U.S. Department of Transportation

National Highway Traffic Safety Administration

ODI RESUME

INVESTIGATION: EA99- 013 DATE OPENED: 11 -Jun-99
SUBJECT: Post-Collision Fuel System Integrity
PROMPTED BY: PE99-010
PRINCIPAL ENGINEER: J. L. Quandt

MANUFACTURER: DaimlerChrysler Corporation
MODELS: NS-minivans (Dodge Caravan and Grand Caravan, Plymouth Voyager and Grand Voyager, and Chrysler Town and Country)
MODEL YEARS: 1996-99
VEHICLE POPULATION: 2,074,393 produced through April 3, 1999

PROBLEM DESCRIPTION: The filler tube assembly may be damaged or separate from the tank in certain crash modes.

FAILURE REPORT SUMMARY

	ODI	MANUFACTURER	TOTAL
COMPLAINTS:	0	0	0
FIRES:	0	0	0
INJ INCID:	0	0	0
FAT INCID:	0	0	0
OTHER:	2	0	2

DESCRIPTION OF OTHER: FMVSS 214/SINCAP left-side impact tests resulting in filler neck assembly leakage.

ACTION: An Engineering Analysis has been opened.

ENGINEER: _____ DIV CHF: _____ OFC DIR: _____

6/9/99 6/11/99 6/11/99

DATE DATE DATE

SUMMARY: On January 5, 1999, a 1999 Dodge Caravan 3-door minivan was crash tested at the MGA Proving Ground in Burlington, Wisconsin to assess compliance with Federal Motor Vehicle Safety Standard No. 214, Side Impact Protection, NHTSA No. CX0305 (Figure 1). During the crash test the fuel filler assembly hose separated from the fuel tank fill nipple allowing approximately 11 gallons of test fuel to spill from the tank assembly (Figure 2). The tank, which has a nominal capacity of 20 gallons, had been filled with 18.43 gallons of Stoddard solvent for the test.

Prior to the FMVSS 214 crash test, two long wheelbase NS-minivans (1999 Dodge Grand Caravan 4-door minivans) had been crash tested at MGA in NHTSA's Side Impact New Car Assessment Program

6/17/99

continued

SUMMARY: (SINCAP). The first test, conducted on November 30, 1998 (MX0301), did not acquire the required dummy injury data and another test was scheduled. The second test was conducted on December 18, 1998 (MX0307), and resulted in trace leakage from an unidentified source in the vicinity of the fuel filler assembly. Subsequent inspection of filler assembly components identified the source of the leak as a small split in a plastic segment of the filler vent tube sandwiched between the steel filler tube and the left frame rail.

NHTSA SINCAP tests are conducted with the same 3,000 pound Moving Deformable Barrier and crash configuration as required by the dynamic portion of FMVSS 214. The FMVSS 214 dynamic impact test is conducted in a 27 degree "crabbed" configuration with a barrier impact speed of 33.5 mph. The test is meant to represent a side impact collision in which the striking vehicle is traveling 30 mph and the struck vehicle 15 mph. The SINCAP test is conducted with the same "crabbed" configuration and a barrier impact speed of 38.5 mph, representative of a collision in which the striking vehicle is traveling 34 mph and the target vehicle 17 mph.

The purpose of FMVSS 214 is to specify performance requirements for the protection of occupants in side impact crashes. All passenger cars built on or after September 1, 1993 (model year 1994) and all multi-purpose passenger vehicles, light trucks, and vans built on or after September 1, 1998 (model year 1999) are required to meet the side impact occupant protection requirements of FMVSS 214. Since September 1993, NHTSA has conducted 116 FMVSS 214 dynamic side impact tests with the first and only fuel leakage incident occurring in the test that prompted this investigation. Since September 1996, NHTSA has conducted 77 SINCAP tests with only two fuel leakage incidents, a fuel tank puncture in a 1999 Chevrolet S-10 pickup truck (PE99-009) and the previously cited 1999 Dodge Grand Caravan (MX0307).

