



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: EA06-007
 Prompted By: PE06-002
 Date Opened: 05/09/2006 Date Closed: 11/30/2007
 Principal Investigator: Kyle Bowker
 Subject: Fuel Tank Leakage

Manufacturer: Kia Motors America, Inc.
 Products: 1996-2002 Kia Sportage
 Population: 268,137

Problem Description: The steel fuel storage tank allegedly leaks.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	37	128	149
Crashes/Fires:	0	0	0
Injury Incidents:	0	0	0
# Injuries:	0	0	0
Fatality Incidents:	0	0	0
# Fatalities:	0	0	0
Other*:	0	391	391

*Description Of Other: Warranty claims.

Action: This Engineering Analysis has been closed.

Engineer: Kyle M. Bowker **KMB**
 Div. Chief: Jeffrey L. Quandt
 Office Dir.: Kathleen C. DeMeter

Date: 11/30/2007
 Date: 11/30/2007
 Date: 11/30/2007

Summary: A safety-related defect trend has not been identified at this time. Review of the warranty data revealed elevated tank leakage experience in vehicles produced from June 1999 to October 2000. Analysis of complaints and warranty claims identified multiple causes and origins of fuel tank assembly leakage. The majority of complaints involve non-specific allegations of fuel leakage where more than one fuel system component was replaced. ODI's analysis focused on leaks occurring on the underside of the tank due to corrosive failure caused by disruption of the protective PVC coating. The analysis indicates that such leaks are rare and do not show evidence of an increasing trend.

Accordingly, this investigation is closed. The closing of this investigation does not constitute a finding by NHTSA that a safety-related defect does not exist. The agency will take further action if warranted by the circumstances.

KMB
 11-30-07

ENGINEERING ANALYSIS CLOSING REPORT

SUBJECT: Fuel storage tank leakage.

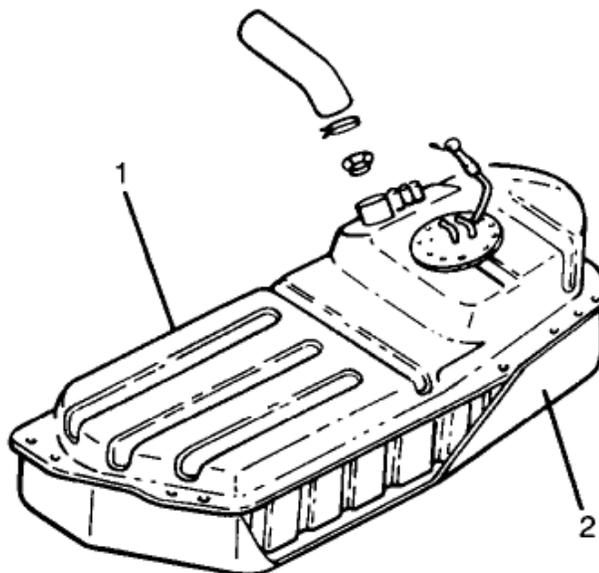
INVESTIGATION: EA06-007

DATE OPENED: 9-May-2006 **DATE CLOSED:** 30-Nov-2007

SUBJECT VEHICLES: Model year (MY) 1996 through 2002 Kia Sportage

BASIS: The National Highway Traffic Safety Administration's (NHTSA) investigation of alleged fuel tank leakage in certain Kia Sportage vehicles began with Preliminary Evaluation PE06-002, which covered model year (MY) 1999-2000 subject vehicles. NHTSA's Office of Defects Investigation (ODI) sent a letter to the manufacturer on January 25, 2006, requesting certain information about the eight alleged complaints and about these and other Kia Sportage vehicles. As a result of information obtained during the Preliminary Evaluation, the range of subject vehicles under investigation was expanded to include all MY 1996-2002 Kia Sportage vehicles which use the same or substantially similar steel fuel storage tank design when the investigation was upgraded to an Engineering Analysis (EA06-007) on May 9, 2006.

