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

ODI RESUME

Investigation: EA08-006
Date Opened: 02/21/2008 Date Closed: 04/15/2009
Principal Investigator: Cynthia Glass
Subject: Engine Compartment Fire

Manufacturer: Chrysler LLC
Products: 2007 Chrysler Pacifica with 4.0L Engine
Population: 51,590

Problem Description: A fire occurred in the engine compartment.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	4	32	36
Crashes/Fires:	4	22	26
Injury Incidents:	0	0	0
# Injuries:	0	0	0
Fatality Incidents:	0	0	0
# Fatalities:	0	0	0
Other:	0	257	257

Description of Other: Warranty claims of a power steering fluid leak.

Action: This Engineering Analysis is closed.

Engineer: *Cynthia Glass* Date: *04/15/2009*
Div. Chief: *Thomas Z. Cooper* Date: *04/15/2009*
Office Dir.: *Kathleen C. DeMeter* Date: *04/15/2009*

Summary:

The agency has closed this investigation based on its review of consumer complaints, field reports, warranty claims and other data regarding engine compartment fires and power steering fluid leakage in Model Year (MY) 2007 Chrysler Pacifica vehicles with 4.0L engines.

The available evidence indicates that power steering fluid leaks in the subject vehicles and the fires that may result from these leaks occurred early in the vehicle's service life. Moreover, changes in the assembly process appear to have remedied the condition causing the leaks. The available data confirms a declining trend for both complaints and warranty claims as the subject vehicles remain in service.

The closing of this investigation does not constitute a finding by the agency that a safety-related defect does not exist. The agency reserves the right to take further action if warranted by the circumstances.

Background

The Office of Defects Investigation (ODI) opened a Preliminary Evaluation (PE07-052) on October 19, 2007, to investigate allegations of engine compartment fires in Model Year (MY) 2007 Chrysler Pacifica vehicles, (subject vehicles). ODI's review of the complaint data indicated that the problem was concentrated in the subject vehicles with 4.0L engines. On February 21, 2008, PE07-052 was upgraded to an Engineering Analysis (EA08-006) to further investigate MY 2007 Chrysler Pacifica vehicles with 4.0L engines.

Population

The subject vehicle population is 51,590.

Alleged Defect

The alleged defect is fire in the engine compartment. Consumers allege that while driving, a fire started on the driver's side, near the front of the vehicle. Some consumers report observing a puddle of power steering fluid on the ground under the vehicle prior to the alleged fire. Other complaints report a power steering fluid leak but no fire, (Figure 1).

Figure 1: Example of a power steering fluid leak

Description of Components

The power steering gear is located beneath the engine compartment. An engine driven pump sends the power steering fluid under high pressure to the steering gear to provide boost that assists steering. A high pressure hose connects the pump and the steering gear.

The end of the hose is fitted with a metal tube with a flare, an o-ring, and a tube nut for connection to the power steering gear.

The Manufacturing Process

The power steering high pressure hose for the 4.0L engine vehicles is attached to the steering gear during final vehicle assembly. An operator begins the attachment by turning a tube nut into a threaded hole in the steering gear until an o-ring at the end of the tube seats against the bottom of the threaded hole. Failure to properly complete this step is likely to result in a leak. Chrysler implemented three assembly plant process changes for the attachment of the high pressure line. The changes are described under the section "Process Changes."

Failure/Malfunction Modes

A fire may result when power steering fluid contacts a hot engine component, particularly the exhaust system. Chrysler has indicated that leaks occurred at the connection between the high pressure hose and the power steering gear. Chrysler discovered that the tube nut on the high pressure power steering hose could be cross-threaded during the assembly process. The cross-threading connection prevents the o-ring from properly sealing the steering gear (Figure 2). An improperly seated o-ring may allow power steering fluid to leak onto a hot exhaust system and cause a fire.

