General Motors Engineering Analysis 1972

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PRESENTATION ON FUEL SYSTEM INTEGRITY

A recommended level of fuel system performance is given for front, side and rear impacts, and rollover, premised on the concept that occupants involved in collisions which produce occupant impact forces below the threshold level of fatality should be free from the hazard of post-collision fuel fires.

RECOMMENDATIONS

1. As a long range goal, all GM vehicles should be equipped with a fuel system which will not leak during and after impact, when the vehicle is subjected to a 30 mph side moving barrier impact.

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BENEFITS

1. This level of fuel system performance would have eliminated 75% of the leakages and four out of eight fires in the data shown in the 1970–71 MIC Occupant file.

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CLOSING

1. Lawsuits where fire is involved can be costly. Including wins, settlements, and losses, the average cost per lawsuit is approximately one-half million dollars. This is about ten cents per passenger car in a five million unit production year.

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4. The level of fuel system performance recommended herein would have eliminated 20 of 28 lawsuits (75%).

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6. Seventy-five percent of the estimated 60 lawsuits should be prevented by the recommended performance level. This would represent a 22.5 million dollar savings, or about $.90 per passenger car based on 25 million units built during the five year period.

7. Should the cost of achieving this level of performance be less than $.90 per vehicle, a net savings would accrue to the Corporation.

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ABSTRACT OF PRESENTATION ON FUEL SYSTEM INTEGRITY

A recommended level of fuel system performance is given for front, side and rear impacts, and rollover, premised on the concept that occupants involved in collisions which produce occupant impact forces below the threshold level of fatality should be free from the hazard of post-collision fuel fires. A recommendation is made to examine and, if warranted, control the vehicle electrical system as a possible source of fuel ignition if fuel leakage occurs above the recommended fuel system performance levels. The benefits available from the achievement of these performance levels are show, including the possibility of realizing potential cost savings.

INTRODUCTION

1. Present vehicle or vehicle component performance specifications relating to minimizing deaths and injuries are based on human tolerance to impact. Generally speaking, there are acceptable levels of injury resulting from impact in automobile collisions. Examples are the 80 g/3 ms requirement for the instrument panel and seat backs and the 2500# requirement for the E.A. column. Furthermore, test conditions to determine compliance with these specifications based on such injury levels can be duplicated. We are not aware of any acceptable level of burn injury resulting from fire in motor vehicle collisions. Even assuming for the moment that there is an acceptable level of burn injury, a fire cannot be completely controlled so that we could assure compliance with a specification based on this acceptable burn injury level. Therefore, the recommended performance level which follows is given in terms of a fuel system performance specification unrelated to human tolerance to burn injury.

2. Any fuel leak represents a potential fire hazard to the occupants. Therefore, a standard established to minimize the hazard of fire should be directed towards preventing fuel leaks. Additional work to reduce or eliminate the electrical system as a possible source of ignition during, or immediately after the collision should a leak occur will effectively supplement this standard.

3. The potential for a fire, i.e., fuel leaks, should not occur in collisions which produce occupant impact forces below the threshold level of fatality. Above this level of severity, fatal injuries occur from various causes, including fire.

4. It is recognized that the recommended performance levels included herein exceed the present day state of the industry. Accordingly, the recommendations are made as long range goals.

FRONT IMPACT

1. Fatalities are not likely to occur in today's cars to an occupant using a lap belt and shoulder harness in a collision with a severity level below a 30 mph front fixed barrier impact. [GM response USG 656, Nov. 2, 1971 commenting on Occupant Crash Protection].

2. Based on the 1970-71 MIC Occupant file, 90% of the occupants involved in injury producing frontal accidents were subjected to accidents less severe than an equivalent 30 mph front fixed barrier impact.

RECOMMENDATIONS

1. As a long range goal, all General Motors passenger cars should be equipped with a fuel system which will not leak during and after impact when the vehicle is subjected to a 30 mph front fixed barrier impact.