DESCRIPTION OF COMPONENT OR VEHICLE SYSTEM: The subject vehicles are equipped with a steel fuel storage tank mounted longitudinally underneath the passenger side of the vehicle, adjacent to the drive shaft, in front of the rear axle and below the rear seat. The tank is made of a proprietary chromate-processed zinc galvanized sheet steel that has been stamped and welded together. A stamped steel "gravel shield" bolted to the seam flange provides additional protection from flying debris (Figure 1).



1 FUEL TANK
2 SHIELD

Figure 1: Subject Fuel Tank Diagram

Fuel tank capacity is approximately 57 L (15.1 gal) with approximately 71 mm (2.8 in) of vapor space between the fuel pump mounting plate and the fuel level inside the tank when full (Figure 2). Surface treatments are applied to the exterior of the tank to inhibit corrosion. The exterior upper half of the fuel tank above the welded seam is treated with a proprietary paint-like coating and the exterior bottom half of the fuel tank below the welded seam is treated with a polyvinyl chloride (PVC) coating.

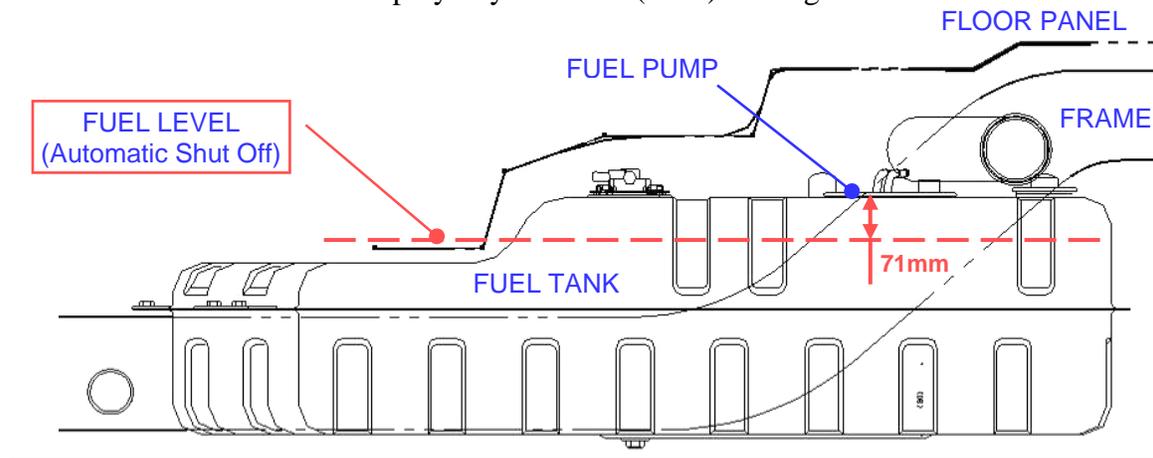


Figure 2: Subject Fuel Tank Fuel Level Diagram

THE ALLEGED DEFECT: The alleged defect is fuel tank leakage. Kia identified three primary causes of leakage in the area of the fuel tank assembly: (1) corrosion on the underside of the tank due to disruption of the PVC coating; (2) corrosion of the fuel sending plate and associated fastening screws; and (3) cracked fuel line connector nipple on the fuel sender unit. Because of the greater risk of fuel leakage from holes developing in the underside of the tank, ODI focused its analysis on this issue.

FAILURE MECHANISM: The failure mechanism for leakage from the underside of the tank is disruption of the protective PVC coating resulting in corrosion and subsequent perforation. These failures often occurred in areas where five retaining clips for the gravel shield insulation pad are located (and where the protective shield most closely approaches the fuel tank). Kia attributed contact with the retaining clips to undercarriage impacts, possibly while driving off-road, that could push the shield closer to the tank. Water and mud/salt thrown from the road surface collects in the shield and insulation pad a cause corrosion to develop in areas where the PVC coating has been disrupted.