Although NHTSA has considered the FMVSS 214 dynamic test as a possible replacement for the lateral impact portion of FMVSS 301, Fuel System Integrity, there currently is no fuel system performance requirements associated with FMVSS 214[1]. There are no performance requirements of any kind associated with the SINCAP tests, which are conducted each model year to provide consumers with new vehicle side impact crash performance information.

The subject filler neck assembly is routed from the filler door through the forward portion of the left-rear wheelhouse. A plastic liner covers the assembly in the wheelhouse. The assembly extends forward from the bottom of the wheelhouse, through a space between the inner sill wall and the left rail structural member, to the fuel fill and vent fittings of the fuel storage tank (Figure 3). The tank is mounted inboard the left rail structural member forward of the rear axle.

The filler neck assembly consists of the fuel filler tube and the fuel tank vent tube. A five inch long hose connects the steel filler tube to a 40 mm (1.6 inch) ID high-density polyethylene

---

[1] Chrysler has submitted comments to NHTSA in favor of replacing the current FMVSS 301 lateral test with the FMVSS 214 dynamic impact test on at least two occasions. Most recently, in a June 19, 1995 letter responding to an Advanced Notice of Proposed Rulemaking published by NHTSA in the April 12, 1995 Federal Register, Chrysler submitted the following comments in favor of using the FMVSS 214 dynamic impact test to assess fuel system integrity in lateral impacts:

> **Based on testing experience with both standards and comparison of the test conditions and impact energies of both tests, Chrysler agrees that the FMVSS 214 test is more directly related to motor vehicle safety and more practicable.**

(HDPE) spud on the side of the tank. The hose is secured to the filler tube and tank spud by standard worm drive type hose clamps.

ODI's analysis of the filler hose separation incident finds that the crash resulted in substantial collapse/buckling of the sill. Sill buckling resulted in collapse of the front wheelhouse structure and some torsional deformation of the rail member. Wheelhouse collapse forced the filler neck assembly into the rail member (Figure 4) and pushed the park brake cable tight against the lower section of the filler tube (Figure 5). Some downward displacement of the tank spud was also evident, apparently resulting from rail deformation. The relative displacement of the filler tube and tank spud produced a tensile load in the connecting hose (i.e., stretched the hose) which was great enough to cause the hose to slide up the tank spud and off the bead (Figure 7).

Factors believed to contribute to the risk of hose separation are: (1) the packaging/routing of the filler neck assembly near body components which experienced substantial crush deformation in the crash; (2) the relatively short length of the filler hose (approximately 3¼ inches from clamp to clamp) resulting in greater joint loads per unit displacement between the spud and filler tube; and (3) several aspects of the tank spud hose joint design and manufacture which reduce its ability to resist hose pull-off forces, including low spud modulus, spud bead design, and the use of lubricants as assembly aids.

ODI's analysis of the two SINCAP test vehicles found evidence of similar filler tube loading and movement, rail deformation, hose stretch, and hose slippage on the tank spud. ODI's analysis of peer vehicle (Ford Windstar, Chevrolet Venture, and Toyota Sienna) performance in FMVSS 214 and SINCAP dynamic left-side impact tests found no similar evidence of fuel filler tube loading, hose stretch, or hose slippage.

#

Figure 1 - Post-Test Body Crush (CX0305).