2. Recognizing that there are practical limits in controlling fuel leakage, and further recognizing that electrical equipment on the automobile may become a cause of ignition, additional gains may be derived from controlling the electrical system as an ignition source. Accordingly, the passenger car electrical system should, as a long range goal, be examined and, if warranted, removed as a possible ignition source if fuel leakage occurs at any impact level above a 30 mph front fixed barrier impact.

BENEFITS

1. With the recommended level of fuel leakage control, approximately 65% of the fuel leakages listed in the 1970-71 MIC Occupant file would have been prevented, and nine out of 15 fires eliminated.

2. With the same level of fuel leakage control, two out of four of the Class I lawsuits in our files involving fire and front impact would have been eliminated.

3. It is expected that a further reduction in fires and lawsuits would result from controlling the electrical system as a possible source of ignition if fuel leakage occurs above the recommended level of fuel leakage control.

REAR IMPACT

1. Based on the data in the 1970-71 MIC OCcupant file, the threshold of occupant fatality due to rear vehicle impact is above the point where severe deformation of the vehicle takes place (50" to 60" of crush). These cases are classified as extreme accidents in which considerable intrusion of the passenger compartment occurs, and are clearly above the practical limits for controlling fuel leakage.

2. A 45 mph moving rear barrier impact, which is equivalent to a 30 mph fixed barrier impact, would provide the same minimum performance level to the front and rear of the vehicle.

3. Based on the 1970-71 MIC Occupant file, 90% of the occupants involved in injury producing rear accidents were subjected to accidents less severe than an equivalent 45 mph rear moving barrier impact.

RECOMMENDATIONS

1. As a long range goal, all GM model passenger cars should be equipped with a fuel system which will not leak during and after impact when the vehicle is subjected to a 45 mph rear moving barrier impact. (Equivalent to a 30 mph fixed barrier impact.)

2. Recognizing that there are practical limits in controlling fuel leakage, and further recognizing that electrical equipment on the automobile may become a cause of ignition, additional gains may be derived from controlling the electrical system as an ignition source. Accordingly, the passenger car electrical system should, as a long range goal, be examined and, if warranted, removed as a possible ignition source if fuel leakage occurs at any impact level above a 45 mph rear moving barrier.

BENEFITS

1. The recommended level of fuel leakage control would have eliminated approximately 67% of the fuel leakages and two out of five fires based on the 1970-71 MIC Occupant file.

2. The same level of fuel leakage control would have prevented 16 out of 21 Class I lawsuits involving fire and rear impact. The balance of the lawsuits involved vehicles with extremely severe rear crush and significant intrusion of the passenger compartment which would, according to an ACIR definition, classify the accident as non-survivable.

3. It is expected that a further reduction in fires and lawsuits would result from controlling the electrical system as a possible source of ignition if a fuel leakage occurs above the recommended level of fuel leakage control.

SIDE IMPACT

1. Proving Ground experience with side moving barrier impacts to the rear quarter at speeds up to 30 mph shows that crush to the target vehicle rarely exceeds 15 inches. The most ever experienced was less than 20 inches.

2. The level of impact at which fatalities start to occur in side impacts to the door area with vehicles equipped with the side guard beam is thought to be approximately 45 mph. This impact resulted in 18 inches of crush in the door area of a "B" size car. This impact level at the door area will produce less or at the most equal crush to the vehicle rear quarter.

3. Twenty inches of crush in the rear quarter is approximately equivalent to a 30 mph moving barrier impact centered at the rear quarter.

4. Based on the 1970-71 MIC Occupant file, 90% of the occupants involved in injury producing side collisions were subjected to accidents less severe than an equivalent 30 mph side moving barrier impact.

RECOMMENDATIONS

1. As a long range goal, all GM vehicles should be equipped with a fuel system which will not leak during and after impact, when the vehicle is subjected to a 30 mph side moving barrier impact.

2. Recognizing that there are practical limits in controlling fuel leakage, and further recognizing that electrical equipment on the automobile may become a cause of ignition, additional gains may be derived from controlling the electrical system as an ignition source. Accordingly, the passenger car electrical system should, as a long range goal, be examined and, if warranted, removed as a possible ignition source if fuel leakage occurs at any impact level above a 30 mph side moving barrier.

