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"CURRENT AUTOMOTIVE SAFETY FEATURES"

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I appreciate this opportunity to discuss the subject of traffic safety and to highlight what the automotive industry is doing in this important field. My remarks today are related to the traffic safety efforts of the automotive industry rather than the efforts of any particular company in the industry.

My livelihood is in automotive engineering but my interest in safety is very personal. I want as much safety for myself and my family as you want for yours. A subject that important to each of us deserves our serious attention and action. But it is equally important that we consider this problem and our action on the basis of facts -- not emotionalism or wishful thinking.

Fact number one is that traffic safety is a very complex and far reaching social problem. There are no simple or quick solutions.

The variety of possible factors in an accident is staggering. In addition to the many possible car-driver-highway interactions, the accident situation can vary greatly in the number of vehicles or passengers involved, the direction of impact, and the forces and speeds. Passengers also vary considerably-- in size, shape and weight, as well as in driving ability and mental and physical condition. And how about the weather and the condition of the vehicles, particularly of older cars? All of these factors and others influence the judgment of the driver and the effectiveness of the actions he may take in an accident situation.

As manufacturers, our job is to engineer mass-produced cars and trucks capable of accomodating all these driver and operational variances with a maximum of safety. At the same time, these vehicles must provide convenient and dependable transportation and at prices customers are willing to pay.

Fact number two is that safety has been a prime objective in both the design and production of our automobiles since the beginning of our industry. Virtually every engineering advance over the past 60 years has contributed to the safety of our vehicles and those who use them.

However, further improvements in the safety characteristics of the car itself will not bring all the necessary advancements in traffic safety. Significant reduction in the number of deaths and injuries on our highways will come only if intensive efforts are devoted to all three parts of the safety triangle -- the car, the road and the driver.

For this reason, the automotive industry over the years has devoted extensive efforts to the improvement of highway safety on all fronts. This has included development and use of improved highway design concepts at our proving grounds, extensive support of driver education programs and cooperation with, and support of, a variety of safety organizations, government agencies and universities on the broad problem of highway safety.

While traffic safety has received increased attention recently from government, the press and the general public, the challenge is not new to us.

Essentially, the manufacturer has responsibility for only one part of the safety triangle - the vehicle - and that responsibility involves two basic elements: accident prevention and accident survivability. I would like to discuss each of these items in some detail.

Accident prevention is fundamental in traffic safety. Only if the accident does not occur can real improvement in traffic safety be expected. So, the automobile industry has devoted significant efforts over the years to building into our cars the capability of avoiding accidents.

This evolutionary process is evident in the advanced vehicle system of today's automobiles - brakes, lighting, visibility steering and suspension systems. The response of today's car to driver action is precise, quick and highly controllable. Our cars without question have the built-in potential to avoid accidents.

Here we see a portion of a brake test during which the brake system effectiveness is measured under conditions that cause severe heat build-up.

The dual master cylinder brake system protects the driver against a sudden loss of brake line pressure by providing separate hydraulic circuits to the front and rear brakes. In effect they become two complete systems, either of which will remain functional should the other experience a failure for any reason. Should a failure occur, the driver is alerted by a warning light located on the instrument panel.

The performance of tires, wheels and suspension systems is tested in high speed cornering situations like this.

Tire rims now incorporate what we call a safety hump or slightly raised area, which is shown in yellow on this slide. This hump is situated inside the tire bead and helps prevent the bead from breaking away from the rim during hard cornering.

In addition tires now incorporate a tread wear indicator bar to warn the owner that his tires are worn to the point of replacement. The tread wear bar is evident on the worn tire on the right in this slide.

Rearward visibility is maximized by the inclusion of inside and outside rear view mirrors which provide the driver with a wide angle of undistorted vision to the rear of his vehicle.

Improved vehicle lighting provides better visibility for the operator in addition to making his vehicle more readily distinguishable to other motorists.

Side marker lights and/or reflectors enable a motorist approaching your vehicle at right angles to see and orient himself with respect to the front and rear of your vehicle.

In addition, backup lights signal your rearward movement to an approaching motorist and provide light to improve rearward visibility while backing up at night.

The four way hazard warning flasher is a device which activates the front and rear turn signal lamps to warn other drivers of an emergency situation.

Thus far I have been discussing the things we do to insure the capabilities of our cars for avoiding accidents.

Now, let's examine in more detail the second major objective of automobile safety engineering which I mentioned earlier -- Accident Survivability. This deals with our efforts to provide features which reduce injury potential for passengers in the event an accident does occur. Efforts in this direction have made the car body a stronger basic container for people with more occupant protection inside.