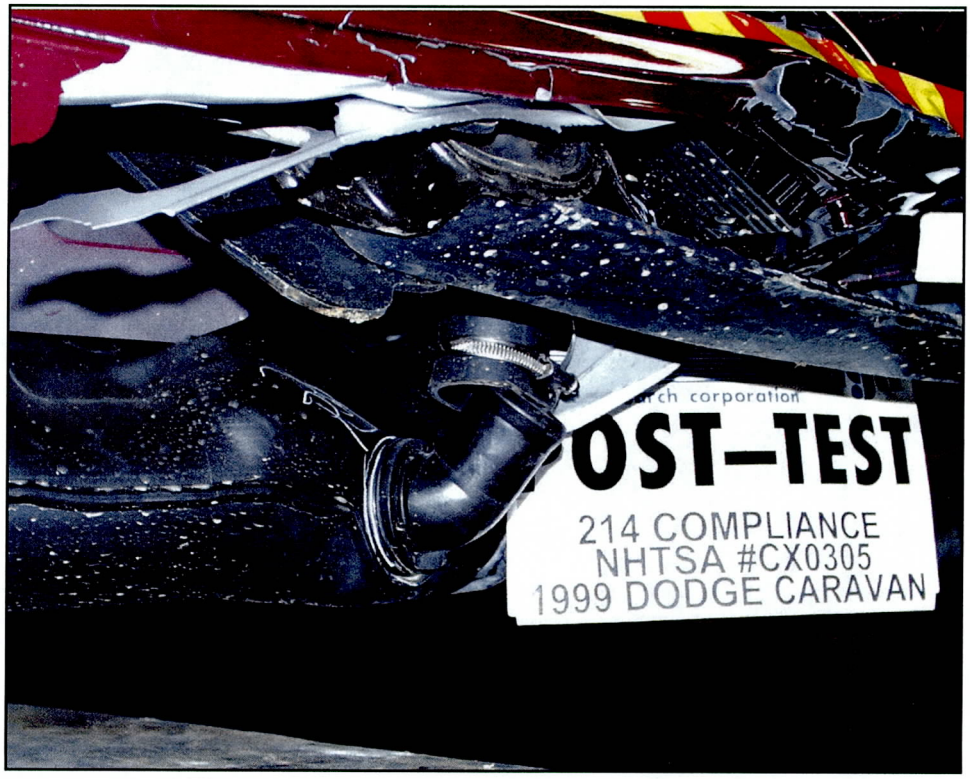

Figure 2 - Post-Test Filler Hose Separation (CX0305).

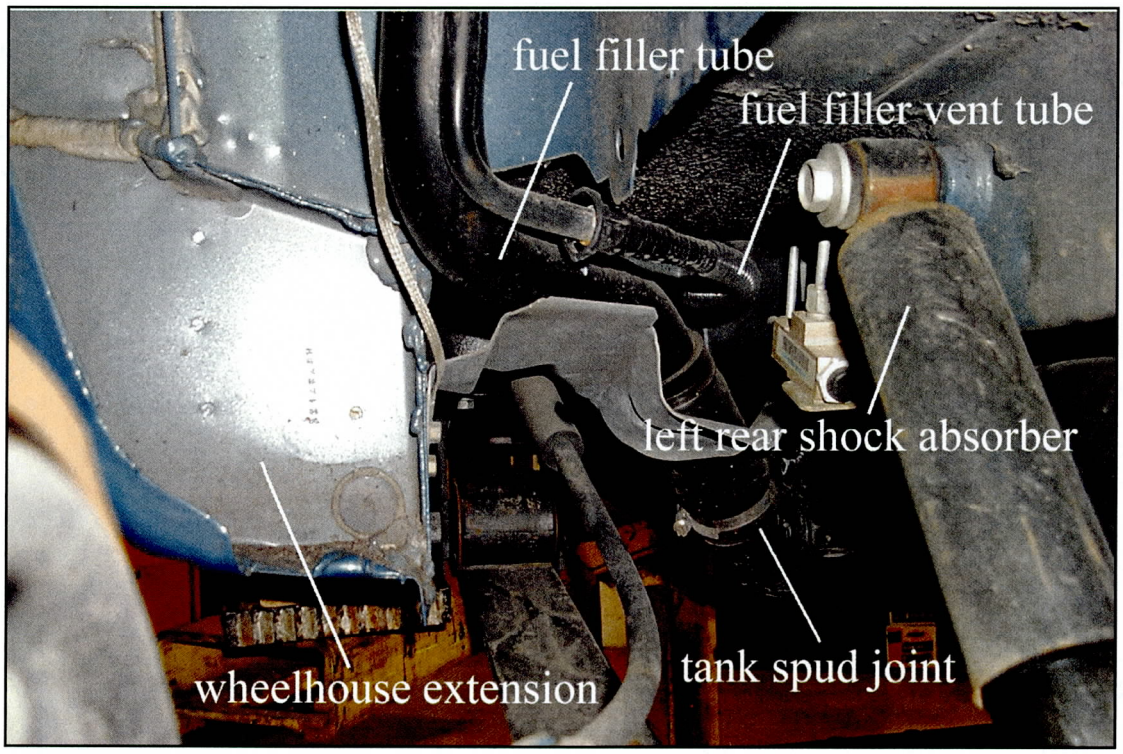

Figure 3 - Filler Neck Assembly Packaging/Routing (Exemplar Vehicle).