BENEFITS

1. This level of fuel system performance would have eliminated 75% of the leakages and four out of eight fires in the data shown in the 1970-71 MIC Occupant file.

2. The same level of fuel system performance would have prevented all of our Class I lawsuits (three) involving side impact and fire, since the vehicles involved had less than 20 inches of crush.

3. It is expected that a further reduction in fires and lawsuits would result from controlling the electrical system as a possible source of ignition if fuel leakage occurs above the recommended level of fuel leakage control.

ROLLOVER

Rollover as a principle mode of collision represents:

1. Two percent of all accidents and accounts for 19% of all fatalities occurring in these accidents.

2. In addition, rollover as a subsequent event of a front, rear, or side collision is not documented extensively, but a Safety Research and Development Laboratory-MIC data analysis indicates that less than 1% (.4% and .9% respectively) of rear and front impacts result in a secondary rollover.

3. Injury due to rollover and the hazard of fire due to fuel leakage in rollover collisions is not well documented. However, an early Cornell study indicates:

   A. Should an accident occur where fire results from the collision, 23% of the occupants exposed to the fire in rollover accidents would have been fatally burned as compared to 4% and 3% in front and rear impact accidents, respectively.

   B. 26% of the occupants in rollover-fire accidents suffered burn injuries compared to 11% and 17% in front and rear impact fire accidents, respectively.

4. The current level of public interest as expressed by NHTSA in MVSS 208 and the proposed revision to MVSS 301 indicates future requirements may be established which would affect the occupant survivability level and fuel system integrity during rollover accidents.

RECOMMENDATIONS

1. As a long range goal, all GM model passenger cars should be equipped with a fuel system which will not leak after being subjected to impact specified for front, rear, and side impact directions and when rotated to a completely inverted position about its longitudinal axis.

2. Recognizing that there are practical limits in controlling fuel leakage, and further recognizing that electrical equipment on the automobile may become a cause of ignition, additional gains may be derived from controlling the electrical system as an ignition source. Accordingly, the passenger car electrical system should, as a long range goal, be examined and, if warranted, removed as a possible ignition source if fuel leakage occurs upon inversion of the vehicle.

BENEFIT

1. Provide General Motors with a more comprehensive plan for fuel system and electrical system performance with a view towards minimizing the hazard of post-collision fires in impact and/or rollover accidents.

CLOSING

1. Lawsuits where fire is involved can be costly. Including wins, settlements, and losses, the average cost per lawsuit is approximately one-half million dollars. This is about ten cents per passenger car in a five million unit production year for each Class I fire lawsuit filed against General Motors.

2. In the period between 1966 and 1969, six Class I lawsuits involving a post collision fuel tank fire were filed against GM.

3. In 1970-71, 25 Class I lawsuits involving a post collision fuel tank fire were filed against GM.

4. The level of fuel system performance recommended herein would have eliminated 20 of 28 lawsuits (75%) where there was sufficient data to make such a determination.

5. It is estimated that 60 Class I lawsuits involving a post collision fuel tank fire will be filed against GM in the next five years. This represents future costs of doing business of thirty million dollars.

6. Seventy-five percent of the estimated 60 lawsuits should be prevented by the recommended performance level. This would represent a 22.5 million dollar savings, or about $.90 per passenger car based on 25 million units built during the five year period.

7. Should the cost of achieving this level of performance be less than $.90 per vehicle, a net savings would accrue to the Corporation. It is recognized there may be a possibility of non-uniform performance levels among the different car lines, and any variance in performance could provide for more or less potential savings per vehicle depending on the modifications required to meet this recommended performance level.

SUMMARY OF BENEFITS

1. Minimize the hazard of post collision fuel tank fires.

2. Reduction in the number of lawsuits which GM would otherwise have to defend, and provide GM with a plan for fuel system integrity which would enable it to better defend those post collision fire lawsuits which would not have been prevented by this recommended level of fuel system performance.

3. Provide GM with an opportunity to realize a potential cost savings.

4. Reduce adverse publicity associated with lawsuits which would result in intangible savings.