When I talk about "Accident Survivability" I am primarily talking about occupant injuries which result from the "second collision.". This is a term with which some of you may be familiar. The "second collision' takes place between the occupant and the vehicle interior.

Not until after World War II did data processing equipment and ultra high speed recording cameras "arrive", so to speak, so that we could initiate more meaningful studies into human engineering factors or the reaction of the human element to collision.

Our work in the area of accident survivability has also been guided by statistical data taken from accident investigations.

Early reports of the Cornell automotive crash injury research indicated the relative frequency of injuries. Our efforts toward improvements in steering assemblies, instrument panels, ejection and windshields were intensified because they were high on the injury list. However, the leading cause of fatality at that time was ejection.

Occupant ejection occurs through either the door or glass areas. Accordingly the strength of door latches and hinges was increased and efforts were made to insure that the doors would not open during a collision situation.

Safety door locks were introduced for three important reasons. First they prevent accidental opening from the outside. Second they prevent intrusion from the outside and third they prevent accidental opening from the inside in an amergency situation.

I emphasize this point because it is vital to your safety. Ejection from the vehicle has been cited as the leading cause of traffic fatalities in one of the most authoritative accident studies ever conducted. Take advantage of safety door locks and latches by keeping all doors locked at all times.

The other highly successful innovation to control ejection has been the new windshield. Dr. Haddon referred to this windshield yesterday. This new windshield contains a clear plastic interlayer which forms a tough flexible membrane. It is twice as thick as the plastic interlayer in the old windshield and is attached less rigidly to the glass.

Here we have set up a demonstration to show the basic difference when a head impacts the windshield. The old glass was tough - quite a solid impact was required to crack it.

When the impact is more severe, the head breaks through the old glass. In other words, once cracked, it has very little resistance to penetration.

If the head goes through the opening, the splinters of glass wedge or cut deeply into the face and neck, both on the way through and on the bounce back.

Even more severe lacerations are experienced if the head encounters the sides of the jagged hole or bounces off its lower edge. This is shown here.

Now he breaks the new glass. It cracks at about the same impact load as the old glass. This is necessary, because if the glass were too hard the head would suffer concussion or even skull fracture.

In developing the new glass, an attempt was made to increase penetration resistance, to make the windshield act as a net - or rough rubber like material.

This windshield is saving thousands of people from severe injuries. Accident investigations have confirmed the development data - that there are injury reductions attributable to the new glass. Penetration resistance has been increased. Lacerations have been less severe and edge loading injuries, resulting from contact with broken glass after the windshield is penetrated have been reduced.

However, of all the safety features on the vehicle, none is more critical or fundamental than the restraint system; and this is the subject of a paper to be given tomorrow. Either the lap belt or the combination of lap and shoulder belt. Unfortunately customer acceptance is very low. Even though seat belts have been standard equipment for several years, they are more sat upon than used. Current surveys indicate a use rate of less than thirty percent.

Accident investigations verify beyond question that many people who are fatality statistics would be alive today if they had observed the simple ritual of buckling their belts. Driving or riding in a vehicle without seat belt protection is an unnecessary risk.

The lap-shoulder belt combination offers the possibility of additional protection by restraining the upper torso and thus reducing the chance of occupants striking the car interior in forward impacts. You can see here that the occupant is restricted from striking the windshield header, the windshield, the instrument panel and the pillar, the side pillar, the door pillar.

When properly adjusted, the restraint system need not restrict the driver's reach of essential controls. Lap belts should be worn snugly on the hips which have been shown to be one of the strongest parts of the body. Shoulder belts should have a little slack - about a hand's width between the belt and the body. One final reminder is that a separate shoulder belt should never be worn without a lap belt as there would be a tendency for the occupant to submarine out under the shoulder belt during a collision situation.

The protection of children during impact presents some unusual requirements. Special provisions are necessary because the child's size is continually changing, the bone structure is immature and the head is large and heavy in proportion to the rest of the body.

These slides represent two different designs of child safety seats which are currently available.

Analysis of steering wheel injury statistics cited the need for a steering device which would not penetrate into the passenger compartment during a frontal collision. As a result of these studies two different steering column design concepts have been developed. The first of these as shown here is called the energy absorbing steering column. This steering column and the reduction in injury attributable to it will be discussed in some detail by the speaker following. This view shows the energy absorbing steering column before and after a total collapse of 8 1/4 inches. In simple terms, the column compresses under heavy load, thereby reducing the impact forces on the driver's chest.

The second type of steering column designed to prevent penetration into the passenger compartment employs an offset in the column with a break-away joint. The steering column is the two-piece shaft shown in the lower part of this slide. It has a breakaway joint in the centre.

Padding is seldom criticized. Its main function is to distribute the impact forces over a larger area.

