



August 4, 2008

**VIA FEDERAL EXPRESS**

Jeffrey L. Quandt, Chief  
Vehicle Control Division  
Office of Defects Investigation  
U.S. Department of Transportation  
National Highway Traffic Safety Administration  
1200 New Jersey Avenue, S.E.  
Washington D.C. 20590

Re: **Preliminary Evaluation (PE08-033)**  
**MY 2002 through 2004 Kia Sedona; Binding or Lock-Up of Steering**  
**Intermediate Shaft**

Dear Mr. Quandt:

This letter contains Kia's supplemental response to Request Numbers 8, 9, 10, 11 and 12 of your letter dated May 5, 2008 (Reference NVS-213 cnl / PE08-033) pursuant to the extension you granted on June 11, 2008.

**REQUEST NO. 8:**

Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, "actions") that relate to, or may relate to, the alleged defect in the subject vehicles that have been conducted, are being conducted, are planned, or are being planned by, or for, Kia. For each such action, provide the following information:

- a. Action title or identifier;
- b. The actual or planned start date;
- c. The actual or expected end date;
- d. Brief summary of the subject and objective of the action;
- e. Engineering group(s)/supplier(s) responsible for designing and for conducting the action;  
and
- f. A brief summary of the findings and/or conclusions resulting from the action.

For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action.

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HATCI is an authorized representative of both Hyundai Motor Company and Kia Motors Corporation; which are separate and distinct automotive manufacturers.

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**RESPONSE TO REQUEST NO. 8:**

Several actions were conducted which may relate to the alleged defect in the subject vehicles. The table below summarizes the actions conducted by or on behalf of Kia.

Action Title	Start Date	End Date	Subject/Object of Action	Group Responsible	Finding/Conclusion Summary
Investigation of Steering Resistance Reports from Customers in Indonesia	08/02	09/02	Investigate possible reasons for reports of steering resistance from customers	KMC Quality Assurance Team 1	KMC determined that lubrication was being lost through the cap seal in the U-Joint spider protecting the needle bearings. A rib was added to the seal to improve sealing, thereby reducing steering heaviness. <b>See Tab 3 &amp; 4.</b>
Investigation of Noise and Steering Resistance Reports from Customers in Korea	06/03	12/03	Investigate reasons of reports of steering noise and resistance from customers	KMC Quality Assurance Team 1	Dust cover changed in 10/03 to reduce noise from that location. Cap seal further changed in 12/03 to better retain lubrication and prevent entry of moisture into needle bearing area. KMC changed shape and decreased inner diameter of the oil-seal rib. <b>See Tab 3 &amp; 4.</b>
Sedona Intermediate U-Joint Heavy Efforts Investigation Report	05/04	05/20/04	Static and driving tests with 4 returned intermediate shafts to determine cause of Canadian steering wheel sticking incidents.	KMC Quality Assurance Team 1	Some higher steering resistance identified. Steering control found to be unimpaired. KMC and vendor jointly determined that lubrication had been lost due to insufficient sealing of the U-Joint area. <b>See Tab 1.</b>
GQ Intermediate Shaft Returned Parts Inspection and Test Report (Inspection)	05/29/08	06/02/08	Inspect and measure the steering torque of 38 returned intermediate shafts and disassembly of 20 of those shafts	KMC Quality Assurance Team 1	Inspection and disassembly revealed evidence of corrosion of the spider portions of the U-joint protected by the cap seal. Abrasion to the rib of the oil seal cap area allowed water



