

INVESTIGATION REPORT

PHASE I

C7 - 38

ALLEGED FUEL TANK AND FILLER NECK DAMAGE IN REAR-END
COLLISION OF SUBCOMPACT PASSENGER CARS

1971 - 1976 FORD PINTO
1975 - 1976 MERCURY BOBCAT

OFFICE OF DEFECTS INVESTIGATION
ENFORCEMENT
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

MAY 1978

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I. BACKGROUND

1.

A. BASIS FOR INVESTIGATION:

A formal defect investigation case was initiated on September 13, 1977, based upon allegations that the design and location of the fuel tank in the Ford Pinto make it highly susceptible to damage on rear impact at low to moderate closing speeds.

On August 10, 1977, a press conference was held in Washington, D.C., to announce the release of an article entitled, "Pinto Madness", which was published in the September/October issue of Mother Jones magazine. The article made several allegations concerning the safety of the Pinto fuel tank. The most significant of these charges as related to the National Highway Traffic Safety Administration's (NHTSA) defect investigation are as follows:

1. That the Pinto fuel tank is designed and located so that in rear-impact collisions at low to moderate speeds, it is displaced forward until it impacts the differential housing on the rear axle, resulting in tank cuts and/or puncture. The leakage of gasoline thus presents a significant fire hazard.
2. That the Ford Motor Company had knowledge of this "defect" during the developmental phase of the Pinto through its own test programs, but concluded that it was more cost-effective to produce the vehicle without modifications which would have corrected the problem but added to the production cost.

Investigation was initiated to determine whether the alleged problem constitutes a safety-related defect within the meaning of the National Traffic and Motor Vehicle Safety Act of 1966.

B. DESCRIPTION AND FUNCTION:

The Pinto fuel tank is of sheet metal construction and is attached to the undercarriage of the vehicle by means of two metal straps. In addition, the fuel filler tube extends into the top left side of the tank in a sliding fit through a gasketed opening. At its other end the fuel filler tube is affixed to the inner side of the left rear quarter panel by means of a bracket which is firmly attached to the quarter panel surface.

The fuel tank is the reservoir which holds the supply of gasoline required for engine operation. In the Pinto and Bobcat of model years in question, the tank capacity is approximately 11 gallons.

C. ANALYSIS OF THE ALLEGED PROBLEM:

MODE:

Allegedly, rear impact of the Pinto by another vehicle at low to moderate closing speed displaces the fuel tank forward until it is cut or punctured

2.

by the differential housing, or its bolts. Fuel tank filler necks pull out of the tank as well. The resulting fuel spillage may then be ignited, creating a fire hazard of obvious significance.

SYMPTOMS:

There are no symptoms to indicate the existence of the alleged safety hazard. The alleged problem addresses the rear impact crashworthiness of the Pinto and Bobcat which is exhibited only under collision conditions.

D. INVESTIGATIVE INPUTS AND ACTIONS:

Following public release of the article, "Pinto Madness", the NHTSA initiated, on August 11, 1977, a preliminary evaluation of the alleged safety defect, and on September 13, a formal defect investigation case. The following activities were undertaken in these efforts.

- A. The author of the magazine article, Mark Dowie, was asked to make available to the NHTSA, documentation and evidence upon which his article was based.
- B. Consumer letters, including Congressional inquiries on behalf of constituents, were received and appropriately processed.
- C. The National Center for Statistics and Analysis conducted a search of the Fatal Accident Reporting System (FARS) files, to compile relevant fatal accident statistics and data.
- D. The Ford Motor Company was requested to provide various technical and legal data concerning the matter.
- E. Contact was established and maintained with the Canadian Ministry of Transport (CMOT), which also initiated an investigation of the "Pinto Madness" charges.
- F. A test program of staged vehicle-to-vehicle rear-end collisions was developed and a contract awarded for the performance of these tests.

The details of the aforementioned sources of information, as well as NHTSA actions taken and the findings which resulted, are detailed in subsequent sections of this report.

