



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: PE 10-020

Date Opened: 06/28/2010

Investigator: Michael Lee

Approver: Frank Borris

Subject: Sticky Steering

Date Closed: 06/28/2011

Reviewer: Scott Yon

MANUFACTURER & PRODUCT INFORMATION

Manufacturer: BMW OF NORTH AMERICA, LLC

Products: 2003-2005 BMW Z4

Population: 48,485

Problem Description: "Sticky steering" can occur during periods of high ambient temperatures. An increased steering effort typically occurs when the steering wheel is at the center position and the driver attempts to make small steering adjustments.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	216	134	320**
Crashes/Fires:	1	1	2
Injury Incidents:	0	1	1
Number of Injuries:	0	1	1
Fatality Incidents:	0	0	0
Other*:	4	18	22

*Description of Other: Steering system issues other than sticky steering or loss of power assist.

** Count indicates duplicate reports received by ODI and manufacturer.

ACTION / SUMMARY INFORMATION

Action: This Preliminary Evaluation is closed.

Summary:

ODI has evaluated the sticky steering condition, which included reviews of complaints and warranty claims, interviews and surveys of owners of complaint vehicles, road tests of complaint vehicles, and a review of BMW's engineering and test data. ODI found the sticky steering condition does not result in a significant steering effort, thus the impact on the driver's ability to control the vehicle does not appear to be significant.

A safety-related defect trend has not been identified at this time and further use of agency resources does not appear to be warranted. Accordingly, this investigation is closed. The closing of this investigation does not constitute a finding by NHTSA that no safety-related defect exists. The agency will monitor the issue and reserves the right to take future action if warranted by the circumstances. See the attached report for additional information.

In addition, during this investigation, ODI became aware of allegations of failure or loss of electric power-assisted steering on the subject vehicles. As a result, ODI is separately reviewing this issue to determine whether additional agency action is needed.

Additional Information:

This investigation focused on the concern of “sticky steering” that can occur during periods of high ambient temperatures in the vehicle’s passenger compartment. High ambient temperature and exposure to direct sunlight will increase the internal temperature of the electric power-assisted steering (EPS) system in the subject vehicles. If the temperature of the EPS system becomes sufficiently high, the worm gear in the steering system can expand causing increased friction within the system and an increase in steering effort. The increased steering effort typically occurs when the steering wheel is at or near the center (straight ahead) position and when the driver attempts to make small steering adjustments at moderate to highway speeds.

Complaints state that the steering wheel in the subject vehicles sticks or feels stiff, sluggish, uneven, jerky or “notchy” at the straight ahead or center steering wheel position. Other complaints state that the steering wheel is difficult to turn or requires an increased steering effort. Based on the complaints, the condition usually occurs when the outside temperature is higher than 75 degrees Fahrenheit and after the vehicle has been parked in the sunlight for several hours or longer causing the interior of the vehicle to reach a high ambient temperature. The condition subsides when the interior of the vehicle returns to a normal temperature. Also, the condition is reportedly more noticeable at vehicle speeds greater than 45 mph and when the steering wheel is at or near the center position and the driver attempts to make small, low-input effort steering wheel adjustments to maintain course, such as to stay in a lane of traffic or make a gradual lane change. Some drivers reported difficulty maintaining steering control during straight-ahead driving. To overcome the condition, drivers allegedly are turning the steering wheel more forcefully and abruptly causing slightly more steering input than intended and the potential for a momentary lane departure. A few other complaints state that the steering wheel sticks when making a turn or the steering wheel does not automatically return to its center position after it has been turned.

BMW stated that conditions of “sustained high temperatures, combined with long periods of intense sunlight” can cause the worm gear within the EPS system to expand causing increased friction within the system. BMW has evaluated this condition and provided test data showing the steering effort in a subject vehicle equipped with a complaint EPS system. The nominal steering wheel torque (without any increased friction in EPS system) is approximately [REDACTED] N-m (or about [REDACTED] lb-ft)¹. The BMW test data were taken during various driving maneuvers at a high ambient temperature (55° C or 131° F) and during a test condition at an extreme internal temperature of the EPS system (80° C or 176° F). The largest increase in steering torque occurred during the 80° C temperature test. At this temperature, the maximum steering wheel torque (as a result of the increased friction in the EPS system) due to the high heat conditions was approximately 5 N-m (or about 3.7 lb-ft)², or an increase of [REDACTED] N-m (or about [REDACTED] lb-ft)

¹ Values in brackets are confidential information and have been removed in the redacted version for the general public.

² For reference, a complete loss of power assist can result in increased steering efforts typically ranging from approximately 25 to 35 lb-ft steering wheel torque, based on findings from other defect investigations involving loss of power assist. By comparison, the increase due to the condition in the subject vehicles is marginal.

from the nominal torque level. BMW stated that the increase in steering wheel torque represents a minor increase and that in its view this issue “does not represent an unreasonable risk to safety; rather, it is a quality/comfort issue.” BMW also stated that the subject issue does not result in a loss of EPS.