Relatively soft padding, such as foam material, easily indentable under thumb pressure, is often assumed to be the most effective. Here the intuitive approach is incorrect.

One obvious shortcoming of "too soft" padding is that it bottoms out too easily. This carries two penalties. It offers no shock absorption value or "ride-down" and secondly it does not distribute the load over a larger area, because it cannot carry a load.

Padding that is "too hard" is equivalent to no padding.

Optimum crushability requires an element that yields at a relatively high load, something short of the serious injury threshold, and it should deform at a uniform rate.

A second shortcoming of padding is that it must be quite thick to be effective. But, thick padding tends to arrest the head, or pocket, when hit at an angle, as shown in the upper sketch. This can actually increase rather than decrease the deceleration pulse on the head. There is also the more obvious problem of compromising visibility when thick padding is used on window and door pillars.

Instead, a good case can be made for using a layer of sheet metal having more conventional exterior dimensions than thick padding. This is shown in the bottom sketch. It not only eliminates the pocketing problem, but adds to the structural strength of the body.

On this cut-away model of a typical 1968 instrument panel, note that relatively thin padding is backed by a sheet metal base. In this design, impact energy is absorbed by the crush of the pad and its base through the air gap. Even the size and shape of the holes in the instrument panel itself are planned for optimum energy absorption. Many experiments and tests are required in the design of instrument panels that are soft enough to reduce injury, yet strong enough to support the steering column and reinforce the door pillars.

This cut-away view of a new seat back shows the combined use of padding and energy absorbing substructure in the head impact area.

This view of a safety armrest shows the full depth construction which extends downward to spread the load of impact and ensure that the armrest cannot penetrate the soft area between the bottom of the rib cage and the top of the hip bone. The armrest is also padded to minimize its lacerative potential.

In addition the door handle is protected from occupant contact by the safety armrest.

Window regulators have been redesigned to incorporate a soft vinyl knob and better deflecting characteristics on impact.

I have spent most of my time this morning talking about what the automotive industry is doing to 1) minimize the probability that you will become involved in an accident and 2) minimize the seriousness of the consequence if you should become involved in an accident.

I have also mentioned the other two parts of the traffic safety triangle - the road and the driver.

In order to emphasize that significant improvements in the field of traffic safety can only be accomplished by improvements in all three areas of the traffic safety triangle, I would like to close with a brief analogy between aircraft and automotive safety. The question is often asked "with the scientific know-how to put a man on the moon, why is it so difficult to get him from home to work and back without a traffic accident?" The recent successful launching of the Saturn V was certainly one of the engineering marvels of this century. The current big jets like the 707 or the DC 8 rank close behind. Those who conceived these complex vehicles fifteen years ago and had the confidence that these vehicles could carry 125 or more passengers at speeds over 600 miles per hour, 5 to 6 miles above the earth's surface are to be congratulated. However, in these systems, the designers felt that there were some guidelines which must be adhered to:

- The pilots must be in top physical and mental condition especially their eyesight.
- The pilots must not have had a drink for at least 24 hours prior to a flight.
- They must be highly trained in all phases of their job.
- They must have regular check-ups.
- The aircraft must be designed and manufactured to rigid government specifications.
- The aircraft must have regular, specific, thorough and documented maintenance with all systems in top repair before they are permitted to travel.
- The flying conditions must be acceptable for weather before the take-off is permitted while several men with sophisticated equipment guide the take-off.
- In the air, the craft must fly set routes with no bumper to bumper traffic, flying a few feet apart, cutting in and out.

When the automobile traffic situation is compared to this most precise means of transportation, the mathematicians skilled in systems analysis, looking at the traffic system as a whole, tell us that it is equally as complex. Then is when you consider that the drivers may be in any physical condition. They may be drunk or sober, trained or amateur, aggressive or defensive and so on. They are driving vehicles in various states of repair, within inches of other vehicles travelling in the same or opposite direction. With only limited communication between vehicles, and driving rules left largely to the discretion of the driver with little outside control or policing. The road systems may be narrow, with poor visibility at intersections, while the escape routes at the edges of the roads may be non-traversable. Of course, this must be done during all kinds of weather.

We all know that a steering wheel cannot steady the hand of the drinking driver, no windshield can clear his fogged vision, no mechanical marvel can compensate for his slow reaction time, no road, no matter how wide, can compensate for his erratic manoeuvres. Traffic safety cannot be purchased as a "kit of extras". But, to the extent that any of these things can be brought about, we have the task of providing them in their most practical form.

We like to think of it as we have shown in some of our more recent advertisements and I know I speak for all automobile manufacturers when I say this: "Safety comes first in the automotive industry". But remember, you are in the driver's seat.