CONTRIBUTING FACTORS: One factor contributing to the alleged defect in the subject vehicles appears to be exposure to road de-icing materials (e.g., road salt). More than 80% of the complainants operate their vehicles primarily in northern “salt-belt” states¹ where such road de-icing materials commonly used. Other contributing factors

¹ For the purposes of this investigation, “salt-belt” or corrosion states include the following 20 states and the District of Columbia: Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

include undercarriage impact, such as might be experienced when the vehicle is operated off-road over rough terrain where ground clearance may be limited. This could diminish the available free space between the fuel tank and the fuel tank gravel shield, increasing the potential for the insulation pad and/or insulation pad retaining clips to make contact with the tank and disrupt the protective coating.

VEHICLE POPULATION: The manufacturer provided Vehicle Identification Number (VIN) level detail for each of the subject vehicles, as defined by ODI, including the date of production, the date the warranty coverage period commenced, and the U.S. State where the vehicle was first sold. Table 1 provides a summary of the populations by model year for all subject vehicles sold in the United States and for those sold in the salt belt states.

Model Year	Quantity of Subject Vehicles Produced	Quantity of Subject Vehicles 1st Sold in Salt Belt States
1996	8,651	13
1997	23,494	5,987
1998	26,426	13,210
1999	38,229	20,834
2000	66,523	34,006
2001	57,927	26,002
2002	46,887	19,425
Grand Total	268,137	119,477

Table 1: Subject Vehicle Population by Model Year

FREQUENCY OF THE ALLEGED DEFECT: Table 2 provides counts of complaints and warranty claims associated with the alleged defect in the subject vehicles. These include tank assembly leak allegations and claims for all causes, most of which were of unknown cause/origin (see ODI Analysis).

	ODI	Manufacturer	Total
Complaints:	37	128	149
Fires:	0	0	0
Injury Incidents:	0	0	0
# Injuries:	0	0	0
Fatality Incidents:	0	0	0
# Fatalities:	0	0	0
Other*:	0	391	391

*Description Of Other: Warranty claims paid by manufacturer to repair or replace the fuel tank due to alleged leakage where tank identified as causal component.

Table 2: Alleged Fuel Tank Leakage

COMPLAINTS: ODI identified 149 non-duplicative complaints alleging non-crash related fuel tank leakage on the subject vehicles including alleged leakage from the top of the tank (any location above the full level), the bottom (any location below the full level), and/or unknown (see ODI Analysis). The subject complaint rate is approximately 56 per 100,000 vehicles produced (approximately 0.06%). The complaint exposure rate is approximately 7.5/100k/ year. There are no known vehicle fires as a result of the alleged defect. Figure 3 shows the complaints and associated rates by month of production.