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Action Title	Start Date	End Date	Subject/Object of Action	Group Responsible	Finding/Conclusion Summary
			to identify alleged cause of heaviness, sticking, and noise.		exposure to the spider and needle bearings. 37 of the 38 intermediate shafts came from salt states. <b>See Tab 2.</b>
GQ Intermediate Shaft Returned Parts Inspection and Test Report (Parking Effort Test—Static Condition)	06/03/08	06/10/08	Selection by KMA of 38 U.S. intermediate shafts with high rotational resistance. Severe resistance to hand turning]. Sent to KMC for evaluation for static (parking) resistance to turning at both the U-joint and the steering wheel; 4 shafts with high torque resistance selected for detailed testing;	KMC Quality Assurance Team 1	The “parked” torque measurement for a new intermediate shaft ranged from 2.09~3.03 kgf. The torque measurements for the four high resistance intermediate shafts subjected to detailed testing. Steering wheel torque ranged from 2.08~4.68 kgf to turn. Kia’s target for new parts is 4.0 kgf. Although some steering heaviness was found, no locking or blocking of steering control was present. <b>See Tab 2.</b>
GQ Intermediate Shaft Returned Parts Inspection and Test Report (Returnability Test—Driving Condition)	06/03/08	06/10/08	To determine if high resistance U-joints installed in a vehicle would allow the steering wheel to return when released during low speed, high angle steering and to measure the return.	KMC Quality Assurance Team 1	The Returnability of the steering was tested by releasing the steering wheel while driving a circle 24m (75 feet) in diameter at 24km (15 mph) at approximately 280 degrees. Small increases noted in time of return over 3 seconds. Also, final angle for the corroded parts were about 32 degrees compared to 17 degrees for a new part. <b>See Tab 2 and related video.</b>

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Action Title	Start Date	End Date	Subject/Object of Action	Group Responsible	Finding/Conclusion Summary
GQ Intermediate Shaft Returned Parts Inspection and Test Report (Slalom Test)	06/03/08	06/10/08	To evaluate whether the driver can maneuver the vehicle as intended during slalom driving.	KMC Quality Assurance Team 1	The two parts with the highest torque resistance were tested in a slalom at low speed and compared to a vehicle with a new intermediate shaft. Testing showed that the driver is able to steer the vehicle as intended without high effort during slalom maneuvering. <b>See Tab 2 and related video.</b>

**REQUEST NO. 9:**

Describe all modifications or changes made by, or on behalf of, Kia in the design, material composition, manufacture, quality control, supply, installation or routing of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject vehicles. For each such modification or change, provide the following information:

- a) The date or approximate date on which the modification or change was incorporated into vehicle production;
- b) A detailed description of the modification or change;
- c) The reason(s) for the modification or change;
- d) The part number(s) (service and engineering) of the original component;
- e) The part number(s) (service and engineering) of the modified component;
- f) Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;
- g) When the modified component was made available as a service component; and
- h) Whether the modified component can be interchanged with earlier production components.

Also, provide the above information for any modification or change that Kia is aware of which may be incorporated into vehicle production within the next 120 days.

**RESPONSE TO REQUEST NO. 9:**

The following changes were made to the intermediate shaft.



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- a) **September 15, 2002;**
- b) A rib was added to the U-Joint assembly oil seal located under the cap which protects the needle bearings.
- c) The reason for adding the rib was to improve the seal around the needle bearings thereby better maintaining lubrication and reducing the chance of corrosion to the bearings.
- d) The part number for the intermediate shaft is 0K52Y 32 550. Kia does not have the part numbers for the individual components of the intermediate shaft.
- e) See (d).
- f) September 14, 2002.
- g) September 15, 2002.
- h) Yes.  
**See Tab 3.**

- a) **October 12, 2003**
- b) Shape change to oilless assembly to increase the width of the grease pockets and the number of grease pockets from (1) to four (4).
- c) To reduce rotation friction noise of the U-Joint.
- d) The part number for the intermediate shaft is 0K52Y 32 550. Kia does not have the part numbers for the individual components of the intermediate shaft.
- e) See (d).
- f) October 11, 2003.
- g) October 12, 2003.
- h) Yes.  
**See Tab 3 & 4.**

- a) **October 12, 2003**
- b) Shape change to the diameter of the inner dust cover.
- c) The change is to support the change in the oilless assembly.
- d) The part number for the intermediate shaft is 0K52Y 32 550. Kia does not have the part numbers for the individual components of the intermediate shaft.
- e) See (d).
- f) October 11, 2003.
- g) October 12, 2003.
- h) Yes.  
**See Tab 3 & 4.**

- 
- a) **December 27, 2003**
  - b) Shape change to oil-seal assembly and decrease inner diameter of the oil-seal rib.
  - c) The reason for this change was to minimize the chances of quality deviation in production and improve the seal protection for the needle bearing, thus reducing the chance of friction resistance.
  - d) The part number for the intermediate shaft is 0K52Y 32 550. Kia does not have the part numbers for the individual components of the intermediate shaft.
  - e) See (d).

