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Administration**



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DOT HS 813 587

June 2024

**Special Crash Investigations:  
Remote Move-Over-Law Crash  
Investigation;  
Vehicle: 1996 International 4000/  
Nonmotorist;  
Location: Washington State;  
Crash Date: April 2021**

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<b>16. Abstract</b> The crash occurred in April 2021 in Washington State. The struck vehicle was a 1996 International 4000 rollback tow truck and the striking vehicle was a 2011 BMW 335d 4-door sedan. The other involved vehicle was a 2013 Kia Sorento compact SUV. The tow truck had responded to a prior single-vehicle crash involving a 2018 Kia Stinger. The tow truck and Sorento were stopped on the right shoulder and the Stinger was loaded on the tow truck. The tow truck's emergency lights were activated. The 63-year-old male tow truck driver (nonmotorist) was standing at the back end of the International while securing the Stinger to the flatbed. The Sorento occupants were a belted 55-year-old male driver, a belted 54-year-old female front passenger, and a belted 25-year-old male in the second-row left seat. The 25-year-old male was the Stinger driver involved in the prior crash. The BMW was driven northbound by a belted 43-year-old female. The BMW departed the roadway on the right edge and its front plane struck the back plane of the Sorento. The Sorento was pushed forward where its right plane struck the tow truck driver (nonmotorist) and tow truck. The tow truck driver and front-row occupants of the Sorento sustained fatal injuries and were pronounced deceased on-scene. The 25-year-old male occupant sustained police-reported "A" (incapacitating) injuries and was transported and hospitalized. The BMW driver sustained police-reported "A" injuries and was transported and hospitalized. Police determined she was driving under the influence of six prescription drugs and arrested her on charges of vehicular homicide and vehicular assault.			
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**Special Crash Investigations**  
**Remote Move-Over-Law Investigation**  
**Case No. DS21011**  
**Vehicle: 1996 International 4000/Nonmotorist**  
**Location: Washington State**  
**Crash Date: April 2021**

## **Background**

This report documents the remote investigation of a crash selected by the Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration to be included in their “Move-Over-Law” investigations. The investigation used data obtained from local authorities including police reports, supplemental reports, on-scene police photos and videos, medical records, and event data recorder (EDR) reports. The source material was used to document the facts of the case and reconstruct the causal factors of the crash relative to Washington State’s Move-Over Law requiring drivers to slow down, proceed with caution, and when possible, move to the far lane when passing an official emergency response vehicle on the side of the road with its emergency lights activated. This investigation was initiated by SCI in response to a notification sent by the SCI team in October 2021 containing the State crash report and online news reports. The SCI team was directed to obtain additional source material before determining whether the investigation would be conducted remote or on-site. After obtaining sufficient source material in November 2021, the SCI team determined this would be a remote investigation.

The crash occurred in the morning in April 2021 in a rural area of Washington. The crash site was in the northbound lanes of a physically divided north/south interstate highway. Conditions at the time were daylight, raining, and wet. The asphalt roadway had three northbound lanes and asphalt shoulders with rumble strips on the left and right sides. The posted speed limit was 113 kmh (70 mph).

The struck vehicle was a 1996 International 4000 medium-duty commercial tow truck with a rollback-style flatbed (Figure 1). The striking vehicle was a 2011 BMW 335d 4-door sedan. The other vehicle was a 2013 Kia Sorento compact SUV. A non-contact 2018 Kia Stinger was loaded on the International. The driver of the International tow truck had responded to a prior single-vehicle crash at this site involving the Stinger and 25-year-old male driver. Police left the scene prior to the second crash. At the time of the second crash, only the International, Sorento, and Stinger were stopped on the right shoulder.



*Figure 1. 1996 International 4000 (police photo)*

The International was parked facing north with its emergency lights activated. The 63-year-old male driver (nonmotorist) was standing on the right shoulder behind the vehicle while securing the Stinger to the flatbed. The Sorento was parked facing north behind the International and its occupants were a belted 55-year-old male driver, a belted 54-year-old female front passenger, and a belted 25-year-old male second-row left occupant. The 25-year-old male occupant had been the Stinger driver involved in the prior crash. The Sorento driver and front passenger were the parents of the Stinger driver and had come to pick up their son. The BMW was driven northbound in the second or third lane from the right by a belted 43-year-old female. For unknown reasons the BMW traveled to the right, departing the roadway on the right edge and entering the right shoulder where its front plane struck the back plane of the Sorento. Impact forces pushed the Sorento forward in a counterclockwise rotation, causing its right plane to strike the nonmotorist and back plane of the International. The vehicles and nonmotorist came to rest near the areas of impact.

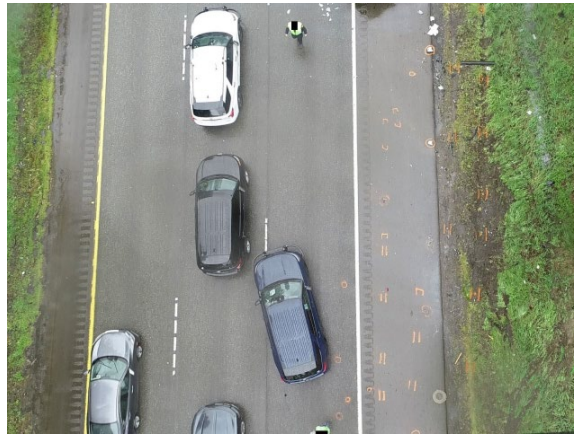
The 63-year-old tow truck driver (nonmotorist) and both front-row occupants of the Sorento sustained fatal injuries and were pronounced deceased on-scene by paramedics. The 25-year-old male occupant sustained police-reported “A” (incapacitating) injuries and was transported to a hospital where he was admitted. The 43-year-old female driver of the BMW sustained police-reported “A” (incapacitating) injuries and was transported to a hospital where she was admitted overnight. She was determined to be driving under the influence of a combination of prescription drugs and was arrested on charges of vehicular homicide and vehicular assault.

All vehicles involved in the crash were towed and placed into evidence by police. The Sorento had an air bag control module (ACM) supported by the Global Information Technology Kia EDR tool. Police imaged the EDR data and provided SCI with a copy of the EDR report in PDF format. The EDR report with hexadecimal data omitted is included in Appendix A of this report.

## Summary

### Crash Site

The police report, photos, video, and satellite imagery were used to obtain crash site data. The crash site was in the northbound lanes of the divided north/south interstate highway (Figure 2). The roadway had three northbound asphalt lanes each measuring approximately 3.6 m (12 ft) wide. The lanes were separated by dashed white painted stripes and raised reflective markers located on the dashes and within the spaces between the dashes. The left roadway edge had a solid yellow painted fog line and an asphalt shoulder with a milled-in type rumble strip. The right roadway edge had a solid white painted fog line and an asphalt shoulder with a milled-in type rumble strip. The right shoulder was approximately 3.6 m (12 ft) wide. The roadway was straight, level, and crowned to allow for runoff. Based on police photos and the police report narrative, the pavement and pavement markings were in good condition. The right roadside was a descending grass embankment and a line of trees oriented parallel to the roadway. The posted speed limit was 113 kmh (70 mph). Conditions at the time were daylight and wet with light rain. Police noted water standing in the rumble strip depressions on the right shoulder. The ambient temperature was 8.3°C (47°F). No supplemental warning devices were in use at the site prior to the crash and according to the police report no unusual conditions were present.



