole at 5 miles per hour, with no damage to either the pole or the Firebird, again. I might mention there that the same energy management system, the same components and fascia were used in all of these tests with no replacements, so there were 16 tests on the same components.

This is at 5½ miles per hour, bumper to bumper. Notice that the Aspen bumper is not functioning, which means that the force level of the Firebird is very low. That is at 10 miles an hour, the same kind of impact. Again, there is very little movement of the Aspen bumper, confirming that most of the energy was absorbed in the Firebird.

Mr. SCHEUER. Supposing the car that was hit had had its——

Mr. WELLER. Excuse me. The only damage done to the Aspen were the two nicks in the grill.

Mr. SCHEUER. Supposing that car that was hit and bounced way back either had been in gear or that the brakes had been on. Would there have been a great deal more damage? I am not sure it is a fair test to hit a car that is not in gear and the brakes of which are not on. It just sort of bounces back.

Mr. WELLER. If the brakes were on, then the Aspen bumper system would have started working and absorbed the additional energy. So I doubt that there would have been significantly more damage.

Mr. BROYHILL. Why did you conduct the test that way? Why did you set it up that way?

Mr. WELLER. Which way?

Mr. BROYHILL. Without the brakes on.

Mr. WELLER. Because that is the normal way a car-to-car impact test is done, and it compares with all the other tests that the Insurance Institute, Calspan and all the others have done.

Mr. SCHEUER. In other words, when a car is moving, the brakes aren't on. They are in gear, but I don't suppose being in gear is much of a brake when you are moving.

Mr. WELLER. Certainly not at those low speeds. We estimate that if that Firebird had impacted another similar Firebird with the same system, that it probably could have gone to 14 or 15 miles per hour without damage to either vehicle.

Mr. BROYHILL. Are you saying it is standard test product not to have the brakes on?

Mr. WELLER. Well, there is no standard car-to-car test, but it is the test system which has been used. Actually, in the pendulum test that you saw——

Mr. BROYHILL. I would think in a low-speed test you would have your brakes on all you can. I have been in low-speed incidents like that, and I am always one to keep my brakes on so I don't hit the guy in front of me.

Mr. WELLER. That is true. But, for instance, if you were running into the car ahead of you, he probably really would not have his brakes on in a front-to-rear impact, for instance.

Mr. BROYHILL. No. I am saying that I have been involved in them and I always have my brakes on, in both the hitting and receiving. I have been at both ends.

Mr. FERRARI. Excuse me. Regardless of what should be done, I think the fact of the matter is that this test run this way is what

the industry is doing right now. So perhaps we should change, but the fact of the matter is we did this test this way because this is the common way of running it.

Mr. WELLER. And it provides comparative information, then, with all the other tests which have been run.

Mr. SCHEUER. Mr. D'Amours, have you anything to add?

Mr. D'AMOURS. I just want to say thank you, Mr. Chairman.

Mr. SCHEUER. Thank you very much for bringing these witnesses, Congressman D'Amours.

Mr. FERRARI. Thank you.

Mr. SCHEUER. Thank you very much for your interesting testimony. I take it you three will remain for questions.

Mr. FERRARI. Yes.

Mr. WELLER. Yes.

Mr. SCHEUER. I will be interested in hearing any comments the Houdaille representatives have about the movie we just saw and that rather remarkable—what is that, a rubber fender?

Mr. HOPKINS. It is urethane plastic.

Mr. SCHEUER. We would now like to hear from Mr. Donald McHugh of the State Farm Mutual Automobile Insurance Co.

Mr. McHugh, By whom are you accompanied?

STATEMENT OF DONALD P. McHUGH, VICE PRESIDENT AND GENERAL COUNSEL, STATE FARM AUTOMOBILE INSURANCE CO., ACCOMPANIED BY WAYNE W. SORENSON, VICE PRESIDENT IN CHARGE OF RESEARCH

Mr. McHUGH. Thank you, Mr. Chairman.

I am accompanied by Mr. Wayne Sorenson, who is vice president in charge of State Farm Research Department. My purpose here this morning, in response to your suggestion that we summarize and keep the statement within the time limit, is to summarize some of the major research findings that we want to report to you today, and at the conclusion of that to make some suggestions we think you ought to take under consideration in terms of your own deliberations as to whether or not congressional action is suitable.

Mr. SCHEUER. Very good.

Mr. McHUGH. Dr. Sorenson, however, would be able to explain the methodology involved in the research which is the basis of the study. Any considerations that this testimony might produce in the minds of the members of the committee, hopefully, we would be prepared to respond to. State Farm is the largest auto insurer in the business. It has a tremendous interest in protecting our policyholders' stake in keeping the costs in the repair of the automobile down. Therefore, from the beginning of this debate we have been actively involved both in the enactment of the Motor Vehicle Information Cost Saving Act and the development of a bumper standard in response to that.

I should point out in the first instance, Mr. Chairman, that the State Farm research I am referring to here is based upon the actual claims files that State Farm uses, and what we are talking about here are the claims repair estimates which are actually taken out of the claims files. They provide the basis of some 60,000 estimates that are the basis of the study upon which these findings are based. They reflect exactly what State Farm is paying to repair

cars in the real world. State Farm's Research Department regularly, as part of its monitoring functions on behalf of the company, is monitoring these claims for the purpose of a number of issues, but an important one is to determine what consequences have resulted at State Farm from the 5-mile-an-hour bumper system. There are many other things being done by the research department in examining those claims files, but this is certainly a critical one.

In the course of it, these findings would be reported to management for management's judgment and for taking whatever appropriate action it may decide. At the same time, in due course those findings, as they are deemed significant, will be reported to public officials, public bodies, including NHTSA. It would have been our plan that these findings would be in the normal course of things made public and report to NHTSA. In a sense, I think that orderly consideration by our research department of these findings has been diverted as a result of the publication by Houdaille of their cost/benefit study, and we have been forced now to redirect our attentions utilizing what findings we have made in this research and applying it to the Houdaille study.

Mr. SCHEUER. What don't you tell us what your findings are?

Mr. McHUGH. All right. First, according to State Farm's research there has been a definite reduction in the number of claims reported to State Farm where the direction of impact was front center or rear center. These are, of course, the areas protected by the bumper. Vehicles meeting Motor Vehicle Standard 215, 5 mile an hour, in comparison to pre-215, have experienced an overall 18-percent decline in the number of damage claims requiring any repairs from accidents involving front, rear, or corner impacts.

Frequency of accidents necessitating bumper repair itself has sharply declined. Now, this is a very important finding. These are actual data from State Farm showing that there has been a decline in the frequency of accidents as a result of the 215 bumper.

Mr. SCHEUER. That is the 215 bumper. That is the 5 mile an hour?

Mr. McHUGH. That is 5 mile an hour. This result is illustrated graphically on page 10. I would like to call your attention to that for a moment because indeed, that exhibit, just talking about the reduction in the frequency of bumper repairs themselves, will show that during the pre-215 bumper, which was in 1970 and 1971, both on front and rear accidents, the percentage of involvement of impacts was in the neighborhood of 14 percent. After 215 was enacted that dropped down to about 9 percent, or between 9 and 7 percent.

Second, Mr. Chairman, State Farm's data contributed, we believe, important new information about crash speed distributions. They show that for cars not subject to the 215 standards, almost half were damaged in front center crashes in impacts at barrier equivalent speeds of 5 miles per hour or less. That is, half of those incidents were in extremely low-speed crashes.

The Federal bumper standards have had an important impact on reducing the number of claims for damages in this low-speed range. I call your attention here, Mr. Chairman, to exhibit 2 on page 11. Very briefly, this exhibit, the solid bar, shows what was happening with a 1969-71 models, that is, before the 5 mile per hour. The broken bar which we are illustrating here is showing the models

from 1973 to 1977, and that represents essentially the results under the 5-mile-per-hour bumper standard, showing what happens at the different speed distributions reflected.

The most important one, of course, congressman, is what happens at—

Mr. SCHEUER. They are pretty much the same after 5 miles an hour.

Mr. McHUGH. They are pretty much the same after 5 miles an hour. The interesting thing is our information indicates that we had a little under 50 percent involvement pre-5-mile-an-hour bumper standard, and that dropped down to 6.6 percent of cases where there was front and rear bumper damage that resulted in claims reported to State Farm.

Now, in testimony in the Senate yesterday, witnesses or representatives from Houdaille announced they had not seen this data or findings on velocity and frequency until that time, and criticized the arithmetic involved in this figure. If you will note, the solid bar for the different speeds adds up to 100 percent. That is not so in the case of the broken bar showing what happens under the 5 mile per hour. It is hard to believe that they could have misread that figure in this way. Dr. Sorenson has assured me there is no mathematical error. It is done in this way simply for the purpose of reflecting the substantial difference in the number of incidences that occur, accidents under 5 miles per hour, which now result in insurance claims, claims paid for by State Farm.

Before that time, it was up to 47 percent in which we were paying front and center accidents involving damage to the car. Now that is down to 6.6 percent. To properly reflect the entire picture, I suppose it would have been appropriate from the bottom of 6.6 to have simply drawn that line up to the top, because of course the bumper did not eliminate the 47 percent of impacts that are occurring. Indeed, they did occur. But if we were to do that, it would simply show that between 6.6- and 40-some percent, you are dealing then with impacts which occurred on which there was no reported damage.

What I would like to now comment on. Mr. Chairman, is what has been the effect of these two findings upon the judgment made in the Houdaille cost/benefit study, which indicates that the 2½-mile-per-hour bumper is more cost beneficial to the consumer than the 5 mile per hour.

We have said that unfortunately Houdaille's studies relied on these assumptions, not the kind of real world data reflected in these findings. Houdaille assumed that only one-third of all the impacts that take place in American roads occur at barrier equivalent velocities of 5 miles per hour or less. However, as just described, our real world data involving active claims shows almost 50 percent occurred at these low speeds. If one were to take into account unreported damage, it would be even considerably more.

Second, on the frequency side, Houdaille, in the formula which they used for the purposes of their cost/benefit study, assumed that the frequency of report repair claims per car year remained the same, constant on both the 2½- and 5-mile-per-hour system. In its analysis, Houdaille incorrectly uses only one frequency figure for both bumper systems.

In other words, Houdaille claimed the introduction of the 5-mile standard had absolutely no effect on the frequency of repair to the bumper. In fact, this is clearly demonstrated in exhibit 2, page 11. Frequency varies considerably because of the elimination of damage-causing accidents of less than 5 miles per hour under the more demanding standards.

Now, I have to tell you, Mr. Chairman, we have great doubts and great concerns about the validity and reliability of the Houdaille cost/benefit study. We have not been able to develop any such study ourselves. It is probable that we do not have the capability of doing that, but relying simply on what Houdaille did and factoring in, now, not some of the assumptions which they made but the kinds of findings which State Farm research indicates are based upon what actually happens to State Farm-paid claims, we come up with a completely different bottom line result concerning the 2½-mile-per-hour bumper against the 5-mile-per-hour bumper.

In brief—

Mr. SCHEUER. What is your conclusion?

Mr. McHUGH. Our conclusion is the 5-mile-per-hour standard would provide \$65 in additional net benefits above the 2½-mile-per-hour during the life of the vehicle. If you recall, the Houdaille cost/benefit system concluded that there was approximately a \$39 net direct benefit for the 2½ mile. Now, it is true that the \$65 that we have produced here includes corner impacts. The Houdaille study made no effort to analyze what the benefits would be as a result of corner impacts. We think it is critically important in our analysis. That amounts to about \$51 over the life of the car. But if we were to take that \$51 out of our study, you still come down to a net benefit for the 5-mile-per-hour system which is \$14 as against what Houdaille had claimed on the 2½-mile-per-hour system. Let me just say in conclusion that the question of cost/benefit analysis is an extremely complicated and extremely difficult issue. It would seem to us it must be a horrendous chore for a legislator to have to make decisions upon the basis of that. For these reasons, it has seemed that the logical and reasonable way to dispose of these kind of issues is in a rulemaking procedure which NHTSA is conducting. They are presently in the process of doing just that.

In point of fact, as I understand it, the only reason the Congress is being asked to give some special attention to that is because of an emergency appeal on behalf of one manufacturer of steel bumpers, based upon their claim that if they are required to meet the phase II of the current bumper standard, they may be forced to close down their plant that manufactures steel bumpers in Huntington, W. Va., in September of this year.

Well, we had been assuming that that is the reason for the emergency requirement that Congress act now and circumvent what is going on in the administrative rulemaking procedure. Yesterday, Mr. Chairman, in testimony before the Senate committee on this issue, the chairman of the board and the chief executive officer, in response to questioning, now state that Houdaille, at its Huntington, W. Va. plant, has contracts for the construction of steel bumpers for the year 1981. At best, as I understand the testimony, they are suggesting that sometime thereafter, in 1982, the effect may be to some reduction of personnel. Well, I strongly

suggest that if the only reason for not following the regular rule-making procedure is the emergency situation in which Houdaille finds itself, that emergency apparently has disappeared and it would seem logical that this issue be debated carefully in the way it has been up until this time in the course of the NHTSA rule-making procedure.

Thank you.

[Testimony resumes on p. 252.]

[Mr. McHugh's prepared statement and attachments follow:]

STATEMENT OF DONALD P. McHUGH,
VICE PRESIDENT AND GENERAL COUNSEL
OF
STATE FARM MUTUAL AUTOMOBILE INSURANCE COMPANY
BEFORE THE SUBCOMMITTEE ON
CONSUMER PROTECTION AND FINANCE
OF THE HOUSE COMMITTEE ON
INTERSTATE AND FOREIGN COMMERCE
MARCH 28, 1979

I am Donald P. McHugh, Vice President and General Counsel of State Farm Mutual Automobile Insurance Company. With me today is Dr. Wayne W. Sorensen, State Farm's Vice President for Research.

As the world's largest automobile insurer, State Farm insures approximately 20 million vehicles. Accordingly, State Farm is the largest single source of funds for the payment of the costs of property damage and personal injury resulting from automobile crashes. In 1978, we paid \$1,200,000,000 to repair cars damaged in highway accidents -- approximately \$215,000,000 of which went for parts and labor to repair or replace car bumper systems.

The enormous economic impact of automobile crashes to our policyholders, coupled with our obligation to these policyholders to seek realistic ways to reduce automobile crash losses, explains State Farm's strong interest in better bumpers. Our support has been

reflected by our continuing participation in rulemaking proceedings at NHTSA and in testimony before congressional committees considering this issue.

We believe that the wealth of data we have collected and studied in the course of paying automobile crash claims places us in a unique position to comment on the effectiveness, from the consumer's viewpoint, of the improved bumpers required in recent years by federal standards.

Recent research by State Farm confirms our view that the National Highway Traffic Safety Administration's current 5 mph bumper standard is beneficial to consumers. Similarly, we are also confident that Phase II of NHTSA's "no damage" 5 mph bumper standard, now scheduled to be implemented on 1980 models, will likewise be beneficial.

Finally, on the issue of the relative merits of the 2.5 and 5 mph bumpers, we have come to quite opposite conclusions from those of Houdaille Industries -- by substituting reliable, real-world data in their formulae to overcome the effects of their incorrect assumptions.

State Farm Research Confirms the Benefits of
the 5 mph Standard to the American Consumer

Findings from State Farm's research demonstrate that the implementation of federal bumper standards has, in fact, benefited American consumers. Although our experience has been mainly with Standard 215 which mandated no damage to safety equipment, information developed by the Insurance Institute for Highway Safety and furnished to the Congress has shown that this safety standard has effectively eliminated much economic damage in low speed crash tests. The current standard expanded these safety related requirements. It now directs that no economic damage occur to the car in low speed crashes beginning in September 1978, and then to the bumper itself beginning in September 1979.

Our most recent research efforts, which encompassed 60,000 claim files, have revealed two important new findings.

First, according to State Farm's research, there has been a very definite reduction in the number of claims reported to State Farm where the direction of impact was front-center or rear-center. Those are, of course, the areas protected by the bumper. Vehicles

meeting Federal Motor Vehicle Standard 215, in comparison with pre-215 cars, have experienced an overall 18 percent decline in the number of damage claims requiring any repair from accidents involving front, rear, or corner impacts. Frequency of accidents necessitating bumper repair itself has sharply declined. This result is illustrated graphically in Exhibit 1 included in this statement on page 10. Reduced frequency constitutes a key element in containing insurance costs. By no means is this the full picture. Cars that are uninsured or damaged below insurance deductible amounts experience the same benefits -- benefits which accrue directly to the car owner.

Second, State Farm data contribute, we believe, important new information about crash speed distributions. They show that for cars not subject to 215 standards, almost half were damaged in front-center crashes in impacts at barrier equivalent speeds of 5 mph or less. That is, half of those instances were extremely low speed crashes. The federal bumper standards have had an important impact in reducing the number of claims for damage in this low speed range. See Exhibit 2, page 11. For cars meeting Standard 215, there were 86 percent fewer front-center impacts

occurring at 5 mph or less barrier equivalent speeds which resulted in claims reported to State Farm.

These conclusions, which are described in more detail in Attachment I, are based upon the Insurance Institute for Highway Safety's crash test results correlated with State Farm damage repair estimates of 60,000 claims and upon the assumption that driving patterns have remained constant. As noted above, these findings also strongly support our belief that the 5 mph bumper standard has helped control insurance costs.

The Application of Stage Farm's Data to the Houdaille Methodology Supports the Conclusion That the 5 mph Bumper Standard Is More Cost Beneficial Than a 2.5 mph Bumper Standard

The new information outlined above relating to frequency and velocity distribution of car damage incidents is of critical importance to any cost-benefit analysis of bumper standards. Recently, Houdaille Industries made public its analysis of the cost benefits of 2.5 and 5 mph bumper standards.

Unfortunately, Houdaille's study relied on certain assumptions in the absence of real-world data. Houdaille assumed that only one-third of all impacts that take place on American roads occur at barrier

equivalent velocities of 5 mph or less. However, as just described, our real-world data involving active claims show that almost 50 percent occur at these low speeds. If one were to take into account impacts unreported to insurance companies, the percentage of low speed crashes would be even greater. Thus, because of this assumption, the Houdaille report significantly understated the benefits of the 5 mph bumper.

