U.S. Department of Transportation

National Highway Traffic Safety Administration

ODI RESUME

OFFICE OF DEFECTS INVESTIGATION

NHTSA

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Investigation:	EA 14-002		
Prompted by:	PE13-035		
Date Opened:	05/12/2014	**Date Closed:**	01/15/2021
Investigator:	Michael Lee	**Reviewer:**	Scott Yon
Approver:	Stephen Ridella		
Subject:	Panoramic Glass Sunroof Breakage		

MANUFACTURER & PRODUCT INFORMATION

Manufacturer: Kia Motors America

Products: Model Year (MY) 2011-2013 Kia Sorento

Population: 65,347

Problem Description: The panoramic glass sunroof may spontaneously break primarily while the vehicle is in motion or possibly while stationary.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	89	338	379**
Crashes/Fires:	0	0	0
Injury Incidents:	9	35	40**
Number of Injuries:	14	52	60**
Fatality Incidents:	0	0	0

** Total eliminates duplicates received by ODI and manufacturer.

ACTION / SUMMARY INFORMATION

Action: This Engineering Analysis is closed without action for the reasons described below and as further explained in the closing report available at NHTSA.gov under NHTSA ID EA14-002.

Summary:

The investigation focused on spontaneous breakage (fracture) of the "panoramic sunroof" (sunroof) on MY 2011-2013 Kia Sorento vehicles. The sunroof is constructed of tempered glass (often referred to as “safety glass”), which, when broken, crumbles into granular chunks rather than splintering into jagged shards. The failure summary above shows NHTSA reports identified by the Office of Defects Investigation (ODI), and reports submitted by Kia from start of production of the subject MY 2011-2013 Kia Sorento through October 8, 2019, the date of ODI's last request for Kia data.

Reports of sunroof failures typically occurred while the vehicle was in motion and often described a loud noise when the fracture occurred. If the sunshade is closed when the sunroof fractures, the particles are contained, otherwise the particles can drop into the passenger compartment. Reported injuries generally were minor in nature, such as nicks and cuts that often occurred when complainants were cleaning-up glass particles post-incident. No crash incidents have been identified, and complaints display a declining trend since 2014.

During EA14-002, ODI requested and obtained failure data for the subject vehicles, the MY 2014 Sorento (which used a similar sunroof from a different supplier), and other peer Kia products (Optima and Sportage). ODI also requested and obtained failure data for peer vehicles produced by Hyundai, Ford, Nissan, and Volkswagen and failure reports through a General Order NHTSA issued to 13 OEMs (including Kia) in April 2016. This produced a significant volume of data upon which ODI bases this closing. NHTSA's Vehicle Research and Test Center (VRTC) also conducted testing on the subject sunroofs in an attempt to better understand potential hazards.

In its responses to ODI, Kia states it has continuously monitored sunroof failure allegations throughout this

investigation, and that the only consistently identified cause is external impact from foreign objects. Kia notes that the sunroof complies with the applicable Federal Motor Vehicle Safety Standards for glazing, and that it has not identified a manufacturing defect or assembly process error despite significant investigative efforts. Kia maintains that the field data supports its conclusion that an unreasonable risk to motor vehicle safety does not exist, citing a comparatively moderate failure rate, low injury risk posed by tempered glass, and the lack of an identified defect mechanism. Kia further notes it has received no reports of crashes due to driver distraction related to roof failure events, nor is NHTSA aware of any such reports.

NHTSA's April 2016 General Order requested data on vehicles with panoramic glass sunroofs greater than 0.5 square meters in area. The response identified 97 distinct models produced over 11 model years totaling some 10 million vehicles. Over 4,000 sunroof fractures were reported (none of which alleged a crash due to driver distraction) forming a high to low frequency continuum by model. While the subject vehicles were at the high end of the spectrum, they were not the highest.

Through its analysis of the information obtained to date, ODI has not identified sufficient evidence of a safety-related defect in the subject sunroof. This includes the absence of any suggestive trends by region, seasonality, date of production, or vehicle age, together with the minor nature of the alleged injuries and the lack of crash allegations in the subject or any of the peer vehicles. Accordingly, the investigation is closed. ODI will take further actions if warranted by new evidence. The reference numbers for the ODI failure reports cited above, as well as additional information on ODI's assessment and testing, can be found in the closing report available at NHTSA.gov.