*Figure 2. Crash site overhead view (police video)*

The International driver had responded to a prior single-vehicle crash at this site involving the Stinger. He was standing on the right shoulder at the back end of the tow truck while securing the Stinger to the flatbed. Police cleared the scene of the prior crash after the tow truck arrived. At the time of the second crash, only the International, with the Stinger loaded onto its flatbed, and the Sorento were stopped on the right shoulder. A crash diagram and crash site satellite view are included at the end of this report.

### Pre-Crash

The International was stopped facing north on the right shoulder with its emergency lights activated. Police said the vehicle had red flashing emergency lights activated. Its driver was standing behind the vehicle securing the Stinger to the flatbed. The Sorento arrived approximately 16 minutes before the crash. At that time, a Washington State Patrol vehicle was stopped south of the International and the Sorento was stopped facing north behind the International and in front of the police vehicle. According to the Sorento's EDR report, the

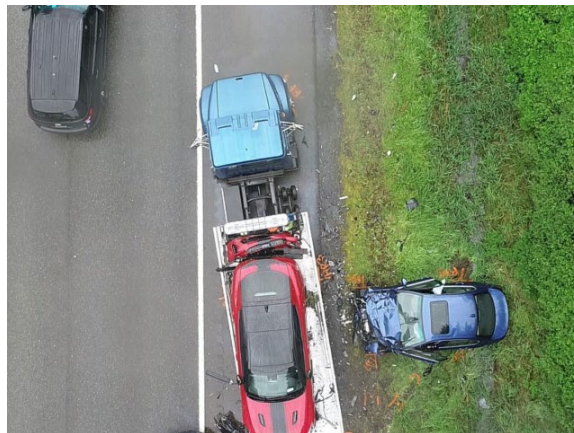
vehicle's engine was idling at 600 rpm, the service brake was activated, and the front-row occupants were belted. Approximately 13 minutes prior to the crash, the police vehicle left the scene.

The BMW was traveling northbound in either the second or the third lane from the right, according to a witness to the crash who was traveling behind the BMW. For unknown reasons the BMW traveled to the right and departed the roadway on the right edge. The witness said the BMW suddenly changed its direction and appeared to travel intentionally in the direction of the tow truck. The witness told police that he observed the International's emergency lights from an estimated distance of 0.8 km (0.5 mi) south of the crash site.

## Crash

The BMW's front plane struck the back plane of the Sorento (Event 1). Police identified a group of gouge marks in the pavement as the point of maximum engagement for this impact. The BMW driver's frontal air bag deployed. The Sorento's EDR captured a deployment level event with a maximum longitudinal delta V of 66 kmh (41 mph) at 115 ms and a maximum lateral delta V of -5 kmh (-3 mph) at 65 ms. The vehicle's seat-mounted side impact and inflatable curtain (IC) air bags deployed and the front-row seat belt pretensioners actuated at 51 ms. For the BMW, a police reconstruction calculated an impact speed of 126 to 129 kmh (78 to 80 mph) with no braking applied, and a longitudinal delta V of -75.8 kmh (-47.1 mph).

Following the impact the BMW departed the paved shoulder on the right edge, initiating a counterclockwise yaw, and deposited tire furrow marks in the ground measuring 15.3 and 20.8 m (50.2 and 68.2 ft) long before coming to rest facing west on the roadside. Impact forces from the first event pushed the Sorento forward in a counterclockwise rotation and its right plane struck the nonmotorist (Event 2) and the back plane of the International (Event 3). The Sorento's EDR captured a second deployment level event with a maximum longitudinal delta V of -12 kmh (-7.7 mph) at 300 ms and a maximum lateral delta V of -7 kmh (-4.4 mph) at 300 ms. The four triggered air bags had already deployed in the first impact. The nonmotorist was struck by the right plane of the Sorento and then struck the back plane of the International and was wedged between the two vehicles. The International and nonmotorist were pushed forward approximately 3 m (10 ft). The vehicle came to rest facing north on the right shoulder (Figure 3) and the nonmotorist came to rest on the ground. The Sorento came to rest facing north on the right shoulder and right lane.



*Figure 3. Overhead view of the 1996 International 4000 and 2011 BMW 335d at final rest (police video)*

## **Post-Crash**

A passerby employed by the State department of transportation stopped at the crash site and called the Washington State Patrol dispatch center. The first medical unit was dispatched 1 minute after the call was answered and the State Police were dispatched 2 minutes after the call. The first emergency response unit arrived 12 minutes after the call.

The tow truck driver sustained serious injuries and was pronounced deceased on-scene by paramedics. The BMW driver exited her vehicle in an unknown manner. Following field sobriety tests and blood tests, she was determined to be driving under the influence of a combination of six prescription drugs and was arrested on charges of vehicular homicide and vehicular assault. She sustained serious injuries and was transported and hospitalized overnight. The 55-year-old male Sorento driver sustained a maximal injury and was declared deceased on-scene. The 54-year-old female Sorento front passenger sustained serious injuries and was pronounced deceased on-scene. The 25-year-old male Sorento occupant sustained serious injuries and required approximately 22 minutes extrication time, after which he was transported and hospitalized. All vehicles involved in the crash were towed on orders of police and placed into evidence.

## **Move-Over Discussion**

Washington's Move-Over Law was passed in 2007 and amended in 2010. The Washington State Patrol website states that since 2007 the number of collisions involving emergency vehicles and workers has increased. The current law enforces an "emergency zone" defined as the adjacent lanes of the roadway 61 m (200 ft or 10 car lengths) before and after a stationary emergency vehicle with flashing lights, a tow truck using red lights, an emergency assistance vehicle using warning lights, or any police vehicle using emergency lights. Given the roadway in this crash had three lanes heading in the same direction, changing lanes to the left away from the tow truck would be considered the appropriate driver response.

The International was stopped on the right shoulder with its emergency lighting activated. The vehicle had four solid red tail lamps, and a light bar with rear-facing solid red lamps and flashing amber lamps. These are seen in a video taken approximately 9 minutes before the second crash by one of the front-row occupants of the Sorento that was stopped behind the tow truck.

The tow truck driver was standing on the right shoulder between the back of the tow truck and the front of the Sorento.

The Sorento was parked approximately 15 m (50 ft) behind the International facing north on the right shoulder. It was unknown if the Sorento's emergency lighting was activated. No other supplemental warning devices were in place. Conditions were daylight, raining, and wet.

According to a witness, the BMW was originally traveling in the second or third lane from the right. He observed the International's emergency lights and prepared to move over one lane to the left. The BMW then traveled to the right, departed the roadway on the right edge, and struck the back plane of the Sorento. The witness stated the BMW did not activate its brake lights prior to impact. The BMW driver told police she had no memory of the crash and could not explain why she departed the roadway.

