C15 Fuel Tank and Filler Neck Modifications to Improve Vehicle Crashworthiness

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The goal of this presentation is to present an objective, scientific demon- stration of how a real-world collision was evaluated, defects were identified, alternative designs were developed, and dynamic testing was conducted to validate those designs.

This study impacts anyone who rides in a vehicle equipped with an internal combustion engine using volatile fuels like gasoline. This study will impact the forensic science community by showing the hazards of fuel system failure and its effect on vehicle occupants. This research should be of interest to crash investigators, safety officials, and vehicle designers.

The goal of this paper is to present dynamic crash testing depicting a modification of a production fuel tank and filler neck. OEM and modified fuel systems were tested in vehicle-to-vehicle collisions under identical test conditions. This test series proves conclusively that technically and economically feasible, significantly safer design alternatives exist for vehicle fuel systems, even those found in subcompact cars. This has significant safety implications for the public, as well as vehicle designers, safety officials, and crash investigators.

A subcompact passenger car was struck in the rear quarter panel by the front of a utility vehicle at approximately 60 mph. The filler neck separated from the fuel tank, allowing massive fuel leakage to occur. Several restrained occupants of the struck vehicle, including children in the rear seat, incurred severe burns due to a fire caused by fuel leaking from the failed fuel tank and filler neck. There were no impact-related injuries due to the offset nature of the collision. Since the failure of the filler neck was obvious from the real- world collision evidence, it was desired to determine if there were reasonable alternative designs. Two vehicle-to-vehicle crash tests were conducted by a certified test laboratory that regularly performs similar crash testing for gov- ernment safety agencies and auto manufacturers. The crash tests were de- signed to be at least as severe as the upper end of the calculated accident reconstruction velocities of the subject collision. An identical exemplar bullet vehicle traveling approximately 60 mph struck a stationary exemplar vehicle in the right rear quarter panel. The filler neck of the target vehicle was directly in line with the front bumper of the bullet vehicle. The OEM filler neck on the subject vehicle passed through the open wheel well of the vehicle.

One crash test involved an unmodified, completely “stock” exemplar of a later model year of the subject vehicle, which had shown changes to the filler neck and fuel system by the manufacturer. In that crash test, there was no fuel system failure, and the filler neck remained attached to the exemplar fuel tank. The second crash test involved an identical exemplar vehicle from the same production year. The OEM fuel tank was retained in its original location. The fuel tank and filler neck were modified to allow re-location of the filler neck. The tank and filler neck were modified to prevent separation of the filler neck from the fuel tank, as well as to prevent cutting or other breach of the filler neck. A filler cap outlet from the same manufacturer was installed in a slightly different position, yet remaining within the rear quarter panel of the vehicle. An OEM filler cap and distal part of the filler neck were utilized, with off-the-shelf additional parts utilized to connect to the fuel tank. Minor reinforcements were made to the vehicle structures to improve shielding of the filler neck.

With the modified fuel system, there was no fuel leakage. The crush damage to the vehicle was more severe than was seen in the subject collision.

This test series proved that with off-the-shelf parts and common fabri- cation equipment found in most automotive repair shops, it was economically and technically feasible to design and build a significantly safer vehicle fuel tank and filler neck. The hazards of an exposed, un-tethered filler neck were avoided; despite dynamic crash testing that was in all probability more severe than the subject crash.

This test series proved that vehicle can be subjected to increased injury risk due to massive fuel leakage and resulting fire due to fuel system failure in readily survivable collisions, even with fuel systems that apparently meet applicable U.S. Federal Motor Vehicle Safety Standards.

Reasonably similar failures have been seen in a wide variety of fuel systems found in other vehicles from various manufacturers. The defects in this fuel system are not apparent to the average consumer.

Fuel System Integrity, Vehicle Fire, Crash Testing