Second, Houdaille assumed that the frequency of reported and repaired claims per car per year remained constant under both the 2.5 mph bumper system and the 5 mph system. In its analysis, Houdaille incorrectly used only one frequency figure for both bumper systems. In other words, Houdaille assumed that the introduction of the 5 mph standard had absolutely no effect on the frequency of repair of the bumper. In fact, as is clearly demonstrated by the data shown in Exhibit 2, page 11, frequency varies considerably because of the elimination of damage-causing accidents of less than 5 mph under the more demanding standard. This assumption resulted in Houdaille's seriously underestimating the 5 mph bumper's low speed benefits.

We share most of the concerns about the validity and the reliability of the Houdaille study that have been expressed here by other witnesses. However, we wanted to evaluate Houdaille's conclusions, using its methodology, but substituting our real-world experience for the flawed Houdaille assumptions. Thus, using the Houdaille methodology, but incorporating State Farm's real-world data described above, the analysis reflects that the 5 mph bumper standard is more cost beneficial than the 2.5 mph standard. A summary of our analysis is reflected in Attachment I to this statement. It shows that the 5 mph standard would provide \$65 in additional net benefits above the 2.5 mph standard during the life of the vehicle. Note that this figure includes an assessment of costs and savings associated with corner impacts, a crucial factor that the Houdaille study ignored. Even a limited study that excluded consideration of corner impacts would show a comparative net benefit of \$14 based on the substitution of our real-world data while using Houdaille's methodology.

We believe that evaluation of the new data we have assembled and the correction of errors of methodology employed in its preliminary study would also lead the National Highway Traffic Safety Administration to conclude that the 5 mph bumper standard is more cost beneficial than the lower standard.

Our presentation today of necessity has attempted to focus only on the essential conclusions of the highly complex issues of determining the most appropriate bumper standard. Indeed, this question must involve safety considerations as well as cost-benefit analysis. We respectfully submit that the details of this issue are best addressed in the pending administrative rulemaking proceeding.

The Motor Vehicle Information and Cost Savings Act of 1972 expressed a strong congressional policy that the public was entitled to car repair savings in low speed crashes resulting from a properly designed bumper system. It took almost 6 years after the Act was passed before a 5 mph bumper system became effective. The public is just beginning to experience the substantial benefits that can flow from this relatively modest improvement in bumper construction. We would strongly urge the Congress to take no action impeding the progress which has been made. Any weakening of the standard should occur only after a thorough fact-finding review pursuant to the pending NHTSA rulemaking proceeding.

We are now preparing a report fully setting forth State Farm's research and conclusions and which also addresses other issues raised in the Advance Notice of Rulemaking. As part of that preparation process, we would be pleased to discuss our research and the conclusions summarized in our attachment with any interested parties.

Attachment I to
Statement of Donald P. McHugh,
Vice President and General Counsel
of

State Farm Mutual Automobile Insurance Company
Before the Subcommittee on Consumer Protection and Finance
of the House Committee on Interstate and Foreign Commerce,
March 28, 1979

Summary

Reanalysis of the cost benefit study sponsored by Houdaille Industries¹ in which "real world" data were substituted for certain assumed values revealed that the 5 mph bumper standard does appear to be cost justified. The reanalysis utilized the same methodological paradigm presented by Houdaille modified only by the substitution of figures derived from research on actual State Farm damage repair estimates.

Applying the more realistic data to the Houdaille model yielded conclusions diametrically opposite to those reached by Houdaille; i.e., instead of a net cost, there was a net benefit associated with the 5 mph standard compared to the 2.5 mph standard.

The State Farm analysis demonstrated that the cost to repair damage from insurance reported bumper accidents over the life of the car (restricted to front center and rear center impact directions) resulted in \$47 direct net benefits for the 5 mph bumper system compared to the 2.5 mph bumper system. Based on analysis of damage which goes unreported to insurance companies, but is repaired, State Farm estimates an additional \$47 net benefit for the 5 mph bumper system. State Farm estimates that the cost to repair damage from insurance reported corner bumper accidents over the life of the car resulted in \$51 more benefits for the 5 mph bumper system than the 2.5 mph system. Using Houdaille's nominal value of \$5 in benefits from reduction in unrepaired damage, plus Houdaille's estimate of \$4 for lifetime consumer benefits, net benefits for the 5 mph system total \$154 greater than for the 2.5 mph system.

Houdaille's estimates of the net additional costs of the 5 mph system consisted of \$29 for additional fuel used and \$60 for additional initial manufacturing costs. Subtracting these additional costs from the additional benefits resulted in a final net benefit estimate for the 5 mph bumper system of \$65 per car over its lifetime.

¹"A Cost-Benefit Analysis of Bumper Standards," papers by Professor David Wise and by Dr. Neil Roth, submitted on behalf of Houdaille Industries, Inc., December 27, 1978. (Analyses and methodology in these papers will be referred to as "Houdaille's methodology, analyses," etc.)

Houdaille Methodology

Houdaille's symbols and equations are used in this attachment to facilitate comparison. Houdaille lets T represent the total cost of a bumper system which is the sum of three variable costs;

- C - the incremental cost to the consumer for one bumper system design.
- D - the cost to repair damage from bumper accidents discounted over the life of the car (unreported and repaired combined with reported and repaired).
- U - the value for unrepaired damage discounted over the life of the car.

Let T_5 and $T_{2.5}$ be the total costs for 5 mph and 2.5 mph bumper systems respectively. The net cost benefit, N, of the 5 mph bumper system can be calculated from the following equation:

$$\begin{aligned} N = T_5 - T_{2.5} &= (C_5 + D_5 + U_5) - (C_{2.5} + D_{2.5} + U_{2.5}) \\ &= (C_5 - C_{2.5}) + (D_5 - D_{2.5}) + (U_5 - U_{2.5}) \end{aligned}$$

Houdaille's 'best' estimates for each of the above quantities are shown below:

$$N = T_5 - T_{2.5} = \$44$$

$$C_5 - C_{2.5} = \$60$$

$$U_5 - U_{2.5} = -\$5$$

$$D_5 - D_{2.5} = -\$11.$$

A negative cost value corresponds to a net discounted benefit for the 5 mph bumper system over its lifespan; i.e., negative values estimate a beneficial effect of the 5 mph bumper.

State Farm Analysis

Insurance company data are the most reliable source for repaired and reported collision costs (costs which are represented in the 'D' used by Houdaille). State Farm limited its analyses to the direct cost benefits ($D_5 - D_{2.5}$), without correcting Houdaille's estimates of benefits from a reduction in unrepaired damaged ($U_5 - U_{2.5}$), lifetime consumer benefits (\$4), or the additional initial manufacturing cost of the 5 mph bumper system over the 2.5 system (\$60).

The formula used by Houdaille in their direct cost calculations is shown below:

$$D = \sum_{t=1}^T \sum_{i=1}^I \frac{f P_i d_i}{(1+r)^t}$$

This equation can be written equivalently as:

$$D = \frac{1 - (1+r)^{-T}}{r} \sum_{i=1}^I f P_i d_i$$

The variable symbols were defined by Houdaille as follows:

f = frequency of repaired and reported bumper accidents combined with the number of repaired, but unreported bumper accidents per car per year. (Houdaille uses a value of .148 incidences per car per year).

P_i = probability of accidents occurring in speed interval i .
(Houdaille uses four speed intervals: 0-5 mph, >5-10 mph, >10-15 mph, and >15 mph).

d_i = expected damage cost of accidents in speed interval i .

r = discount rate (State Farm analysis used Houdaille's 'best' estimate of .11).

I = 4 velocity intervals.

T = 10 years as the estimated lifespan of a passenger car.

Reduced frequency of accidents necessitating bumper repair is the first research finding referred to in State Farm's statement. The \$11 in discounted direct cost benefits calculated by Houdaille, using their 'best' fit has two frequency components: .07 reported and repaired bumper incidents per car per year and .078 unreported, but owner repaired bumper incidents per car per year. The .07 bumper incidences per car per year used in past analyses by NHTSA represents the repaired facebar frequencies for impact points which can experience facebar damage—i.e., front and rear corners, as well as front center and rear center impacts. NHTSA derived the .07 frequency by applying the average reported (1977) State Farm collision and property damage claim frequency times the 1974-77 model year average facebar replacement frequency per claim for vehicles that were repaired.

$$\begin{array}{rcl}
 .07 & = & .165 \times .424 \\
 \text{repaired facebar incidents} & & \text{incidents per} \quad \text{repaired front \& rear} \\
 \text{per car per year} & & \text{car per year} \quad \text{facebars per repaired} \\
 & & & \text{car (1974-77 model year} \\
 & & & \text{vehicles)}
 \end{array}$$

Unfortunately, Houdaille did not take into account that the collision and property damage claim frequency is significantly different for a 5 mph vs. 2.5 mph bumper system and, in addition, the number of repaired facebars per repaired car is different for a 5 mph bumper system than a 2.5 mph bumper system. Finally, Houdaille applied the .07 frequency (which is representative of corners as well as front and rear center impacts) times dollar costs which are reflective of two crash configurations—front and rear center only. Appropriately, Houdaille should have limited their cost benefit analysis to front center and rear center impacts since their only available crash damage costs were based on these two configurations.

Figure 1 shows that among all damaged cars, the percentages in front and rear center impacts that also required bumper facebar replacement were dramatically affected by FMVSS 215. Prior to the standard,

between 12% and 14% of all damaged cars reported to State Farm were shown to have had crashes involving front or rear center impacts with damage that required replacement of the bumper facebar. In the model years, when both front and rear bumpers were required to satisfy the 5 mph barrier criteria, these percentages were considerably below 9%.

Figure 2 shows the impact that the 5 mph bumper system has had on claim frequency around the car. After the 1976 model year vehicle's impact point distribution is adjusted for constant 1971 side involvement frequency (.35), State Farm data show an 18% decline in collision frequency for corners combined with front center and rear center reported accidents ($.65 - .47 = .18$). 1974-1977 State Farm data consistently predict the 18% reduction in claim frequency.

The differences in repaired facebars per repaired car combined with an 18% reduction in property damage and collision claim frequency for the 5 mph bumper system over the 2.5 mph bumper system results in different repaired and reported incidences of front and rear center bumper damage—.021 for the 5 mph bumper system and .040 for the 2.5 mph bumper system (f in Houdaille's analysis of direct costs).

An improved estimate for the real world crash velocity distribution is the second research finding referred to in State Farm's statement. State Farm analyses show that the 'real world' barrier equivalent front center barrier impact velocity distribution is 47% below 5 mph and 53% above 5 mph. Figure 3 shows the percentages of damaged cars in front center impacts for different barrier equivalent crash speed ranges for two groups of model years—1969-71 models with no bumper standard and 1973-77 models meeting FMVSS 215 (the 1973-77 percentages were standardized by keeping constant the proportion of accidents which have equivalent front center barrier impact velocities above 5 mph or .53). Most (86%) of the below 5 mph front center repaired damaged incidences have been eliminated for cars meeting FMVSS 215. State Farm research shows that the 'real world' equivalent rear center barrier impact velocity distribution is similar to the front center barrier impact velocity distribution.

State Farm developed an improved estimate of the 'real world' equivalent barrier impact velocity distribution compared to that used by Houdaille and, in fact, different velocity distributions have been developed for application to front and rear center impacts for repaired bumper accidents. However, State Farm assumed because Houdaille did, that one velocity distribution applies to both front and rear center collisions. The velocity distribution used by State Farm when using Houdaille's methodology for calculating benefits from direct costs is tabulated below:

<u>Velocity Interval (BEV)</u>	<u>State Farm Distribution</u>	<u>Houdaille Distribution</u>
0 - 2.5	.235	.200
2.5 - 5.0	.235	.180
5 - 10.0	.295	.250
10 - 15.0	.209	.180
>15	.026	.190

The final component required in State Farm's analysis of Houdaille's direct costs by velocity intervals were the average repair cost by velocity interval. Recently, Dr. Neil Roth adjusted upwards the repair costs used in the Houdaille report.² State Farm believes these latest Houdaille repair costs are more representative of the 'real world' experience. State Farm decided to use Houdaille's most recent estimate of repair costs by velocity interval shown below:

<u>Velocity Interval (BEV)</u>	<u>Repair Cost</u>	
	<u>2.5 mph Bumper System</u>	<u>5 mph Bumper System</u>
0 - 2.5	\$ 33	\$ 0
2.5 - 5.0	102	0
5.0 - 10.0	360	336
10.0 - 15.0	952	978
>15	2616	2644

²Letter to Mr. Richard Copaken Dated February 15, 1979.

State Farm recomputed the net discounted repaired and reported cost benefit using more realistic values for the velocity distribution and the repaired bumper incidences per car per year (restricted to front and rear center only).

$$\begin{aligned}
 (D_5 - D_{2.5})_{\text{Reported}} &= \left[\frac{1 - (1 + .11)^{-10}}{.11} \right] \sum_{i=1}^4 \left[f^5 P_1^5 d_1^5 - f^{2.5} P_1^{2.5} d_1^{2.5} \right] \\
 &= (5.889) \times \sum_{i=1}^4 \left[(.021) P_1^5 d_1^5 - (.040) P_1^{2.5} d_1^{2.5} \right] \\
 &= (5.889) \times (\$8 - \$16) \\
 &= -\$47.
 \end{aligned}$$

State Farm predicted (using Houdaille's repair costs and methodology, restricting analysis to front and rear center only, not considering the benefits of unreported and repaired damage) a net discounted benefit for the 5 mph bumper system of \$47.

State Farm assumed that the unreported, but repaired analysis should be calculated in the same manner as repaired and reported collision damage (as Houdaille computations show). Houdaille used a bumper incident frequency (repaired, but unreported) of .078 bumper incidents per car per year. This frequency, under the assumption that it should be applied in the same formula as the .07 bumper incidents (repaired and reported), suffers from the same criticisms used against the .07 frequency for the reported/repaired analysis. State Farm in its analysis assumed that the .078 frequency should be adjusted to represent the 5 mph vs. 2.5 mph bumper systems. Being conservative, State Farm used the same frequencies calculated for repaired, but reported bumper incidences (.021 and .040 for the 5 mph and 2.5 mph bumper systems respectively). As a result, State Farm, using Houdaille's methodology to account for repaired, but unreported damage, predicts an additional \$47 benefit for the 5 mph bumper system over the 2.5 mph bumper system.

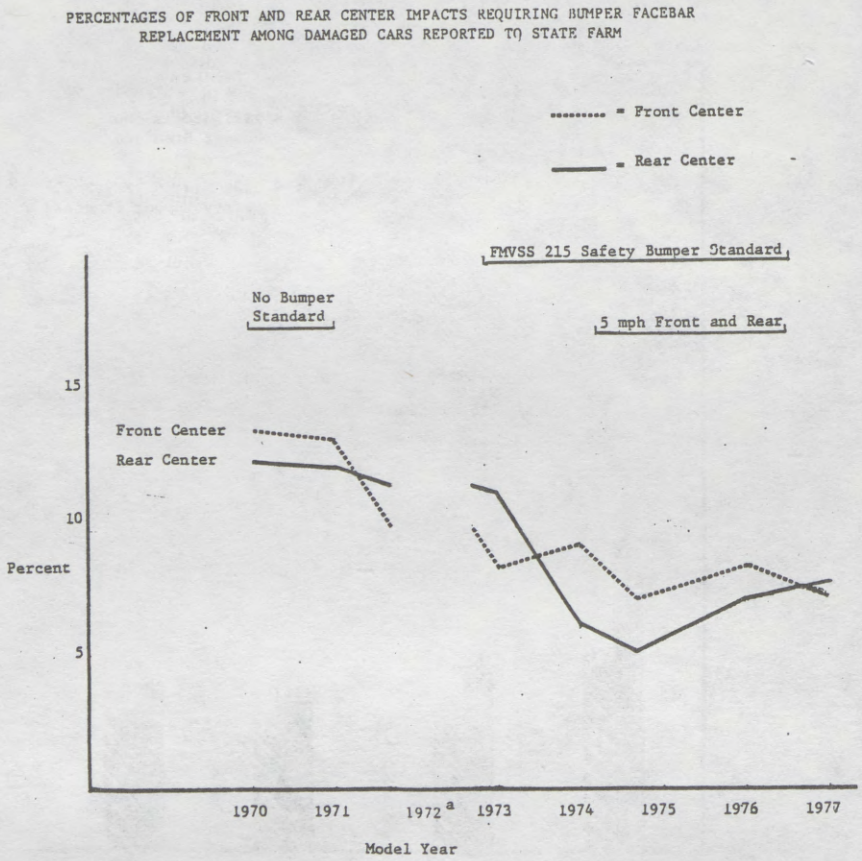
$$\begin{aligned}
 (D_5 - D_{2.5})_{\text{Unreported}} &= -\$47.
 \end{aligned}$$

Using Houdaille's 'best' estimate for $C_5 - C_{2.5}$, and $U_5 - U_{2.5}$, and State Farm's estimate for $D_5 - D_{2.5}$, the net total cost difference, $(T_5 - T_{2.5})$, excluding fuel cost differences, corner impacts, and consumer inconvenience costs, was calculated to be:

$$\begin{aligned}
 N = T_5 - T_{2.5} &= (C_5 - C_{2.5}) + \underset{\text{Reported}}{(D_5 - D_{2.5})} + \underset{\text{Unreported}}{(D_5 - D_{2.5})} + (U_5 - U_{2.5}) \\
 &= \$60 + (-\$47) + (-\$47) + (-\$5) \\
 &= -\$39.
 \end{aligned}$$

Before fuel cost differences and customer inconvenience estimates were taken into account, State Farm analysis shows a net benefit for the 5 mph system of \$39, restricted to front and rear center impact directions only. State Farm's estimate for the additional benefits of the 5 mph bumper system in corner impacts is \$51. Using Houdaille's conservative dollar amount for customer inconvenience (\$4) and Houdaille's 'best' estimate for the fuel cost difference (\$29 advantage for the 2.5 mph bumper system), the overall net benefit of the 5 mph bumper system over the 2.5 mph bumper system is \$65 per car over its lifespan.

