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

ODI RESUME

INVESTIGATION: EA 02-026
DATE OPENED: September 10, 2002
SUBJECT: Brake Power-Assist Failure
PROMPTED BY: PE 02-009
PRINCIPAL ENGINEER: Scott Shadle

MANUFACTURER: Volvo Cars of North America (Volvo)
MODEL(S): S40 and V40 (X40)
MODEL YEAR(S): 2000 and 2001 (2001 model year added with opening of EA)
VEHICLE POPULATION: 2000 model year - 35,387; 2001 model year - ~35,000

PROBLEM DESCRIPTION: The complaints allege, or describe symptoms consistent with, a loss of brake power-assist, which results in significantly higher than normal brake pedal effort being required to stop or slow the vehicle. Although, most of the reports indicate this occurs only for a brief period immediately following a "cold start-up" (after the vehicle has been sitting for at least several hours), some complaints allege the problem can occur after the vehicle has been driven a significant distance.

FAILURE REPORT SUMMARY

	ODI	MANUFACTURER	TOTAL
COMPLAINTS:	15	45	58*
WARRANTY CLAIMS:	NA	1530 (see Summary)	1530
CRASHES:	1	11**	11***
INJ CRASHES:	0	0	0
FAT CRASHES:	0	0	0

* Two of Volvo's owner complaints are duplicate of owner reports received by ODI.
** Volvo's response to the Information Request for the Preliminary Evaluation (PE-IR) identified 9 crashes/incidents that were reported to Volvo. A review of that response revealed two additional crashes not identified by Volvo.
*** One of the crashes indicated in the owner reports submitted by Volvo (but not identified by Volvo as a crash is a duplicate of a report submitted to ODI.

ACTION: The Engineering Analysis (EA) has been opened.

ENGINEER: _____ DATE: 9/10/02
DIV CHF: _____ DATE: 9/10/02
OFC DIR: _____ DATE: 9/10/02

SUMMARY:
Since the opening of the PE for this investigation, one of the ODI complaints (that reported a crash) that was included in the PE has been deleted from the investigation since our review indicates that it is unlikely to have involved a failure of the brake power-assist system. However, ODI is seeking to obtain additional information to confirm this conclusion. Also, since the opening of this investigation, ODI has received five new complaints related to failures of the brake power-assist system, one of which reported a crash. It should be noted that one report included in the PE was a vacuum pump failure on a 2001 MY S40 vehicle.

SGS 9/10/02

Volvo's May 2, 2002 response to the PE-IR, separately listed warranty claims for those claims that included the labor operation code for repairs performed as directed in Tech Net Note 52-01 and for those that did not include that code. It was discovered that rather than there being 280 warranty claims that did not include that labor operation code, there seem to be only 155 individual repair records. Further examination of the warranty data shows that 22 of these 155 claims involve subject vehicles produced after February 1, 2000, when Volvo began producing vehicles with brake vacuum pumps that were sealed in a manner similar to that laid out in the Tech Net Note mentioned above. Also, several owners have reported having the vacuum pump replaced two or more times, with most of those replacements occurring after February 1, 2000, bringing into question the adequacy of the action taken by Volvo to address these failures. Given this, together with ODI's receiving a report involving a 2001 MY S40, the subject vehicle population is being expanded to include 2001 MY S40 and V40 vehicles.

In its response to the PE-IR, Volvo takes the position "that an unreasonable risk to motor vehicle safety does not exist in the subject vehicles" as a result of the failures of the brake power-assist system "caused by excessive moisture in the brake vacuum pump." They base this conclusion on two factors. The first is that the test to determine compliance with "inoperative brake power assist" requirements of FMVSS 135, the safety standard for the performance of passenger car braking system, indicates that the vehicle complies with "a wide margin (45%) of safety." The second is that no injuries have been reported to have resulted from the failure of the brake power-assist system "after more than one (1) billion miles of travel by the subject vehicles."

ODI believes that the performance of the braking system is so crucial to the safe operation of a vehicle that any failures in that system are by there nature safety-related. As for compliance with the "inoperative brake power assist" requirements of FMVSS 135, the expectation is that failures that would result in the vehicle's operating in an "inoperative brake power assist" condition would be extremely rare and would only be expected to occur in a very small portion of a vehicle's population. Given the large number of warranty claims and complaints, ODI believes that this investigation should be upgraded to an Engineering Analysis.

However, the PE has raised other issues relate to the performance of the brake power-assist system on the subject vehicles. One which relates directly to the issue of water entering the brake vacuum pump is a statement in one of the "field reports" submitted with Volvo's response to the PE-IR that indicates that "for the next M/Y (model year) the pump will be moved into the engine compartment." There are three other issues related to failures of the brake power-assist system that have come to light in the investigation. One is that several reports refer to excessive amounts of water being present in the lines of the brake vacuum system beyond the vacuum pump itself and several of these mention the formation of rust within some metal lines that are part of that system. The presence of water alone could have negative consequences on the performance of the brake vacuum system, but the presence of rust results in even greater likelihood of degraded performance. In some cases, the corrosion in the metal lines of the brake vacuum system was so extensive that the lines needed to be replaced. The second issue that is related to "rust" in the system is that one of Volvo's field reports mentions that "rust was found coming out of vacuum lines, damaging also the one way check valve for booster pump," a failure that could result in low brake booster vacuum under all driving conditions. For the later of these new issues, there are two reports of battery electrolyte leaking onto the vacuum pump and its related lines, disabling the pump and

corroding the metal brake vacuum lines. These issues, together with the original problem of excessive moisture in the pump, indicate that the potential number of failures of the brake power-assist system on the subject vehicles may constitute an unreasonably high failure rate.

RECOMMENDATION:
For these reasons, this investigation is upgraded to an Engineering Analysis.