Following field sobriety tests and blood tests taken under exigent circumstances and a search warrant, a police drug recognition expert determined the BMW driver was under the influence of several prescription medications. The toxicology results revealed her blood contained diazepam,

lorazepam, nordiazepam, pseudoephedrine, buprenorphine, and norbuprenorphine. According to a State forensic scientist, all the above listed drugs taken alone could potentially cause impairment, and the risk increases when several drugs are used at the same time. The BMW driver was arrested on charges of vehicular homicide and vehicular assault.

Police determined the cause of the crash to be the BMW driver's high level of impairment that drastically reduced her ability to perceive and react to her surroundings. Additionally, she was traveling an estimated speed 21 to 24 kmh (13 to 15 mph) above the posted speed limit on a wet roadway.

## 1996 International 4000

### Description

The 1996 International 4000 was identified by police using the Vehicle Identification Number (VIN) 1HTSCABM5THxxxxxx. The manufacture date was unknown. The International was a 4700 series cab-behind-engine medium duty truck with a gross vehicle weight rating class of 8,845 to 11,794 kg (19,500 to 26,001 lb). It was manufactured as an incomplete vehicle straight truck and used commercially as a tow truck with a Jerr-Dan rollback style flat carrier deck. It had a V-8 7.3-liter diesel International/Navistar engine, rear-wheel drive, hydraulic brakes, and 245/70R19.5 tires.

### Emergency Lighting Discussion

The International was stopped facing north on the right shoulder with emergency lights activated (Figure 4). The leading end of the carrier had an LED light bar. The left and right sides of the carrier deck had red and white reflective tape extending its length. Police photos show the activated emergency lighting features included the light bar with rear-facing amber lamps, 4-way flashers with forward and rear-facing amber lamps, and red taillights. A witness to the crash told police he first observed the International's emergency lights from an estimated distance of 0.8 km (0.5 mi) south of the crash site. At the time of the crash, the International had four solid red tail lamps illuminated, and the light bar had solid red lamps and flashing amber lamps activated.



*Figure 4. 1996 International 4000 with light bar activated (police photo)*

### Exterior Damage

Based on the police report and photos, the International sustained minor damage to the back and left planes of the metal carrier deck in the impact with the Sorento. The damage included scrape marks to the trailing edge, top surface, and left plane of the deck. No other damage was noted by police or visible in police photos. The estimated truck deformation classification for the International in Event 1 was 06BDFWA (Figure 5).





*Figure 5. Area of impact, back plane of 1996 International 4000 (police photo)*

### **NHTSA Recalls and Investigations**

A VIN-based search for NHTSA recalls in February 2022 revealed one recall campaign from March 6, 2003. In summary, if the driver's seat is adjusted forward, from outside the cab, and the parking brake is set, the seat will contact the parking brake and release it. Police determined this was not a related factor for this crash. A recall search in April 2024 revealed no unrepaired recalls.



## Nonmotorist

### Tow Truck Operator Demographics

Age/sex: 63 years/male  
 Height: 180 cm (70 in)  
 Weight: 72 kg (158 lb)  
 Clothing: Blue cap, black jacket, blue shirt, gray pants, white socks, gray shoes  
 Eyewear: None  
 Alcohol/drug data: None  
 Transport from scene: Not transported  
 Type of medical treatment: None, declared deceased on-scene

### Tow Truck Operator Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1 2	Hemothorax, minor, bilateral lungs	442200.3 442200.3	Tandem IPC Exterior of other motor vehicle / exterior of occupant's vehicle	Probable
3	Fracture, open, right humerus	751101.3	Tandem IPC Exterior of other motor vehicle / exterior of occupant's vehicle	Probable
4	Fracture, open, right femur	853001.3	Tandem IPC Exterior of other motor vehicle / exterior of occupant's vehicle	Probable
5	Fracture, open, left femur	853001.3	Tandem IPC Exterior of other motor vehicle / exterior of occupant's vehicle	Probable
6	Fracture, open, right patella	854501.2	Exterior of other vehicle	Probable
7	Fracture, nose	251000.1	Exterior of other vehicle	Probable
8	Fractures NFS, bilateral ribs, left more extensive than right	450200.1	Exterior of other vehicle	Probable
9	Abrasion, left shoulder	710202.1	Exterior of other vehicle	Probable
10	Abrasions, right abdomen	510202.1	Exterior of occupant's vehicle	Probable

<b>Injury No.</b>	<b>Injury</b>	<b>Injury Severity AIS 2015</b>	<b>Involved Physical Component (IPC)</b>	<b>IPC Confidence Level</b>
11	Abrasions, right hip	810202.1	Exterior of other vehicle	Probable

Source: Autopsy report

### **Tow Truck Operator Kinematics**

The nonmotorist was standing on the right shoulder behind the back end of the International while securing the Stinger to the flatbed. He was not wearing safety gear or reflective clothing. He was struck by the right plane of the Sorento and pinned between the Sorento and the back plane of the International. He likely contacted the front plane of the Stinger that was loaded on the tow truck. His injuries were likely caused by a combination of the three vehicles and include fractures and hemothoraces to both lungs; open fractures to the right humerus, bilateral femurs, and right patella; fracture to the nose; and abrasions to the upper and lower extremities. While pinned between the vehicles, he was displaced northbound approximately 3 m (10 ft) as the Sorento and International vehicles traveled northbound post-impact. Following the crash, he fell to the ground and remained there until moved by emergency responders. He was declared deceased on-scene.

## 2011 BMW 335d

### Description

The 2011 BMW 335d was identified by police using the VIN WBAPN7C58BAxxxxxx. The manufacture date was unknown. The BMW was a 4-door sedan with rear-wheel-drive and 5-passenger seating. Standard equipment included a 3.0-liter, 6-cylinder diesel engine, automatic transmission, hydraulic brakes, automatic headlights, high density discharge headlights, fog lights, and daytime running lights. The vehicle manufacturer recommended size P225/45R17 tires for the front and rear. It had Caldera Confidence C3 tires of the recommended size with tread depths of 4 to 5 mm (5/32 to 6/32 in).

### Exterior Damage

Based on the police report and photos, the BMW sustained major severity damage to the front plane (Figure 6) in the Event 1 crash with the Sorento. Direct damage appeared to be distributed from bumper corner to bumper corner. The front bumper fascia was displaced, engine compartment components were displaced rearward, and the left fender, right fender, and hood were crumpled. The estimated collision deformation classification (CDC) for the BMW in Event 1 was 12FDEW3. The vehicle's ACM was not supported by the Bosch Crash Data Retrieval system so police could not image any vehicle crash data.



*Figure 6. Front plane damage, 2011 BMW 335d (police photo)*

### NHTSA Recalls and Investigations

VIN-based NHTSA recall searches in February 2022 and April 2024 revealed no unrepaired recalls for this vehicle.