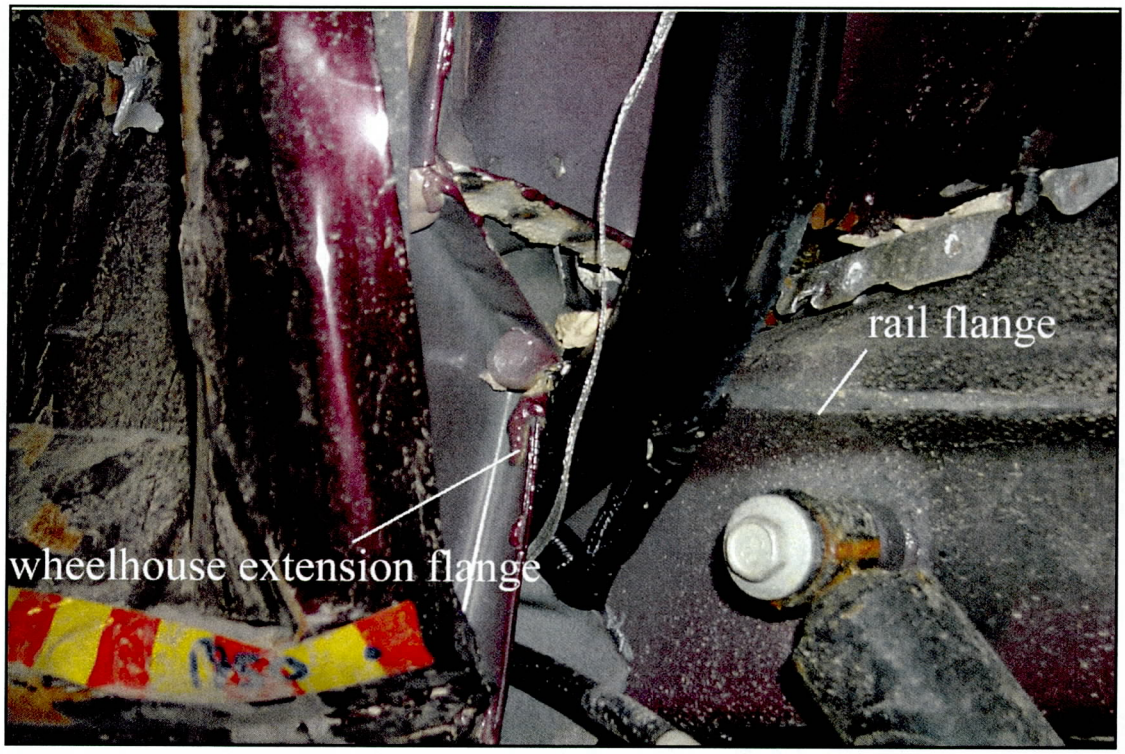

Figure 4 - Filler Tube Loading from Wheelhouse Extension (CX0305).