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- f) December 26, 2003.
- g) December 27, 2003.
- h) Yes.

**See Tab 3 & 4.**

- a) **July 14, 2008** (This part is not being used in the current production model; it is only used as a replacement part)
- b) Attached to the oil rubber seal is a steel shim. KMC determined that there could be an off-center mounting of the seal on the shim. KMC increased the number of jig points on the shim and added an edge to control the seals left to right deviation.
- c) The reason for this change was to minimize the eccentric deviation between the steel shim and seal.
- d) The part number for the intermediate shaft is 0K52Y 32 550. Kia does not have the part numbers for the individual components of the intermediate shaft.
- e) See (d).
- f) July 13, 2008.
- g) July 14, 2008.
- h) Yes.

**See Tab 4.**

**REQUEST NO. 10:**

State the number of subject components that Kia has sold that may be used in the subject vehicles by component name, part number (both service and engineering/production), model and model year of the vehicle in which it is used and month/year of sale (*including the cut-off date for sales, if applicable*).

For each component part number, provide the supplier's name, address, and appropriate point of contact (name, title, and telephone number). Also identify by make, model and model year, any other vehicles of which Kia is aware that contain the identical component, whether installed in production or in service, and state the applicable dates of production or service usage.

**RESPONSE TO REQUEST NO. 10:**

The supplier of the intermediate shaft (0K52Y 32 550) and intermediate shaft assembly (Part No. 0K52Y 32 090) is Namyang Ind. Co., Ltd. (2<sup>nd</sup> Plant) located at 643 Seongkock-Dong, Danwon-Gu, Ansan-shi, Kyunggi-Do, Korea. The point of contact is Ko Jae Sik (General Manager of Quality Assurance Team 2). Mr. Sik can be reached at 82-031-491-3861.

**REQUEST NO. 11**

Provide three field return samples of the subject components representative of the most extreme condition of steering binding/resistance associated with the alleged defect condition and a sample of the current service part.



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**RESPONSE TO REQUEST NO. 11:**

The requested samples will be shipped to you by KMA simultaneously with this response.

**REQUEST NO. 12:**

Furnish Kia's assessment of the alleged defect in the subject vehicle, including:

- a. The causal or contributory factor(s);
- b. The failure mechanism(s);
- c. The failure mode(s);
- d. The risk to motor vehicle safety that it poses;
- e. What warnings, if any, the operator and the other persons both inside and outside the vehicle would have that the alleged defect was occurring or subject component was malfunctioning; and
- f. The reports included with this inquiry.

**RESPONSE TO REQUEST NO. 12:**

- a. **Causal or contributory factors for binding:** Binding as used in response to your inquiries means any increased resistance of any amount to turning of the steering wheel compared to production design objectives. Such binding of the intermediate steering shaft has occurred due to impairment of sealing in the cap of the spider in the U-Joint.
- b. **The failure mechanism for such binding:** Abrasion to the rib in the oil cap seal allowed a loss of lubrication around the needle bearings and spider. This also increased the possibility of the entry of water around the bearings and corrosion. When such water contains salt, increased corrosion is possible.
- c. **The failure mode for such binding:** The corrosion of the needle bearings and possibly the spider can increase friction resistance within the U-joint.
- d. **Possible risk to motor vehicle safety:** The corrosion to the needle bearings and spider causes noise and thus creates a customer satisfaction issue. Noise is in fact identified 93% of the time as the initiating customer complaint leading to a replacement of the intermediate shaft or shaft assembly based upon Kia warranty claim analysis. It is also clear that some customers do not have the vehicle repaired until they encounter some increased steering resistance. Due to the nature of the issue and the effect of the power steering, such resistance starts at very slow speeds and then may increase. It is clear that these are not issues which provide an increase in risk to highway safety.