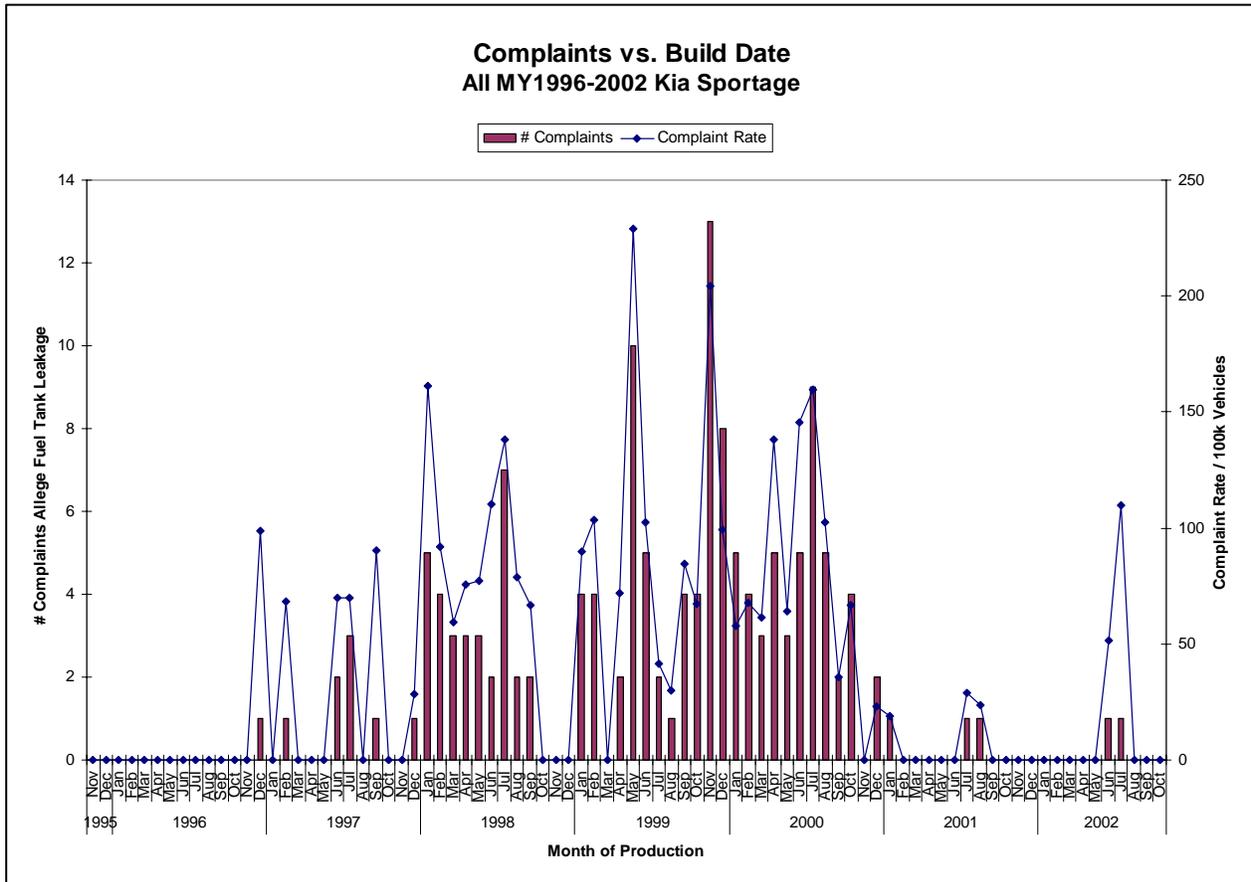


Figure 3: Complaints by Production Month

WARRANTY: Kia warrants the subject vehicles free from defects in material or workmanship subject to the terms and conditions of the New Vehicle Limited Warranty, which is divided into three categories: Basic Warranty Coverage, Power Train Coverage, and Adjustment Coverage. The subject fuel storage tanks are subject to Kia’s Basic Warranty Coverage. For MY 1996-2000 Sportage vehicles built through July 1, 2000, the Basic Warranty Coverage period is three years or 36,000 miles, whichever occurs first. For MY 2000-2002 Sportage vehicles built on or after July 1, 2000, the Basic Warranty Coverage period is five years or 60,000 miles, whichever occurs first. Kia did not offer any extended or additional warranty for fuel tank failures beyond the New Vehicle Limited Warranty.

The subject vehicles are well beyond Basic Warranty Coverage. However, Kia has paid a limited number of warranty claims on subject vehicles beyond the warranty coverage

period pursuant to a service inspection campaign (SC059) or as an act of goodwill. In total, Kia has paid 391 warranty claims from June 1998 through June 2007 (the date of the last information update from the manufacturer) to repair or replace the fuel storage tank on the subject vehicles due to alleged leakage where the tank was identified as the causal component. The subject warranty rate is approximately 145 per 100,000 vehicles produced (approximately 0.15%). Figure 4 shows warranty claims for tank replacement for leakage and for all other causes by month of production.