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## 2011 BMW 335d Occupant

### Driver Demographics

Age/sex: 43 years/female  
 Height: 155 cm (61 in)  
 Weight: 82 kg (180 lb)  
 Eyewear: None  
 Seat type: Bucket with adjustable head restraint  
 Seat track position: Unknown  
 Manual restraint usage: Lap and shoulder belt used  
 Usage source: Police report, medical records  
 Air bags: Frontal, IC, and seat-mounted side impact equipped; frontal and IC deployed; unknown if side impact deployed  
 Alcohol/drug data: Negative for alcohol; positive for diazepam (0.050 mg/L), lorazepam (100 ng/mL), nordiazepam (0.20 mg/L), pseudoephedrine (0.44 mg/L), buprenorphine and norbuprenorphine  
 Egress from vehicle: Unknown  
 Transport from scene: Ambulance to hospital  
 Type of medical treatment: Admitted overnight and released

### Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Subdural hemorrhage, 2 mm, posterior cerebrum along the left tentorium	140651.3	Head restraint	Possible
2	Contusions, left breast and right chest	410402.1	Seat belt	Probable
3	Contusion, lower abdomen	510402.1	Seat belt	Probable
4	Laceration, minor, left hand	710602.1	Left IP	Possible
5	Abrasions, dorsal left hand including all fingers	710202.1	Left IP	Possible
6	Abrasions and contusions, bilateral hips	810202.1	Seat belt	Probable
7		810402.1		
8	Contusion, left buttock	810402.1	Seat cushion	Probable

Source: Medical records

### Driver Kinematics

The BMW driver was a belted 43-year-old female. She had borrowed the vehicle from a friend. At impact with the Sorento, her frontal air bag deployed and she was displaced forward loading the seat belt and air bag. She sustained abrasions and contusions to the chest, abdomen, and hips caused by the seat belt. Her left hand was possibly displaced forward contacting the left instrument panel (IP) causing a minor laceration and abrasions to the fingers. Her head contacted an unknown component causing a subdural hemorrhage to the cerebrum. She remained held in

her seated position by the seat belt. After coming to rest, the driver remained in the vehicle and using her hands signaled to responders through the closed side window. She exited the vehicle in an unknown manner and was transported by ambulance to a hospital where she was admitted overnight.

## 2013 Kia Sorento

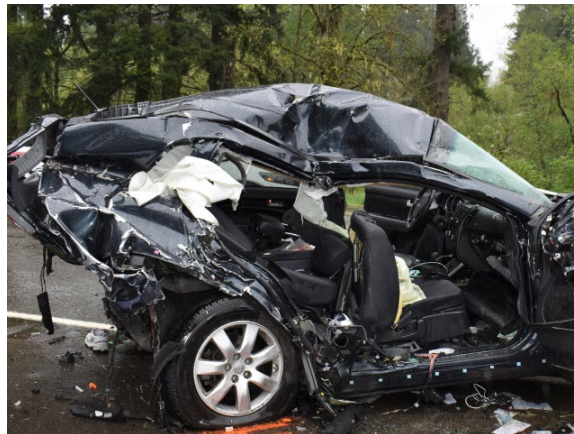
### Description

The 2013 Kia Sorento was identified by police using the VIN 5XYKT4A65DGxxxxxx. The manufacture date was unknown. The Sorento was a 4-door SUV with front-wheel-drive and 5-passenger seating. Standard equipment included a 2.4-liter, 4-cylinder gasoline engine, automatic transmission, and disc brakes with an antilock brake system. The vehicle manufacturer recommended size P235/65R17 tires for the front and rear. The vehicle had Prometer, unknown model, tires of the recommended size.

### Exterior Damage

Based on the police report and photos, the Sorento sustained major severity damage to the back plane in the Event 1 crash with the BMW. Direct damage to the back plane appeared to be distributed from bumper corner to bumper corner. The back bumper fascia and rear hatch were crushed, the left and right rear quarter-panels were crumpled, the left and right wheelbases appeared to be reduced an unknown length, and the rear tires were restricted. Damage flow to the back plane suggested the BMW underrode the Sorento's back bumper. The estimated CDC for the Sorento in Event 1 was 06BDEW3.

Police photos show the Sorento sustained severe crush damage to the right plane (Figure 7) in the Event 3 impact with the International. Direct damage appeared to begin at the right A-pillar and extended to the back right bumper corner where it overlapped damage from the prior event. Damage extended vertically from the frame to above the roof side rail. Maximum crush appeared to be near the junction of the right B-pillar and roof side rail. The estimated CDC for the Sorento in Event 3 was 01RDAW4.



*Figure 7. Right plane damage, 2013 Kia Sorento (police photo)*

### Event Data Recorder

The Sorento had an ACM supported by the Global Information Technology Kia EDR tool. Police imaged the EDR data and provided SCI with a copy of the EDR report in PDF format. The EDR report with hexadecimal data omitted is included in Appendix A of this report. At the time of the crash, the vehicle's engine was idling at 600 rpm and the service brake was activated. The EDR captured two deployment level events. Event 1 was the back plane impact with the

BMW. The EDR reported a maximum longitudinal delta V of 66 kmh (41 mph) at 115 ms and a maximum lateral delta V of -5 kmh (-3 mph) at 65 ms. Event 2 was the right plane impact to the back of the tow truck. The EDR reported a vehicle speed of 9 kmh (6 mph) at time 0.0, a maximum longitudinal delta V of -12 kmh (7 mph) at 300 ms and a maximum lateral delta V of -7 kmh (-4 mph) at 300 ms. The EDR did not capture an event for the impact with the nonmotorist.

### **NHTSA Recalls and Investigations**

A VIN-based NHTSA recall search in February 2022 revealed no unrepaired recalls for this vehicle. A recall search in April 2024 revealed one unrepaired recall dated September 25, 2023 (manufacturer recall number SC284XM; NHTSA recall number 23V-652), involving a risk of fire while the vehicle is parked.



## 2013 Kia Sorento Occupants

### Driver Demographics

Age/sex: 55 years/male  
 Height: 178 cm (70 in)  
 Weight: 116 kg (255 lb)  
 Eyewear: None  
 Seat type: Bucket with adjustable head restraint  
 Seat track position: Unknown  
 Manual restraint usage: Lap and shoulder belt used  
 Usage source: Police report and EDR report  
 Air bags: Frontal, IC, and seat-mounted side impact equipped; seat-mounted side impact and IC deployed  
 Alcohol/drug data: None  
 Egress from vehicle: Removed by emergency responders  
 Transport from scene: Not transported  
 Type of medical treatment: None. Pronounced deceased on-scene

### Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Transection, spinal cord, with dislocation, C1/C2	610234.6	This occupant's seat back This occupant's head restraint	Probable Possible
2	Fractures NFS, multiple right ribs	450210.2	Steering wheel hub, spokes, and rim	Probable
3	Fracture, nose	251000.1	Steering wheel rim	Probable
4	Laceration, minor, left upper eyelid	210602.1	Steering wheel rim	Probable
5	Laceration, minor, left lower back	510602.1	Seat back	Possible
6	Abrasions, bilateral radial forearms	710202.1	Steering wheel rim	Possible
7	Abrasion, left lateral thigh	810202.1	Left door panel	Possible