Figure 1



^a Data not available for 1972

Figure 2

PERCENTAGES OF FRONT AND REAR BUMPERS AMONG DAMAGED 1971 AND 1976 MODELS REPORTED TO STATE FARM

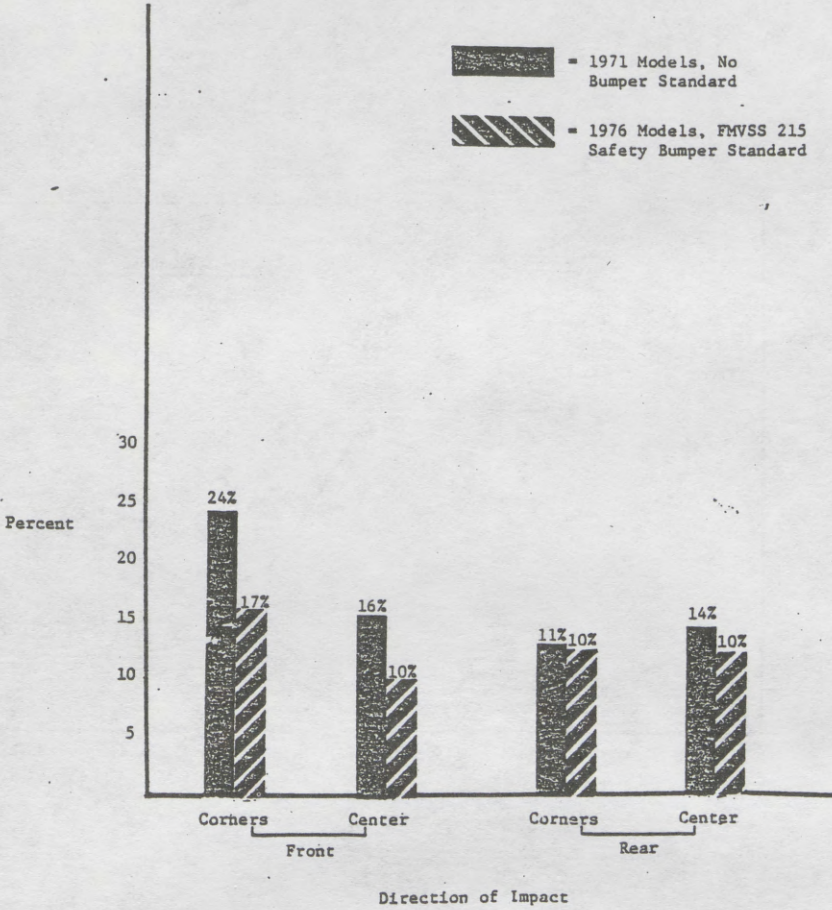
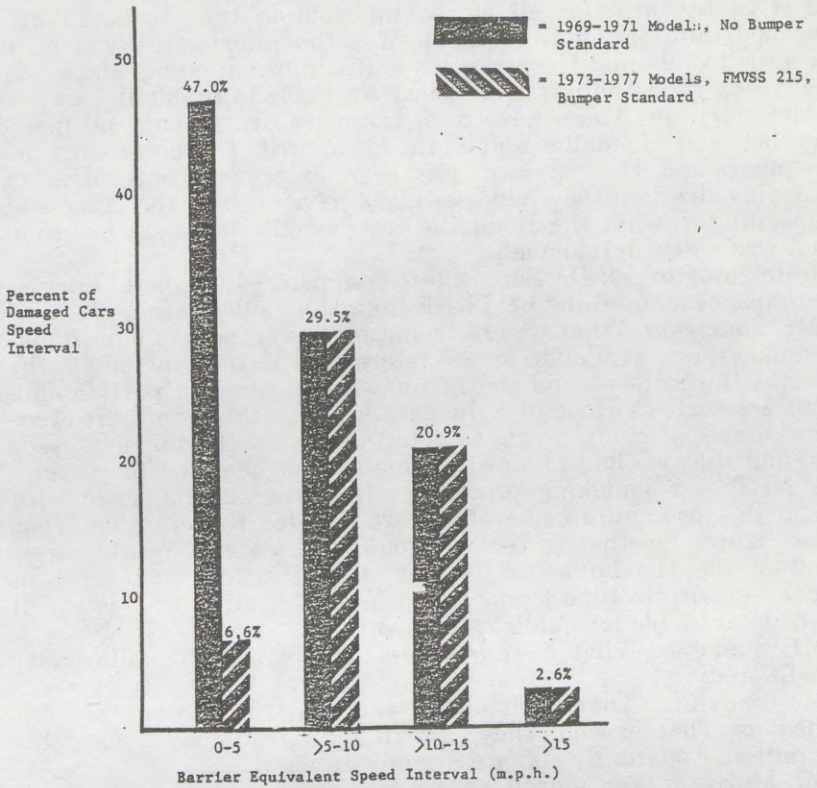


Figure 3

PERCENTAGES OF DAMAGED CARS IN FRONT CENTER IMPACTS REPORTED
TO STATE FARM BY BARRIER EQUIVALENT CRASH SPEEDS



Mr. SCHEUER. Thank you. You have made some impressive points and we appreciate your testimony.

Mr. BROYHILL. May I ask you a question? You made an interesting statement there that perhaps information had not been made available to Houdaille. They had testified before that they had asked State Farm for all of the information they had and had obtained information from them. Was the information you have given us today—and I assume this is the information on which you are basing your findings here—made available to Houdaille?

Mr. McHUGH. There have been extensive discussions and meetings between Houdaille and State Farm with Dr. Sorenson's department, and Dr. Sorenson has been extremely cooperative in providing the data they have seen. We have been in the process of responding to what the Houdaille cost/benefit statement has said. That was a new development.

I am going to ask Dr. Sorenson to comment as to whether or not there has been anything held back from Houdaille on that.

Mr. SORENSON. What we are trying to do as a part of our studies is make them available to all interested parties, including the Federal Government and the manufacturers and the parts manufacturers such as Houdaille. In parallel with this effort, we were doing a special study trying to determine what the impact speeds are, and that we had planned to publish and planned to put into the NHTSA rulemaking procedure. However, at the haste with which this procedure came about, we doubled the effort and put these figures together so that we could make a very quick assessment of the Houdaille cost/benefit study. So that just came in under the wire in time for us to get here. But all of this data will be made available for public assessment.

Mr. SCHEUER. What is your assessment of the Houdaille cost/benefit study?

Mr. BROYHILL. They went on, by the way, that no one has critiqued us. That is what they said in their testimony before this committee. Apparently you are disagreeing now.

Mr. McHUGH. Yes, indeed, we are.

Mr. SORENSON. That would have been true then, but it is not true now, as today amply testifies.

Mr. BROYHILL. Do you mean because of new data or different conclusions based upon the same data?

Mr. SORENSON. I think there have been substantial critiques of the Houdaille study by the earlier witnesses and others you will hear today just quarreling with their methodology and the assumptions they have made. I think the unique contribution we have to make is to substitute some actual damage repair estimate data for some of the assumptions that Houdaille made in their absence, putting those actual figures in, the actual figures in the exact same methodology they used—which is in no way an endorsement of it. To put that in tipped it the other way in favor of benefits for the 5-mile-an-hour safety standard bumper compared to the 2½ or no standard.

Mr. SCHEUER. I take it you feel it is an open and shut case, really, that the 5-mile-per-hour standard is far more cost-effective; that per dollar of expenditure, you get a great deal more protection for the safety elements of the car as well as other parts of the car.

Mr. SORENSON. I feel it is still partly an open question because all we have now is a 5-mile-per-hour safety standard. The 5-mile-per-hour damage standard has only taken effect with this model year, and that is only phase I, which still allows damage to the bumper. So the phase II bumper standard will take effect in the model year beginning with 1980, and we will have to assess it at that time.

So, by no means is it an open and shut question, because it is a very complex and difficult issue.

Mr. McHUGH. We do have this feeling however, Congressman. If this bumper were to be rolled back to $2\frac{1}{2}$, which is roughly the equivalent of the state of the art at about the time that Congress passed the Motor Vehicle Information and Cost Savings Act, it would seem as if Congress has done a useless thing and that nothing significant has occurred.

In point of fact, there have been vast improvements in the state of the bumper art over this period of time, largely in response to what they believe the Congress was saying to automobile manufacturers, that they ought to be producing bumpers that will really work and will, indeed, save people a great deal of money. We think it would be tragic if the benefits which have now occurred as a result of manufacturers making bumpers that meet the $5\frac{1}{2}$ -mile-per-hour bumper standards were to be lost.

Mr. BROYHILL. Let me ask you another question because I don't think you have really gotten to some of the testimony or have commented on the testimony I understood the Houdaille people to give this committee. In the first place, as I remember what they said, they indicated that the bumper does not provide much protection above 5 miles per hour. In other words, when you get above 5 miles per hour, the protection drops off very rapidly. Is that an accurate statement?

Mr. SORENSON. Our feeling on that is that as you get above 5 miles per hour—I don't know what the impact velocity would be, but somewhere above 5, perhaps 10 or 7, somewhere in there—you are going to have to start being more concerned about safety of occupants and forget about protection to the car itself. What we are primarily interested in is the elimination or the minimization of damage that occurs in low-speed crashes.

Mr. BROYHILL. But you are still not addressing yourself to the point that they were making. The point they were making is that most accidents are above 5 miles per hour and that the cost of replacing the more expensive bumper is not a benefit to consumers because most of the accidents are in that range.

Mr. SORENSON. I think our data clearly shows that—

Mr. BROYHILL. When you measure the savings you are talking about against the higher costs imposed on consumers because of accidents, most of them occurring above 5 miles per hour, there is more cost than benefit.

Mr. SORENSON. I think our data clearly shows that they made an incorrect assumption; that there are many more crashes below 5 miles per hour than they allowed for in their study. I think they said something like one-third, and our data shows at least one-half, if not more. So there are a lot more in that low range than they showed. When we combine this information with those above 5

miles per hour, then we show that it is cost-beneficial, in contrast to what they show.

Mr. BROYHILL. All right. Thank you.

Mr. SCHEUER. Thank you very much. We hope you will be available when the panel meets.

We will now hear from Mr. John Steel, manager of automotive sales for the Reynolds Metals Co. Your formal remarks will be printed in full in the record.

Mr. STEEL. You may take your 10 minutes.

STATEMENT OF JOHN S. STEEL, CHAIRMAN, AUTOMOTIVE AND TRUCK COMMITTEE, ALUMINUM ASSOCIATION, INC., ACCOMPANIED BY BARRY MEYER, VICE PRESIDENT OF GOVERNMENT RELATIONS

Mr. STEEL. I am John Steel, automotive sales manager, Reynolds Metals Co.

Mr. SCHEUER. And by whom are you accompanied?

Mr. STEEL. I am here representing the Aluminum Association, and I am here accompanied by Barry Meyer, who is the vice president of government relations for the association. My presentation may be a little disjointed because I am trying to encapsulate it and keep within your time.

Mr. SCHEUER. What you may feel is disjointed doesn't seem to us to be at all disjointed. We are the experts.

Mr. STEEL. The association supports and intends to fully participate in the formal rulemaking process. Let's start by identifying where aluminum is used in bumper systems.

Mr. SCHEUER. Were you here to see the movie? Did you see the movie they showed of the plastic bumper?

Mr. STEEL. Yes.

Mr. SCHEUER. That was a pretty impressive performance, I thought. It may mean that that substance, in comparison to aluminum, is perhaps a more appropriate substance for this energy-absorbing function. Does that—

Mr. STEEL. It is a very fine product line.

Mr. SCHEUER. Yes.

Mr. STEEL. Fortunately, it requires a metal hackup bar. Davidson has not chosen aluminum, but other people have. So we are not ruled out of the system by choosing a soft face. It is a good system. We are used as a backup bar or as a reinforcement, as it is called. This might be for a soft face, as you saw in that picture.

Mr. SCHEUER. That bar under the black area there, under the red, would be a hard substance?

Mr. STEEL. No. Behind that in their system, further back, would be a support bar. They could probably identify it better than I could. It is their system. But they, for one reason or another, have chosen high strength alloy steel. We have backups on some General Motors systems where they make a similar product.

Mr. SCHEUER. With your backup?

Mr. STEEL. With an aluminum backup, yes, sir.

Mr. SCHEUER. In other words, you are not proposing an aluminum bumper as against one made of plastic.

Mr. STEEL. No. That is what I was trying to clarify. You hear a lot about aluminum bumper systems, steel bumper systems, plastic

bumper systems. We are really looking at a combination of materials in this system.

Mr. SCHEUER. Right.

Mr. STEEL. We participate behind steel bumpers, we participate behind steel or plastic bumpers as a reinforcement.

Mr. SCHEUER. Wait a minute. You would participate behind a steel bumper? They put aluminum behind a steel bumper for reinforcement?

Mr. STEEL. That is correct, for the high strength of the aluminum.

Mr. SCHEUER. Why not make a bumper out of aluminum in the first place, because it is lighter than steel?

Mr. STEEL. I try to convince them to do that.

Mr. SCHEUER. I expect some kind of a commission.

Mr. STEEL. The car engineer really is put in the position of making the judgment on an individual car line as to what is the most cost-beneficial system, and this system can be combinations of all three or any two or one of the materials. We have the advantage of bringing light weight to the system, which we think affects energy usage. This is an aluminum extruded bar. It has the advantage of combining the facebar and reinforcement by the extrusion process. That means instead of having to bolt on an individual backup bar, it is all self-contained in one product and it gives us a very lightweight, very effective system.

Mr. SCHEUER. I notice you have—is that rubber on the ends or is it plastic?

Mr. STEEL. That, I believe, is rubber.

Mr. SCHEUER. Now, if you had rubber on the ends, why shouldn't you also have a front layer of rubber?

Mr. STEEL. Some of them do cover the face bar with a soft plastic material so it tends to prevent damage to the surface, but I must also emphasize that they have to bring something out here to the corner under the present standard to take a 30 degree hit at, I think it is, what, 3-miles-an-hour pendulum test? The proposed standard which Houdaille is proposing is a barrier test, which is straight into a wall at 90 degrees. You are looking at no support in the corner. In theory, an automotive engineer could say I will just lay something between the frame members because all of the shock is taken up in the frame. On the corner, no protection, and headlights, taillights and safety-related items. It is a small point.

The other area where we might fit in is bracketry such as this [indicating], just attachments and that sort of thing. Because of combination of materials, judging the cost-effectiveness of a given bumper system is very complex and must be related to all of the materials used, the type of design involved, and its performance and service. The present standard has challenged industry to develop new technology and they have responded well. As an example, in their downsize 1977 "B" body models using high-strength steel face bars with aluminum reinforcements. Buick's press release on August 26, 1976, credits this new bumper design with saving 135 pounds on their Buick Le Sabre sedan. This represented 20 percent of the total weight saved on this model. The Buick bumper system really saved, with weight compounding, 200 pounds or 220 gallons of gasoline over the life of the car. At 85 cents per gallon, this

represents a present value of \$111 to the consumer over the life cycle. This certainly would far offset any premium cost involved.

I then go on to talk about technology which has developed because of the standard. In the base year of a 5-mile-per-hour front bumper, the Pinto weighed 59.64 pounds and cost \$109. Through technology and the development of new alloys and the development of new designs, the 979 bumper system, meeting more difficult tests on the same vehicle, weighs 45.13 pounds and costs \$79.28, a weight reduction of 14.5 pounds and a cost reduction of \$30.54.

Mr. BROYHILL. Mr. Chairman, what happens to technology if the standard is lowered to 2½-miles-per-hour?

Mr. STEEL. I think really if they analyze the 2½-mile-per-hour standard, what they are saying is eliminate—and this is assuming you can eliminate these things—the shock absorbers attached directly to the frame, and eliminate any reinforcement bars. When you go to that, you are really saying why do you need a bumper? Your entire shock is being taken up by the frame. You could really go to just a frame extension which would meet in two points, the barrier. You would go back to a cosmetic position where the bumper would become a trim item, and this really was the problem which brought about standards to begin with. Bumpers were not withstanding any impact. Damage was related to safety equipment and to just high cost to the consumer. We really don't see aluminum in the system at 2½ miles per hour at this point in time.

Mr. SCHEUER. Why not?

Mr. STEEL. Just because of their ability to almost design bumpers off cars.

Mr. SCHEUER. Elaborate on that.

Mr. STEEL. OK. What we are saying is you are to the point where the bumper really doesn't do anything except carry the impact to the frame.

Mr. SCHEUER. There is no energy-absorbing function?

Mr. STEEL. There is no energy absorption, so why not just have the frame run into the wall? You would still pass the test. So you just have to go to a frame extension, which, if you have got the frame here, you have got a corner sitting out here [indicating]. There is nothing in the suggested rule that causes any support to be put out on that corner, so you end up with fender damage, headlight damage, taillight damage in anything other than a direct front barrier hit. And you might also run into a pole or something of this type which doesn't happen to hit on the frame and which would create a lot of damage.

Investment. The aluminum industry and the aluminum fabricators have responded to the 5-mile-per-hour standard. It is estimated that over \$5 million have been spent so far in the industry on research and alloy development. An investment of over \$15 million has been made in production facilities at Grand Rapids, Mich. Additional investment by component manufacturers is estimated to be in excess of \$7 million. Employment. We have listed some 1,312 people who are involved in the production of face bars, bracketry and bumper reinforcements. This represents a potential job loss to these people. It does not include the people who are employed within the car companies making reinforcements, nor does it include the people who are making the metal that goes into these

various parts. There is an average of 118 pounds of aluminum used in the 1979 model cars.

Mr. SCHEUER. This represents a lifetime fuel savings of almost 3 billion gallons of gasoline. Isn't aluminum production extremely energy intensive, far more so than the production of plastic or the other metals that are used?

Mr. STEEL. Yes, that is correct.

Mr. SCHEUER. Have you factored that in?

Mr. STEEL. Yes. We looked at an energy study. We attached that as a submission, where we have the initial energy to produce the material, and then the energy required to carry the weight through the lifetime of the car.

Mr. SCHEUER. On a—

Mr. STEEL. A life cycle basis.

Mr. SCHEUER. It is energy saving?

Mr. STEEL. That is correct.

Bumper studies. We have serious reservations about the validity of the economic and benefit analysis in the Hodaille report.

Mr. SCHEUER. Yes. Several of the witnesses have attacked the validity of that report. If you have those reservations, I wish you would document them as specifically and professionally as you possibly can. You need not do so now, but you can submit further testimony. I think it is unfair to make unsupported, generalized attacks on the professionalism of a study like this which purports to be a good cost-effective study.

If you have criticisms, they are perfectly welcome. This is an open forum. But I would hope that you would support them with as much detailed and specific data on their lack of professionalism, or whatever, as you possibly can muster.

Mr. STEEL. OK, we will do that.

[See letter dated April 10, 1979, p. 271, this hearing.]

Mr. SCHEUER. I would say that goes for all of the witnesses. Let me say it just once more. With regard to any criticism you have of the methodology or the lack of professionalism of the Houdaille study, please, buttress your critique with as detailed and specific a rationale for your criticism as possible.