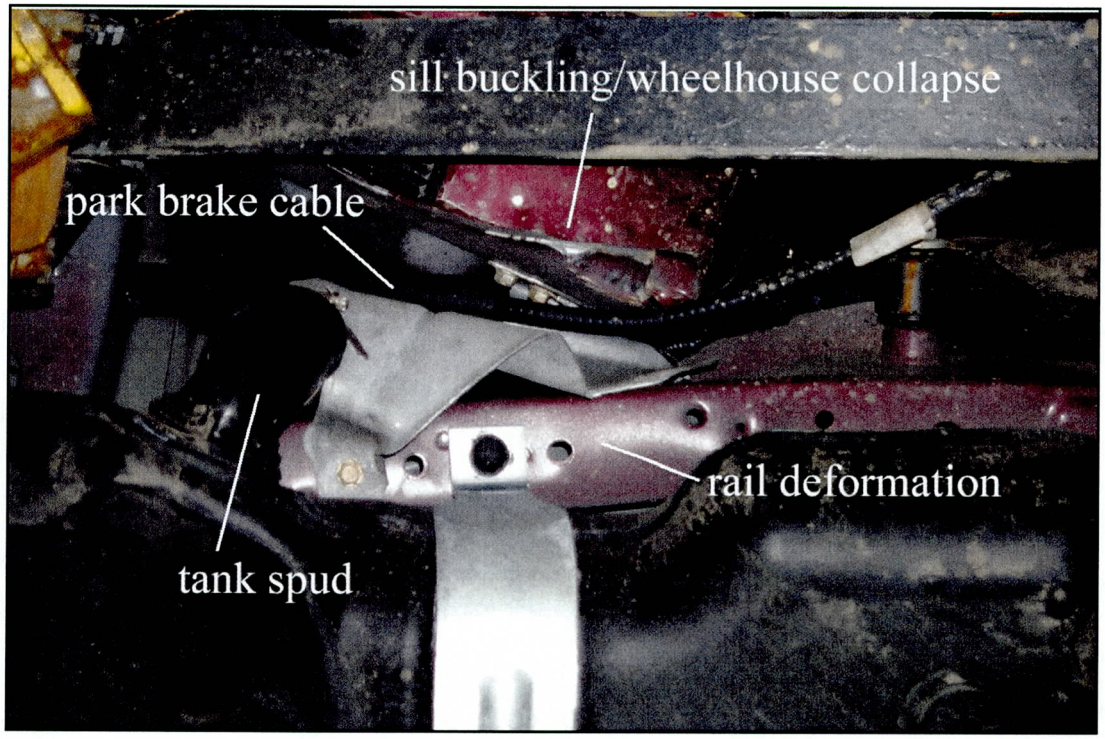

Figure 5 - Filler Tube Loading from Sill/Wheelhouse Collapse and Park Brake Cable (CX0305) - Bottom View, Filler Tube Hidden from View.