II. PROBLEMS ALLEGED

A. REPORTS FROM CONSUMERS:

Since public release of the Mother Jones article, the NHTSA has received over 900 inquiries from the public concerning this matter. The defect investigation case file contains 54 letters and telephone contacts, including 18 Congressional inquiries on behalf of constituents. The Office of Public Affairs and Consumer Participation has received approximately 540 inquiries from Pinto and other vehicle owners concerning this matter, in addition to an estimated 30 inquiries from the media, and several inquiries from various consumer groups. The Auto Safety Hotline reported that an estimated 250 telephone inquiries have been received with no further contacts made with these consumers. In addition, over 40 telephone contacts have been made by ODI Staff personnel with various consumers, media representatives and with NHTSA representatives in Regional Offices. These contacts were generally non-contributory to the investigation in terms of furnishing factual data, and are not documented in the record.

Of the consumer letters and other inquiries, only one involved an actual report of a fire occurrence in a Pinto vehicle upon rear-end impact, not previously reported to the NHTSA through other sources. This particular instance involved a parked Pinto sedan of unknown model year which was rear-ended by a 1969 Pontiac Firebird in a residential area. The incident resulted in fire damage to both the Pinto and other real property, but no bodily injuries and/or fatalities were sustained.

B. REPORTS FROM FORD MOTOR COMPANY (FORD):

In response to the NHTSA's requests, Ford provided information concerning the number and nature of known incidents in which rear impact of a Pinto vehicle reportedly caused fuel tank damage, fuel system leakage or fire occurrence. This information disclosed the following:

Total Number Rear Impact/Fuel Leakage/Fire cases reported: 35
Lawsuits/Liability Claims: 29

Total Number injuries, including fatalities, reported in all vehicles: 107

Total Number injuries, including fatalities, sustained by Pinto occupants: 57

Total Number fatalities reported: 26

Number fatalities sustained by Pinto occupants: 25

Lawsuits/Liability Claims: 29
(Cases involving fires/burn injuries or claims of defective/dangerous fuel tank/negligence in fuel system design)

Number burn injuries: 23

Number fatalities reported (non-impact): 21

Number cases settled out of court or by judgement against
Ford/defendants: 8

Number cases pending trial: 19

Cases settled in favor of Ford/under investigation: 2

C. REPORTS FROM CANADIAN MINISTRY OF TRANSPORT (CMOT):

Since the initiation of this defect investigation case, two incidents have been reported to the NHTSA by the CMOT, involving rear-impact collisions of Ford Pintos which resulted in fires. These incidents resulted in one fatality, and two impact/burn injury cases.

D. SUMMARY OF PROBLEM REPORTS:

In total, the NHTSA is aware of 38 cases in which rear-end collisions of Pinto vehicles have resulted in fuel tank damage, fuel system leakage and/or ensuing fire. These cases have resulted in a total of 27 fatalities sustained by Pinto occupants, of which one is reported to have resulted from impact injuries. In addition, 24 occupants of these Pinto vehicles have sustained non-fatal burn injuries.

III. TECHNICAL DATA

The following technical data acquired from Ford and other sources has relevance to the design, materials, construction or performance aspect of the fuel tank installed in the 1971-1976 Pinto and 1975-1976 Bobcat.

1. The Pinto two-door sedan was introduced for sale in the United States on September 11, 1970, as a 1971 model year vehicle. A 1971 model year Pinto three-door version was introduced in February 1971. The station wagon model was introduced as a 1972 model year vehicle on March 17, 1972.

2. Production statistics for the pre-1977 Pinto are as follows:

Model Year	2-Door Sedan	3-Door Sedan	Station Wagon	Totals
1971	267,694	59,173	0	326,867
1972	171,616	187,657	96,221	455,494
1973	109,080	141,440	204,514	455,034
1974	120,911	159,999	217,351	498,261
1975	58,697	63,129	83,137	204,963
1976	<u>86,842</u>	<u>87,101</u>	<u>99,138</u>	<u>273,081</u>
Totals	814,840	698,499	700,361	2,213,700