Based on the BMW data, the total maximum force required to turn the steering wheel in a subject vehicle with the subject condition is approximately 6.4 pounds (this is based on a measured steering torque of 3.7 lb-ft and the subject vehicle steering wheel radius of 0.58 ft). The increase in steering wheel force as a result of the subject condition is approximately [REDACTED] pounds. During the investigation, ODI staff drove complaint vehicles during high ambient temperatures conditions and was able to verify the sticky or stiff steering condition in each case. Although noticeable, ODI did not find that the increase in steering wheel effort significantly impacted the driver’s ability to maintain control of the vehicle. Additionally, ODI noted that the condition subsided and the vehicle returned to normal steering operation, when the interior of the vehicle returned to a normal ambient temperature.³

BMW has implemented three modifications to the steering system components in the subject vehicles in its efforts to reduce friction during high ambient temperature conditions. In mid-June 2005, BMW began producing steering systems with revised dimensional adjustments between the worm gear and worm gear shaft. These modified components, which were produced for service parts only, have lower internal friction during high ambient temperatures. On July 5, 2006, BMW implemented two additional production changes: 1) a new machining process that produces a smoother surface of the worm gear and 2) a new lubrication for the worm gear. ODI found the number of complaints and warranty claims declined significantly for model year 2006-2008 BMW Z4 vehicles built after these production changes were implemented.

ODI has identified a total of 320 complaints related to the sticky steering issue in the population of 48,485 subject vehicles (~ 0.7%). Also, ODI found that the subject issue accounts for the majority of approximately 3,100 warranty claims related to various steering issues on the subject vehicles. Some of the complaints noted that the out-of-pocket repair cost was very high (a few thousand dollars). Through contacts and interviews ODI also found that the majority of the owners currently experiencing this condition are electing not to repair their vehicles (primarily due to financial considerations) and are continuing to drive on a regular basis.

ODI has identified two complaints that allege the sticky steering condition caused, or was a factor in a vehicle crash. In one crash allegation, the vehicle owner reported that his vehicle had previously experienced the sticky steering condition during warm weather conditions. The complaint stated, “I attempted to swerve to avoid an obstacle on the highway and had to yank the wheel so hard to get it out of the ‘stuck on center’ issue. I then ran off the road and into the ditch.” No injuries were reported. In spite of multiple attempts, the complainant has failed to respond to ODI’s requests for additional information, and given the lack of information and cooperation, ODI is unable to make any reasonable assessment as to the cause of the crash, or whether or not the subject condition was a factor.

³ In the test drives, the sticky steering condition subsided within approximately 10 minutes after the vehicle’s air conditioner was turned on.

In the second crash allegation, which occurred in July 2008 and appears to be the subject of potential litigation, the owner stated that their vehicle was parked outside for several days before they drove it on a very hot day. The owner was driving on a highway at about 65 mph in a slight right-hand curve with the steering wheel turned to the right and held fixed in the same position for several seconds. Then, as the road straightened, the owner attempted to move the steering wheel but was allegedly unable to turn the wheel left towards the straight-ahead position. As a consequence, the vehicle contacted a concrete barrier on the right side of the road. After the initial impact, the owner reportedly was able to turn the steering wheel (hard) to the left at which time the vehicle crossed three lanes of traffic. The owner regained control of the vehicle and no other impacts occurred. The police were not called and there were no other witnesses to the incident. The driver, who reportedly received some soft tissue injuries, was able to drive the vehicle home from the incident scene without further incident. The suspect EPS unit was replaced under warranty in August 2008 and the manufacturer, as a goodwill gesture, also reimbursed the consumer for their insurance deductible for body damage repairs. The whereabouts of the suspect part is unknown and thus it is unavailable for analysis; ODI has not identified any other analysis, whether performed by BMW or another party.

In ODI's view, it is possible that the subject vehicle experienced a sticky steering condition, meaning a condition that (marginally) affected normal turning effort and/or return of the steering wheel to the straight ahead position. However, ODI has not at this time identified any failure mode or mechanism that would prevent the steering wheel from being turned if marginally higher than normal force is applied, much less one that would cause a "locking" condition such as is alleged in documents describing this incident. Establishing the cause of the crash is complicated by the fact that there is no police report or secondary witnesses, and the suspect part is unavailable and has not been assessed. It may be possible that the driver, when faced with the task of an increased steering effort, may have believed he did not have the ability to turn the steering wheel and thus did not apply the required force. However, other causal factors could have been involved. For instance, a component failure other than the one currently under investigation, or other vehicle (tire condition, steering alignment), roadway (surface anomalies), or driver (attentiveness) factors could also have played a role. Accordingly, ODI concludes the actual cause of the crash would be difficult to establish with any level of certainty.

A safety-related defect trend has not been identified at this time and further use of agency resources does not appear to be warranted. Accordingly, this investigation is closed. The closing of this investigation does not constitute a finding by NHTSA that no safety-related defect exists. The agency will monitor the issue and reserves the right to take future action if warranted by the circumstances.