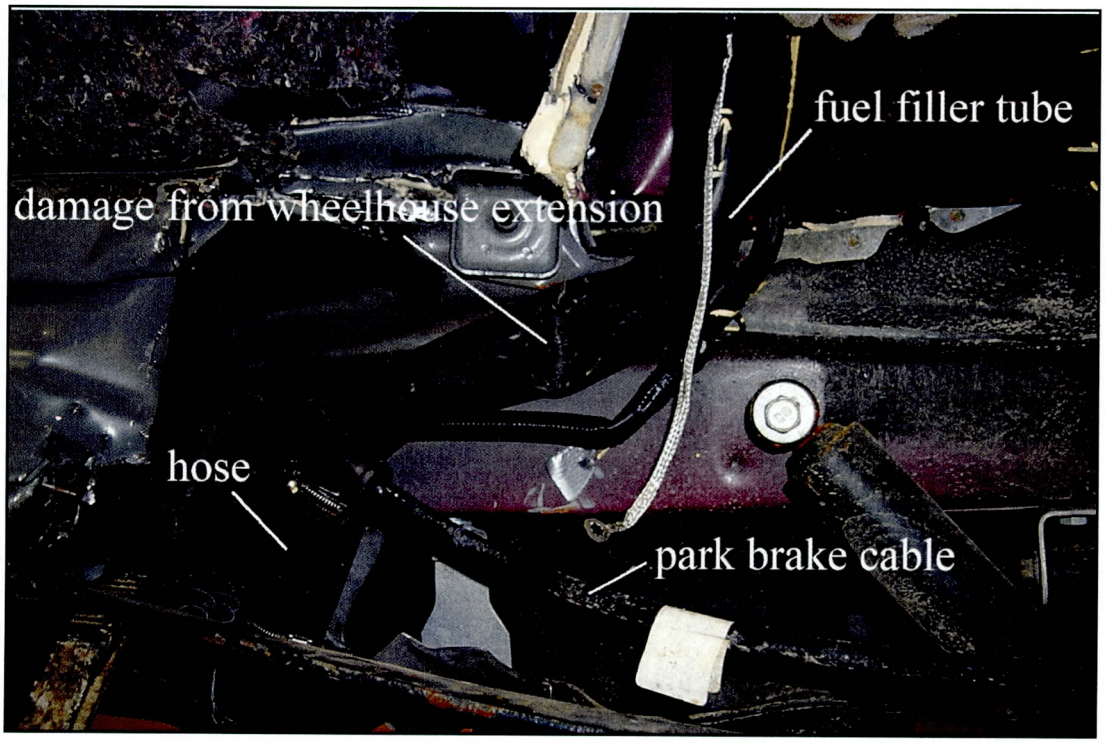

Figure 6 - Filler Neck Assembly Position/Damage (CX0305) - Side View, Body Sheet Metal Removed.

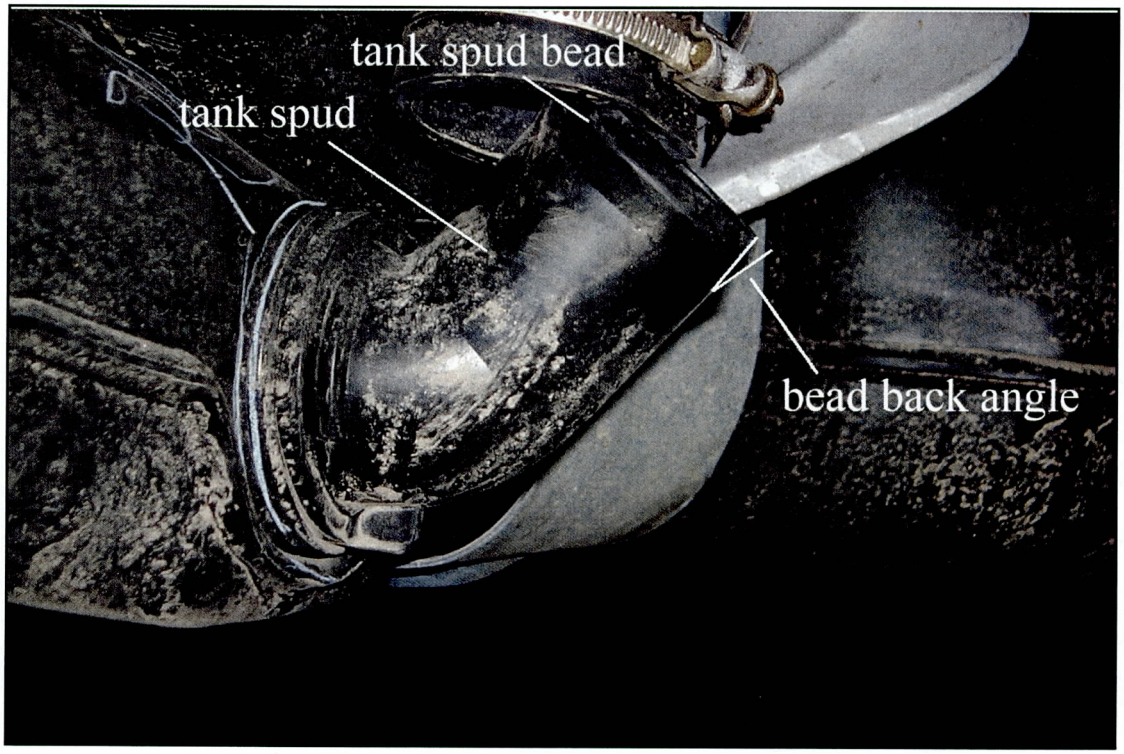

Figure 7 - Fuel Tank Spud (CX0305).

Figure 8 - Tank Spud Deformation - Axial View (CX0305).