Attachment to Closing Resume

List of 89 reference (ODI) numbers for the VOQs cited in the closing resume for EA14-002:

10345933, 10366885, 10380921, 10410440, 10432904, 10453957, 10478778, 10492886, 10502219, 10508983, 10514388, 10531972, 10534883, 10553341, 10556130, 10556212, 10559627, 10562460, 10562516, 10563779, 10564555, 10567351, 10568629, 10575487, 10583122, 10583626, 10584650, 10597677, 10599023, 10608047, 10619260, 10626138, 10632804, 10649161, 10649446, 10651462, 10654434, 10655203, 10670206, 10670611, 10689475, 10689999, 10705302, 10705737, 10706032, 10747107, 10748676, 10759876, 10809487, 10822330, 10854478, 10887642, 10903122, 10906156, 10906999, 10916586, 10943707, 10948099, 10990760, 11005338, 11011960, 11019516, 11041803, 11062786, 11073171, 11076805, 11080343, 11083719, 11090390, 11092147, 11101109, 11102486, 11121797, 11130973, 11131539, 11152026, 11161343, 11174480, 11175806, 11182326, 11185054, 11203416, 11228852, 11243288, 11258895, 11270143, 11291224, 11311942, 11319333

ENGINEERING ANALYSIS CLOSING REPORT

SUBJECT: Panoramic Glass Sunroof Breakage

EA No.: EA14-002 Date Opened: May 12, 2014 Date Closed: January 15, 2021

BASIS: This Engineering Analysis was upgraded from Preliminary Evaluation (PE) 13-035 based on the Office of Defects Investigation's (ODI) review of Kia's January 10, 2014 response to ODI's PE13-035 information request letter dated October 24, 2013, and related Vehicle Owner Questionnaire (VOQ) reports submitted to NHTSA and identified by ODI.

THE ALLEGED DEFECT: The panoramic glass sunroof may spontaneously shatter while the vehicle is in motion or stationary. The suddenness and accompanying noise may, hypothetically, cause the driver to lose vehicle control, and additionally the vehicle occupants can potentially be injured by broken pieces of glass or other sunroof components that enter the occupant compartment.

DESCRIPTION OF COMPONENT OR VEHICLE SYSTEM: The model year 2011-2013 Kia Sorento vehicles (subject vehicles) are equipped with panoramic sunroofs as shown below. The sunroof is divided into two panels, one in the front, and one in rear, and the front section can be retracted (moved to open position). The glass is tempered (a form of heat-treatment) and designed to fracture into granular chunks, (i.e., small nuggets typically referred to as cutlets) in contrast to non-tempered glass that can break into large pieces with sharp edges.

CORRESPONDENCE:

During the investigation, ODI made the following information requests (via information request letters) from the subject manufacturer (Kia).

NHTSA to MFR	MFR to NHTSA	NHTSA to MFR Supplement
10/24/2014	11/26/2014	12/18/2014
9/19/2017	10/6/2017	None
10/8/2019	10/30/2019	None

In addition to the above, ODI also sent information request letters to vehicle manufacturers Ford, Hyundai, Nissan and Volkswagen in July, 2014, requesting panoramic sunroof design feature, functionality and specification, as well as field failure data on similar model year and market segment peer vehicles produced by these manufacturers. Responses were received during August and September of 2014.