Figure 2: Damaged threads in the tube nut

Process Changes

Process Change A: On May 12, 2006, Chrysler revised the assembly process to require an operator to install a clip that attaches the power steering high pressure line to the steering gear assembly in the 4.0L engine, (Figure 3). The purpose of the clip was to hold the power

steering high pressure line stationary while the operator secured the high pressure hose to the steering gear with a tube nut. Chrysler later found that the clip may have created a mis-alignment of the tube nut with the threaded hole in the steering gear, creating a risk that the operator may cross-thread the tube nut.

Process Change B: On November 9, 2006, Chrysler divided the assembly process into two parts, to be performed by two operators:

- One operator hand starts the attachment 2 turns, then, performs a pull test to ensure that there is no cross-threading condition. Hand starting the tube nut allows for a positive tactile feedback of proper thread seating before the final torque is applied.
- A second operator rotates the connection 2 more turns by hand, then, completes the final secure with a direct current (DC) tool. The DC tool has a torque and angle measurement with an automatic stop.

Chrysler found that while this process change improved the situation, it did not completely eliminate the possibility of the tube nut cross-threading.

Process Change C: On May 12, 2007, Chrysler revised the assembly process for a single operator to "first hand start the tube nut prior to attaching the clip." Chrysler found that hand starting the tube nut BEFORE stabilizing the power steering high pressure line with a clip, reduced the potential for cross-threading.