Thus, Kia has focused its efforts on trying to understand potential cases of maximum effect when such resistance is allowed to occur. Kia believes the results of those

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evaluations, both before and after the commencement of the current investigation, confirm this.

- KMC has monitored issues related to the intermediate shaft since 2002. The earliest reports of heavy steering from Indonesian customers that year resulted in a change in the cap seal in the spider to reduce lubrication loss and thus eliminate customer complaints regarding steering.
- New complaints of both noise and heavy steering were received from Korean customers in mid 2003. Changes were made to the dust cover in October 2003, to reduce noise complaints. Further changes were made in December, 2003 to reduce heavy steering complaints.
- When complaints were received from Canada in May 2004 regarding the steering being "sticky", KMC tested four (4) returned parts from Kia Canada, Inc. to determine if such increased steering resistance was a safety issue. Driving and static vehicle testing was conducted with these 4 returned parts and using a new part for comparison. Such testing in a "parked" condition is a worst case scenario from the standpoint of minimal power steering assistance. Kia's target for maximum resistance in the steering for a new vehicle is 4.0 kgf. In addition, Kia has a design requirement that a vehicle must be steerable and controllable if the engine stalls and power steering is lost. Kia has determined that the nominal acceptable number for such an effect on steering controllability is 11.0 kgf. The static test results showed that the steering force needed to turn the wheel ranged from 2.51 kgf ~ 3.36 kgf for a new part and ranged from 2.18 kgf ~ 4.59kgf for the returned parts. Only one (1) of the four (4) returned parts had a kilogram force higher than Kia's engineering target and that part was approximately 42% of the steering force required to turn a stalled vehicle. Driving a vehicle using the parts showed that there was some increased resistance, which was recorded as "slight heaviness" in the steering when the 4.0 kgf level was exceeded.
- Upon receipt of your IQ, KMC conducted additional testing. KMA provided 38 returned warranty parts from the field for evaluation by KMC. KMA selected those parts on the basis that they were essentially unmovable by hand when inspected. KMC in Korea inspected and tested all 38 returned parts statically and selected four (4) intermediate shafts with the high torque resistance for further testing in a vehicle. Its engineering evaluation on inspection was that the parts were experiencing unusual stiffness due to their extended period of non-use. Two were from the highest range of resistance as measured at the U-joint (90 + kgf cm), one from the 70+ range and one from the 50+ range. KMC conducted static parking effort tests to measure the torque resistance of the 4 intermediate shafts at the steering wheel. The static test results showed that the torque resistance needed to turn the wheel ranged from 2.09 kgf ~ 3.30 kgf for a new part and ranged from 2.13 kgf ~ 4.68 kgf for the returned parts, with an average resistance of 3.15 kgf. Only one (1) of the four (4) returned parts had a kilogram force



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higher than Kia's target for this part (4.0 kgf) and the comparison to the stalled vehicle steering number was again 42%.

- KMC also conducted driving Returnability testing of the four (4) parts to determine if any steering impairment would create a serious situation when the steering wheel was released in a turn. The test was performed by releasing the steering wheel while driving a circle 24m (75 feet) in diameter at 24km (15 mph). This test was videotaped. It established that the increased resistance did not create a dangerous situation, with the time of return only increasing a small fraction of a second and the angle at 3 seconds only increasing from 17 degrees to 32 degrees, compared to a new part.
- KMC conducted a slalom test to evaluate subjective steering capabilities. The two returned parts with the highest torque resistance were chosen for this testing. As can be seen in the video, the driver is able to steer the vehicle as intended during slalom maneuvering without a significant increase in effort.
- The warranty claims analysis demonstrates that the intermediate shaft issue is primarily a noise and customer satisfaction issue. Out of a total of 4,003 warranty claims (previously submitted on July 3, 2008) 3,719 warranty repairs (92.91%) were done as a result of noise related complaints (N29). A deeper analysis of the claims attributed to issues which might indicate increased resistance shows very little support for the possibility of unsafe impairment of steering control.
- Kia's review and analysis of its consumer assistance files and VOQ communications indicates that there are occasional times where the increased resistance will show up in a more pronounced fashion, especially in a high steering angle, low speed term. This can result in a report that the steering "locked" or did something similar. However, Kia engineers believe that this is because the change in resistance can be non-linear and substantial in rare cases, and when that happens, the driver needs to substantially increase their steering effort momentarily -- with no additional steering wheel movement for a small fraction of a second -- thus creating the sense to the driver that the steering is "locked". Kia's long evaluation and testing of this issue has led it to the repeated conclusion that the steering wheel does not "lock" from a safety standpoint, because customers are able to turn the wheel as modest additional force is added. Customer interviews have consistently shown that even when customers say that the steering did something indicating a lack of any movement, they consistently report that additional force provided by their arms quickly exceeds the resistance.