Mr. STEEL. We would suggest that any tests being run in the future should test current technology in aluminum, and I say that because we started in 1974 with an alloy and bumpers that weighed about 14 pounds, where in the same size car today, we are down to bumpers weighing about 4 pounds as an average.

Mr. SCHEUER. And which give just as good protection?

Mr. STEEL. Oh, yes. Your protection has intensified, and this has come about through this alloy development I talked about where we have a 20-percent improvement, and we have some more improvements on the horizon.

Mr. SCHEUER. Perhaps if you don't have anything further of great importance to say, you could finish up as you have gone substantially over 10 minutes. Assuming the bells are generous, we will all have a chance to react further.

Mr. STEEL. I do have one or two key points. As to this aluminum reinforcement as you see it here, we enter an estimate on that. They happened to pick one that weighs 12 pounds, and we looked at its premium cost, the 2-pound reinforcement, as being \$8.36.

Looking at it as far as consumer benefits discounted over the lifetime use, again through gas savings based upon weight savings, it returns to the consumer at today's value, \$36.52.

The Chevrolet Caprice as a backup bar. This in finished form weighs 8.2 pounds. As we look at the actual material going into that bar, the material is less than \$8 in cost, plus a heat treating cost of about \$1. So that is about a total cost of material, plus the additional processing involved in aluminum over and above steel, of, let us say, \$9. You will hear a lot about the cost of aluminum, but I am not sure that people understand fully costs in automobiles, and this is cost to the car manufacturer I am speaking about. Let me read quickly here. There are bumpers in production today and now being tooled for production this summer meeting the phase II requirements. These bumpers will use aluminum, steel or plastic to meet the design requirement for performance of the total system. No individual material has been ruled out. The judgment as to design, material and cost-weight benefits are all interrelated and up to the judgment of the car engineer. He is not regulated into a specific consumer cost-beneficial design and may opt for a less efficient design for a variety of reasons—

Mr. SCHEUER. What would they be?

Mr. STEEL [continuing]. Which may include important judgment concerning consumer appeal. It may also include—

Mr. SCHEUER. Consumer appeal as to what point of view?

Mr. STEEL. Judgment as to design, styling. He may say I want a long-pointed nose on this car, that is the only way it will look good. Or he might say I need a blunt nose. And that affects the offset he can place on the bumper and some of these things. He also might be protecting an internal investment made some years ago in a facility.

Mr. SCHEUER. Do you mean dies and molds and all of that?

Mr. STEEL. Dies and molds, a bumper-producing plant of a particular type. There could be a lot of reasons interrelated as to why he makes a judgment.

Mr. SCHEUER. He may be producing an obsolete car from the point of view of competing with other manufacturers who are not burdened by those constraints or who are willing to make new investments in the most cost-effective bumpers. I would think the forces of competition would help him organize his thinking on that matter.

Mr. STEEL. Oh, yes, they are continually reviewing that. And I don't mean to criticize them, but they are in the business of producing a car and looking at the initial cost of production. So it may or may not be the most cost-beneficial to the consumer in the long run.

I think we have gotten over most of the points, and I think you understand my position.

[Testimony resumes on p. 282.]

[Mr. Steel's prepared statement and attachments follow:]

STATEMENT OF JOHN S. STEEL, CHAIRMAN, AUTOMOTIVE AND TRUCK COMMITTEE,
ALUMINUM ASSOCIATION, INC.

Mr. Chairman, Subcommittee members, I am John S. Steel. I am here today to represent The Aluminum Association, Inc. I am Manager of Automotive Sales, Reynolds Metals Company.

We appreciate this opportunity to present our views regarding bumper systems which are being considered in connection with the fiscal year 1980 authorization for the DOT National Highway Traffic Safety Administration.

The Aluminum Association is a non-profit corporation with 87 member companies who produce 100% of the primary aluminum and approximately 85% of the semi-fabricated aluminum products in the country. The Association is a primary source for technical standards, marketing data, statistics, and general information on aluminum and the industry. It has an Automotive and Truck Committee and an Automotive Technical Committee whose members are expert in automotive applications of aluminum. These committees have asked me to testify on their behalf, and on behalf of the Association, on proposals to change the Part 581 Bumper Standard presently in effect under Title I of the Motor Vehicle Information and Cost Savings Act of 1972.

On March 1, 1979, the National Highway Traffic Safety Administration (NHTSA), in an "Advanced Notice of Proposed Rulemaking," invited public comment on a wide range of issues involving the current so-called 5 mph bumper standard and alternatives to it. The Association intends to fully participate in the formal rulemaking process. In fact, we filed a letter dated February 27, 1979 with the agency prior to the Federal Register Notice requesting that full opportunity be provided to all interested parties to participate and suggested that an additional aluminum bumper system be tested and that the cost

effectiveness of aluminum bumper systems be fully analyzed during their test program.

Classification: Aluminum in bumper systems include a) aluminum bumper face bars made from new alloys of extruded or sheet aluminum with newly developed anodized or chrome plated finishes; b) extruded or sheet aluminum bumper reinforcements that are used with steel, plastic or aluminum face bars; and, c) aluminum bracketry.

It should be noted that bumper systems cannot be simply classified as aluminum, soft face plastic or steel. For example, a so-called steel system, such as the one so classified on the Chevrolet Caprice, has a chrome plated steel face bar (hence the designation steel), and an aluminum reinforcement. In smaller compact and sub-compact cars, an aluminum or steel face bar may be the only structural member. In so-called soft face plastic bumpers, a backup reinforcement of aluminum or steel is normally used. Thus, judging the cost and effectiveness of a given bumper system is very complex and must be related to all of the materials used, the type of design involved, and its performance in service.

The present standard has challenged industry to develop new technology, and they have responded well. As an example, in their downsized 1977 "B" body models on which 675 pounds were saved, GM redesigned the bumpers using high strength steel face bars with aluminum reinforcements. Buick's press release of August 26, 1976 credits this new bumper design with saving 135 pounds on their LeSabre Sedan. This represented 20% of the total weight saved on this model. The Buick bumper system really saved, with weight compounding, 200 pounds, or 220 gallons of gasoline over the life of the car. At 85 cents per gallon, this represents a present value of \$111.13,

Another example of progress is represented by the Pinto front bumper. In the base year of 1973, it met a 5 mph standard with a weight of 59.64 pounds at a cost of \$109.82 (DOT Report HS 803 973 prepared by John Z. DeLorean, Inc.).

The 1979 system, meeting more difficult tests on the same vehicle, weighs 45.13 pounds and costs \$79.28 - a weight reduction of 14.5 pounds, and a cost reduction of \$30.54.

The demands for safety and increased energy efficiency have forced the development of new materials and systems, which, while meeting the 5 mph standard, in many cases also offer weight savings. Further studies will show that the consumers with these new developments, have also benefited from life cycle cost reductions. Moving to a lesser standard would be a step backwards.

Investment: The aluminum industry and aluminum fabricators have responded to the 5 mph standard. It is estimated that over \$5 million have been spent so far in the aluminum industry on research and alloy development alone. An investment of over \$15 million was made in a production facility in Grand Rapids, Michigan. Additional investment by component manufacturers is estimated to be in excess of \$7 million.

Employment: Over 1300 jobs are involved in the fabrication of aluminum bumper components - not including the manufacture of the metal. These are detailed in the following table:

<u>Company</u>	<u>Location</u>	<u>Employment</u>
Aetna Industries	Centerline, Michigan	20
Dieomatic, Inc., Division of Magna	Montezuma, Iowa	50
Douglas and Lomason	Carlton, Georgia	40
Iroquois Die and Manufacturing	Warren, Michigan	21

<u>Company</u>	<u>Location</u>	<u>Employment</u>
ITT-Thompson	Valdosta, Georgia	30
Lobdell-Emery Manufacturing Company	Alma, Michigan	15
Modern Tool & Die Co.	Cleveland, Ohio	50
Reynolds Metals Company	Grand Rapids, Michigan	675
Star Tool and Die	Detroit, Michigan	150
Stolle Corporation	Sidney, Ohio	270

The 1,312 people who are employees of these companies would be directly affected if the 5 mph bumper were no longer required. This job loss would be much greater if the employees of the automobile manufacturers involved in the production of other components such as energy absorber systems, steel reinforcements, and plastic fascias, as well as the independent manufacturers of those parts, are considered.

Energy Savings: We estimate that aluminum shipments to U.S. automotive manufacturers in 1978 totaled 1.52 billion pounds or about 12% of our domestic shipments.

Because of their favorable strength/weight ratio, aluminum automobile components make an important contribution towards energy saving. For example, we estimate that the average 118 pounds of aluminum used in 1979 model U.S. cars represents a lifetime fuel saving of almost 3 billion gallons of gasoline. The derivation of this and other data comparing the energy efficiency of aluminum with other materials is detailed in Attachment I, "Use of Aluminum in Automobiles - Effect on the Energy Dilemma."

Bumper Studies: We have serious reservations about the validity of the economic and benefit analysis in the Houdaille Report, as well as the data base used to draw conclusions. Further, we are deeply concerned about misstatements made about aluminum contained in the Houdaille Report, and the failure of NHTSA to properly evaluate the benefits associated with the use of aluminum bumper systems. In our February 27, 1979 letter to the agency, we recommended that a U.S. automobile with a "state of the art" bumper system be included for evaluation in their current test program. Specifically, we recommended the aluminum Omni/Horizon bumper system.

In DOT Report HS 803 868, "Calculations and Supporting Material for the Preliminary Analysis of the Bumper Standard," the bumper system cost data given in Table III, page 15, for aluminum systems, is, in our opinion, conservative. For example, a weight and price of 52 pounds and \$102.00 respectively, is given for a 2.5 mph aluminum bumper. Corresponding values for aluminum systems used on sub-compacts at today's standards are typically 41-45 pounds and \$70.00

As a further comment on NHTSA "Calculations and Supporting Material for the Preliminary Analysis of the Bumper Standard," we are concerned with the weights shown for soft face systems shown in Table III, page 15. These weights become the basis for evaluating the price of the system and at each design speed they are lower than that of aluminum.

We have not been able to find a case in the DeLorean Report, the Inco Report, or any indication in the market place that a soft system is lighter, and in turn less costly.

Houdaille states that aluminum is considerably more expensive than steel, and therefore concludes that aluminum is not cost effective in bumper systems. No economic data is provided to support this claim. A major use of aluminum in 5 mph bumper systems today is for reinforcements for steel face bars. Our comparison of the lifetime economics of aluminum reinforcements indicates that \$8.36 initial consumer premium cost for the aluminum parts are justified by a fuel saving at a present value of \$36.52 to the consumer over the car's 100,000 mile life (see Attachment II, "Comparison of Aluminum and Steel Bumper Systems").

Note that we claim only a conservative one-half pound secondary weight saving for every pound of primary weight saving. In contrast, Houdaille uses a factor as high as 1.6.

The Houdaille Report states on page 93, "A general industry rule of thumb is that steel face bars are about twice the weight of aluminum ones." This is not true as aluminum face bars produced today have a minimum yield strength of 49,000 psi - in excess of common steels used, and higher than most high strength low alloy steels. Gauge for gauge substitutions are often possible when space will allow for the difference in deflection, bringing about a 2/3 weight reduction. A further example is the use of the extrusion process which permits combining the face bar and reinforcement functions making further weight reduction benefits possible.

The generalization or assumption made by Houdaille that energy absorbers and reinforcements can automatically be dropped from existing designs and meet a 2.5 mph standard is false. Each car system is engineered individually to meet a performance specification.

Designs of frames, chassis and car body structures are developed in a balanced system. It does not follow that any part of the total system may be removed while still maintaining overall structural requirements. We are also concerned that the Houdaille Report failed to test and evaluate in detail, other than by assumption and extrapolation, the use of aluminum and soft face bar systems which have allowed for major technological breakthroughs.

Additional points which we feel invalidate the conclusions of the Houdaille Report are:

- (1) Insufficient data base - only one car model and only one bumper system was tested.
- (2) Weight and cost of Volare-Aspen System - its bumper system has the highest percentage of bumper weight to curb weight of any other compacts or any other Chrysler car. There is no aluminum in the system. It is twice as heavy as the Ford Fairmont system and \$73.00 more costly (see Attachment III).
- (3) Size of sample - the Volare-Aspen model represents only 3.7% of the 1978 North American car production. Variations in offset, weights, etc. will not allow it to be grouped with other similar Chrysler systems.
- (4) Type of bumper tested - the conclusions reached concerning a 2.5 mph system are based upon a bumper that did not pass the barrier test at that speed.
- (5) Insurance rates - the analysis did not include the added insurance premiums which would be required to cover the damage that would occur between 2.5 and 5 mph.

- (6) Averaging of data - the analysis is based on the averaging of the impact on the front and rear bumper which is absolutely inappropriate.

Conclusion: To change to a 2.5 mph standard today, assuming, it could be changed back at a later date, is not practical. Investments have been made, facilities placed in production, and car designs completed to support the current Part 581 bumper standard.

There are bumpers in production today and now being tooled for production this summer, meeting the Phase II requirements. These bumpers will use aluminum, steel or plastic to meet the design requirement for performance of the total "system." No individual material has been "ruled" out - the judgement as to design, material, and cost/weight benefits are all interrelated and up to the judgement of the car engineer. He is not regulated into a specific consumer cost-beneficial design and may opt for a less efficient design for a variety of reasons - which may include a very important judgement concerning improved customer appeal.

The unsupported assumptions of the Houdaille Report and unanswered questions left by the NHTSA summary, emphasize the need for further technical study, testing and analysis before any decision is reached. The Aluminum Association supports the efforts of the National Highway Traffic Safety Administration and the automotive industry in developing the data that provide substantiation as to what is the best standard.

Our industry has worked to develop aluminum alloys whose performance characteristics enable automotive engineers to design bumper face bars and reinforcing bars capable of meeting the requirements of Part 581. We accepted the challenge of the Congress,

NHTSA and the automotive industry to carry out the mandate of Title I of the Motor Vehicle Information and Cost Savings Act of 1972. We have willingly participated in the battle of materials in the market place under the rules established to implement the 1972 Act.

We believe that the hearings which led to the enactment of that legislation and the promulgation of Part 581 had definitively addressed any questions concerning consumer benefits. In our view, no factual evidence has been presented to this Committee which forms the basis for an abrupt change in these rules.

[Attachment I--Use of aluminum in automobiles--Effect on the energy dilemma. Second edition, April 1977, maybe found in the subcommittee files.]

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Attachment II

COMPARISON OF ALUMINUM AND STEEL
BUMPER REINFORCEMENT - EQUAL GAUGE

<u>ITEM</u>	<u>TYPE 950 STEEL</u>	<u>TYPE X7021 ALUMINUM</u>
1. Part Weight Per Reinforcement		
Blank	(lb) 42	15
Offal (20%)	(lb) 8	3
Net Part Weight	(lb) <u>34</u>	<u>12</u>
2. Weight Saving Per Reinforcement		
Primary	(lb)	22
Secondary (50% Primary)	(lb)	<u>11</u>
Total Weight Saving	(lb)	<u>33</u>
3. Cost Per Reinforcement		
Blank Cost (steel @\$0.20/lb., alum.@\$0.83/lb)	(\$) 8.40	12.45
Scrap Credit (steel @\$0.04/lb., alum.@\$0.36/lb)	(\$) -0.32	-1.08
Subtotal	(\$) <u>8.08</u>	<u>11.37</u>
Heat Treatment Cost	(\$)	1.00
Cost of Additional Metal to support Heavier Bumper	(\$) 2.20	
Total Cost Per Reinforcement	(\$) <u>10.28</u>	<u>12.37</u>
NET COST INCREASE PER REINFORCEMENT (\$)		2.09*
4. Savings to Consumer		
Fuel Saved by Lighter Reinforcement in Life of Car (100,000 miles) (33 lb. x 1.1 gal/lb. x \$0.85/gal.)	(\$)	31.00
Present Worth of Fuel Saved (@11% for 10 years)	(\$)	18.26
LESS COST TO CONSUMER*		-4.18
NET BENEFIT TO CONSUMER		
a) EACH REINFORCEMENT (\$18.26 - \$4.18)	(\$)	14.08
b) PER CAR (\$14.08 x 2)	(\$)	<u>28.16</u>

*Includes 100% Markup

Attachment III

CRITIQUE OF HOUDAILLE REPORT

The Houdaille Report uses crash test and other cost data based on the Chrysler Volare. It is evident that the Volare is an extremely poor choice to represent current automotive bumper systems.

- Highest in percentage of curb weight among cars in its weight class (see page two).
- Even higher in percentage of curb weight than bumper systems on other Chrysler products (see Table I below).
- Highest cost of bumper systems in its class (see Table II below).

Of the \$60 and 41-lbs. difference between 5 and 2.5 mph Volare systems, over 2/3 of the difference is in the energy absorbers. More modern systems would show only a fraction of above cost and weight reduction

Per the DeLorean Report, there are 5 mph systems available today at lower weight and costs than the Volare-Aspen 2.5 mph systems for equal weight class. Example: Ford Fairmont.

TABLE I - WEIGHTS OF CHRYSLER BUMPER SYSTEMS

	<u>Total Weight</u>	<u>Curb Weight</u>	<u>% of Curb Weight</u>
Volare	146 lb.	3223 lb.	4.5 %
LaBaron	152	3745	4.1
Horizon	41	2265	1.8

TABLE II - COSTS FRONT AND REAR BUMPER SYSTEMS - MY 1979

	<u>Total Costs</u>	<u>Bumper Weights</u>	<u>Curb Weights</u>
Volare	\$201.00	152 lb.	3223 lb.
Fairmont	128.00	76	3100
Firebird	150.00	84	3595
Camaro	197.00	121	3660
Nova	177.00	154	3555
Malibu	171.00	128	3350

INSURANCE INSTITUTE FOR HIGHWAY SAFETY

1979 MODEL LOW SPEED CRASH TESTS

VEHICLE BUMPER SYSTEM WEIGHTS¹

	Weight of Bumper System Including Mounting Hardware (lbs.)			Curb Weight (lbs.)	Bumper System Weight as a Percent of Curb Weight
	Front	Rear	Total		
<u>SUBCOMPACTS</u>					
Plymouth Horizon	20	21	41	2265	1.8
AMC Spirit	29	33	62	2697	2.3
Ford Mustang III	58	48	106	2638	4.0
Volkswagen Rabbit	31	29	60	2029	3.0
Chevrolet Chevette	35	33	68	2139	3.2
Averages	35	33	67	2354	2.8
<u>COMPACTS</u>					
AMC Concord	29	32	61	3135	1.9
Plymouth Volare	75	71	146	3223	4.5
Chevrolet Malibu	53	59	112	3158	3.6
Ford Fairmont	43	33	76	2882	2.6
Averages	50	49	99	3100	3.2
Overall Averages	41	40	81	2685	3.0

¹ Rounded to nearest pound.

