the highway
loss reduction

STATUS REPORT

INSURANCE INSTITUTE
for Highway Safety

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Test Results Released

Car Designs Allow Crash Fire Hazard

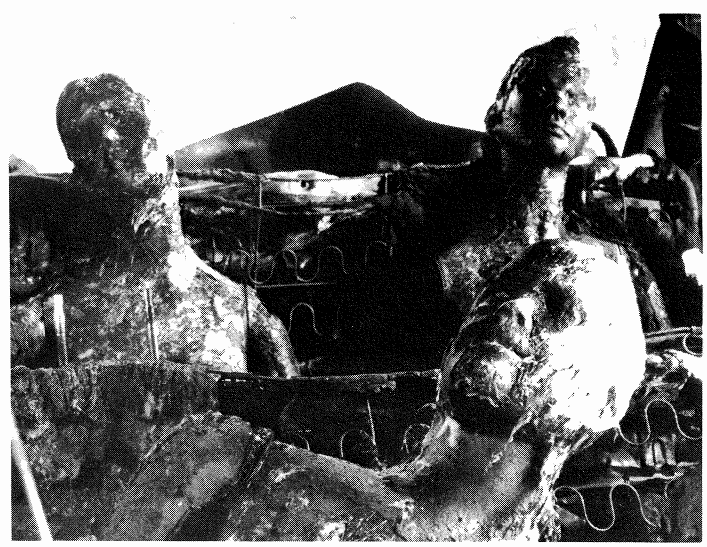
Fuel tank design deficiencies in even the latest model cars are needlessly exposing drivers and passengers to the possibility of death by burning in moderate-speed rear-end crashes – the kind of crash from which occupants otherwise would emerge with little or no injury.

Reporting on the results of a new Institute test series involving six moderate-speed rear-end crashes of 1973 cars, William Haddon, Jr., M.D., president of the Insurance Institute for Highway Safety, told a subcommittee of the House Commerce Committee that in every test, the impacted car's fuel system failed. "All six of the struck cars had gasoline pouring, gushing or leaking out," he said.

In one of the six crashes, he said, fire erupted spontaneously when "the crash itself provided the spark." In another, fire occurred when technicians provided a source of ignition – "a typical roadside flare."

The Institute decided to undertake the tests, Haddon said, "because we were alarmed by reports, cropping up all the time and in all parts of the country, suggesting that people are frequently, needlessly dying in fires that burst out during car crashes that otherwise would have resulted in little or no injury to those people."

Mute testimony to the hazard posed by inadequate fuel tank design, these manikins were charred by fire that spontaneously engulfed the 1973 Toyota Corona, in which they were riding, when it was crash tested.



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 Association, the National Association of Automotive Mutual Insurance Companies, the National Association of Independent Insurers

The tests, he said, were run with six pairs of new 1973 model cars "typical of those on the highway. The cars' occupants were human-form manikins – four in each car. Prior to testing, each car's fuel tank was filled with regular automotive gasoline and its engine, headlights and accessories were turned on. In each test, the moving car struck the parked one at a speed between 36 and 40 miles per hour, considerably lower than commonplace highway travel speeds. The target cars were parked with their foot brakes on, as if waiting at a stop light."

Haddon showed filmed results of the six crash tests, in which the fuel tank failed in each struck car:

1973 Plymouth Fury III sedan into a 1973 Chevrolet Vega: "During postcrash inspection, we found that in this impact, the Vega's design had allowed its own shock absorber bracket to penetrate and rupture its gas tank . . . (and) we found that the Vega's right front door was jammed – the sort of hazard that could have lethal implications for occupants in a crash fire."