**e. The warnings received by the operator and the other persons both inside and outside the vehicle as to the binding of the steering wheel:**

In almost all cases, the vehicle operator is prompted to bring their vehicle in for service when they become aware of noise coming from the operation of the vehicle steering



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system. As corrosion increases, there is a commensurate increase in noise. In some cases, it is possible for the corrosion to advance to the point that the vehicle operator will identify either increased resistance to turning -- or a slowdown in steering return response -- when coming out of a sharp turn. Since the power steering acts to overcome any such resistance, any increased resistance will first be felt at the slowest speeds, often in a parking lot or driveway. If not remedied, and if the corrosion to the needle bearings and spider increases, the resistance would also logically be felt at slowly increasing higher speeds. Customer interviews have confirmed that the vehicle operators have long periods of time where they are receiving noise and resistance signals to get the vehicle serviced.

f. The VOQ reports included with this inquiry:

**1. VOQ No. 10223568; 04/07/08 (VIN KNDUP131946561940)**

"While her daughter was driving at about 5 to 10 mph, the steering wheel became difficult to turn in all driving conditions. . . . also heard a squeaking sound when turning the steering wheel. The steering shaft U-Joint failure (badly corroded) caused the contact to crash the front end of her vehicle into the "bridge" on her driveway. She has not taken the vehicle to a dealer. The dealer said that there is national order for steering intermediate shaft . . . . The current mileage was 90,000 and failure mileage was 89,000."

Kia contacted family on repeated occasions and spoke to both parents but was not able to get to talk to the daughter who was driving. Prior to the incident wife heard noise coming from the steering and noticed that the steering seemed "weird". She expressed this to her husband, a backyard mechanic, who suspected that the rack and pinion was wearing out, but did not inspect the vehicle. Kia also spoke with customer's husband, who confirmed his wife's report of ongoing noise. Neither husband or wife could recall when the noise started and neither claimed any locking up of the steering wheel prior to the incident. Husband also stated that the vehicle damage was so minor that no body work was done; only small scratches were involved. It was not possible to determine if there was any evidence that this was anything other than a poor depth perception decision by the daughter.

Customer did not retain the old part and Kia could not conduct a further evaluation of this matter. Kia also noted that although not reported previously, husband now asserts that the daughter told him that the steering had locked up.

**2. VOQ No. 10223110; 04/02/08; (VIN KNDUP131X36416467)**

"Vehicle was performing normally until a right hand turn was attempted at a street intersection at which time the steering wheel jammed at approximately the two o'clock position. It took all my strength to get the wheel to turn past this



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position. Once accomplished I again had the same difficulty returned to the twelve o'clock position. This situation caused the vehicle to drift into the opposition traffic lane. Fortunately the lane had no oncoming traffic. The problem continued but I was able to get the vehicle to my mechanics shop. They diagnosed the problem as a defective universal joint in the steering column (intermediate shaft). . . ."

Kia contacted customer. Customer had experienced intermittent stiffening of the steering wheel for about a month prior to the reported incident. Customer states that while driving to the mechanic to have the vehicle serviced, the steering wheel locked up and he was unable to complete his turn into the driveway of the mechanic's shop. He had to stop the vehicle and then he was able to turn the wheel. Kia obtained customer's repair order record from City Tire Co.,--Keene. The repair order states that the customer complaint is that the vehicle "steers extremely hard, better after 25 mph."