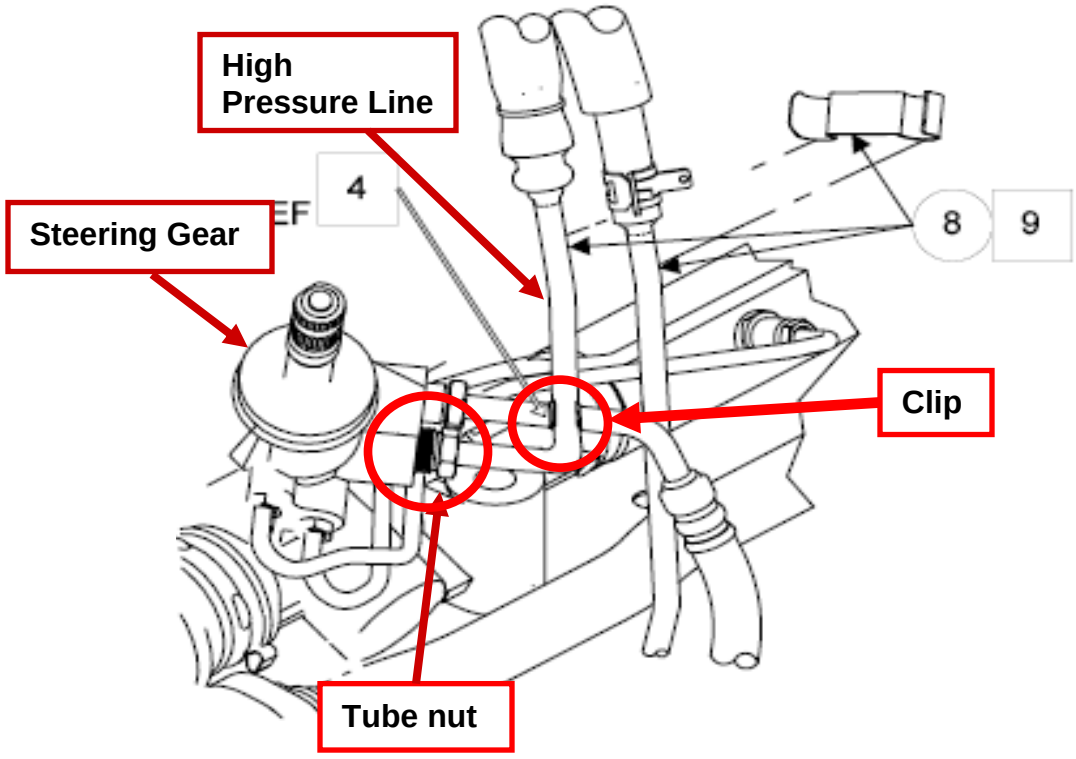

Figure 3: Sketch of the 4.0L engine with the clip and tube nut attachments

Consumer Complaints

The following chart (Figure 4) summarizes the complaints received by ODI and Chrysler related to fires in the engine compartment and/or leakage of power steering fluid. Consumers may have complained of a power steering leak, a fire, or both a power steering leak and a fire; therefore, the count of complaints contains duplicates of the counts in other rows. The 36 complaints represent reports of a fire or reports of a power steering leak. There are no reports of injuries or fatalities.

	ODI	Chrysler	Total
Complaints	4	32	36
Fires	4	22	26
Power Steering Leak	2	16	18
Injuries/Fatalities	0	0	0

Figure 4: Consumer Complaints

Warranty Claims

Chrysler identified three problem codes in the warranty system related to the alleged defect: line or fitting leak, oil leak, and housing leaks. Figure 5 summarizes the warranty claims for the problem codes related to power steering fluid leaks. The warranty claims do not include fires. Fire reports are counted separately under the Consumer Complaints, (Figure 4). The counts shown for each problem code are not duplicated in other problem codes.

Problem Code	Description	Total
62	Line or fitting leak	48
71	Oil leak	203
E1	Housing Leaks	6
Total Claims		257

Figure 5: Warranty Claims

Chrysler's Evaluation of the Alleged Defect

Chrysler does not dispute that a cross-threaded connection may cause power steering fluid to leak onto the exhaust system and potentially result in a fire. Chrysler contends that this cross-threading condition and subsequent potential for power steering fluid leak occurs within the first month of ownership and does not pose a risk to motor vehicle safety while driving.

Chrysler contends that the vehicle operator may experience a warning before seeing smoke or fire. The warning may be in the form of a noisy power steering pump, increased steering effort, or a power steering fluid leak. Chrysler states that "given the immediate cooling of the exhaust system, if ignition were to occur, it would happen shortly after key-off or while the vehicle is running." Complaint data indicates that the vehicle operator would be warned of an impending failure by experiencing a noisy power steering pump or witnessing a leak of red power steering fluid. Chrysler states that "a leak of this nature would be apparent early in the life cycle. The failure mode is consistent in that it occurred at low mileage and within the first month of ownership."

Chrysler also states that a cross-threaded connection that could increase the possibility of a power steering fluid leak is most likely to occur during "parking lot maneuvers when the steering travel is at or near its stop and the power steering system pressure is greatest. Under these circumstances, the cross-threading condition may allow power steering fluid to leak and in rare situations, the fluid to contact the underbody exhaust system, produce a significant amount of smoke, and possibly ignite."

Furthermore, Chrysler implemented assembly process changes and process improvements, as indicated above, and released a Rapid Response Transmittal (RRT) in May 2008 to field service personnel, instructing them to inspect the power steering line connection on 248 unsold MY2007 Pacifica 4.0L vehicles. In response to the RRT, Chrysler did not find any vehicles with the cross-threading condition.

Chrysler states that "the rate of occurrence of the reported power steering related fires is less than 0.02% and has only occurred within the first month of service. Based on all available data, Chrysler has determined that a vehicle beyond one month of service is not at risk for this condition" and that any remaining risk of under hood fires caused by a cross-

threaded tube nut at the steering gear in MY2007 Pacifica vehicles equipped with 4.0L engines is extremely low.

ODI's Evaluation

Cross-threading of the tube nut occurs when an operator does not properly align the tube nut, (i.e. the threads on the nut do not align with the threads in the hole), and then turns the nut until it is tight. In a cross-threaded condition, the resisting tightening (turning) torque is produced by the interference between the threads on the nut and the threaded hole. As a result, the nut may not properly turn to the bottom of the threaded hole and the o-ring will not seal even though the nut may feel tight to the operator. When the line is pressurized, power steering fluid may leak out.