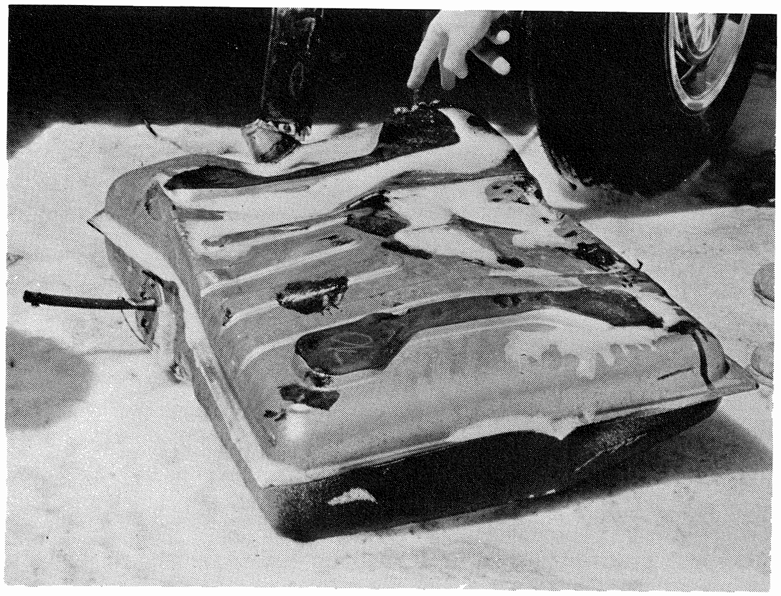
1973 Datsun 610 sedan into a 1973 Ford Pinto: ". . . because of the struck Pinto's design, a corner of its fuel tank was torn by its own differential housing structure in this crash – torn so severely that it leaked gas at the rate of more than a quart each minute."

(Cont'd on page 3)

INSURANCE INSTITUTE FOR HIGHWAY SAFETY
SUMMARY OF RESULTS
1973 MODERATE SPEED FRONT-INTO-REAR CRASH TESTS

MOVING CAR	PARKED CAR	SPEED	GAS LEAKAGE	FIRE
1973 Plymouth Fury III	1973 Chevrolet Vega	39.8 mph	Yes Vega	Potential
1973 Datsun 610	1973 Ford Pinto	38.5 mph	Yes Pinto	Potential
1973 Ford Galaxie 500	1973 AMC Ambassador	37.2 mph	Yes Ambassador	Potential
1973 Volkswagen Beetle	1973 Plymouth Fury III	38.8 mph	Yes Fury	Initiated
1973 Chevrolet Impala	1973 GM Opel 1900	36.4 mph	Yes Opel	Potential
1973 AMC Gremlin	1973 Toyota Corona	39.8 mph	Yes Corona	Spontaneous

NOTE: In addition to the moderate speed front-into-rear crashes of 1973 vehicles tabulated above, in an earlier pilot test a 1959 Oldsmobile 98 was crashed into the rear end of a 1964 Mercury Comet at 39.2 miles per hour. Spontaneous ignition occurred.



1973 Ford Galaxie 500 into a 1973 AMC Ambassador: "In this crash, the struck Ambassador's filler tube was allowed by the car's design to be torn from the hose that connects it to the fuel tank, and the tank itself was exposed to view . . . . A spark would have sent these cars up in flame literally in a split second. (See photo lower right.)

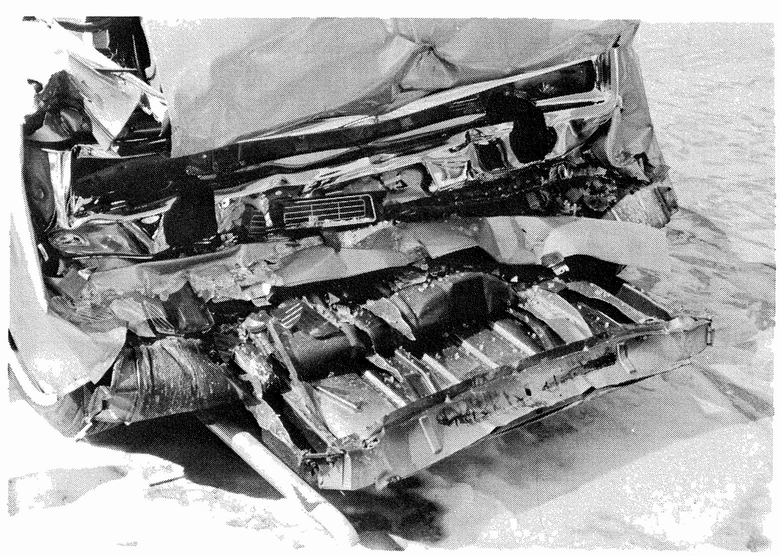
"Like all the test manikins, the ones in the Ambassador were safety belted. Had they been human, their belts probably would have kept them conscious and alert enough during the crash to escape right afterwards . . . only to find, if flames had suddenly engulfed the car, that the doors were jammed shut."