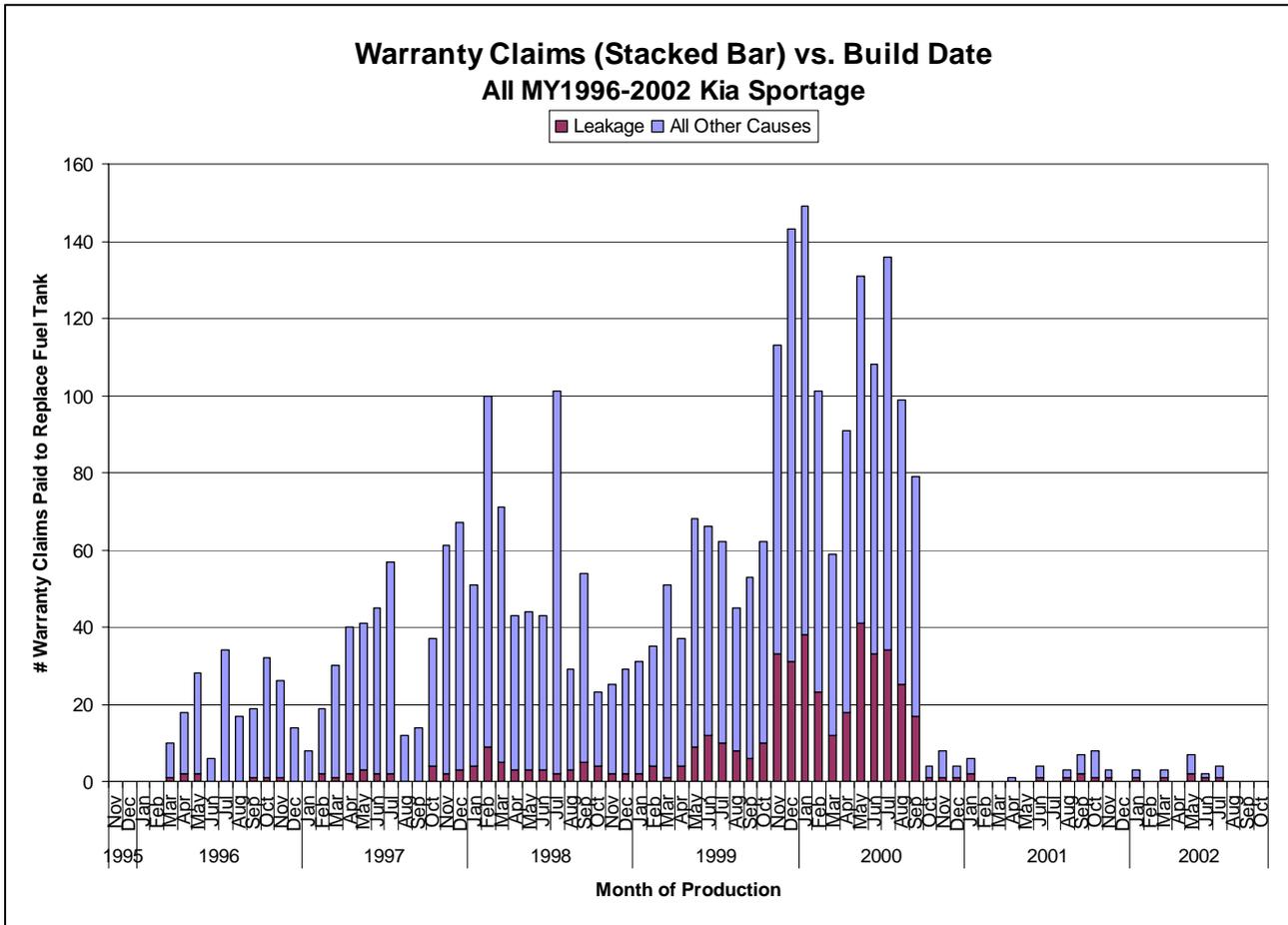


Figure 4: Warranty Claims as a Function of Production Date

According to Kia, the vast majority of warranty claims involving the fuel tank are related to an internal, non-leak corrosion condition which most often results in the illumination of the “Check Engine” tell-tale lamp. Kia asserts that dealers are unable to replace the fuel pump and flush the tank clean due to non-leak corrosion of the fuel sending unit (fuel pump) mounting plate and screws. As a result, Kia claims dealers have often had to replace the entire fuel tank instead of just the pump.