Source: Autopsy report

### Driver Kinematics

The belted 55-year-old male driver sustained fatal injuries. At impact with the BMW, he was displaced rearward loading his seatback and possibly his head restraint. His head and neck hyperextended causing a transection with dislocation of the cervical spinal cord at C1. Impact forces caused the Sorento to rotate counterclockwise and travel northbound until its right plane struck the tow truck driver and back plane of the International. The occupant was displaced forward and right in response to the 1 o'clock direction of force. His torso and hips loaded the

seat belt. His head, neck, and chest continued to be displaced forward and right until they contacted the steering wheel hub, spokes, and rim causing fractures to the right ribs, fracture to the nose, and minor laceration to the left eyelid. This occupant's frontal air bag did not deploy and would not be expected to deploy given the absence of a sufficiently severe impact to the front of the vehicle.<sup>1</sup> His seat-mounted side impact air bag and IC air bag did deploy. The occupant's seat back was likely displaced forward due to loading by the second-row occupant, which possibly caused a minor laceration to the left lower back. Abrasions to the bilateral forearms were possibly caused by contact with the steering wheel rim. The occupant was declared deceased prior to his removal from the vehicle by emergency responders. His autopsy stated the cause of death was blunt force neck trauma.

### Front-Row Right Occupant Demographics

Age/sex: 54 years/female  
 Height: 165 cm (64 in)  
 Weight: 91 kg (200 lb)  
 Eyewear: Unknown  
 Seat type: Bucket with adjustable head restraint  
 Seat track position: Unknown  
 Manual restraint usage: Lap and shoulder belt used  
 Usage source: Police report, medical records  
 Air bags: Frontal, IC, and seat-mounted side impact equipped; IC and seat-mounted side impact deployed  
 Egress from vehicle: Removed by emergency responders  
 Transport from scene: Not transported  
 Type of medical treatment: None. Declared deceased on-scene

### Front-Row Right Occupant Demographics

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Fracture NFS, basilar skull	150200.3	Right IP This occupant's head restraint or seat back	Probable Possible
2	Fracture NFS, with dislocation, cervical spine	650216.2	Right IP This occupant's head restraint or seat back	Probable Possible
3	Fracture NFS, left humerus	751100.2	Seat back	Possible
4	Abrasion, forehead	110202.1	Right IP	Probable
5	Lacerations NFS, gingiva (mouth)	243204.1	Right IP	Probable
6	Fractures NFS, anterior/lateral, bilateral ribs	450200.1	Right door panel	Probable

<sup>1</sup> According to 2013 Kia Sorento owner's manual.

<b>Injury No.</b>	<b>Injury</b>	<b>Injury Severity AIS 2015</b>	<b>Involved Physical Component (IPC)</b>	<b>IPC Confidence Level</b>
7	Abrasions, chest and right breast	410202.1	Shoulder seat belt	Certain
8	Abrasions, abdomen	510202.1	Lap seat belt	Certain
9	Lacerations, minor, right elbow	710602.1	Right door panel	Probable
10	Abrasions, bilateral arms	710202.1	Flying glass	Possible
11	Abrasion, upper left thigh	810202.1	Center console	Possible

Source: Autopsy report

### **Front-Row Right Occupant Kinematics**

The belted 54-year-old female front passenger of the Sorento sustained fatal injuries. At impact with the BMW, she was displaced rearward loading her seatback. Her left upper arm possibly loaded the seat back with sufficient force to cause a fracture to the left humerus. Impact forces caused the Sorento to rotate counterclockwise and traveled northbound until its right plane struck the tow truck driver and back plane of the International. The occupant was displaced forward and right in response to the 1 o'clock direction of force. Her torso and hips loaded the pretensioned seat belt causing abrasions to the chest and abdomen. Police photos suggest her head and neck continued to be displaced forward and right until her head contacted the right IP, causing a fracture to the basilar skull and fracture with dislocation to the cervical spine. This occupant's frontal air bag did not deploy and would not be expected to deploy given the absence of a sufficiently severe impact to the front of the vehicle. Her seat-mounted side impact air bag and IC air bag did deploy. The front-right door panel intruded laterally reducing the occupant compartment. It likely contacted the occupant's torso causing bilateral rib fractures and a laceration to the right elbow. Flying glass from the right window possibly caused abrasions to both arms. The autopsy report stated the cause of death was blunt force head and neck trauma, with another significant condition listed as chest and upper extremity trauma.

## Second-Row Left Occupant Demographics

Age/sex: 25 years/male  
 Height: 175 cm (68 in)  
 Weight: 109 kg (240 lb)  
 Eyewear: None  
 Seat type: Bench with folding backs  
 Seat track position: Not adjustable  
 Manual restraint usage: Lap and shoulder belt used  
 Usage source: Police report, medical records  
 Air bags: IC air bag equipped; deployed  
 Egress from vehicle: Removed by emergency responders, 22-minute extrication  
 Transport from scene: Ambulance to hospital  
 Type of medical treatment: Emergency department, transferred to another hospital, admitted for unknown duration, transferred to inpatient rehab facility for unknown duration, follow-up treatment unknown

## Second-Row Left Occupant Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Compression injury, cervical spine, with complex with moderate to severe narrowing in the right lateral canal and medial right foramen, C4-C5	650234.3	This occupant's seat back	Probable
2	Hematoma (moderate size), with compression fractures T6-T7, thoracic spine	610404.3	This occupant's seat back	Probable
3	Contusions, medial right upper kidney, superior left kidney (grade I)	541612.2	This occupant's seat back	Probable
4	Hematoma, mesentery	542010.2	Lap seat belt	Probable
5	Spleen injury with subcapsular hematoma (grade II)	544212.2	Lap seat belt	Probable
6	Fracture, distal right ulna	752313.2	Front-row seat back	Possible
7	Fracture, mid-shaft, left fibula	854441.2	Front-row seat cushion	Probable
8	Fractures, displaced, posterior left ribs L9-L11	450200.1	This occupant's seat back	Probable
9	Abrasions, right eyebrow	210202.1	Front-row seat back	Probable
10	Abrasions, left chest	410202.1	Shoulder seat belt	Probable
11	Abrasions, lower abdomen	510202.1	Lap seat belt	Probable

<b>Injury No.</b>	<b>Injury</b>	<b>Injury Severity AIS 2015</b>	<b>Involved Physical Component (IPC)</b>	<b>IPC Confidence Level</b>
12	Fracture, transverse process displaced at right L2, lumbar spine	650620.1	This occupant's seat back	Probable
13	Abrasions, left posterior hip	810202.1	This occupant's seat back	Probable
14	Abrasions, right knee, right lower leg, left knee, left lower leg	810202.1	Front-row seat back	Probable