[The following letter and attachments were subsequently received for the record:]

the Aluminum Association
Incorporated



818 Connecticut Avenue, N.W.
Washington D.C. 20006
(202) 862-5100

April 10, 1979

The Honorable James H. Scheuer, Chairman
Subcommittee on Consumer Protection and Finance
Committee on Interstate and Foreign Commerce
Rayburn House Office Building, Room 2402
Washington, D.C. 20515

Dear Mr. Chairman:

During our testimony on March 28, 1979 at the hearings of the Subcommittee on Consumer Protection and Finance on National Highway Traffic Safety Administration Authorizations, you requested that we submit for the record our analysis of the Houdaille Industries, Inc. study on the Part 581 Bumper Standard promulgated under the 1972 Motor Vehicles Information and Cost Safety Act.

In response to your request, we are submitting the attached supplemental comments. These also include our analysis of the NHTSA study.

We thank you for allowing us the opportunity to present our views on this important subject.

Sincerely,

John S. Steel, Manager, Automotive Sales
Reynolds Metals Company
Chairman, Automotive and Truck Committee
The Aluminum Association, Inc.

JSS/pvd
Attachments

In statements submitted to the Subcommittee on Consumer Protection and Finance of the Committee on Interstate and Foreign Commerce at a hearing on March 28, 1979, we stated that a reduction of the current bumper standard to one which only requires bumpers to withstand a 2.5 mph barrier test would effectively delete light weight systems and the consumer benefits derived from these systems (such as aluminum and soft face). Since many car frames today will withstand a 2.5 mph barrier impact load, car companies could, through frame extension, even delete bumpers entirely and still pass the 2.5 mph barrier test. The suggested standard would offer no corner impact protection, thereby allowing damage to safety related components at very low speeds (see Attachment I).

In response to your request for supplemental comments on the Houdaille Report, we are submitting the following statements:

- 1) Insufficient data base: The most significant item that we noticed was the lack of an ample data base. The Houdaille Report studied the crash speed versus damage for only one car, the Volare-Aspen. Because of the limited number of cars tested, only one result was obtained for each test speed and averaged for both the front and rear bumper.
- 2) Weight and cost of Volare-Aspen system: The Volare-Aspen, with bumpers made entirely of steel, was not a representative selection for the tests. Approximately 65% of all the 1979 model cars produced

in the U.S. utilize aluminum in some form for components in their bumper systems. Not only do we feel that a system containing aluminum should have been tested, but we feel that the selection of the Volare-Aspen was improper due to both its weight and replacement cost. Data recently given by the Insurance Institute on Highway Safety before the Subcommittee on Consumer Protection and Finance on the subject of auto repair dated December 04, 1978, showed that the Plymouth-Volare had the heaviest bumper system as measured by percentage of curb weight of any of the other compact and sub-compact cars tested. These data are shown in Attachment II of this report. Further analysis of Chrysler products show that the Volare-Aspen also has the heaviest bumper weight expressed as a percentage of curb weight of any of the other cars in the Chrysler line

To point to the high cost and weight, we refer you to Table II, Attachment III, excerpt of cost and weight data from the DeLorean Report, which shows the Volare to be \$73.00 more expensive and twice as heavy as the Fairmont system.

3) Size of sample: The Volare-Aspen model represents only 3.7% of the 1978 North American car production. Variations in offset, weights, etc. will not allow it to be grouped with other similar Chrysler systems. For any valid results, more than one system representing a larger profile of the bumpers in production today should be used.

4) Type of bumper tested and its applicability to the 2.5 mph barrier only standard: The Mexican Volare-Aspen would not meet the requirements for the U.S. 2.5 mph standard with the retention of the pendulum test requirements or even the barrier test requirements. This is a change in bumper contour since, according to Table B4 on page 63 of Part 2, "A Cost-Benefit Analysis of Bumper Standards," the Houdaille Report indicated a damage of \$112.00 at 2.5 mph. This invalidates the basic data concerning cost of the 2.5 mph system.

In addition, the Mexican Volare bumper used does not necessarily reflect what would be designed to meet a 2.5 mph barrier only standard. This standard would not require any corner strength or any specific depth to prevent override/underride.

Assumptions are also made that a 2.5 mph system will mean the dropping of reinforcements and absorbers. We know of instances where this is not possible because designs have been revised using the reinforcements as frame members.

5) Variation of test vehicle weight: We cannot comment on the effects of variation of vehicle weight on test crash data; however, it appears inconsistent that according to Calspan test reports, the U.S. car with energy absorbers weighs as little as 3510 pounds, while the Mexican car with a "reduced weight" system weighed 3540 pounds.

6) Aluminum is more expensive: Houdaille states that aluminum is considerably more expensive than steel, and therefore concludes that

aluminum is not cost effective in bumper systems. No economic data is provided to support this claim. A major use of aluminum in 5 mph bumper systems today is for reinforcements for steel face bars. Our comparison of the lifetime economics of aluminum reinforcements indicates that \$8.36 initial consumer premium cost for the aluminum parts are justified by a fuel saving at a present value of \$36.52 to the consumer over the car's 100,000 mile life (see Attachment IV, "Comparison of Aluminum and Steel Bumper Reinforcements").

Note that we claim only a conservative one-half pound secondary weight saving for every pound of primary weight saving. In contrast, Houdaille uses a factor as high as 1.6.

7) Weight of aluminum: The Houdaille Report states on page 93, "A General industry rule of thumb is that steel face bars are about twice the weight of aluminum ones." This is not true as aluminum face bars produced today have a minimum yield strength of 49,000 psi - in excess of common steels used, and higher than most high strength low alloy steels. Gauge for gauge substitutions are often possible when space will allow for the difference in deflection, bringing about a 2/3 weight reduction. A further example is the use of the extrusion process which permits combining the face bar and reinforcement functions making further weight reduction benefits possible.

8) The value of innovations have been ignored: The present standard has challenged industry to develop new technology, and they have

responded well. As an example, in their downsized 1977 "B" body models on which 675 pounds were saved, GM redesigned the bumpers using high strength steel face bars with aluminum reinforcements. Buick's press release of August 26, 1976 credits this new bumper design with saving 135 pounds on their LeSabre Sedan. This represented 20% of the total weight saved on this model. The Buick bumper system really saved, with weight compounding, 200 pounds, or 220 gallons of gasoline over the life of the car. At 85¢ per gallon, this represents a present value of \$113.13.

Another example of progress is represented by the Pinto front bumper. In the base year of 1973, it met a 5 mph standard with a weight of 59.64 pounds at a cost of \$109.82 (DOT Report HS-803973 prepared by John Z. DeLorean, Inc.).

The 1979 system, meeting more difficult tests on the same vehicle, weighs 45.13 pounds and costs \$79.28 - a weight reduction of 14.5 pounds, and a cost reduction of \$30.54.

The demands for safety and increased energy efficiency have forced the development of new materials and systems, which, while meeting the 5 mph standard, in many cases also offer weight savings. Further studies will show that the consumers with these new developments have also benefited from life cycle cost reductions.

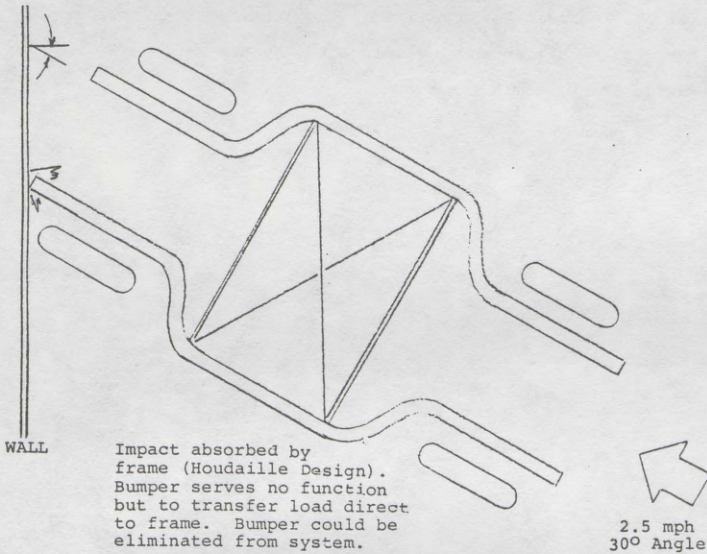
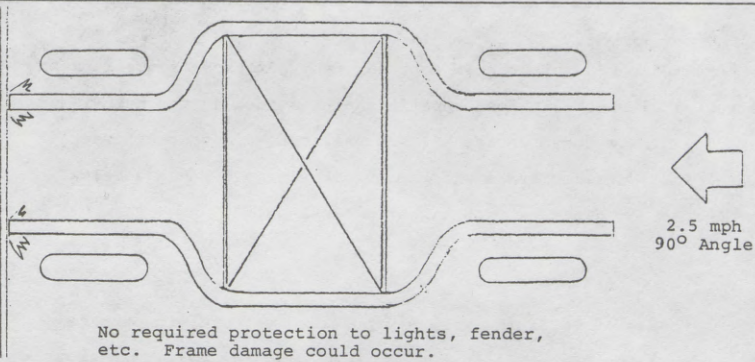
9) Insurance rates: The analysis did not include the added insurance premiums which would be required to cover the damage that would occur between 2.5 and 5 mph.

10) Assumptions: This report contains many admitted assumptions on statistics vital to any cost benefit analysis such as the number and frequency of low speed accidents. Houdaille used a best estimate figure of 38% for accidents which occur at speeds 5 mph and below, but other reports show a much higher percentage.

We plan to assist NHTSA in every way possible to determine the best test criteria on bumper standards for providing the maximum cost benefits for the American Consumer. This complex issue can only be resolved through a detailed and complete study by the National Highway Traffic Safety Administration.

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ATTACHMENT I: POTENTIAL CONSUMER ACCIDENT/HOUDAILLE SYSTEM



ATTACHMENT II: INSURANCE INSTITUTE FOR HIGHWAY SAFETY/1979 MODEL
LOW SPEED CRASH TESTS/VEHICLE BUMPER SYSTEM WEIGHTS¹

	Weight of Bumper System Including Mounting Hardware (lbs.)			Curb Weight (lbs.)	Bumper System Weight as a Percent of Curb Weight
	Front	Rear	Total		
<u>SUBCOMPACTS</u>					
Plymouth Horizon	20	21	41	2265	1.8
AMC Spirit	29	33	62	2697	2.3
Ford Mustang III	58	48	106	2638	4.0
Volkswagen Rabbit	31	29	60	2029	3.0
Chevrolet Chevette	35	33	68	2139	3.2
Averages	35	33	67	2354	2.8
<u>COMPACTS</u>					
AMC Concord	29	32	61	3135	1.9
Plymouth Volare	75	71	146	3223	4.5
Chevrolet Malibu	53	59	112	3158	3.6
Ford Fairmont	43	33	76	2882	2.6
Averages	50	49	99	3100	3.2
Overall Averages	41	40	81	2685	3.0

¹ Rounded to nearest pound.

ATTACHMENT III: COMPARISON OF CHRYSLER WITH OTHER BUMPER SYSTEMS

The Houdaille Report uses crash test and other cost data based on the Chrysler Volare. It is evident that the Volare is an extremely poor choice to represent current automotive bumper systems.

- Highest in percentage of curb weight among cars in its weight class (see page two).
- Even higher in percentage of curb weight than bumper systems on other Chrysler products (see Table I below).
- Highest cost of bumper systems in its class (see Table II below).

Of the \$60 and 41-lbs. difference between 5 and 2.5 mph Volare systems, over 2/3 of the difference is in the energy absorbers. More modern systems would show only a fraction of above cost and weight reduction.

Per the DeLorean Report, there are 5 mph systems available today at lower weight and costs than the Volare-Aspen 2.5 mph systems for equal weight class. Example: Ford Fairmont.

TABLE I - WEIGHTS OF CHRYSLER BUMPER SYSTEMS

	<u>Total Weight</u>	<u>Curb Weight</u>	<u>% of Curb Weight</u>
Volare	146 lb.	3223 lb.	4.5 %
LaBaron	152	3745	4.1
Horizon	41	2265	1.8

TABLE II - COSTS FRONT AND REAR BUMPER SYSTEMS - MY 1979

	<u>Total Costs</u>	<u>Bumper Weights</u>	<u>Curb Weights</u>
Volare	\$201.00	152 lb.	3223 lb.
Fairmont	128.00	76	3100
Firebird	150.00	84	3595
Camaro	197.00	121	3660
Nova	177.00	154	3555
Malibu	171.00	128	3350

DOT-HS-803873: Cost Evaluation for Four Federal Motor Vehicle Standards/Task VI, 1979 Selected Bumper Systems

ATTACHMENT IV: COMPARISON OF ALUMINUM AND STEEL
BUMPER REINFORCEMENT - EQUAL GAUGE

<u>ITEM</u>	<u>TYPE 950 STEEL</u>	<u>TYPE X7021 ALUMINUM</u>
1. Part Weight Per Reinforcement		
Blank	(lb) 42	15
Offal (20%)	(lb) 8	3
Net Part Weight	(lb) 34	12
2. Weight Saving Per Reinforcement		
Primary	(lb)	22
Secondary (50% Primary)	(lb)	11
Total Weight Saving	(lb)	33
3. Cost Per Reinforcement		
Blank Cost (steel @\$0.20/lb., alum. @\$0.83/lb.)	(\$) 8.40	12.45
Scrap Credit (steel @\$0.04/lb., aluminum. @\$0.36/lb.)	(\$) -0.32	-1.08
Subtotal	(\$) 8.08	11.37
Heat Treatment Cost	(\$)	1.00
Cost of Additional Metal to Support Heavier Bumper	(\$) 2.20	
Total Cost Per Reinforcement	(\$) 10.28	12.37
NET COST INCREASE PER REINFORCEMENT	(\$)	2.09*
4. Savings to Consumer		
Fuel Saved by Lighter Reinforcement in Life of Car (100,000 miles) (33 lb. x 1.1 gal/lb. x \$0.85/gal.)	(\$)	31.00
Present Worth of Fuel Saved (@11% for 10 years)	(\$)	18.26
LESS COST TO CONSUMER*	(\$)	-4.18
NET BENEFIT TO CONSUMER		
a) EACH REINFORCEMENT (\$18.26 - \$4.18)	(\$)	14.08
b) PER CAR (\$14.08 x 2)	(\$)	28.16

*Includes 100% Markup

Mr. SCHEUER. Fine. Very good. Thank you very much. We will expect to hear from you after our last witness. We will hear from Mr. Richard Copaken of Houdaille Industries. You have heard the array of witnesses who have appeared here this afternoon Mr. Copaken. We expect that you won't have any trouble filling up your 10 minutes.

Mr. COPAKEN. Thank you very much, Mr. Chairman. We will do our best to keep within the 10 minutes.

Mr. SCHEUER. I will say this. I would expect that we will get some further written analyses of the criticisms that have been made of your cost/benefit study and we will put them in the record.

Incidentally, for all of the other witnesses, we will hold the record open for the next 10 days or 2 weeks for submissions of any criticisms that you might have of the Houdaille cost/benefit study. We will submit those criticisms to you gentlemen for our comment. We will print in the record their criticisms of your methodology along with any comment that you care to make about the criticism. Is that not a reasonably fair process?

Mr. COPAKEN. That sounds very fair. We very much appreciate your fairness. We would like to do essentially three quick things, if we can.

Mr. SCHEUER. Would you identify yourself for the record?

Mr. COPAKEN. Yes. I am Richard Copaken.

Mr. SCHEUER. Let me make one comment at this point in the record. You may have noticed that during the testimony of the witness who just preceded you, you had a conference with Ed Rovner, our staff director. This concerned the use of the word "downsize" as either a verb or a noun.

We are under a sworn obligation to protect the Constitution, and we think the use of the word "downsize" as either a verb or a noun is a bloody assault on the English language. It therefore constitutes cruel and unusual punishment of our Anglo-Saxon heritage, our cherished Anglo-Saxon heritage, the English language. Therefore, it is constitutionally proscribed in this or any succeeding hearing. I will not tolerate the use of the word "downsize" as either a verb or a noun. All right, please proceed.

STATEMENT OF RICHARD COPAKEN, COUNSEL, HOUDAILLE INDUSTRIES, INC., ACCOMPANIED BY PHILIP O'REILLY, EXECUTIVE VICE PRESIDENT; THOMAS A. NORTON, GROUP EXECUTIVE, AUTOMOTIVE DIVISION; H. DANIEL ROTH, PH. D., STATISTICAL CONSULTANT; DAVID A. WISE, ECONOMIST CONSULTANT; EDWARD PECHAN, MATHEMATICIAN; AND RONALD CANTRELL

Mr. COPAKEN. Thank you very much. We have with us today Mr. Philip O'Reilly, executive vice president of Houdaille, on right; Dr. Neil Roth, the mathematician who has been involved with our study; Prof. David Wise of Harvard University; and Mr. Ed Pechan, another mathematician working with Dr. Roth; and Mr. Tom Norton, who right now will begin to demonstrate to you graphically with a couple of bumper systems the difference between the 2.5 and 5 mile per hour system. Essentially, we would like to cover three items as quickly as we can. One, Tom will take a current

1979 bumper, which is the bumper sold on the most popular parcel in the United States today, the 1979 Chevrolet Caprice, and graphically try to make points as to what the differences are between the 2.5 and the 5.

Second, Dr. Roth and Professor Wise will respond to the technical points which have been raised in the criticism. Third, Mr. Cantrell from Houdaille will make a brief presentation about his observations at current tests that are being conducted by NHTSA out in Phoenix, Ariz. This last point we think is a very important one because it indicates why, Mr. Chairman, we look to this Congress and your committee to take legislative action rather than awaiting the further action by the NHTSA. But first I would like Tom to make his demonstration.

Mr. NORTON. Thank you. Mr. Chairman, I have with me half—a whole bumper was too heavy to carry because it is a 5-mile-an-hour bumper system. This is just half of a 1979, 581, phase I bumper. We don't just deal in the 1978 and beyond. This is the bumper for the future, the 581.