1973 Volkswagen Beetle into a 1973 Plymouth Fury III sedan: "The VW's tank survived its frontal impact into the Plymouth Fury with *no* fuel spillage. The struck Fury's tank, however, failed in the crash. Punctured by two bolts on the VW's license plate bracket, it spewed gas. . . .

"To find out how occupants in this fuel-spilling crash might have fared, we introduced an ignition source – a typical roadside emergency flare – less than a minute after impact. . . . Less than two minutes after the fire started, the fire fighters moved in to put it out. By then it was raging so fiercely that they needed minutes to bring the flames completely under control.

". . . The Volkswagen's gas tank was located in the front of the car, behind the spare tire. This tank was so designed that it successfully resisted damage. It remained intact during the crash, and even survived the fire without rupturing." (See photo, page 5.)

1973 Chevrolet Impala into a 1973 GM Opel 1900: "The Opel's tank, held in place by only one metal strap, was literally torn from the car and hurled to the ground, where it *spewed* gas from a number of failure points. (See upper left photo, page 3.) The tank (was) losing fuel at a rate of nearly a quart per minute. Both the striking Impala and the struck Opel are made by the same manufacturer, General Motors. In a company sponsored study of gas tank ruptures in 1968, GM engineers concluded that 'fuel tanks of General Motors cars are highly satisfactory."



"The inadequacies of its design allowed the Opel tank and its attachments to fail in a number of ways, any one of them a potential fire hazard: a severed fuel gauge line, severed fuel return and vent lines, the severed fuel filler, the broken tank strap and its bracket, and a hole in the tank itself, punched there by the Opel's own rear suspension mounting brackets. . . .

". . . both (the Opel's) right doors were jammed shut, greatly increasing the danger to occupants had the leaking gasoline erupted in flame."

1973 AMC Gremlin into a 1973 Toyota Corona: "Here's the Toyota tank. Design permitted it to rupture . . . a 3/8 inch hole that spilled enough fuel to start and feed a raging inferno. Its fuel cap was also torn off in the crash, creating another escape route for gasoline. . . .

"We did not initiate this fire – it started somewhere in the process of the crash itself, just as fires start in crashes on highways, unplanned, when a fuel system rupture combines with a momentary spark from electrical components, crash friction, road flares or some other source." (See photo, upper right.)

JAMMED DOORS

Recapping the results of the tests, Haddon pointed out that "the design and structure of five of those (struck) cars was so inadequate that one or more doors jammed on impact – doors that otherwise could have been escape routes for occupants. . . ."

He also pointed out that the cars were certified by their manufacturers as meeting the current federal safety standard for fuel tanks. "That standard (FMVSS No. 301) was issued in 1967. It covers front-end crashes, by requiring that in a front-into-barrier impact at 30 miles an hour, a car's tank and system lose no more than an ounce of fuel per minute. But today, six years after issuing its front-end standard, the U.S. Department of Transportation has still not set a standard for fuel tanks in rear-end crashes – the kind, as we've seen, in which these tanks were so vulnerable – not to speak of side, corner and roll-over impacts, in which fuel system failures also kill people.