3. Based upon R.L. Polk and Company statistics of vehicle registration as of July 1, 1976, it is estimated that 1.9 million Pintos of 1971-1976 model years are currently in use. These Pinto vehicles accounted for 2.0% of all registered cars as of July 1, 1976.
4. The 1971-1976 Pinto fuel tank is of sheet steel construction and is attached to the vehicle's rear undercarriage by two metal straps, with mounting brackets. The tank is located aft of the rear axle which, in the Pinto, may be one of two types; 6 3/4 - inch ring gear with integral carrier, or 8 - inch ring gear with removeable carrier. The rear differential cover on the 8 - inch axle is welded on, and employs no mechanical fasteners. The 6 3/4 - inch axle differential cover is attached by eight 5/16 - 18x0.62 hex head locking screws. The differential cover dome protrudes further aft than do the the screw heads, as follows:

	<u>Height of Fastener Head Relative to Adjacent Cover</u>	<u>Distance of Fastener Head Forward of Cover Dome Surface</u>
S.O.P. 1971 -	.314/.246	1.954/1.827
Approx. 3/71 - Model Year 1977	.313/.293	1.907/1.827

The outer edge of the differential cover dome also protrudes aft approximately 1/8 - inch, the apparent result of the dome forming process.

In answering NHTSA questions, Ford provided information concerning nominal distances from the forward surface of the fuel tank to the aft surface of the differential cover. While the true distance from the fuel tank body to the nearest point on the rear axle varies from one model year to another and from sedan to station wagon models, the 1971-1976 Pinto with the 6 3/4 - inch axle maintained this distance at approximately 3 inches. In the 1977 model year, this distance was increased by a minimum of 1 inch. It was also disclosed that the left shock absorber is located approximately equidistant from the fuel tank as the rear axle.

In this investigation, the fuel filler neck is considered to be an integral part of the tank. The filler neck is firmly attached by a flange with mounting screws, to the inner side of the left rear quarter panel. At its other end, the filler neck extends into the fuel tank through a gasketed opening in the left side of the tank.

Ford initiated 82 post-introduction engineering changes in the Pinto fuel tank, fuel filler neck, and associated hardware utilized for attaching the fuel tank to the vehicle underbody. Review of these data disclosed the following changes with potential relevance to the rear-impact crash performance of the fuel tank.

- . 1973 Station Wagon filler pipe - length of fuel filler pipe reduced by 0.50 inches at tank attachment end. Initiated at Job #1.
 - . 1977 Sedan and Station Wagon fuel tank shield - plastic shield added between fuel tank and straps. Initiated at Job #1.
 - . 1977 Sedan filler pipe assembly - filler pipe assembly lengthened to reduce fuel capacity by 1.3 gallons and vehicle weight by 8 pounds.
 - . Other engineering changes involved various items including tank capacity, filler pipe flange and seals, and tank straps and brackets.
5. According to Ford, Mercury Bobcat vehicles "... utilize essentially the same structures as Pintos of contemporary manufacture and their fuel systems and related components are identical to those employed in such Pintos."

Production statistics for the pre-1977 Mercury Bobcat are as follows:

Model Year	3-Door Runabout	Station Wagon	Totals
1975	14,605	17,851	32,456
1976	<u>20,212</u>	<u>21,207</u>	<u>41,419</u>
Totals	34,817	39,058	73,875

6. Prior to initial introduction of the Pinto for sale, Ford performed four rear impact barrier crash tests which included "...assessment of the post-impact condition of the fuel tank and/or filler pipe." These tests were reportedly conducted on "...experimental vehicles equipped with differing rear structure and fuel system designs proposed from time to time for incorporation in the Pinto..." Ford further reported that "...none of the tested vehicles employed structure or fuel system designs representative of structures and fuel systems incorporated in the Pinto as introduced in September 1970." These tests were conducted May 1969 through November 1969, utilizing a vehicle identified as a "Special Maverick."

Following initial introduction of the Pinto for sale, Ford continued a program of rear barrier impact tests on Pintos which included assessment of the post impact condition of the fuel tank and/or filler pipe. Reports of 55 rear barrier crash tests conducted "... on both production vehicles and vehicles with experimental components and/or modified structures..." were provided, including tests of Mercury Bobcats. While these tests were reportedly performed, in part, in connection with proposed NHTSA rulemaking activities, three items developed a history of consistent results:

- a. At impact speeds as low as 21.5 miles per hour with a fixed barrier (Crash Test No. 1616), the fuel tank was punctured by contact with the differential housing and/or its bolts, or with some other underbody structure.
- b. Under similar test conditions as (a), above, the fuel filler neck was pulled out of the tank completely.
- c. Again, under similar test conditions as (a), above, structural and/or sheet metal damage to the vehicle was sufficient to jam one, or both of the passenger doors closed.