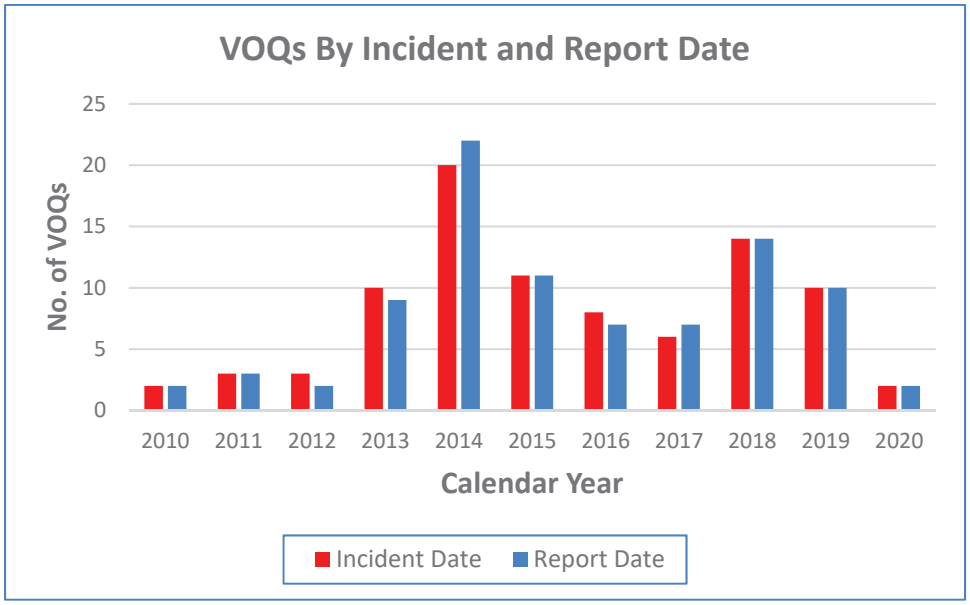
STATUS:

The following subject vehicle report and injury counts were identified by ODI:

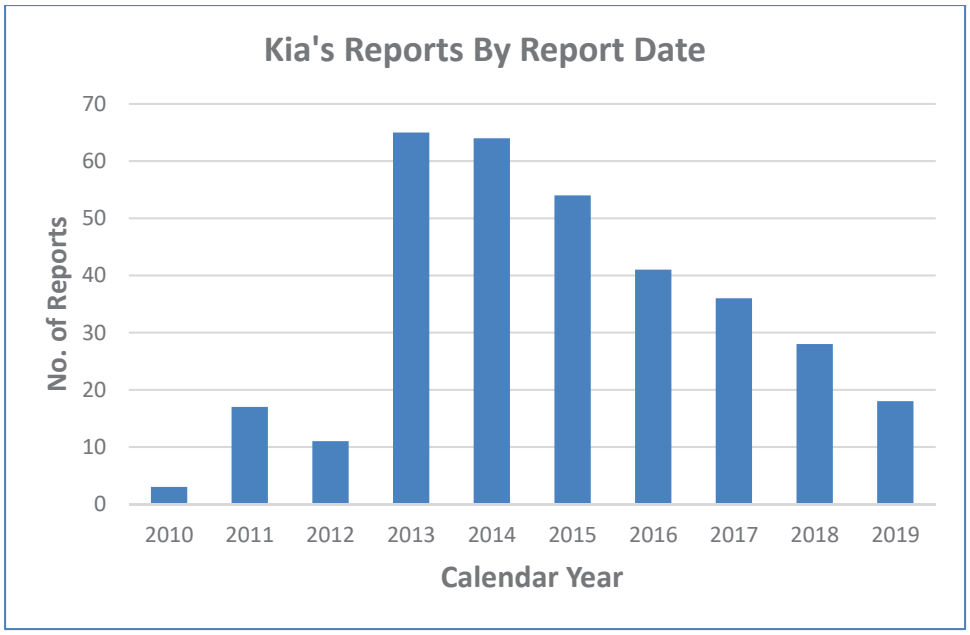
Problem Experience	EA Opened		EA Closed		Total*
	ODI	MFR	ODI	MFR	
Owner Reports*	26	123	89	338	379
Crash Incidents	0	0	0	0	0
Injury Incidents*	4	14	9	35	40
Injuries*	6	16	14	52	60
Fatal Incidents	0	0	0	0	0

*Total eliminates duplicates between ODI and MFR reports/injuries.

The manufacturer report counts shown above were received by Kia through October 8, 2019, the date of ODI's last request for Kia field data. Both the ODI and Kia reports show a generally declining trend over the last few years, as shown in the charts below.[1]



[1] Kia reports do not consistently state an incident date, therefore only the report dates can be accurately reported.