Mr. SCHEUER. Isn't the phase II bumper the bumper of the future?

Mr. NORTON. Yes, but this is phase I. Phase II is not out yet.

Mr. COPAKEN. It will be even heavier.

Mr. NORTON. So I couldn't bring you a sample. But this component cost \$28 list price. There are four of them on the car. It weighs about 7 pounds. This [indicating] is a 5-mile-an-hour bumper. It has a support bar list price of \$10, weight of 1.7 pounds. There are two of these on the front bumper of the car, as well as two of those energy absorbers. This front reinforcement [indicating] we cut in half. It is really twice that long and extends the whole length of the bumper. It weighs only 8.2 pounds, as was earlier testified, for the 1979 Caprice. Its cost is \$125.

Then we have the face bar itself, weighing 38 pounds, costing \$124.

Mr. SCHEUER. I am going to ask the three of you to get to the meat of what you are talking about because our time is really running short. We asked you to take 10 minutes, and if the three of you speak for any amount of time, you will be way over that. After you finish we are going to let the other witnesses have a chance to respond to your testimony. So if I were you, I would get to the substance of your points.

Mr. COPAKEN. The substance is that this piece with the bracket that he is showing right now is what a 2½-mile-per-hour system would be, and you can see the price. This is on the most popular bumper. So the price is what, Tom?

Mr. NORTON. It is \$131; weight, 44 pounds. List price to the consumer.

Mr. COPAKEN. And the one which is 5 miles per hour is what total weight and what total price?

Mr. NORTON. It is \$325; 63.5 pounds.

Mr. COPAKEN. It is that several hundred dollar difference that we are paying for in having a 5-mile standard rather than a 2½.

Mr. SCHEUER. Let's suspend right now. Do any of the other witnesses who preceded the Houdaille representative want to respond to that, to address themselves to this price differential?

Mr. COPAKEN. I want to make it clear.

Mr. SCHEUER. I tell you what. Do any of you have any comment to make on this one point, this very significant cost?

Mr. KELLEY. Mr. Chairman, I have certainly no argument with the costs the gentleman has specified.

Mr. SCHEUER. Will you identify yourself?

Mr. KELLEY. I am Ben Kelley from the Insurance Institute for Highway Safety. I think it is important to point out that the costs you see are replacement parts costs, costs for buying a bumper part to replace on your car.

Mr. COPAKEN. That is correct.

Mr. KELLEY. Which, as we all know, is many times higher than the original equipment costs.

Mr. SCHEUER. What would the difference be from the original cost?

Mr. KELLEY. The Taylor bumper shock mount we looked at earlier, which is the lightweight shock mount, sells through the manufacturer for less than \$5, so you can see the difference right there.

Mr. COPAKEN. It might be most orderly if we could go through these points, Mr. Chairman.

Mr. SCHEUER. OK, try to do it briefly.

Mr. COPAKEN. The point is that the consumer who has a crash, if he has the most popular car on the road, has to go in and buy that bumper at those prices. That is the point we are making.

Let me make the next point, which is to have Neil Roth respond to the technical points. By way of introduction, I would like to note that it is somewhat intriguing to us that all of a sudden we get this kind of critique and this kind of information coming forward. We had a meeting at NHTSA on July 13, 1978, when most of these people here were represented. Mr. Sorenson was there of State Farm Insurance, and Brian O'Neill from the Insurance Institute, and we asked NHTSA at that time for their help and their study.

It was only after we came forward with our study that we got this response. Neil. I turn it over to you.

Mr. ROTH. I would like to make some summary comments outlining problems we found with the Insurance Institute for Highway Safety and the State Farm Insurance critiques of the Houdaille bumper study. A more detailed description of the problems with the IIHS critique is given in two letters sent to you, Mr. Chairman, on March 26. The first was written by Dr. David Wise, and the second was written by myself. Our comments regarding the State Farm critique are brief.

Mr. SCHEUER. I would say that the letter you sent dated March 26 is a little bit late for purposes of this hearing.

Mr. COPAKEN. This was in response to testimony that was—

Mr. ROTH. First given yesterday.

Mr. SCHEUER. Yesterday, on the Senate side?

Mr. COPAKEN. Yes. We have been very busy this week trying to deal with the Senate side as well as the House side on this issue.

Mr. SCHEUER. Yesterday was March 27. How could you—

Mr. ROTH. To comment on that, we received the IIHS critique on March 19 or 20. The letter was dated the 19th.

Mr. SCHEUER. All right. Don't use all your time up on this. I am sorry I brought up the question.

Mr. ROTH. Our comments regarding the State Farm critique are brief since we first received this critique less than 1 day ago and have not had adequate time to review it.

Mr. SCHEUER. As you know, we are holding the record open for another week or 10 days, and you may submit whatever you please. [The following letter was received for the record:]

H. DANIEL ROTH ASSOCIATES, INC.
STATISTICAL CONSULTING FIRM
KENWOOD PROFESSIONAL BUILDING
5272 RIVER ROAD SUITE 550
BETHESDA, MARYLAND 20016

March 28, 1979

The Hon. James H. Scheuer
Chairman, Subcommittee on
Consumer Protection and Finance
3275 House Office Building
Annex II
Washington, D.C. 20515

Dear Congressman Scheuer:

Below are summary comments outlining problems we found with the Insurance Institute for Highway Safety (IIHS) and the State Farm Insurance critiques of the Houdaille bumper study. A more detailed description of the problems with the IIHS critique is given in two letters that were sent to you on March 26. The first was written by Professor David Wise to Mr. Copaken; the second letter was written by myself. Our comments regarding the State Farm critique are brief, since we first received this critique less than a day ago and have not had adequate time to review it. We became aware of the State Farm critique only yesterday, moments before State Farm representatives testified before a Senate hearing on bumpers. In about a week we will send you a more detailed critique of the State Farm analysis.

Comments on the IIHS Critique

1. The critique erroneously states that the Houdaille study failed to take into account factors such as crash frequency, repair frequency, and crash speed. Our sources for these variables were State Farm Insurance Company, Ford Motor Company, and NHTSA data.
2. The critique charges that much of the data used in the Houdaille Report were unreliable. However, the data used in the study are the best available data to date. Moreover, the data were confirmed using different sources of information and where appropriate a broad range of values were employed.
3. In several instances the IIHS critique misrepresents Houdaille Report findings by stressing selective points made in the Report while ignoring others. For example, the critique stresses the benefits of better damage resistant bumpers without recognizing the heavier weight and high initial and replacement cost of these bumpers.

4. The IIHS report criticizes the use of the Volare/Aspen as a test car in the Houdaille analysis because the Volare/Aspen bumper system is heavier, less damage resistant, and more expensive than many bumpers on the road today. However, according to IIHS's own test crash results, the Volare/Aspen is a better than average damage resistant bumper and many bumpers on the road today are more expensive and heavier than the Volare/Aspen. Moreover, the IIHS critique also fails to recognize that the Houdaille analysis made adjustments to account for any cost, weight, and damage resistance disadvantage that the Volare/Aspen bumper might have compared to other bumper systems.

5. The IIHS critique states that the Houdaille analysis uses "an inapplicable set of formulas and assumptions" without ever specifically describing the problems with them. It is surprising to hear that IIHS now has problems with the conceptual approach used in the Houdaille analysis since IIHS representatives have known our approach since July 13, 1978, when NHTSA held an open meeting to discuss it. Representatives of the insurance industry (including IIHS), automobile manufacturers, and others were present at that meeting. Mr. Brownlee of NHTSA emphasized during the meeting that the conceptual approach set forth by Professor Wise would form the basis for future work by NHTSA to determine the benefits and costs of bumper systems.

6. Finally, we are deeply troubled by the attitudes of the Insurance Institute representatives which clearly emerged during a meeting we had with them. In the course of our conversations with them they clearly stated that they believe a 5 m.p.h. bumper system is more cost beneficial than a 2.5 m.p.h. system and when pressed to explain this assertion they confessed that they have no data or study to support it and base their conviction on "intuition". Moreover, they also claim that it would be virtually impossible to obtain all the information necessary to conduct what they consider to be a sound cost-benefit analysis of bumper systems. Thus, on one side there now exists at least three studies showing the 2.5 m.p.h. system to be more cost beneficial than the 5 m.p.h. system. These include the NHTSA study, an Economic and Science Planning study, as well as our own study. On the other side we only have IIHS's intuition that a 5 m.p.h. system is more cost beneficial than a 2.5 m.p.h. system.

Comments on the State Farm Critique

1. Despite State Farm claims that their analysis of bumper standards uses the same model as the one used in the Houdaille study, this is far from the case. There are major differences between the Houdaille analysis approach and the State Farm approach.

2. The State Farm Report contains serious errors in the way it uses data developed in the Houdaille study. These errors are in the direction that make the 5 m.p.h. bumper system appear to be more cost beneficial than it is.

3. There are several mathematical errors such as the double counting of the benefits of the 5 m.p.h. system in the State Farm analysis.

Sincerely,

Dr. Neil Roth

Dr. Neil Roth

Mr. ROTH. We became aware of the State Farm critique only yesterday, moments before the State Farm representatives testified before a Senate hearing on bumpers. In about a week, we will send you a more detailed critique on the State Farm analysis. Point No. 1: comments on the IIHS critique. First, I was surprised to hear Mr. Kelley testify today and make his comments about the current number standard, especially in the light of this passage I will read to you that he testified, and these are his words, on December 4, 1978 in testimony before this very committee. He said the new Federal bumper standard is a fraud. He was speaking about the 5-mile-an-hour bumper standard.

It is clear from the Institute's test results for both 1979 models and past years that the standard has produced no improvement this year in the ability of new car bumpers to resist damage at very low speed impacts.

Mr. SCHEUER. Was he implying or stating we ought to go back to a 2½-mile-an-hour—

Mr. ROTH. I have no idea. You should ask him, perhaps.

Mr. COPAKEN. He was stating that there was no material difference between the bumper damage experienced under the standard and the bumper damage experienced in the past years when there was no standard.

Mr. SCHEUER. Do you have any explanatory comments?

Mr. KELLEY. Sure. I testified twice before your subcommittee last year, Mr. Chairman.

Mr. SCHEUER. It wasn't my subcommittee last year.

Mr. KELLEY. I am sorry; the subcommittee. Once in October and once in December. In both cases, and in particular in December, we testified, as we mentioned today in summary, as to the Institute's very great dissatisfaction with the current bumper standard, and particularly with the test requirements under it, because we don't think those test requirements represent what is happening sufficiently in the real world in impacts. We in our tests have done a number of crashes, including corner impacts and intervehicular impacts, and we believe that the sorts of damage that occur to the corners of cars in pole tests and front-to-rear car crashes have to be taken into account in the standard. We intend to make that point to NHTSA in its rulemaking. As we said, it would be presumptuous in the extreme for you to come here and ask you as a matter of legislative fiat to do what we know the agency will have to look at in light of comments from many parties, and that continues to be our position.

Mr. SCHEUER. Yes, it is not easy for us to legislate a 2½-mile standard or a 5-mile standard. We are in the business of legislating a requirement for a regulatory agency to set up a standard and to set the criteria for their establishing the standard—cost, convenience, safety, and so forth.

So I would have to tell you how I am inclined to proceed. I do not think that it is my business to perform the function of a regulatory agency.

Mr. COPAKEN. Mr. Chairman, I appreciate that point. It is only because we are driven here by NHTSA's failure to live up to that responsibility. And it seems to us that the case is well made on that score, rather than it being a congressional oversight function to do the job.

In NHTSA's own study, of course they came in with different numbers on January 26 and February 26, but the latest numbers, corrected for arithmetic errors, reveal that there is an excess of \$1 billion in cost advantage to consumers per model year, and a fuel advantage in excess of 29 million barrels of crude oil, which is 3 days of our national import of foreign oil simply by changing the bumper standard from 5 to 2½. In the face of their own study results, NHTSA, however, failed to propose to change the rule, and instead simply published and advanced notice of rulemaking without any commitment whatsoever. Each year that that is delayed represents an enormous fuel cost to the society.

Mr. SCHEUER. Yes, and that billion dollar savings is a life cycle savings?

Mr. COPAKEN. The life cycle savings per model year. In other words, the life of the vehicle at 10-year—

Mr. SCHEUER. Including the cost of the predicted number of accidents and everything?

Mr. COPAKEN. That is a net figure.

Mr. SCHEUER. That is in stark variance with what we have heard.

Mr. ROTH. I haven't seen any cost/benefit analysis from the other parties. IIHS always speaks about the desirability of greater bumpers, but never have I seen the cost of these bumpers factored into their analyses. They are showing one side of the cost/benefit analysis, and that is basically the benefit side. But they haven't shown the cost. Beyond that, there is a second study that says even if the 2½-mile-an-hour bumper costs the same as the 5-mile-an-hour bumper, then it would still be beneficial to go with the 2½-mile-an-hour bumper. This is an economic and science planning study. They say once you go over 5 miles per hour, you have to replace both bumpers. The cost to replace a 5-mile-per-hour bumper, as you have seen, is substantially more than a 2½-mile-an-hour bumper.

I would also like to address some comments made by State Farm Insurance Co. where they said we only consider the case that one-third of the accidents occur under 5 miles an hour. That means approximately half of that one-third still occurs under 2½ miles an hour.

Mr. SCHEUER. Not necessarily.

Mr. ROTH. OK, but a great percentage. Beyond that, we did not only consider the case of one-third but we considered a variety of cases, one of which where 43 percent of the accidents occur under 5 miles per hour.

Mr. COPAKEN. I think Professor Wise had a point he wanted to raise too.

Mr. WISE. I just wanted to ask Mr. Kelley a question. I can't understand how the 5-mile-per-hour system can be cost beneficial if in fact there is no difference in damage between the 5-mile-per-hour system and earlier standards.

Mr. SCHEUER. Does that finish your testimony?

Mr. ROTH. No, I have a list of comments.

Mr. COPAKEN. Why don't you go through them?

Mr. ROTH. I will just take one comment out of the IIHS report to show you how they slandered our results. They say: "In order to

estimate damage costs over the lifetime of the vehicle, for each bumper design being evaluated, the following data are required at a minimum," none of which were available to or employed by Houdaille, and they go through a list, crash frequency, repair frequency, and the end off with crash speed.

We considered every single one of these. We went through a great deal of effort to get data on all of these. They are amply reported in our report, and I don't see how anyone who read the report can make such a comment.

IIHS also criticized the use of the Volare in the Houdaille analysis because the Volare/Aspen bumper system is less resistant. Well, according to congressional testimony given by IIHS itself, the Volare/Aspen was a fairly good damage resistant bumper, and this was in terms of—when was this testimony given?

Mr. PECHAN. December 4.

Mr. ROTH. Of this year?

Mr. PECHAN. Of last year.

Mr. ROTH. December 4, 1978. The IIHS critique also states that the Houdaille analysis uses an inapplicable set of formulas and assumptions without ever specifically describing the problems with them. It is surprising to hear that IIHS now has problems with the conceptual approach used in the Houdaille analyses since IIHS representatives have known our approach since July 13, 1978, when NHTSA held an open meeting to discuss it.

Representatives of the insurance industry, including IIHS itself, automobile manufacturers and others, were present at that meeting. Mr. Brownlee of NHTSA emphasized during the meeting that the conceptual approach set forth by Professor Wise had formed the basis of future work by NHTSA to compute the benefits and costs of future bumper systems.

Finally, concerning the IIHS report, we are deeply troubled by the attitudes of the Insurance Institute representatives which clearly emerged during a meeting we had with them. In the course of our conversation with them, they clearly stated that they believe a 5-mile-per-hour bumper system is more cost-beneficial than a 2½-mile-per-hour bumper system. When pressed to explain this assertion, they confessed they had no data or study to support it and based their conviction on intuition. Moreover, they also claimed that it would be virtually impossible to obtain all of the information necessary to conduct what they considered to be a sound cost-benefit analysis of bumper systems. Thus, on one side there exist at least three studies showing the 2½-mile-per-hour system to be more cost beneficial than the 5-mile-per-hour system. These include NHTSA's own study and Economic and Science Planning Study, as well as our own study. On the other side, we only have IIHS's intuition that a 5-mile-per-hour system is more cost beneficial than a 2½-mile-per-hour system.

Mr. SCHEUER. All right. Let's stop there. Do any of the preceding witnesses wish to be heard?

Mr. COPAKEN. We have a third point we would like to make, if we could, to present our presentation.

Mr. SCHEUER. All right, make your point. Then we will ask the others to come up.

Mr. COPAKEN. Mr. Chairman, this goes straight to the point you raised, which is the propriety of congressional intervention in this complex and technical area.

Mr. SCHEUER. Let's not use the word "propriety," because we do have a perfectly clear oversight responsibility for everything done by the regulatory agencies that are under our jurisdiction.

Mr. COPAKEN. We think a billion dollars to the consumer—

Mr. SCHEUER. Well, they gave an opinion to the contrary. They said, on a life cycle cost-benefit analysis, the 5-mile-per-hour bumper—

Mr. ROTH. They didn't given any study.

Mr. SCHEUER. We are going to give them a chance to comment. If they didn't say that, they will tell you what they did say. But I don't see any great issue of social policy here. I think it is clearly a technical issue of figuring life cycle costs and benefits under the two standards, the 2½-mile standard and the 5-mile standard. That is a technical matter far beyond my ken. I think that kind of matter is very much better left to the regulatory agency which has engineering and economic capability and depth that we don't have.

Mr. COPAKEN. Let me have Ron Cantrell make a presentation which I think may shake your confidence in NHTSA as the appropriate entity to make this decision.

Mr. SCHEUER. Wait a minute. Let's elaborate on that. If NHTSA can't do it, where do you think the decision ought to be made? Let's say this is a seminar on the problems of Government administration. Where do you think those complicated decisions should be made?

Mr. COPAKEN. I think that once the burden has shifted, once it becomes clear that there is no justification for a given regulation and there is considerable evidence that that regulation is costing consumers a great deal of money, that perhaps the appropriate thing for Congress to do is to either set a minimum regulation or abolish the regulation until there can be some incentive behind the agency to do a proper job and justify regulation.

I think regulation in the free market is something that should be done only when there is adequate demonstration that it is doing something of benefit for the people.