The high pressure connection at the steering gear is in close proximity to components of the exhaust system that get very hot during vehicle operation. Power steering fluid is combustible under high temperatures. When power steering fluid comes into contact with a hot surface, such as the exhaust system, it can ignite, resulting in an engine fire. In the subject vehicles, there is no dispute that the root cause of the low-mileage fires is the cross-threaded connection permitting power steering fluid to leak onto components of the exhaust system, which then may result in a fire. Figure 6 shows the proximity of the high pressure connection to the exhaust system.

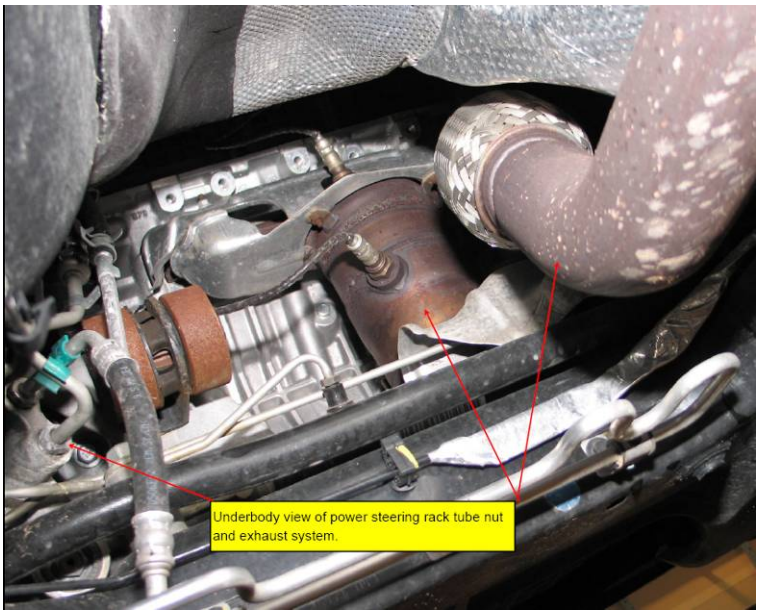

Figure 6: Underbody view of the tube nut and exhaust system

Based on ODI's analysis of the available data, leaks from the high pressure connection will likely occur within the first few months of the subject vehicle's service life. Such a leak is likely to be discovered and remedied at that time under Chrysler's 3yr/36,000 mile warranty at no cost to the owner. The available data confirms a declining trend for fire complaints as the subject vehicles remain in service. Likewise, the warranty claims for power steering fluid leaks are also declining.

Because the leaks occur in the early part of the service life of the subject vehicles, warranty claims with the cross-threading condition were repaired under Chrysler's 3yr/36,000 mile warranty at no cost to the owner.

ODI's analysis indicates that Chrysler's May 2007 assembly and process changes significantly reduced the number of cross-threaded connections in the subject vehicles. In addition, Chrysler evaluated all remaining unsold subject vehicles under an RRT and did not find any cross-threaded tube nut connections.

Based on ODI's analysis of the data, the likelihood of future engine compartment fires due to power steering leaks in the subject vehicle population is low.

Reason for Closing

In ODI's view, vehicle fires represent a serious safety risk. Notwithstanding this, the available evidence in this case indicates that power steering fluid leaks in the subject vehicles and the fires that may result from these leaks occurred early in the vehicle's service life. Moreover, changes in the assembly process appear to have remedied the condition causing the leaks. A substantial decline in complaints and warranty claims indicates that those vehicles likely to experience power steering leaks have already been repaired.

Based on these facts, further expenditure of agency resources on this investigation does not appear to be warranted. The closing of this investigation does not constitute a finding by the agency that a safety-related defect does not exist. The agency will continue to monitor complaints and other information related to the alleged defect in the subject vehicles, and may take further action if warranted by the circumstances.