Among the experimental and other modifications studied in these tests were:

- . Use of rubber bladder with locally reinforced textured nylon patches in "puncture prone areas", installed inside steel tank

- . Modification of filler pipe attachment to the left rear quarter panel and fuel tank to prevent pull-out during impact.
- . Installation of plastic shields on the fuel tank immediately aft of the differential housing.
- . Modified exhaust system with muffler located behind the rear axle.
- . Fuel tank made of molded polyethylene.
- . Increased length of fuel filler neck extending inside the tank.
- . Modified rear underbody structure and reinforced rear quarter panels.

Review of the test reports in question suggested that Ford had studied several alternative solutions to the numerous instances in which fuel tank deformation, damage or leakage occurred during or after impact.

IV. MAJOR NHTSA INVESTIGATIVE ACTIONS

A. EXAMINATION OF ACCIDENT STATISTICS:

A search of the NHTSA's Fatal Accident Reporting System (FARS) file was conducted by the National Center for Statistics and Analysis, Research and Development. Search of the automated FARS file provided information on fatal accidents for approximately 2 1/2 years of data collection. A purpose of the search was to determine whether Pintos had been involved in rear-end fatal crashes with fires.

In terms of the purely quantitative data, the following tabulations specifically applicable to the Pinto were disclosed by the FARS examination (covering 1975, 1976 and approximately half of 1977):

. Total Number Fatal Pinto Accidents Due to All Causes, 1975-1977	1,626
. Total Number Pinto Occupant Fatalities in Accidents Due to All Causes, 1975-1977	1,417
. Total Number Fatal Pinto Accidents with Fire, 1975-1977	33
. Total Number Pinto Occupant Fatalities in Accidents with Fire, 1975-1977	41
. Total Number Fatal Pinto Accidents with Rear End Collision, 1975-1977	95
. Total Number Pinto Occupant Fatalities in Accidents with Rear End Collision, 1975-1977	72
. Total Number Fatal Pinto Accidents with Rear End Collision and Fire, 1975-1977	11
. Total Number Pinto Occupant Fatalities in Accidents Rear End Collision and Fire, 1975-1977	17

The data show that rear-end collisions of Pinto vehicles have resulted in fires and fatalities. This fact is substantiated by the historical details of various litigation cases.

VII. CONCLUSIONS

Based upon the information either developed or acquired during this investigation, the following conclusions have been reached:

1. 1971-1976 Ford Pintos have experienced moderate speed, rear-end collisions that have resulted in fuel tank damage, fuel leakage, and fire occurrences that have resulted in fatalities and non-fatal burn injuries.
2. Rear-end collision of Pinto vehicles can result in puncture and other damage of the fuel tank and filler neck, creating substantial fuel leakage, and in the presence of external ignition sources fires can result.
3. The dynamics of fuel spillage are such that when impacted by a full size vehicle, the 1971-1976 Pinto exhibits a "fire threshold" at closing speeds between 30 and 35 miles per hour.
4. Relevant product liability litigation and previous recall campaigns further establish that fuel leakage is a significant hazard to motor vehicle safety, including such leakage which results from the crashworthiness characteristics of the vehicle.
5. The fuel tank design and structural characteristics of the 1975-1976 Mercury Bobcat which render it identical to contemporary Pinto vehicles, also render it subject to like consequences in rear impact collisions.

B. NHTSA CRASH TEST PROGRAM

On September 30, 1977, a Request for Proposals was issued in order to select a contractor to perform a series of staged vehicle-to-vehicle crash tests at moderate speeds. The program was designed to generate data and to document the results of specified rear impact collisions under actual driving conditions. The stationary vehicles were specified as Pintos, Chevrolet Vegas, and full size sedans, with the moving vehicles to be identical full size sedans. The program required that the fuel tanks of the stationary vehicles be filled to at least 95% of rated capacity, and that the engines of both stationary and moving vehicles be running and at normal operating temperature at the time of impact. In addition, the brake lights were illuminated on the stationary vehicle at impact. Other test variables included:

- . Speed and attitude of the moving vehicle
- . Illumination of headlights on the moving vehicle
- . Angle and parallelism of vehicles at impact

The contract was awarded to Dynamic Science, Incorporated, in Phoenix, Arizona, and testing commenced on February 1, 1978. As originally designed, the test program involved 6 Pintos, 6 Vegas, and 3 full size vehicles for use as stationary cars. The program was subsequently amended to include 4 Pintos of 1974-1976 model years and 2 Pinto Station Wagons. Other changes in test requirements were made as the program progressed; these are identified in the matrix of test results attached as Figure 2, to this report. In its final form, the program entailed:

11 Full size vehicles/Pinto tests

1 Pinto/fixed barrier test (tank filled with Stoddard solvent)

5 Full size vehicle/Vega tests

1 Vega/fixed barrier test (tank filled with Stoddard solvent)

1 Full size vehicle/Full size vehicle test

--- 19 Total tests

The results of the tests are summarized in Figure 1. Therein, it is noted that in two Pinto tests with the full size vehicle travelling at 35 miles per hour, fires resulted. In similar tests at 30 miles per hour, significant leakage of the Pinto fuel tanks resulted without fire. A significant finding in the test program was the fact that the design of the Pinto fuel filler pipe resulted in its being completely dislodged from the tank in some cases. Impacts sufficient to result in puncture/tearing of the

fuel tank generally resulted in leakage of fuel in a pouring fashion. Separation of the filler neck from the tank provided a fuel spillage mechanism in a wide dispersion fashion.

No fires were produced by the tests involving Vegas and full size vehicles as stationary cars.

All of the tests were documented by high-speed and normal speed color motion pictures, as well as by still photography following impacts.

V. OTHER NHTSA ACTIONS

The following are other actions taken by the NHTSA.

A. MEDIA AND CONSUMER GROUPS:

On August 11, 1977, the first of several letters was sent to Mr. Mark Dowie, author of the Mother Jones article, requesting that he make available to the NHTSA, documentation and evidence upon which his article was based.

Because of the sensitivity and widespread media attention given to the Mother Jones article, as well as to the settlements of two related lawsuits during the course of this investigation, specific requests to various media and consumer organizations for information were generally not made. Efforts were expended, however, in cooperating with the media and consumer groups to advise them of the nature, scope and status of the NHTSA's investigation. Included among the organizations contacted were the Center for Auto Safety, ABC-TV Evening News, and various television stations and newspapers.

B. RECORDS CHECKS:

1. Vehicle Owner Letter File

The NHTSA's motor vehicle owner letter file, initiated in September 1966, contains all letters and telephone contacts received from all sources reporting defects and other problems with motor vehicles. At present, approximately 2,500 documents enter this file each month.

All letters received by the NHTSA in specific reference to this investigation were noted in Section II.A., of this report.

2. NHTSA Motor Vehicle Defect Recall Campaign Log

The log contains the make, model, year and a brief description of the defect for all safety defect recall campaigns reported to the NHTSA by manufacturers in accordance with the Act of 1966.

A check of the Campaign Log disclosed that at least 17 previous recalls have been conducted for correction of various specific problems that could allow fuel leakage from the fuel tank/filler neck/cap. Of note is Campaign No. 77V048, in which General Motors recalled 128,700 1968-1970 Opel Kadetts for correction of an uncovered tail-light mounting bolt which could puncture the fuel tank in low speed right rear impacts.

In Campaign No. 77V114, the Ford Motor Company recalled 642 1977 Pintos for replacement of an erroneously installed U-nut on the inboard rear attachment of the rear bumper isolator. The edge of the U-bolt could possibly contact and puncture the fuel tank.

3. Technical Reference Library

A search of the Technical Reference Library filed was conducted for information and publications relevant to this investigation. This search disclosed that previously cited Pinto recall campaign (77V114), as well as three others which could involve possible fuel leakage and fire potential.

A review of all Pinto Standards Enforcement Tests disclosed that a 1976 Pinto Pony MPG failed to meet the requirements of FMVSS 301, Fuel Systems Integrity.