VEHICLE POPULATION:

Model Year and Model	Vehicle Production
2011 Sorento	25,593
2012 Sorento	20,995
2013 Sorento	18,759
Total	**65,347**

COMPLAINTS/FIELD REPORTS:

A review of Kia's complaints and field reports, as well as VOQs received by ODI, indicates that the glass on the front or rear panel can shatter spontaneously without warning, most often while the vehicle was being driven. Complaints often described the sound of the shattering as a loud explosion or a gun shot. Some complaints also described being showered by broken glass, which occurred in those cases where the sunshade was in the open position. Complainants often reported there were no impacts observed to the sunroof immediately preceding the failure, with some also reporting there were no other vehicles present when the failure occurred.

While some reports alleged the driver being startled and momentarily losing vehicle control (e.g., a lane departure or unexpected braking) when the panoramic sunroof shattered, there have been no reports of crashes associated with the alleged defect. Nor have there been any serious injuries reported. Most of the injuries were scratches or minor cuts to hands or other exposed body parts, and in many cases these occurred while cleaning up broken glass. Thirteen complaints indicated that a metal bar (or cross brace) from the panoramic sunroof assembly detached and entered the occupant compartment, and in a few cases struck a vehicle occupant resulting in a bruise or bump.

WARRANTY: Kia reported having 92 warranty claims and 71 goodwill claims related to the alleged defect in the subject vehicles as of September 30, 2014.[2]

SERVICE BULLETINS: None identified.

PART SALES: Information not requested or available.

DESIGN, MATERIAL, AND/OR PRODUCTION MODIFICATIONS: None identified.

ADDITIONAL INFORMATION (Previous Investigations/Recalls): A review of prior safety recalls for sunroof failures conducted by various manufacturers indicates that an identified defect in the design, manufacture or assembly had been identified and formed the basis for the recall. Examples include: (1) glass that was improperly processed (tempered or quenched) during manufacture, (2) sunroof assemblies that were damaged (structurally weakened) during vehicle manufacture causing the glass panel to subsequently shatter in use, (3) glass panels improperly bonded to attaching bracketry/vehicle structure that cause the glass panel to detach while the vehicle is in motion (and creating a roadway hazard). Also, during a previous sunroof investigation (PE12-027) which resulted in a recall action (12V-568) of certain Hyundai vehicles, ODI identified a specific manufacturing process change and a coincident change in failure trend.

TESTING/SIMULATIONS:

In early 2016, ODI began discussing possible testing initiatives with NHTSA's Vehicle Research and Test Center (VRTC), located in East Liberty, Ohio. Multiple potential test objectives were discussed including conducting a general assessment of the subject vehicle panoramic sunroof design and durability, determining if the subject vehicle glass complied with SAE and ANSI standards for tempered glass (including for glass fragment size), and evaluating injury risk from falling glass or other sunroof componentry that may enter the passenger's compartment during a sunroof failure.

VRTC conducted a variety of tests and evaluations in support of the investigation, as described in its February 10, 2016 test plan.[3] Amongst these were assessment of the subject sunroof glass durability, evaluation of potential manufacturing deficiencies, review of subject vehicle VOQ reports, and inspection of peer vehicle glass sunroof designs which were similar to those of the subject vehicles.

VRTC testing also included quasi-static simulations of sunroof glass breakage in a subject vehicle, including some that were intended to simulate the condition of a vehicle in motion. For this testing, the subject vehicle's glass sunroof was intentionally fractured to observe potential effects of a broken sunroof on occupants. Several simulations were conducted to develop a method of initiating the glass fracture, including bench-top simulations, with the final test procedure being conducted on July 13, 2016.

In summarizing its testing, VRTC reported that the subject glazing was found to conform with applicable SAE and ANSI standards. VRTC also noted that sound pressure levels recorded during sunroof fracture are similar to those used in startle testing, and that fractured glazing material (i.e., cutlets) could be held together by a ceramic coating material applied to the outer surface of the glass.[4] The ceramic coating is

[2] ODI did not request additional warranty data past this date, and instead elected to focus on reviewing Kia's complaints and field reports that alleged failures, crashes or injury allegations.
[3] ODI's test request, VRTC's test plan, and a summary of VRTC testing is available at NHTSA.gov under EA14-002.
[4] The ceramic material is applied to make the glass non-transparent primarily for styling/aesthetics and/or to hide unsightly mounting hardware and mechanisms.

non-structural, so the cutlets readily break apart when disturbed manually.[5] The VRTC testing did not identify a safety defect in the glass or subject vehicle.