DESIGN, MATERIAL AND/OR PRODUCTION MODIFICATIONS: The subject vehicles all use the same or substantially similar steel fuel storage tank and gravel shield. However, Kia used two different part numbers to account for minor differences. All MY 1996-2000 subject vehicles were originally equipped with part number (p/n) 0K018 42 110D. MY 1997-2000 subject vehicles equipped with this tank also utilized a 4mm thick

aluminum coated glass-wool insulation pad affixed to the gravel shield via five bendable clips. According to the manufacturer, the purpose of this insulation pad was to help reduce evaporative emissions caused by radiant heat (such as when the vehicle is parked on a hot asphalt surface) pursuant to changes in Environmental Protection Agency (EPA) regulations. MY 2001-2002 subject vehicles were originally equipped with fuel tank p/n 0K07A 42 110. This tank was outfitted with an onboard refueling vapor recovery (ORVR) valve in response to new EPA emissions regulations. Accordingly, the manufacturer determined the glass-wool insulation pad affixed to the gravel shield was no longer needed and so it was removed from the gravel shield. Also, an internal tank chamber/baffle was removed due to a new fuel delivery module design that featured an integrated baffle.

SERVICE BULLETINS: Kia issued one Technical Service Bulletin (TSB) pertaining to a service inspection campaign (SC059) it conducted in an attempt to obtain detailed information on the condition of the fuel tanks in the subject vehicles. Kia randomly selected 5,000 subject vehicles from three designated sales regions of the United States (North, Central, and South). This population was purposely skewed to include vehicles that were likely to have accumulated higher mileages. In May 2006, Kia mailed letters to the vehicle owners, requesting that they bring their vehicle to an authorized Kia dealer for a non-destructive fuel tank inspection. Service technicians were asked to examine the tank in detail and identify any areas of corrosion or apparent fuel leakage. If “deep” corrosion, perforation, and/or visible fuel leakage was identified anywhere on the tank, appropriate repairs were to be made under warranty regardless of the vehicle age or mileage.

In total, 520 vehicle owners responded to the campaign (10.4% of all invited to participate) and 50 vehicles (1%) received replacement fuel storage tanks. According to the manufacturer, only 8 cases showed some indication of leaking. Of those, only 3 had bottom tank leaking conditions while 5 leaks were from various other locations and for various reasons. The remaining 42 cases involving tank replacement were due to “deep” corrosion or perforation, primarily in the top portion of the fuel tank near the fuel sending unit interface.

TESTING: ODI neither conducted nor requested others to conduct any vehicle or component test programs in support of this investigation.

WARNING SYMPTOMS: The smell of fuel vapors is common among complainants who report fuel tank leakage. Only 16 of the 149 complainants reported visible fuel leakage in the form of wet spots, drops, or pools of fuel underneath the vehicle. Because the subject component is located underneath the vehicle and is obscured from view by the gravel shield, any corrosion condition that exists will be less conspicuous and may progress unchecked for some time.

FAILURE MODES: The primary interest to ODI was the potential for fuel leakage from the bottom of the tank due to corrosion. If left unchecked, corrosion may result in a progressive deterioration of the wall thickness, eventually leading to perforation and fuel leakage.

MANUFACTURER’S EVALUATION OF THE ALLEGED DEFECT: Kia claims that the alleged defect in the subject vehicles does not pose an unreasonable risk to motor vehicle safety. For support, Kia cites the low frequency of alleged fuel tank leakage and claims that there have been no alleged fires, injuries, or deaths as a result of the alleged defect, despite years of exposure. The manufacturer also argues that there may be a variety of possible reasons for alleged fuel leakage at/near the fuel tank.