Mr. SCHEUER. We agree with that. There is no question. As you know, there is a whole new mood around here in which we seek to require regulatory agencies to justify what they are doing by a cost-benefit analysis. The President has just set up a big group under the Council of Economic Advisers to review the entire regulatory process. The Congress is extensively debating the wisdom of taking the power to veto regulations. There is much dissatisfaction here because the regulations are getting far away from the original congressional intent when we established these agencies.

So we hear you and we agree. I think there is a feeling in the air that the regulatory agencies have gone beyond the point of cost-benefit, beyond the point of diminishing returns in many of their regulatory acts. So we are sympathetic to the point you are making. But as to what the remedy is, I am not sure.

I do know that this committee certainly does not have the staff to get into the business of yea-saying or nay-saying to the regulatory agencies on a day-to-day or week-to-week basis. However, we

clearly have an oversight function here. This does not mean that we could or should take on the burden of being a regulatory agency ourselves. We simply can't do that.

Mr. COPAKEN. Let me produce the next evidence. At least it is pertinent to your oversight function. It may give you a basis for going back to the agency and somehow persuading them to do a proper job. We have been unable to do so.

Mr. SCHEUER. That is what we would do. We would ask them to make a painful and agonizing reappraisal of what they have done. We would ask them, perhaps to take some time to evaluate everything being said here today and the data that you will be submitting to us in the next 10 days or so. We may very well do that.

Mr. COPAKEN. Ron, why don't you go ahead.

Mr. SCHEUER. I wish you would try to wind up your case, because then we are going to ask the other three or four witnesses to come back and respond to some of the things that you have said. So try and wind it up briefly.

Mr. CANTRELL. Mr. Chairman, my statement is very brief. My name is Ron Cantrell. I am president of the Huntington Division of Houdaille Industries, Inc. By training I am an automotive engineer.

Mr. SCHEUER. Why don't you get into the substance of your testimony?

Mr. CANTRELL. On Wednesday, March 21, 1979, I visited the Dynamic Science facility in Phoenix, Ariz., in the process of completing a series of bumper crash tests for NHTSA. Mr. Rod Garn, the test engineer from Dynamic Science, who was conducting these tests, and I discussed the bumper test program. We examined the test cars and viewed one of the——

Mr. SCHEUER. I really wish you would get to the message. You must be here to give us a message. Please give us the message.

Mr. CANTRELL. OK. I noticed that both of the two U.S. Volares were equipped with bumper guards while the Mexican Volares were not so equipped.

Mr. Garn told me in his judgment the bumper guards would almost certainly reduce the impact on cars so equipped.

In my professional judgment as an automotive engineer, Mr. Garn is absolutely correct and the test conducted for NHTSA is not a valid comparison of the 5-mile-per-hour U.S. system with the approximately 2½-mile-per-hour Mexican system since it will artificially skew the results in favor of the 5-mile-per-hour system because of the presence of bumper guards on those systems only. A fair comparison would have tested systems with bumper guards on both United States and Mexican Volares or bumper guards on neither. As can be discerned from the photographs, the Mexican Volare bumpers each have holes through which bumper guards could easily have been attached. According to Mr. Steven Barrera, production control manager of Chrysler Mexico, all Volares assembled and sold in Mexico are equipped with bumper guards. Half the U.S. Volare systems are sold without bumper guards and they can be easily removed from the U.S. Volare bumpers that come so equipped. Mr. Garn stated that Mr. Bob Lemmer of NHTSA reviewed the cars and test procedures in person and approved the equipment on the cars and the test procedures prior to testing. Mr.

Garn said that he assumed NHTSA wanted bumper guards on the U.S. cars but not on the Mexican cars. Mr. Garn also told me on Thursday, March 22, 1979, that on two Chevrolet Malibu's which were modified to simulate 2½-mile-per-hour bumper systems, NHTSA had insisted on very heavy, rigid bumper mounting brackets, even though Mr. Garn had advised that lighter, less rigid brackets would probably cause less impact damage. I photographed the cars. You can see the photographs there. It would appear that NHTSA did one of two things. They either did not understand the test would not be a fair comparison or they did know it and purposefully arranged the test in such a manner. I think that in the IIHS test film you saw earlier to demonstrate the effect of bumper guards, if you had looked closely you would have noticed that the bumper they were promoting had bumper guards while the other one didn't. I am sure they did not overlook that fact.

Mr. SCHEUER. You are basically saying they are either fools or knaves.

Mr. COPAKEN. One of the two, and it seems to us in either case it is a proper matter for this committee's concern. The point I think Ron makes bears emphasizing. In the movie first shown by IIHS, you saw them show a car going in on an angle impact. Then they showed the one car went in and had damage on the angle impact, and they said they modified it with a TAYCO bumper and it had no damage.

If you look at that film closely—and I would be happy to have them rerun it—you will see that the one that had damage had no bumper guard. In the one which had no damage, the full impact was taken by the bumper guard. They failed to mention that to you. But at least it demonstrates the very great importance of bumper guards in terms of trying to get a comparable test. A fair test would have had bumper guards on both cars or bumper guards on neither, but not skewed as it was. Had we not had Ron there to catch them in the act, so to speak, Congressman, that information would have been passed off as valid data by NHTSA. You would have said: Gee, they are the technical experts and we have to rely on them, and what are we supposed to do, representing the public and concerned about getting to the truth of this matter.

Mr. SCHEUER. All right. Any of the preceding witnesses who want to respond to anything said here, come on back to the table. Maybe we can thin out your ranks somewhat. Is there a representative of NHTSA here? Come on up and join us. Mr. Dugoff, since either your integrity or intelligence has been most severely impugned here, maybe we will give you the first crack. Wait a minute. You cannot keep six men here. You have to thin out your ranks. Your case can't be so bad that you need six people here.

Mr. COPAKEN. The point is there are a lot of technical questions.

Mr. SCHEUER. All right. Sit in the next row, and if one of you wants to come back, you may. But we must have some room for the others.

Mr. DUGOFF. Mr. Chairman, I have several remarks I am prompted to make as a result of sitting and listening here all day.

Mr. SCHEUER. Identify yourself for the record.

Mr. DUGOFF. Howard Dugoff, Deputy Administrator of National Highway Traffic Safety Administration. My first reaction to what I

heard today was one of substantial gratification that the standard which we have promulgated clearly, to me, has prompted a very dramatic and beneficial revolution in the technology of bumper systems. We can and have been spending a lot of effort talking about the precise requirements which have been stipulated and whether they are optimal. To be sure, as I will discuss in a moment, that is a question we consider to be an open one and one which we are viewing with objectivity and concern, notwithstanding some of the remarks which were made. But clearly, the standard which we have promulgated has affected the design and manufacture of bumper systems in a major and very beneficial way.

Mr. SCHEUER. Just elaborate. What change has taken place and how is it beneficial; what do you perceive Houdaille's role to be; how have they been affected by your rulemaking? I understand that you are in the rulemaking process. I am not asking you to say anything here today that would in any way affect the integrity of your rulemaking.

Mr. DUGOFF. I understand that, Mr. Chairman. It was not so much by any means the remarks of Houdaille that prompted that response on my part, but rather the presentations by the gentleman from Davidson Rubber Co. and the Aluminum Association in which they showed us bumper designs which are now getting on automobiles, which provide substantially enhanced levels of protection and which have been developed at weights and costs which are comparable to the costs and weights of bumpers that existed before you had the standard.

Mr. SCHEUER. Let's get to the bottom line. They say there is a \$1 billion penalty per model year that results from your 5-mile-per-hour standard. Is that more or less what you are saying, the cost is a \$1 billion penalty for a model year, with no benefits accruing from that cost?

Mr. COPAKEN. That is a net penalty. There are benefits, but costs less benefits equal \$1 billion per year.

Mr. SCHEUER. Very good. In other words, the cost/benefit factor is a net penalty of \$1 billion per model year.

Mr. COPAKEN. That is correct.

Mr. SCHEUER. That is the bottom line. Now, what is your response to that, Mr. Dugoff?

Mr. DUGOFF. When they first suggested that to us, we—

Mr. SCHEUER. Went back to the drawing board.

Mr. DUGOFF. Yes. And we have produced a study which has been the subject of some discussion here which we conceive to be a credible and professional and certainly objective piece of work, which study does tend to support the nature of the assertion that Houdaille is making. However, as has been pointed out by many of the other witnesses, both Houdaille's study and our own contain a substantial number of engineering assumptions and judgments and analytical efforts to compensate for missing data. As we have heard today, each of those judgments, each of those assumptions is, and, I think, properly should be the subject of debate by experts on all sides of this issue. So what we have done is publish our study, the Houdaille study, and all of the other relevant materials that we conceive to bear on this case, and seek public comment on all of that work.

Mr. SCHEUER. Mr. Dugoff, a few moments ago you heard them testifying. You heard them point to those photographs that, in effect NHTSA phonied up the bumpers. That is instead of having a consistent presence or absence of these vertical bumper guards—on one test you didn't and on one test you did—the implication is either you were grossly negligent or you were duplicitous. Now, that is a serious charge.

Mr. DUGOFF. Yes.

Mr. SCHEUER. And I take it the charge stands. Did I state it incorrectly?

Mr. COPAKEN. It was perfectly fair statement.

Mr. SCHEUER. Very good.

Mr. DUGOFF. We purchased four Chrysler vehicles from a Chrysler dealer. We sent two of the vehicles to Chrysler manufacturing facilities to have them make the modifications that would convert so-called 5-mile-an-hour bumpers into 2½-mile-per-hour bumpers. When the cars were returned, the vehicles that had been converted to 2½-mile-per-hour bumpers did not have bumper guards on them. The 5-mile-per-hour bumper cars that we had purchased did have bumper guards on them.

The test engineer made, in my opinion, an error in judgment in not recognizing this difference and the potential effect it would have on the test results.

Mr. SCHEUER. Do you personally feel that that difference, then, invalidates the test results and that maybe they should be run over?

Mr. DUGOFF. I suspect it well may. We intend to run the tests over. These tests were run on March 21, as Mr. Cantrell has testified.

Mr. SCHEUER. Of this year?

Mr. DUGOFF. Yes, indeed.

Mr. SCHEUER. A few days ago?

Mr. DUGOFF. We have not had these results reported to us yet.

Mr. SCHEUER. In other words, they make a valid point.

Mr. DUGOFF. Yes, indeed, and we intend to conduct tests which will shed light on the extent to which this has influenced the result. And by no means will we bring forth an analysis contaminated by what may be experience—

Mr. SCHEUER. Why are we here today considering this? I mean I consider this an egregious affront to standards of fairness that it could have happened. I don't know whose fault it was. Why did Chrysler return those cars in that inconsistent condition when they knew very well the purpose for which they were being provided?

Mr. DUGOFF. I don't know the answer to that. I was only made aware of the existence of this situation Friday evening by Mr. Copaken. I don't know.

Mr. SCHEUER. I must say I am offended that something like this could have happened.

Mr. KELLEY. Mr. Chairman, if I may, I would like to say something about bumper guards themselves because there is a premise underlying this discussion that disturbs me, frankly, and that is that somehow bumper guards make cars much better or worse in a crash.

Mr. SCHEUER. It is not a question of making it better or worse. Apparently bumper guards reduce the damage resulting from that impact. Do they or don't they?

Mr. KELLEY. The answer is that they don't necessarily. And if I may finish, Mr. Copaken, in many intervehicular crashes which we have run cars front-to-rear, we have found that bumper guards not only don't reduce the damage; they increase the damage by localizing the forces at two points.

Mr. SCHEUER. All right, I can understand that. But it seems to me that it was an egregious error in this test—

Mr. KELLEY. I agree entirely.

Mr. SCHEUER [continuing]. That one car had them and one did not.

Mr. KELLEY. I agree entirely.

Mr. SCHEUER. Would you let me finish, please? I think it was really an unforgivable breach of professional standards, as well as basic fairness in the test for one car to have them and one car not to have them. However, this is not at all to say that bumper guards are good, bad, or indifferent. That is another subject that should be investigated.

Mr. FERRARI. Mr. Chairman.

Mr. SCHEUER. But for the test to be done—that question aside—with one car having them and another car not having them, I find offensive to basic standards of equity, as well as professionalism. I cannot understand how NHTSA could have permitted that to happen. There must be some kind of supervision that you exercise over Chrysler and over the whole testing process. Where was it?

Mr. FERRARI. Mr. Chairman.

Mr. SCHEUER. Hold on. I would like to get the answer.

Mr. DUGOFF. Mr. Chairman, as I indicated, we had not yet even gotten the test results or even the description of the test condition. I can tell you from benefit of hindsight that once these results had been presented to us, we would have made the same observation you are making and corrected it. I agree with you it is not a sensible comparison.

Mr. SCHEUER. All right.

Mr. Dugoff, obviously you are going to have to do a replay on this test. I must say it brings the whole regulatory process under a cloud when something like this is brought to a congressional committee.

Mr. DUGOFF. Mr. Chairman, we are in the middle of this program. The tests in question were only run last week. We haven't even begun to look at the results.

Mr. SCHEUER. All right. You haven't reviewed your tests. Maybe this whole hearing is some weeks or months premature.

Mr. COPAKEN. Mr. Chairman, I would like to make one other point. A NHTSA official, Mr. Bob Lemmer, was in Phoenix and inspected those cars before they were tested, and approved those cars in that condition for testing. So I don't think NHTSA can duck responsibility for those tests.

Mr. SCHEUER. What is your answer to that?

Mr. DUGOFF. That is true.

Mr. SCHEUER. How could he have approved it?

Mr. DUGOFF. We made a mistake. We are going to run tests and determine to what extent the mistake is a real one as opposed to a symbolic one. As Mr. Kelley suggested, we don't really know that yet. We are going to run such a test. I regret that the first set of tests that were completed last week turned out to be the ones that they were.

Mr. SCHEUER. I would like to have a statement from NHTSA submitted for the record explaining how he could have approved those cars for testing in that condition, with one car having the bumper guard and the other not. I would like a written explanation submitted to this committee.

Mr. FERRARI. Mr. Chairman, I would like to make a statement relative to that. This morning at the Senate hearing, Joan Claybrook answered that question.

Mr. SCHEUER. What did she say?

Mr. FERRARI. She said that NHTSA has gone to Chrysler and asked them verbally whether those cars were right for that test. Chrysler told her or someone in her department that they were right. My interpretation of her testimony is that they did that on the basis that those were the way those cars were supposed to be from Chrysler. As a result of this issue which came up this morning, NHTSA is going back to Chrysler to verify what the real car configuration should be. Now, that is a lot different than what is presented here today. Dr. Roth was here this morning.

Mr. SCHEUER. Isn't it agreed that one car had the bumper guards and the other car did not have the bumper guards?

Mr. FERRARI. Yes, but that is what Chrysler said was the Mexican bumper.

Mr. COPAKEN. Mr. Chairman, I would like to make just one other point.

Mr. SCHEUER. It seems to me the only way you could justify that kind of a test would be on the assumption that bumper guards make absolutely no difference at all and have no effect whatsoever on damage resulting from an accident at any speed.

Mr. FERRARI. I am not trying to justify it. I am just telling you it was an honest mistake that NHTSA made, and it is a reasonable mistake under the pressure of the situation. It was represented as a fraudulent effort, and I think that that is fraud.

Mr. SCHEUER. You say that it is reasonable. I am not alleging fraud, but I am saying that when an engineer—is this gentleman an engineer, this NHTSA representative?

Mr. DUGOFF. Yes.

Mr. SCHEUER. When an engineer goes and inspects a car for a bumper test and he looks at the bumper, it seems to me he would almost have to be deaf, dumb and blind for him not to notice the difference in the two cars he is looking at: one has bumper guards and the other does not.

Mr. FERRARI. It is not clear from an engineering standpoint that bumper guards arbitrarily make the bumper better or worse.

Mr. SCHEUER. I understand that, but that is a wholly different question. The only rationale, the only justifiable basis of conducting that test with that differing condition, would be the sure knowledge that bumper guards have absolutely no effect whatsoever and that they are purely decorative. You have not presented

that evidence. It has not been adduced. Presumably bumper guards serve some function other than a Christmas tree decoration on a car.

Mr. COPAKEN. Mr. Chairman, I appreciate your——

Mr. SCHEUER. It is hard to say that that kind of an error is an innocent error. I am not alleging malice. I am not alleging fraud. I am just saying that it very much seems to be a matter of poor judgment for a professional engineer to approve this test of two cars for bumper cost-effectiveness. After all, it is not as if there was a difference in the bumpers and they were testing that car for fuel efficiency or something else. But just looking at the front of that car with the goal of testing bumper cost-effectiveness, with that glaring difference that should have leaped up at them, I find it hard to believe that is an honest error.

Mr. DUGOFF. Mr. Chairman, I share your view as to the stupidity of it, and I can assure you that this agency would not publish the results of that pair of tests in knowledge of that difference without making sure that the condition that would make it valid existed. We have already scheduled additional tests. I apologize for the agency.

Mr. SCHEUER. We don't want to go to excess.

Mr. COPAKEN. I want to go on to another point which bears on the same question, which is: Can this committee repose sufficient confidence in this agency to get to the bottom of this question? In a letter dated March 26 to Mr. Brownlee which Dr. Roth prepared, we noted out of 316 numbers in the NHTSA study, 72 individual numbers were arithmetically incorrect, miscalculated, wrong addition. Those numbers in turn had impact throughout the study. And when you correct for those mathematical errors and other errors based upon cited source material, their numbers, instead of being \$898 million, come out to be \$1,165 million.

Mr. SCHEUER. Did you give us specific data on exactly what those errors are?

Mr. COPAKEN. Yes.

Mr. SCHEUER. Have you had a chance to look at that?

Mr. DUGOFF. Yes; and we have made entry into the public record to take account of that.

Mr. SCHEUER. Let me ask: How long do you think NHTSA's rulemaking on this matter is going to take? I take it you are going to have to re-do some of these. When do you think you are going to have an answer?

Mr. DUGOFF. We will have the docket closing and the test will be completed by May 1. We are hopeful that we will be able to digest and rationalize the multitude of conflicting inputs within 30 days thereafter and be in a position to make a rulemaking decision.

Mr. SCHEUER. Some time in June you would be prepared to come back here, I presume.

Mr. DUGOFF. That is correct.

Mr. SCHEUER. Have we heard from the automobile manufacturers as to what they consider desirable?

Mr. DUGOFF. I do not believe we have yet obtained comments from the auto manufacturers. Typically, we don't receive comments on a docket until very close to its closing. Let me check with my colleague.

[Pause.]

Mr. DUGOFF. I am correct.