FAILURE/MALFUNCTION MODES: Panoramic glass sunroof breakage potentially due to insufficient glass strength or another defect condition, and possibly related to debris impacts (or accumulated impacts) occurring through normal consumer use of the vehicle.

WARNING SYMPTOMS: None.

CONTRIBUTING FACTORS: Road debris such as small rocks "kicked up" by other vehicles could be a contributing factor either in causing the sunroof glass to shatter immediately or causing imperceptible impact damage that can eventually result in a subsequent breakage due to additional stresses or glass damage, or the cumulative effects of multiple such impacts.

MANUFACTURER'S EVALUATION OF THE ALLEGED DEFECT:

Between 2014 and 2019, Kia consistently provided lengthy evaluations of the alleged defect in the subject vehicles. Below are a few of Kia's main points.

Kia and its suppliers of the sunroof assembly (Webasto) and the glass (Guardian) have reviewed all their records and state that they have identified no root cause or defect in the sunroof assembly in the subject vehicles. Kia stated that "at no time have there been any relevant changes to the sunroof design or assembly or the related manufacturing process" for the subject vehicles.

Kia stated that based on its investigation and research, instantaneous breakage can be caused by an external impact by a rock or road debris, or an impact that causes damage to the glass however the breakage does not occur until additional forces or stresses are applied to the glass at a subsequent time. Kia stated that other manufacturers also use tempered glass in their sunroofs, which is designed to fracture into granular chunks or cutlets without sharp edges, and thus does not create a significant injury risk to vehicle occupants, as evidenced by lack of any reported lacerations or serious injuries.

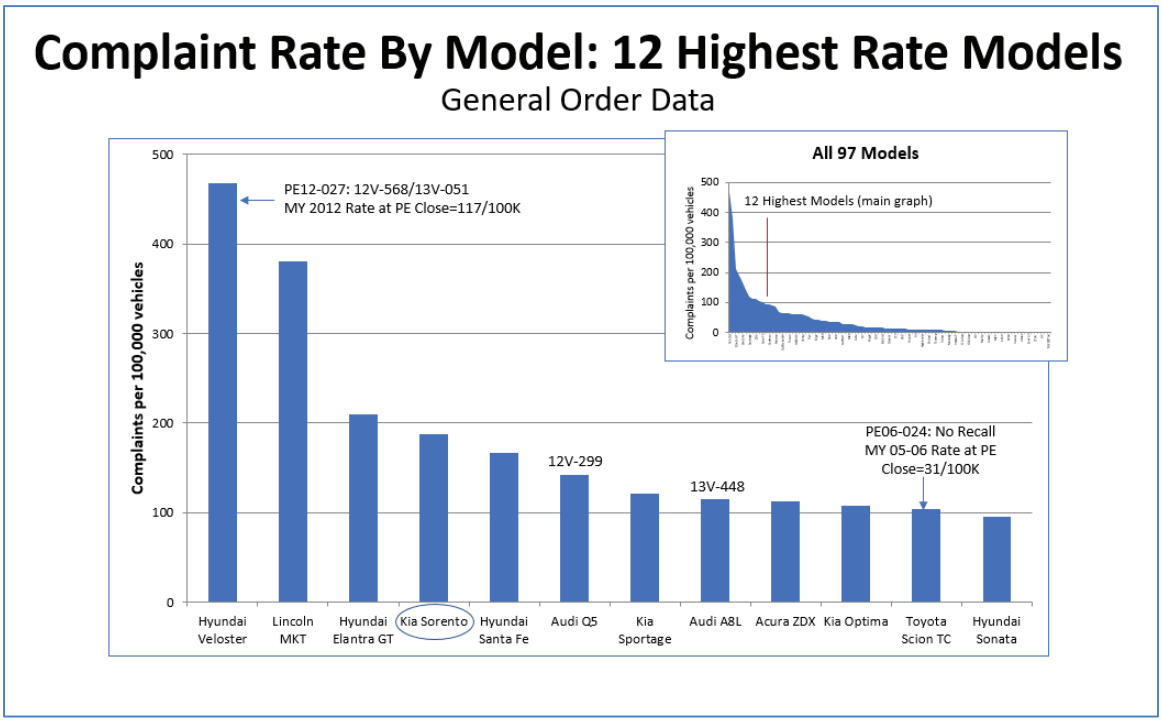
Kia also noted that ODI has previously closed, without influencing a recall, a similar investigation on certain Cadillac SRX vehicles with large sunroofs (EA06-001). Kia stated that ODI's findings in the Cadillac investigation are similar to what Kia has found in this investigation as stated above. Kia also stated the Sorento sunroof complies with FMVSS No. 205 requirements on glazing materials.