According to Kia, corrosion that might contribute to fuel tank leakage may occur at either the top or the bottom of the tank, or both. Corrosion at the top of the tank is primarily at the fuel sending unit interface, which is above the vapor space region of the tank. Accordingly, leakage in this area is limited to minor, infrequent seepage on high mileage vehicles. Kia asserts that corrosion at the fuel sending unit interface is a customer satisfaction issue because of fuel vapor odor and because the corrosion may necessitate replacement of the entire tank if the pump cannot be separated for servicing. Corrosion at the bottom of the tank is most likely due to contact with the gravel shield and disruption of the PVC coating. Kia believes that the frequency of such leaks is very low, citing the results of its service inspection campaign SC059. Kia asserts there is an adequate design gap between the tank and the gravel shield and that infrequent contact is due to undercarriage impact. In both circumstances, Kia believes the corrosion to be normal wear and tear.

ODI ANALYSIS: ODI’s analysis identified a number of potential sources and causes of fuel leakage from the fuel tank assembly in the subject vehicles. Many of the complaints and warranty claims reviewed by ODI do not contain sufficient information to identify the cause, location and/or severity of the alleged leakage. In some instances, there is conflicting information about whether a leak occurred at all, making it difficult to verify a specific number of complaints or claims related to a common cause or origin. Table 3 summarizes ODI’s analysis of complaints by severity and location. The severity and location were unknown in the majority of complaints.

Severity	Location of Alleged Tank Leakage				Total
	Bottom	Top	Multiple	Unknown	
Visible Leak	3	2	2	9	16
Fuel Odor	1	3	0	8	12
Unknown	17	12	0	92	121
Total	21	17	2	109	149

Table 3: Fuel Tank Leakage Complaints by Severity and Location.

Frequently, complainants report non-specific allegations of fuel leakage, with the fuel tank being just one of several fuel system components replaced to remedy the concern, which makes it difficult to confirm which component was primarily responsible. For instance, complainants often report they were first alerted to a problem when they smelled fuel vapor odors. Since very few complainants reported significant fuel leakage and because the tank is obscured from view, the nature of the problem was not immediately apparent to them. When the complainants took their vehicles to service

professionals for diagnosis and/or repair, both the tank and the fuel sending unit would often be replaced as an assembly because corrosion at the fuel sending unit / tank mounting interface would fuse the two components together. Attempts to remove the screw fasteners would often result in breakage, thus requiring replacement of the entire fuel tank assembly.

ODI identified the 391 subject warranty claims based on the administrative codes used by authorized dealers when they submitted warranty claims to Kia for reimbursement. In a few instances, ODI was able to identify additional supporting data that indicated the cause, location and/or severity of the alleged leakage, for instance, the inspection reports that accompanied warranty claims submitted under service inspection campaign SC059. However, the vast majority of warranty claims lack sufficient detail that might indicate what trends may exist, if any, with regards to the three primary causes of leakage in the area of the fuel tank assembly identified by Kia.

ODI's attempts to retrieve fuel tanks were largely unsuccessful because the subject vehicles are no longer under warranty and the damaged components are frequently disposed of immediately. ODI's interviews with service personnel rarely revealed the exact location of the alleged leakage. Typically, service personnel reported corrosion in more than one location, but could not identify one specific location of fuel leakage that would be evident from fuel residue or perforation. ODI was able to obtain three subject fuel tanks from complainants who alleged leakage. ODI did not identify a common cause or origin of fuel leakage in these tanks.

REASON FOR CLOSING: A safety-related defect trend has not been identified at this time and further use of agency resources does appear to be warranted. Accordingly, this investigation is closed. The closing of this investigation does not constitute a finding by NHTSA that a safety-related defect does not exist. The agency will take further action if warranted by the circumstances.

#