"All the *striking* cars in our tests emerged without damage to the fuel tanks, including the one whose fuel tank is up front – the Volkswagen."

COUNTERMEASURES DESCRIBED

Haddon told the subcommittee that countermeasure approaches to the fuel tank design problem underscored by the Institute tests "are well known and straightforward. . . . There are many problems in the world for which we do not know solutions, but here is a problem that for many decades we have known how to handle." He gave these examples:

". . . the first approach is to build structure around the tank in such a way that impact forces are less likely to reach it with violence sufficient to cause rupturing, tearing and dislocation. In our tests, the structure behind and around the gas tanks proved in crash after crash, in vehicle after vehicle, to be so flimsy that it provided little protection for the tank itself. We also know that tanks can be made substantially more rugged, so that even when these forces reach them, they do not spill gas.

"And, there need not and should not be automobile designs that place hostile hardware, such as sharp bolts and sharp ridges, adjacent to the gas tank, with resulting rupture or penetration of the tanks in crashes. As you have seen in our tests, these sorts of designed-in threats to the integrity of gas tanks are commonplace.

"Fuel lines, filler pipes and vent lines also can be designed and made in ways that make them far less likely to shear or to break under the impact forces.

"In the event of rupture, thoughtful design can substantially reduce the likelihood of spark – and, therefore, of ignition of the gasoline – by, for example, better insulation and placement of electrical lines.

"And there are design approaches to stop the exploding gasoline from erupting into the passenger compartment and searing its precious human cargo. Chief among these approaches is the provision of fire-walls – protective shields that have been built into the fronts of cars for decades, but which are found on the rear ends of only a few vehicles now being sold in the United States. . . .

"This is a principle which, if applied, would stop one aspect of the present situation seen in our crashes and in tragedies all over, where the burning gasoline comes directly from a ruptured tank over or through the back seat upholstery and into the passenger compartment, as you already have seen in one of these crashes.

"Finally, if the design is a humane one, designs and structures are provided to insure that the car doors themselves do not jam under impact conditions, trapping the people inside and locking rescurers out. Nothing is so tragic – and yet they are seen over and over again – as situations in which people, screaming in terror and trying to get out of crashed cars as they are reached by the burning gasoline, find their escape routes cut off by designs that allow this kind of jamming."

Concluding, Haddon told the subcommittee:

"Nobody died in our test demonstrations. But out on the highway, thousands of people will die over the next several years in real-world demonstrations of the lethal design inadequacies represented by the gas tanks of even the newest cars. For years to come, tens of millions of cars with this frightening design deficiency will continue to be travelling – and crashing – on America's roads. No new federal standard can help their occupants. But a tough federal standard made effective promptly would help people in cars that will be made and sold in future years. For them, it's still not too late."

(Cont'd on page 6)

FURY FAILURE – The VW's front-end tank survived this crash undamaged, but the Plymouth's tank ruptured, allowing this blaze.

DOT ON NOTICE

Haddon pointed out that dozens of studies conducted or sponsored by DOT in recent years have given notice that automobile fuel tanks and fuel systems are failing, rather than resisting rupture, in even moderate-speed crashes – with fatal fire too often the consequence. He gave these examples:

1968

Car crash fire "constitutes a hazard that is responsible for more deaths than the lives lost in all types of commercial aircraft accidents annually." Fairchild Hiller, Experimental Safety Car Study, Phase I Final Report, Department of Transportation Contract No. FH 11-6820, Aug. 26, 1968.

1970

". . . about one in 24 collisions produced fuel leakage and/or collision fire." Vehicle Postcollision Considerations, a study of crashes in the Los Angeles area sponsored in part by the U.S. Department of Transportation and authored by A.W. Siegel and A.M. Nahum. Published in the International Automobile Safety Compendium, Society of Automotive Engineers, 1970.