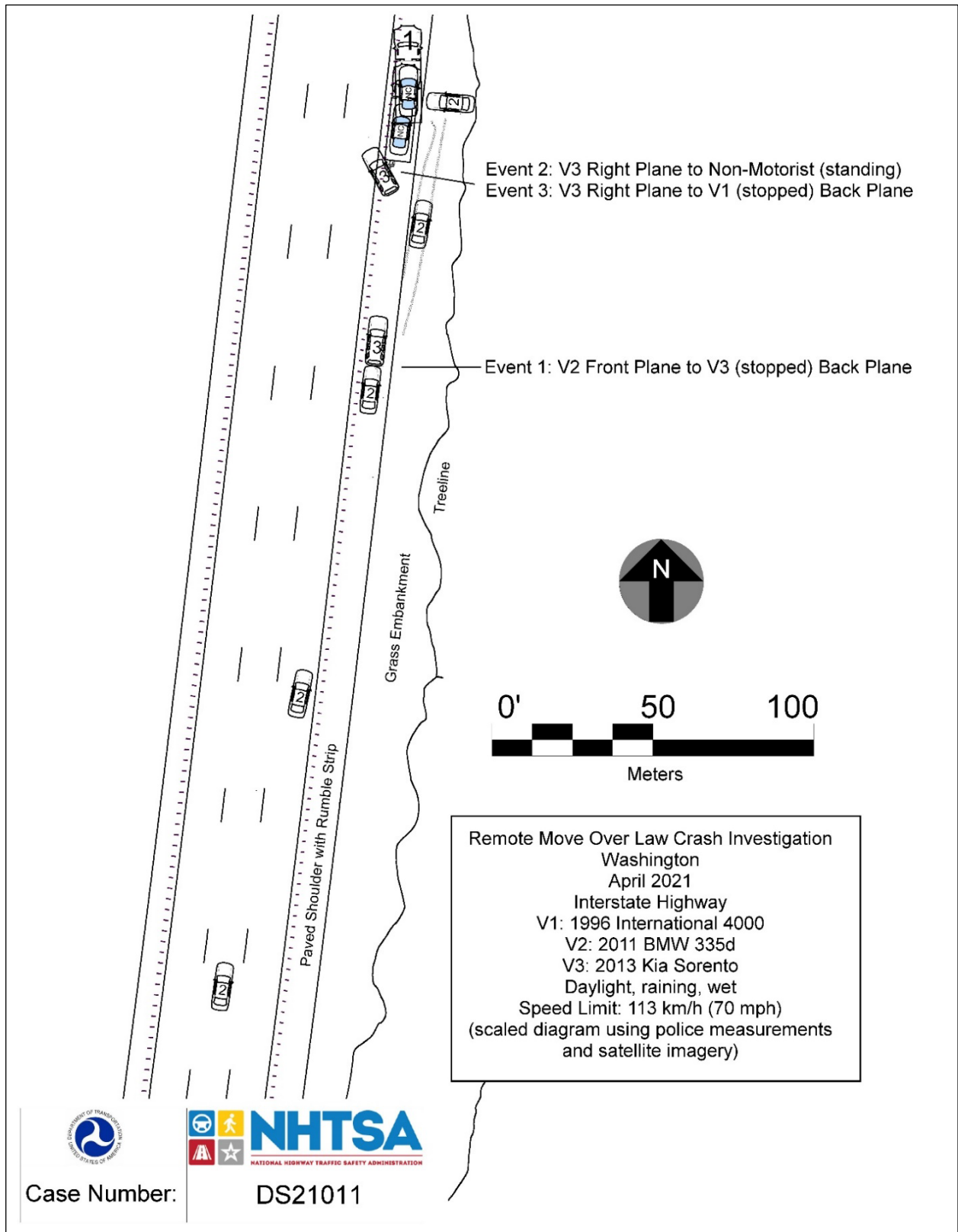
Source: Medical records

### **Second-Row Left Occupant Kinematics**

The 25-year-old male occupant was the Stinger driver involved in the prior crash. The Sorento driver and front passenger were the parents of the Stinger driver and had come to pick up their son. The belted occupant was seated in a forward-facing orientation. At impact with the BMW, he was displaced rearward in response to the 6 o'clock direction of force. Police photos suggest that longitudinal intrusion from the back of the vehicle forced his seat back forward reducing his occupant space. Impact forces and contact with his seat back caused cervical and thoracic spinal injuries including a fracture at C2, compression injury at C4, and compression fracture at T6. The vehicle's right plane then struck the back of the tow truck and the occupant was displaced forward and right in response to the direction of force. He likely loaded the seat belt and contacted the driver's seat back and cushion, and possibly the front-row center console. The combination of forces on his thorax caused internal injuries including fractures to the posterior left ribs, contusions to the left kidney, hematomas to the mesentery and spleen, and seat belt abrasions to his chest and abdomen. His right hand possibly contacted the front-row seat back causing a fracture of the distal right ulna. His knees and legs probably contacted the driver's seat back and cushion causing a fracture to the left fibula and abrasions to the bilateral knees and lower legs. After the vehicle came to rest, the occupant remained in his seated position for approximately 30 minutes, including a 22-minute extrication by emergency responders. He was transported by ambulance to a local hospital, admitted to another hospital, and transferred to an inpatient rehab facility for an unknown duration.

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# Crash Diagram



**Crash Site Satellite View**



(Image source: Google Maps ©2024 Maxar Technologies)



## **Appendix A: Event Data Recorder Report 2013 Kia Sorento<sup>2</sup>**

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<sup>2</sup> The EDR report contained in this technical report was imaged by the investigating police department. Only a PDF copy of the EDR report was provided by the police and the hexadecimal data contained in the report has been deleted due to the potential personal identifiable information contained (VIN) in the report.



▣ Vehicle Information

<b>KIA   SORENTO(XM)   2013   AIRBAG SYSTEM</b>	
VIN as Programmed into EMS	5XYKT4A65DGxxxxxx

▣ Additional Information

User-entered VIN	5XYKT4A65DGxxxxxx
User Name	x
Case Number	x
Crash Date	04/xx/2021
Saved-on Date	2021-xx-04 xxxx
EDR Tool Version	E-Π-K-01-00-0037
EDR Report Version	EDR001-R01
Tire Size(s)	
Memo	

## ▣ Data Limitation

### **General Information:**

Tools for downloading and interpreting the EDRs in Kia vehicles have been developed for vehicles produced after September 1, 2012. Currently, there is no tool for downloading and accurate interpreting data from the EDRs in Kia vehicles produced prior to this date.

The EDR Report requires Adobe Reader Version 9.00 or higher to open.

