

Chronology of Principal Events

2008

April, 2008	<p>Suzuki Motor Corporation (SMC) received a Field Technical Information Report (FTIR) from its Canadian distributor. The report described an incident that occurred in March where it was reported that the steering wheel was very hard to turn.</p> <p>The Canadian distributor found that the shaft of the power steering pump was sheared.</p> <p>SMC requested the supplier to examine the collected part.</p>
May, 2008	<p><Investigation></p> <p>The supplier found that the power steering pump had seized. Sand-like contamination was also detected. SMC's Quality Assurance Committee met and discussed the results of the investigation.</p> <p><Judgment></p> <p>SMC judged that the cause of the problem could be that the sand-like material affected the performance of the oil flow control valve (spool valve), which produced high pump inner pressure that caused the pump side plate to contact the pump rotor, resulting in seizure of the pump. SMC investigated the supplier's production process and judged that the sand-like contamination was introduced during maintenance in the field, not during the production process.</p> <p><Conclusion></p> <p>SMC decided to monitor information from the field.</p>
April – September, 2008	<p>SMC received four FTIRs from its Canadian distributor. The reports described incidents involving power steering not working. The incident dates were March (two reports), April, and August of 2008.</p> <p><Investigation></p> <p>Sand-like contamination was again detected.</p> <p><Conclusion></p> <p>SMC decided to continue monitoring information from the field.</p>

2009

March, 2009	<p>SMC received six FTIRs from American Suzuki Motor Corp. (ASMC) concerning reports of noisy power steering pumps (none of the reports described problems with steering). The incident dates were in December of 2008 and January and February of 2009.</p> <p>SMC requested the supplier to examine collected parts.</p>
April, 2009	<p>SMC received five FTIRs from its Canadian distributor concerning inoperative power steering pumps. The incident dates were in February and March of 2009.</p> <p>SMC received three FTIRs from ASMC concerning fluid leakage from power steering pumps. The incident dates were in February of 2009.</p> <p>SMC requested the supplier to examine collected parts.</p>
April – June, 2009	<p>SMC received six FTIRs from its Canadian distributor concerning reports of noisy power steering pumps (none of the reports described problems with steering). The incident dates were in March, April, and May of 2009.</p> <p>SMC requested the supplier to examine collected parts.</p>
August 26, 2009	<p>SMC's Quality Assurance Committee met and discussed the results of the investigation of cases of power steering pump fluid leakage reported in the FTIRs received in April, 2009.</p> <p><Investigation></p> <p>The collected pumps had no malfunctions and operated properly. The supplier could not reproduce the fluid leakage.</p> <p><Conclusion></p> <p>SMC decided to continue monitoring information from the field.</p>
September 14, 2009	<p>SMC's Quality Assurance Committee met and discussed the results of the investigation of cases of noisy power steering pumps reported in the FTIRs received in March – June 2009.</p> <p><Investigation></p> <p>The collected pumps had no malfunctions and operated properly. The supplier could not find the cause of the noise.</p> <p><Conclusion></p> <p>SMC decided to continue monitoring information from the field.</p>

2011

March, 2011	<p>SMC received an FTIR from ASMC that indicated that the vehicle was leaking fluid and the steering was hard at idle speed. The incident date was in February, 2011.</p> <p>SMC requested the supplier to examine the collected part.</p>
-------------	--

2013 - 2015

February, 2013	<p>SMC received an FTIR from ASMC that indicated that there was no power steering assist. The incident date was in February, 2013.</p> <p>SMC requested the supplier to examine the collected part.</p>
May 27, 2013	<p>SMC's Quality Assurance Committee met and discussed the results of the investigation.</p> <p><Investigation></p> <p>The supplier found that the pump had seized. Sand-like contamination was also detected.</p> <p><Judgment></p> <p>Considering the increasing number of malfunctions, SMC judged that the cause of the failures may not be just sand-like contamination introduced during maintenance in the field.</p> <p><Conclusion></p> <p>SMC decided to continue monitoring information from the field, and to pay more attention to oil leakage and noise incidents as being possibly related to the pump seizure incidents.</p>
May 17, 2014	<p>Although SMC had not yet determined the cause of the malfunctions, SMC decided to address the increasing number of FTIRs by changing the clearance allowance of the spool valve and cartridge, based on the observation that the clearance of all collected parts was close to the minimum clearance allowance. At this time, vehicle production had already been discontinued, so the change only affected service parts.</p>
July, 2014	<p>SMC and the supplier initiated weekly quality meetings.</p>

<p>June – December, 2014</p>	<p><Effort to Reproduce the Problem></p> <p>SMC attempted to reproduce the pump failures based on the supplier's analysis of the problem. SMC was unable to cause the spool valve to become stuck by introduction of sand-like contamination, and was unable to observe the stuck valve condition in the collected parts.</p>
<p>January 18-25, 2015</p>	<p>An SMC engineer and representatives of SMC's Quality Assurance and Service groups visited the states of North Dakota and Vermont to investigate two vehicles that had experienced a power steering pump failure. SMC found that the failure could be reproduced by increasing the engine speed with the steering fully turned to the right or left after parking the vehicle for an extended period in a cold environment.</p>
<p>February – March, 2015</p>	<p>SMC was able to reproduce pump seizure on a vehicle in a cold chamber, using the same process that was used during the field investigation in the U.S.</p> <p>The supplier was able to reproduce pump seizure on a bench, using the same procedure used by SMC. The supplier observed that the pump inner pressure became higher than the designed relief pressure of the relief valve after increasing the engine speed.</p>
<p>March – April 2015</p>	<p>SMC determined the mechanism of the power steering pump failures as follows:</p> <ol style="list-style-type: none"> 1. The power steering oil temperature increases rapidly when the engine speed is increased under a high-pressure condition (relief valve is open). 2. Due to the difference in mass of the spool valve and pump body, a temperature discrepancy occurs. The discrepancy is particularly noticeable in a cold environment. 3. The spool valve becomes hot faster than the pump body and expands, reducing the clearance between the spool valve and the pump body. The spool valve is unable to slide properly and is unable to properly relieve the inner oil pressure of the pump. 4. As a result of the high pressure, the pump side plate deforms and contacts the pump rotor, causing seizure of the pump. 5. The pump system cannot supply enough oil pressure to the steering gear to provide steering assist.

May 7, 2015	<p>SMC's Quality Assurance Committee met and discussed the results of the investigation.</p> <p><Judgment></p> <p>The Quality Assurance Committee accepted that the cause of the malfunction had been determined and that the change to the clearance allowance made in 2014 is an adequate countermeasure to prevent seizure of the power steering pump.</p> <p><Conclusion></p> <p>SMC decided to refer the issue to SMC's Quality Countermeasure Committee.</p>
June 11, 2015	SMC's Quality Assurance Committee decided to refer the issue to SMC's Quality Countermeasure Committee
February, 2013 – June, 2015	SMC received ninety-eight FTIRs related to this issue from the Canadian market and the U.S. market.
September 11, 2015	SMC decided to conduct a safety recall to address the issue. As of September 11, 2015, SMC has received a total of one hundred fifty-eight (158) FTIRs related to this issue from the Canadian market and the U.S. market.