Mr. SCHEUER. Do you plan to hear from the automobile manufacturers themselves in a future rulemaking proceeding?

Mr. DUGOFF. We plan to hear from them in this proceeding. We have already asked certain explicit, specific questions of them, and we also expect them to comment generally on the advance notice we published.

Mr. SCHEUER. Let me ask the Houdaille representatives: Do you have bumper contracts, for or are they planning to bid on contracts for, model years 1980 and 1981 that will enable you to continue manufacturing operations until this rulemaking process is completed? You heard the comment of one of the witnesses that you have contracts into 1980 and 1981 that perhaps reduce the emergency characteristics of your present condition.

Mr. COPAKEN. Before he responds, let me make the point that obviously our interest is the Houdaille plant. But we have discovered an issue that has a bearing on all American consumers to the tune of \$1 billion and on our oil consumption, and that ought to be borne in mind by the committee as well as the particular situation of Houdaille.

Mr. O'REILLY. Yes, Mr. Chairman; we do have some contracts now for the 1981 model year from Ford Motor Co., some from Chrysler, and some from the Buick Motor Division, that we think are going to enable us to operate that plant in 1981. Beyond 1981, without the benefit of a change in the standard, we do not see a future for that plant.

Mr. SCHEUER. It seems to me that the technology in the bumper design and manufacture is a changing one. This is true for most technologies. Thus the state of the art is constantly being improved. We now have new materials, such as this plastic material. What are the reasons—why is it that you can evaluate these improvements in the state of the art and update your product design, too?

Mr. O'REILLY. I found some of the comments, Mr. Chairman, a little bit unusual because we are the sole producer of stamped, plated aluminum bumpers in North America. We would intend, with the change in standard from 5 miles an hour to 2½ miles per hour, to continue to compete for contracts for aluminum-plated bumpers. So we have made a very substantial investment in our Canadian facility of \$8 million to provide for the ability to plate aluminum bumpers.

Mr. SCHEUER. Excuse me. Isn't there some way we could enable you to sit down? Maybe one of you fellows could move aside a bit.

Mr. O'REILLY. We have made a very substantial investment in our facility in Canada to enable us to plate stamp aluminum bumpers, and we see no reason why aluminum shouldn't be very competitive as a bumper material.

Mr. SCHEUER. You are saying if they go to the 5-mile standard you are out of business.

Mr. O'REILLY. In steel. This is a Canadian facility where we produce the aluminum bumpers.

Mr. SCHEUER. So it is just this one plant that would go out of business because it fabricates steel and doesn't make bumpers?

Mr. O'REILLY. That is correct. It is facilitized to make steel bumpers only. However, as I mentioned, we do have the experience of making aluminum bumpers. We buy over \$20 million in raw aluminum per year, and we can't understand the statement by the aluminum industry that there is no future for aluminum as a bumper material. That is not our plan.

Mr. SCHEUER. There is obviously, it seems to me, a future for some combination of aluminum and plastic. That is what the state of the art seems to be.

Mr. O'REILLY. Exactly.

Mr. SCHEUER. Would you suggest, then, that we require NHTSA to adopt a 2½-mile standard simply to keep one steel plant open?

Mr. O'REILLY. By no means, Mr. Chairman. What we are suggesting is that as the result of our study, a 2½-mile-per-hour bumper system, regardless of the material, plastic, aluminum or steel, is both a less expensive and a lighter weight bumper system.

Mr. SCHEUER. But that doesn't mean it is more cost effective from the consumer's point of view. It does not mean that. And what we are trying to find out is which of the two standards will be the most cost effective from the consumer's point of view, in terms of damage, convenience, and safety.

Frankly, I don't see that all of you are giving this subcommittee very clearly understandable, hard data on the cost effectiveness of the 5-mile-an-hour standard vis-a-vis the cost effectiveness of the 2½-mile standard. And frankly, if NHTSA can't come up with a clear difference in cost effectiveness, then it seems to me they really do not have the rationale for any regulations. If there isn't a clear benefit to be derived from a regulation, it seems to me that there is no justification for it—

Mr. O'REILLY. If I may.

Mr. SORENSON. May I answer that?

Mr. SCHEUER. In other words, there has to be an affirmative burden of proof on the regulator—

Mr. O'REILLY. Exactly.

Mr. SCHEUER [continuing]. To justify the cost, hassle, and inconvenience of the regulation itself and all of the procedures, tests, hearings, and rulemaking process. If you don't have a cost/benefit justification which is a heck of a lot less murky than what we seem to be looking at now, I don't see any need for regulation.

Mr. O'REILLY. You are absolutely correct.

Mr. SORENSON. I would like to respond to that.

Mr. O'REILLY. On the basis of our study and on the basis of the NHTSA study, I think that sufficient review will demonstrate to you that the 2½-mile-per-hour bumper system, regardless of the material, is cost-beneficial to the consumer by a very substantial amount.

Mr. SCHEUER. Is more cost-beneficial than the 5 mile?

Mr. O'REILLY. That is exactly what I am saying, by up to \$1 billion a year or over \$1 billion a year.

Mr. SCHEUER. That is the statement we heard before, that billion dollars per model year.

Mr. O'REILLY. And 605 million gallons of fuel per model year.

Mr. SORENSON. May I respond to that? I guess I have been quiet too long. I think we ought to look at that \$1 billion a year figure.

When we inserted our data into the same formula used by the Houdaille cost-benefit analysis—

Mr. SCHEUER. Would you identify yourself for the record?

Mr. SORENSON. Wayne Sorenson with State Farm. We came up with a benefit in favor of the 5-mile-an-hour system of about \$65 a car, which translates into \$715 million per year benefit to the 5-mile-an-hour system. I think that what that illustrates is in part what you said, the murky data that comes out of cost-benefit studies, but I also think it shows it would be very erroneous to leave in the record the fact there is an almost \$1 billion savings in the 2½-mile-an-hour system. Our judgment right now is that the 5-mile-per-hour system would be almost \$750 million a year benefit, so we do not accept their figure. We feel it is quite incorrect and we would not like the record to stand that way.

Mr. COPAKEN. Mr. Chairman, I want to make it very clear. The Houdaille study, which we feel is a conservative study, came out with a figure of \$814 million net benefit to consumers in 1979 dollars. The \$1 billion figure comes out of NHTSA's corrected study. And in this package there is a letter that goes through and details exactly how that is derived. The exact figure is \$1,165,000,000. That is the NHTSA study that was submitted on February 26. It simply applies those numbers to market shares and calculates it in terms of 11 million vehicle years, and it uses the Consumer Price Index to bring that up to current 1979 dollars. I might also add that that figure itself is conservative. It is based upon 65-cent-per-gallon gasoline. NHTSA's own published advance notice of proposed rulemaking indicated that no matter what the material, a 5-mile-per-hour standard is going to cost more fuel than a 2½-mile-per-hour standard. And with the recent announcement in OPEC of a 9-percent increase in our crude oil imports and possible surcharges on top of that, I don't know where anybody could get 65-cent-a-gallon gasoline around here. I would buy all I could if I could find it around here at that price. I think the price of gas is going up and therefore that \$1 billion figure will go up too. Quite apart from Houdaille, that seems to me a very compelling reason for, as you say, letting the consumer have the benefit of that \$1 billion and the country have the benefit of that fuel which is now going down the drain. Till such time as the agency does a professional job and comes back and makes a convincing case that there is a basis for regulation, we will live with any standard that makes sense and stands up to inquiry. Until that time arrives, it seems to us it is a proper congressional role to say let the consumers have the benefit of freedom from this kind of regulation without justification.

Mr. SCHEUER. As I understand it—and I am directing this to the insurance company representative—if the standard is rolled back from 5 miles per hour to 2½ miles per hour there would be a substantial increase in insurance premiums, in the order of magnitude of perhaps \$6 billion a year. This would be necessary in order for the insurance companies to cover the additional damage that would occur in crashes at speeds between 2½ miles an hour and 5 miles an hour that wouldn't have resulted in damage with the 5-mile standard. No. 1 is this true? And No. 2, was this \$6 billion cost

to all insurance carriers factored into your cost-benefit thinking as well as the other studies?

Mr. SORENSON. Let me answer those in order. The \$6 billion figure I believe you are taking from some previous hearings in 1975. What we had at that time was a 2½-mile-per-hour standard.

Mr. SCHEUER. That is correct.

Mr. SORENSON. In our estimate, that is virtually a zero standard because prior to any standards that were promulgated by NHTSA at all, cars could meet about a 2½-mile-per-hour crash to barriers without substantial damage. Now, that \$6 billion figure refers to component damage of all kinds, not just bumpers themselves, which we have been talking about primarily here. So it was our estimate at that time—

Mr. SCHEUER. We are not talking about damage to the bumper itself in these cost-benefit studies. I assume we are talking about damage to the car: bumpers plus these other safety items, the lights, the whole thing, resulting from the accident.

Mr. COPAKEN. Absolutely.

Mr. SCHEUER. If we do not agree on that, I think we have to start completely from scratch, across the board.

Mr. SORENSON. I concur, then, with your comment, or I would continue to stand by the estimate made at that time, that that is the amount of damage that would be effected for all car years based upon going from a 2½- to a 5-mile-per-hour standard.

Mr. COPAKEN. Has there been a reduction in premiums of \$6 billion since the 5-mile standard went into effect? And the other question I would ask—

Mr. SCHEUER. Let's let him answer that one.

Mr. SORENSON. Which?

Mr. SCHEUER. Has there been a reduction in premiums since the 5-mile standard was introduced; and if so, how much annually?

Mr. SORENSON. Since the 5-mile standard has been introduced, the premium rate of increase, I think, is less than what it would have been. There is an increase, but certainly that is affected by a whole host of things other than the bumper. Let me give you one specific example. We all know inflation has been galloping along at a prettv rapid rate. Much of the car damage is covered by a deductible feature. What happens now is if it costs twice as much to repair a car as it did 5 years ago, we run through that deductible much more quickly. Therefore, because of this factor, because of the increased exposure, additional driving, so forth and so on, premium rates can be going up wholly apart from the bumper issue, and I think this has been the case. But it is our definite belief that the bumper standard has ameliorated the increase compared to what it would have been had we not had some sort of a standard in the intervening period.

Mr. COPAKEN. Mr. Chairman, it is very difficult to sit here and listen to this without jumping in, and I apologize if I do too many times. But on exhibit 1 of the State Farm chart, if you will look, they purport to show frequency going down with the introduction of the 5-mile-per-hour standard. But if you look at it with the 215 standard, yes, they show frequency going down. But if you look at the line on their own graph and just draw a line straight down from the 5-mile-per-hour figure, you can see that the frequency has

gone up, not down, since they have had a 5-mile-per-hour economic standard. And the other question I would ask the insurance company is to tell us precisely not just the frequency of accidents but the average cost of claims and the total claims, because we would concede that a 5-mile-per-hour standard would tend to reduce frequency somewhat, which we could understand would be a very keen interest to the insurance companies in terms of their profitability. But in terms of ultimate cost to the consumer, I think if the insurance companies search their computers they might find that the total amounts of claims have gone up as they are replacing these much more expensive 5-mile-per-hour systems.

Mr. SCHEUER. When you propose to come down from 5-miles to 2½-miles-per-hour, would this 2½-mile-per-hour standard you contemplate protect safety items such as directional signals, rear lights, the front radiator system, the exhaust system, and so forth, as did the 215 standard?

Mr. COPAKEN. Yes.

Mr. FERRARI. May I speak to this issue?

Mr. SCHEUER. Hold on. Could you give us any support for that or is it just a flat yes that it would include all those items?

Mr. COPAKEN. What I am saying is one could specify that in the standard. We feel that the companies could build to meet that specification. We wouldn't have any objection to that at all.

Mr. SCHEUER. Wouldn't that increase the cost of the 2½-mile-per-hour standard and therefore tip the cost-benefit balance?

Mr. COPAKEN. Well, Chairman Scheuer, listen to me. Would it tip the cost-benefit balance toward the 5-mile-an-hour standard?

Mr. COPAKEN. You raise a very important point, Mr. Chairman.

Mr. SCHEUER. That is what I am paid to do.

Mr. COPAKEN. You do it very well.

Mr. SCHEUER. Thank you.

Mr. COPAKEN. The so-called safety standard, I think, should be recognized for what it really is. It is not a safety standard. It never was a safety standard. It was promulgated as a safety standard when the agency wanted to expand its jurisdiction to get into economic property protection. They did not have the legislative authority, and they purported to.

Mr. DUGOFF. Mr. Chairman, I deny that. That is absolutely unfounded speculation.

Mr. SCHEUER. In Washington, it is the Congress who are the experts at empire building and jurisdiction. These fellows are innocent.

Mr. COPAKEN. Fair enough. But the point is that once you are at the point of collision, there is not much use of a windshield wiper or headlights, in other words. Under most State laws, if you have safety-related items damaged, you must repair them before you go back on the road. So the question is: Is it really a safety item to protect from the moment of impact until the end of the impact? I would argue with you that that is not a safety matter but a property matter. And I think that Congress—

Mr. SCHEUER. I would say in a 5-mile-per-hour or less collision, that is a property and economic and not a safety matter.

Mr. COPAKEN. And Congress recognized that when they enacted the 1972 act. So again, it is a property question, how much proper-

ty you want to protect and what the cost is versus the benefit. But I think your fundamental point is perhaps the most persuasive of all, Mr. Chairman, which is that unless there is an adequate justification, an adequate professional showing of a need for this kind of regulation, it seems to make sense to let the American public be free of this kind of burden until such time as the agency with all of its experts and all of its budget comes forward and makes a credible showing. They haven't done so. They never have. Even with the stimulation of this whole issue, they have not really come forward very persuasively.

Mr. FERRARI. Mr. Chairman, may I speak to this issue?

Mr. SCHEUER. Yes; and then you [indicating].

Mr. KELLEY. Thank you.

Mr. FERRARI. First of all, I would like to speak to the answer "yes." The answer "yes" is technically incorrect if you take with that proposal the proposal for barrier-only test methods. You cannot test for barrier only and still protect the safety-related items. So the answer "yes" cannot be true if it is joined with that test method. Second of all, I would like to speak to the more important and perhaps broader issue. Is the 2½-mile-per-hour benefits relative to this \$1 billion or energy savings or whatever? If the comparison of the 2½-mile-per-hour bumper had been the 1979 Firebird bumper which is on the road today, the benefits which would have been produced would have been unfavorable to the 2½-mile-per-hour bumper. The main point that we want to make is that the sample that this whole large study is based upon is invalid because it is not representative of current technology. What was shown today as a partial answer to the current technology question was the 1979 Chevrolet "B" body and the Houdaille proposal for a 2½-mile-per-hour bumper. What was not stated but which came out yesterday in questioning was that the 2½-mile-per-hour bumper shown by Houdaille has never been tested to show that it is indeed a 2½-mile-per-hour bumper. There is no valid comparison there between those two systems. It is based only on Houdaille's estimate, which, if you know these other estimates are any indication, is not extremely valuable in this area. Now, if you look at the Firebird, there will be a net cost benefit because it is equal in cost to the 2½-mile-per-hour system, and yet it saves 10 pounds, which will translate into energy dollars and gasoline dollars. And whatever dollar level you use for energy, it is immaterial. While I stress the Firebird, that applies to the aluminum systems and the new steel systems as well. There is a question that came up yesterday, and Houdaille in their reports and yesterday in response to the question talked about the robustness of their endeavor. When asked to define that, Dr. Roth defined that as a variation of plus or minus 25 percent. In our terms, looking at the new technology, that is not robust. We are talking about 00 percent change in the variation when you look at the new technology bumpers; not plus or minus 25, but minus 100 percent. So by our terms, the analysis is anemic, not robust.

Mr. O'REILLY. If I may—

Mr. KELLEY. Two points if I may, Mr. Chairman. Thank you. Comparing in the real world an existing 5-mile-per-hour bumper and what Houdaille cites as the 2½-mile-an-hour bumper, the AMC

Concord 28-pound total system, aluminum and shock mount bumper, is a 5-mile-an-hour 197 phase I system. The Houdaille 2½-mile system weighs 48 pounds. That is a comparison in the real world of a 5 and a 2½ that weighs substantially more.

But I want to make the other additional point. I did not like to see left on the table the notion that the former FMVSS 215, which is, after all, part and parcel now of part I—whatever is done to part I gets done to the safety standard having to do with bumpers—I didn't like to see lying on the table the notion that somehow that really was just an economic standard or even principally an economic standard. When cars are disabled, loss of their lights, loss of their windshield wipers, loss of radiators, brake lines, whatever occur in the equivalent of the so-called minor crashes, which happen to be the preponderance of crashes on the highway today—when their systems are disabled whether in a parking lot or a car-to-car collision, that may be at higher speeds but at very small closing speeds, if you see what I mean, where the relative difference between the speeds of the two cars on the highway may be only 5 miles an hour.

Mr. SCHEUER. They are going to continue to drive?

Mr. KELLEY. You are going to have a car that is down, a car which is a threat to the occupants of that car and to other people in other cars.

Mr. SCHEUER. And you say they are not going to take the car off the road until it is repaired?

Mr. KELLEY. They may right then be a hazard on the highway to themselves and others, as well as later on if they don't get the car repaired. We regard that as a serious safety implication and one which has not been addressed at all in any of these studies. To roll back 215 to 2½ miles per hour is to do something of unmeasurable but very important safety impact, and we hope NHTSA will look very closely to that in its rulemaking.

Mr. SCHEUER. We are going to have to suspend because I must get to this rollcall vote which is on—

Mr. O'REILLY. May I bring up one point?

Mr. SCHEUER. No; not right now. Can we finish this hearing now, or do you wish me to come back after this rollcall vote?

Mr. KELLEY. Whatever you wish is fine with us.

Mr. SCHEUER. Unless there is something very important which has not been said, we have been going 1½ hours over our schedule.

Mr. O'REILLY. I have one important thing to say, Mr. Chairman, if I may.

Mr. SCHEUER. Make it very brief.

Mr. O'REILLY. There has been a great deal of criticism on the weight and size of the Volare/Aspen bumpers, and I would just like to say for the record that before Chrysler chose that system on their car, they ran a competition with "soft-nosed systems to put on that car with an interest, and Davidson Rubber on my right, among others, competed in that competition and were unable to provide a system for the rear of that car that would meet the standards.

Mr. SCHEUER. Thank you very much.

[Whereupon, at 4:30 p.m., the subcommittee adjourned.]