The assertion of reported "jamming" is inconsistent with the RO. However, the subjective statement of being extremely hard to turn and that condition having built up over time would not be inconsistent with Kia's analysis. The statement that the customer could only turn the wheel after stopping is not logical. The RO statement that steering was easier at a higher speed is more consistent with the engineering analysis of the problem.

**3. VOQ No. 10221789; 03/19/08 & 04/03/08; (VIN KNDUP131436466796)**

" . . . .When the contact attempts to turn the steering wheel, it will not automatically return to the proper position. The failure occurs intermittently. The dealer stated that the steering coupler assembly was beginning to freeze. The failure is caused by lack of lubrication that causes the coupler assembly to rust. As a result, the steering column locks into one position. The current and failure mileages were 103,000. Updated 04/03/08: Kia did not make the steering coupler assembly with grease fittings and the steering is starting to freeze up intermittently making it impossible to guess when it's going to happen when turning the wheel while driving. It's very unnerving."

Kia has unsuccessfully attempted to reach this customer to obtain more information. The RO identifies that the customer's complaint was only that the "steering wheel hard to turn".

The VOQ statement that the "steering coupler assembly (sic) "was beginning to freeze" and the updated report that "the steering is starting to freeze up intermittently" is rather consistent with the RO that the vehicle was still steerable. The use of the word "unnerving" supports Kia's belief that the worst that a driver may experience is a momentary phenomenon which resolves itself instantaneously. The use of the term "intermittent" further indicates that the

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driver would be experiencing a "normal" level of noise and increase in turning force during most driving, and had an incident or two where they would experience the need for additional force in a tight slow turn.

**4. VOQ No. 10185684; 03/20/07; (VIN KNDUP131926294974)**

" . . . . On one occasion the steering wheel temporarily locks without warning while the vehicle was [in] motion. The dealer diagnosed the steering intermediate shaft to be the failure. The current and failure mileage were 65,000."

The RO states that the customer reported that the steering was "rough and choppy". No locking is identified. Kia contacted customer. Customer stated he was making a turn and for a "brief second" the steering wheel "locked", which he defined as meaning that it "felt like it caught on something". Customer himself emphasized that the "catching" was only momentary and recalled that he either reacted to the catching by turning the wheel or the wheel corrected by itself. Customer could not recall using any additional effort to turn the wheel. This incident concerned him enough that he drove the vehicle home. He later drove it to the dealer.

The above customer description supports Kia's belief that the intermediate shaft condition which we are concerned with here does not result in any wheel locking. Customer's statement of a brief "catching" is consistent with Kia's analysis of a worst case scenario.

**5. VOQ No. 10156428; 04/29/06; (VIN KNDUP131736447191)**

"Hard to steer, on turning steering does not want to return, also hard to turn at any speed. The U-Joint on the steering intermediate shaft binded up without warning. The rack and pinion was replaced also."

Kia contacted customer. Customer stated he had experienced stiffness in turning the steering wheel for approximately 2 weeks prior to taking the vehicle for repair. When making a turn, the steering wheel would not return as quickly. Customer confirmed that he was always able to turn the steering wheel. This manifestation of the problem here did not result in a safety issue. Kia's evaluation is that the "without warning" language refers to the first time he became aware that there was an issue, which would have been at low speed in a high steering angle turn.



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**Conclusion**

**Kia believes that all of the information developed supports a consistent analysis that Kia has been dealing with a fairly predictable noise and modest steering resistance issue. The reports which have loosely referred to "locking" or similar concepts are not supported by Kia's engineering evaluations and testing, and in fact are not supportable from an engineering standpoint. In the great majority of even very high resistance U-joints, the steering of the vehicle is still maintained with only a modest application of additional force. Some of the more ingenuous descriptions received from customers using terms suggesting "locking" in fact support Kia's evaluation that the worst case scenario for this issue only involves an unusually low speed, high steering angle turn where a customer experiences the momentary need to increase steering force in a non-linear fashion to maintain steering control. While this experience may be perceived as being "unnerving", it does not create an unreasonable risk to highway safety.**

Sincerely,

A handwritten signature in cursive script that reads "Robert Babcock".

Robert Babcock

Senior Manager, Regulation and Certification Department