1971

". . . the National Highway Traffic Safety Administration and the Automobile Manufacturers' Association (should) initiate programs leading to the development of automotive fuel-tank systems which will minimize the escape of fuel in collisions." Recommendation of the National Transportation Safety Board on the basis of multiple-vehicle collisions under fog conditions, followed by fire, on the New Jersey Turnpike on Nov. 29, 1969. Report NTSB-HAR-71-3, adopted Jan. 20, 1971.

"An unsafe condition is assumed to exist in the presence of any liquid or vaporized fuel spillage, as potential ignition may be assumed to exist at all times." In the event of fuel spillage in a crash, a fire may be sparked "not only from the electrical and exhaust sytstems of the vehicle, but also from outside sources . . . such items as a flame, for instance, from a burning tire, a lighted cigarette, sparks from a broken power line, and as a prime ignition source during collisions . . . sparks generated from scraping of metallic vehicle parts against the pavement." Johnson, N.B., An Assessment of Automotive Fuel System Fire Hazards, Final Report of Dynamic Sciences under Department of Transportation Contract No. DOT FH 11-7579, Dec. 1971.

1972

"The Board reaffirms that recommendation (for action by NHTSA and the Automobile Manufacturers' Association to make gas tanks more crashworthy) which is further supported by this report of a typical collision accident between two passenger automobiles." National Transportation Safety Board report on its investigation of a two-car collision on the Dulles Airport access road in 1971, in which fire occurred after one car struck another at an estimated speed of 15-20 miles per hour. Report NTSB-HAR-72-1, adopted March 15, 1972.

There has been "no significant reduction of vehicle fires in recent years . . . as highway speeds increase, the likelihood of fire becomes greater. . . .

"As long as motor vehicles use liquid combustible fuels, the hazard of fire will persist. But this hazard can be materially reduced by attacking both the spillage of fuel and the common ignition sources, since combustion requires both a readily ignitable fuel and ignition.

"Therefore, two main goals need to be considered in a systems approach to this problem:

"a. The limiting of fuel spillage . . . at present, fuel system components seem to be among the most vulnerable of all vehicle subsystems in terms of design, construction and placement, when vehicles are involved in crashes; and

"b. Better management of electrical ignition potentialties. . . .

"Both of these approaches are well within the state of the art and should require only direction and development to meet realistic performance parameters." National Transportation Safety Board conclusion on the basis of multiple vehicle collisions and fires in Ventura, Cal., on Aug. 18, 1971. Report NTSB-HAR-72-4, adopted July 6, 1972.

Fuel Tank Rule: A Study In Delay

Six years ago the U.S. Department of Transportation announced a plan to set a standard to protect fuel tanks and lines from fire-threatening rupture in rear-end and side crashes and rollovers. Somehow, the plan has never materialized. As Haddon said in his appearance before the House hearing: "The U.S. Department of Transportation, which has been on notice as to this problem for years, has been legally empowered for seven years under the National Traffic and Motor Vehicle Safety Act of 1966 to mandate a remedy by using a safety standard. Yet still, there has been no action.

- "In October of 1967, the department issued an Advance Notice of Proposed Rule Making (Docket 3-1, subsequently renumbered Docket 70-20) announcing its plan to set a standard to require 'lateral and rear end longitudinal collision tests, prevention of fuel spillage due to rollover, puncture-resistant fuel tanks, and protection of fuel lines and fittings.'

- ". . .In January of 1969, it issued a Notice or Proposed Rule Making – a more formal step that normally leads to a final standard – proposing that effective Jan. 1, 1970, every new passenger car be required to withstand a 20 mile per hour rear-into-barrier crash without hazardous fuel spillage.

- ". . .In subsequent 'Program Plans,' the agency revealed that it had no intention of putting the standard into effect before Sept. 1, 1976, if at all."

". . . Had that first step been taken – had the standard been adopted – today's new automobiles would reflect designs that tended to protect the integrity of fuel tanks in crashes and, therefore, to protect those cars' occupants against crash fires. But it was not taken," Haddon said.

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