### **EDR(Event Data Recorder):**

- The EDR function is part of the Airbag Control Unit(ACU).
- ACU can store up to two events.
- Event means a crash or other physical occurrence that causes the trigger threshold to be met or exceeded, or any non-reversible deployable restraint to be deployed, whichever occurs first:
  1. Deployment Event:
    - 1) the event which is recorded if an airbag is commanded to deploy.
    - 2) the event is locked and cannot be overwritten.
  2. Non-deployment Event:
    - 1) the event which is recorded, but in which an airbag is not commanded to deploy
    - 2) the event is not locked and can be overwritten by a subsequent event (Deployment or Non-deployment event), for example, Pretensioner(s) only deployment
    - 3) An example of a non-deployment event is a pretensioner-only deployment with no airbag deployments
- Ignition cycle count will increment by 1 in the following cases
  1. the power mode change from OFF/Accessory to IGN ON/RUN
  2. EDR data download by tools
- The ACU can record data for all or some of the following events. But, depending on the vehicle's configurations, data for side crash and/or rollover crash(event) may not be recorded.
- If power supply to the ACU is lost during an event, all or part of the data may not be recorded.

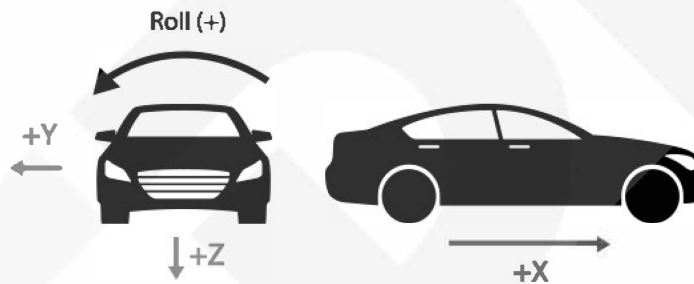
# Data Limitation

## Data Element Sign Convention:

The following table provides an explanation of the sign notation for data elements that may be included in the EDR report. Directional references to sign convention are from the point of view of the driver.

Data element name	Positive sign	Note
Longitudinal acceleration	Forward direction	+X at the figure 1
Delta V, longitudinal	Forward direction	+X at the figure 1
Lateral acceleration	Left to Right direction	+Y at the figure 1
Delta V, lateral	Left to Right direction	+Y at the figure 1
Normal(vertical) acceleration	Downward direction	+Z at the figure 1
Vehicle roll angle	Clockwise about the longitudinal axis	Roll(+) at the figure 1
Steering input	Counterclockwise rotation	-

Figure 1. Sign Conventions



## Data Sources:

Many EDR data elements are sourced from other control modules in the vehicle.

- Most of them can be measured and calculated by the ACU. For example, Delta-V and Rollover angle can be calculated from internal sensors in the ACU (if applicable).
- The following pre-crash data can be transmitted to the ACU via the vehicle's communication network.
  - Vehicle Speed
  - Engine RPM
  - Engine Throttle
  - Acceleration Pedal
  - Service Brake
  - ABS Activity
  - Stability Control
  - Steering Input Angle

\*Note) Depending on the vehicle's configuration and the conditions described above, some items may not be recorded.
- Pre-crash data is recorded in discrete intervals. Due to different refresh rates within the vehicle's electronics, the data recorded may be asynchronous to each other.

# Data Limitation

## Data Definitions:

- Data recorded by the ACU and imaged by the EDR tool is displayed relative to Time zero(T0). Time zero(T0) is not typically the time at which the vehicle made contact with another vehicle or object.
- Time zero (T0) means whichever of the following occurs first
  1. For systems with “wake-up” air bag control systems, the time at which the occupant restraint control algorithm is activated; or
  2. For continuously running algorithms,
    - 1) The first point in the interval where a longitudinal cumulative delta-V of over 0.8 km/h (0.5 mph) is reached within a 20msec time period; or
    - 2) For vehicles that record “delta-V, lateral,” the first point in the interval where a lateral cumulative delta-V of over 0.8 km/h (0.5 mph) is reached within a 5msec time period; or
  3. Deployment of a non-reversible deployable restraint.
- Multi-event crash means the occurrence of 2 events, the first and last of which begin not more than 5 seconds apart. If an event is not part of a multi-event crash, the value of this data element will be “1”.
- Service brake, on or off means the status of the device that is installed in or connected to the brake pedal system to detect whether the pedal was pressed. The device can include the brake pedal switch or other driver-operated service brake control,
- Engine RPM means
  1. For vehicles powered by internal combustion engines, the number of revolutions per minute of the main crankshaft of the vehicle's engine, and
  2. For vehicles not entirely powered by internal combustion engines, the number of revolutions per minute of the motor shaft at the point at which it enters the vehicle transmission gearbox.
- Engine Throttle is a measure of the throttle position.
- Accelerator Pedal is a measure of the accelerator pedal value.
- Seat belt status is determined by whether the buckle switch is open or closed.
- Delta-V means the cumulative change in velocity, and is calculated from internal sensors in the ACU

## EDR Information

Part No. (EOL Code) as programmed into ACU	95910-1U150(XM53)
ECU SW Version as programmed into ACU	01(P9.3)
EDR Version as programmed into ACU	

## < Event 1 >

### Event Status at Event

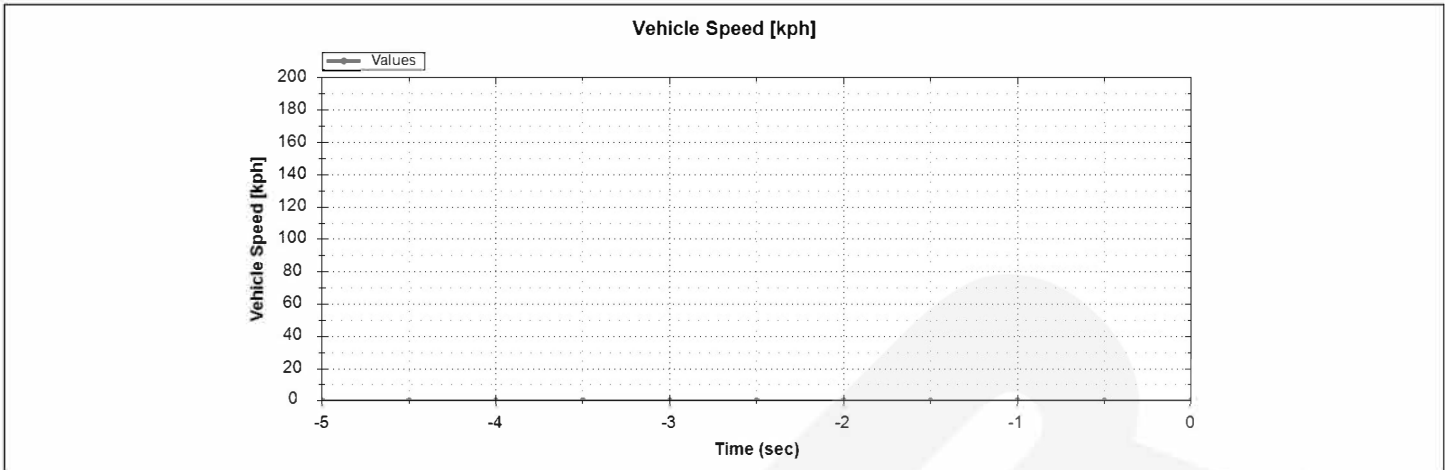
Multi-event, Number of Event (1 or 2)	1 event
Time from Event 1 to 2 [msec]	0
Completed File Recorded (Yes or No)	YES
Ignition cycle, crash [cycle]	14523
Ignition cycle, download [cycle]	14524