4. Canadian Ministry of Transport (CMOT)

On September 30, 1977, a 1974 Pinto was involved in a rear-impact, fatal fire accident in Windsor, Ontario, Canada. The Pinto was impacted by a 1976 Chevrolet Impala in a braking attitude and forced into the rear of a 1976 Mercury Monarch. The fuel tank of the Pinto was punctured or torn in several locations, the filler neck pulled out completely, and the vehicle was completely engulfed by fire. One of the two Pinto occupants sustained fatal injuries.

The CMOT acquired possession of the Pinto and performed a thorough inspection of the vehicle on November 29 and 30. This inspection was attended by NHTSA and Ford representatives.

On February 24, 1978, the CMOT reported the occurrence of a rear impact with fire incident involving a 1973 Pinto. The single Pinto occupant was attempting engine repairs when the vehicle was struck by a 1976 Plymouth Volare reportedly travelling at 35 miles per hour. A report of the incident, with photographs taken within seconds after the collision by a nearby pedestrian, was furnished to the NHTSA on March 30, 1978.

VI. OBSERVATIONS

The fuel tank and filler pipe assembly installed in the 1971-1976 Ford Pinto is subject to damage which results in fuel spillage and fire potential in rear impact collisions by other vehicles at moderate closing speeds.

When impacted from the rear by other vehicles at moderate closing speeds, the Pinto fuel tank may be punctured, cut or torn, by contact with the rear axle differential housing assembly, the left shock absorber and/or its lower bracket, or by other vehicle rear underbody components.

In nine staged collision tests of 1971-1976 Pinto 2-door sedans and 3-door runabouts impacted by 1971 Chevrolet Impalas at closing speeds of 30 and 35 miles per hour, two tests resulted in fires. In all of the remaining seven tests, fuel tank damage occurred with fuel leakage rates ranging from 6 to 700 ounces per minute, with an average rate in excess of 240 ounces per minute.

In one test of a 1972 Pinto towed rearward into a fixed barrier at 21.5 miles per hour, the fuel tank sustained damage and the filler pipe pulled out of the tank. Fuel leakage was measured to exceed 12 ounces per minute.

In tests of 1 ea., 1972 and 1976 Pinto station wagons, no significant fuel leakage rates were measured. Similarly, no punctures or tears of the fuel tanks were caused, and the fuel filler pipes did not completely pull out of the tanks.

Data from the Ford Motor Company indicates that at least 35 rear-end collisions of 1971-1976 Pintos have occurred in the United States, in which fuel tank damage and/or fuel leakage and/or fires have resulted. These incidents have resulted in at least 25 fatalities and 23 cases of non-fatal burn injuries.

Data from the Fatal Accident Reporting System disclosed that from January 1975 through approximately June 1977, 33 fatal Pinto accidents occurred that involved fire, and resulted in 41 Pinto occupant fatalities. During this same period of time, 11 fatal accidents occurred in which Pintos were impacted from the rear and fires resulted; 17 Pinto occupants sustained fatal injuries in these cases.

Since initiation of this investigation, two cases have occurred in Canada involving rear impact of Pintos which resulted in fuel tank fires. These occurrences resulted in 1 fatality and 1 burn injury case.

In the history of product liability actions filed against Ford and other co-defendants involving rear impact of Pintos with fuel tank damage/fuel leakage/fire occurrences, nine cases have been settled. Of these, the plaintiffs have been compensated in 8 cases, either by jury awards or out of court settlements.

These data were recognized to be subject to qualifications and amplifications. Basically pertinent among these are the following:

- . Make/model information in FARS comes from two sources: vehicle registration data and automated decoding of the Vehicle Identification Number. Therefore, a particular car was identified where either one of these two sources indicated it to be the make/model in question.
- . Fire/explosion is not a standard data element on most police reporting forms, unless a non-collision fire caused an accident. Thus, FARS coding of fire is due primarily to its specific mention, if any, in the officer's accident description. In addition, FARS data do not indicate the origin of the fire.
- . If a death due to burns occurred sometime after the crash, it is less likely that it would be reported on the officer's accident report.
- . FARS does not record the cause of death, only its fact; it does not distinguish between deaths due to impact and those caused by the fire.
- . The FARS cases examined disclosed limited availability of data necessary to establish accurate pre-impact closing speeds.