ODI ANALYSIS:

Kia has identified no root cause or design, manufacturing, or assembly defect related to the alleged defect in the subject vehicles, nor has ODI or VRTC. ODI also has not identified failure trends by vehicle manufacture date, failure date (i.e., seasonal affects), or by geographical region (i.e., climate related affects). In the past, manufacturers have conducted safety recalls, both influenced by ODI and uninfluenced, to address sunroof failures; however, in nearly all cases a specific cause in the design, manufacturing or assembly was identified, and/or a trend in vehicle production or field performance was identified. With respect to potential safety consequences, ODI has identified no crashes or serious injuries due to the alleged defect. While in a small percentage of cases, a metal bar (the cross brace) entered the passenger compartment causing minor injuries, there have been no allegations that the metal bar exited the vehicle and created a roadway hazard or projectile.

[5] In the final test, portions of this type material were adhered to a component (the cross brace) that entered the passenger compartment. As noted previously, allegations of the cross brace entering the occupant compartment have been identified in 13 of the 379 (3.4%) subject sunroof failures.

Via a General Order issued by NHTSA's Office of Chief Counsel in April 2016, ODI conducted a comprehensive, industry-wide peer review of reports of spontaneous sunroof glass shattering. The review covered 13 vehicle manufacturers, 97 vehicle models and 11 model years (2006 to 2016), totaling approximately ten million vehicles that utilized panoramic glass sunroofs greater than 0.5 meters square. This review found that spontaneous sunroof glass shattering is not an uncommon occurrence: More than 4,000 complaints of such occurrences were reported by the 13 manufacturers. While the Kia Sorento did stand out from other vehicle models, other models of Audi, Ford, Hyundai and Kia vehicles also stood out (see graph below). Some of these models were associated with recalls, however others were not. No crashes and only a few moderate or greater injuries were reported in the more than 4,000 incidents.



Additionally, ODI is aware of emerging technologies related to sunroof glass design. To achieve increased break strength and durability, certain major sunroof suppliers appear to be moving towards using laminated glass and polycarbonate glass or other improved materials. This should help reduce the incidents of sunroof glass breakage in the future. Also, increased retention strength of the new types of glass is expected to reduce occupant ejections through the sunroof, an additional hazard presented by large or panoramic sunroof designs.

REASON FOR CLOSING: ODI reviewed the VOQ reports, Kia's reports, Kia's and its sunroof supplier's design and test data, past sunroof related ODI investigations, VRTC testing and prior safety recalls, among other information. Most notably ODI also conducted a comprehensive peer review of spontaneous sunroof shattering to help assess potential safety consequences.

Through analysis of the information obtained to date, ODI has not identified sufficient evidence of a safety-related defect in the subject sunroof. This includes the absence of any suggestive trends by region, seasonality, date of production, or vehicle age, together with the minor nature of the alleged injuries and the lack of crash allegations in the subject or any of the peer vehicles over many years in service. A safety-related defect trend has not been identified, accordingly this Engineering Analysis is

closed. The closing of this investigation does not constitute a finding by NHTSA that a safety defect does not exist, and ODI will take further actions if warranted by new evidence.

MICHAEL J LEE Digitally signed by MICHAEL J LEE Date: 2021.01.13 09:10:59 -05'00'

Safety Defects Engineer _____ Date

I Concur:

D SCOTT YON Digitally signed by D SCOTT YON Date: 2021.01.12 17:09:17 -05'00'

Chief, Vehicle Defect Division B _____ Date

STEPHEN ANTHONY RIDELLA Digitally signed by STEPHEN ANTHONY RIDELLA Date: 2021.01.13 14:02:17 -05'00'

Director, Office of Defects Investigation _____ Date