### Pre-Crash Information (-5 ~ 0 sec)

Time (sec)	Vehicle Speed [kph]	Engine RPM [rpm]	Engine Throttle [%]	Service Brake [on/off]	ABS Activity [on/off]	Stability Control [on/off/engaged]	Steering Input [degree]
-5.0	0	600	0	ON	OFF	ON	15
-4.5	0	600	0	ON	OFF	ON	15
-4.0	0	600	0	ON	OFF	ON	15
-3.5	0	600	0	ON	OFF	ON	15
-3.0	0	600	0	ON	OFF	ON	15
-2.5	0	600	0	ON	OFF	ON	15
-2.0	0	600	0	ON	OFF	ON	15
-1.5	0	600	0	ON	OFF	ON	15
-1.0	0	600	0	ON	OFF	ON	15
-0.5	0	600	0	ON	OFF	ON	15
0.0	0	600	0	ON	OFF	ON	15

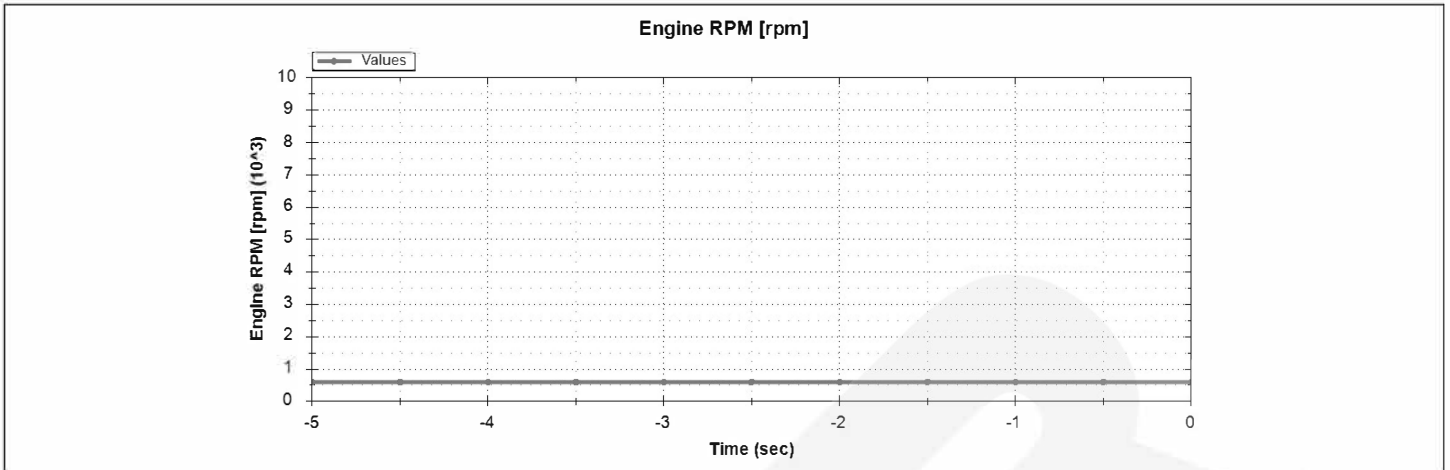
# < Event 1 >

## Vehicle Speed



Num	Time (sec)	Vehicle Speed [kph]
1	-5.0	0
2	-4.5	0
3	-4.0	0
4	-3.5	0
5	-3.0	0
6	-2.5	0
7	-2.0	0
8	-1.5	0
9	-1.0	0
10	-0.5	0
11	0.0	0

< Event 1 >  
 Engine RPM

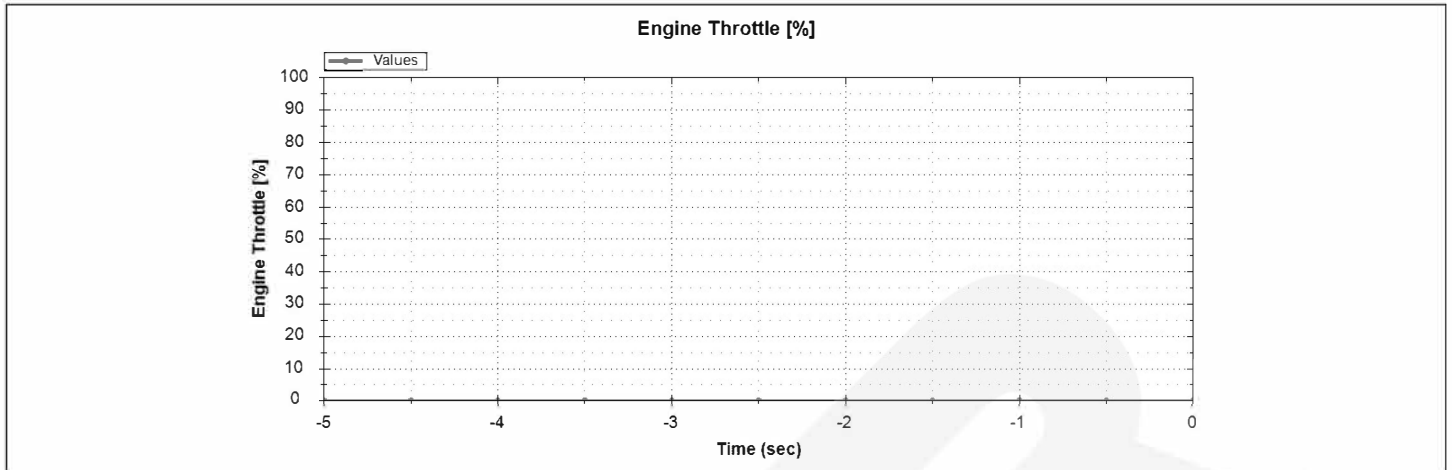


Num	Time (sec)	Engine RPM [rpm]
1	-5.0	600
2	-4.5	600
3	-4.0	600
4	-3.5	600
5	-3.0	600
6	-2.5	600
7	-2.0	600
8	-1.5	600
9	-1.0	600
10	-0.5	600
11	0.0	600



# < Event 1 >

## Engine Throttle



Num	Time (sec)	Engine Throttle [%]
1	-5.0	0
2	-4.5	0
3	-4.0	0
4	-3.5	0
5	-3.0	0
6	-2.5	0
7	-2.0	0
8	-1.5	0
9	-1.0	0
10	-0.5	0
11	0.0	0

## < Event 1 > Service Brake

Num	Time (sec)	Service Brake [on/off]
1	-5.0	ON
2	-4.5	ON
3	-4.0	ON
4	-3.5	ON
5	-3.0	ON
6	-2.5	ON
7	-2.0	ON
8	-1.5	ON
9	-1.0	ON
10	-0.5	ON
11	0.0	ON

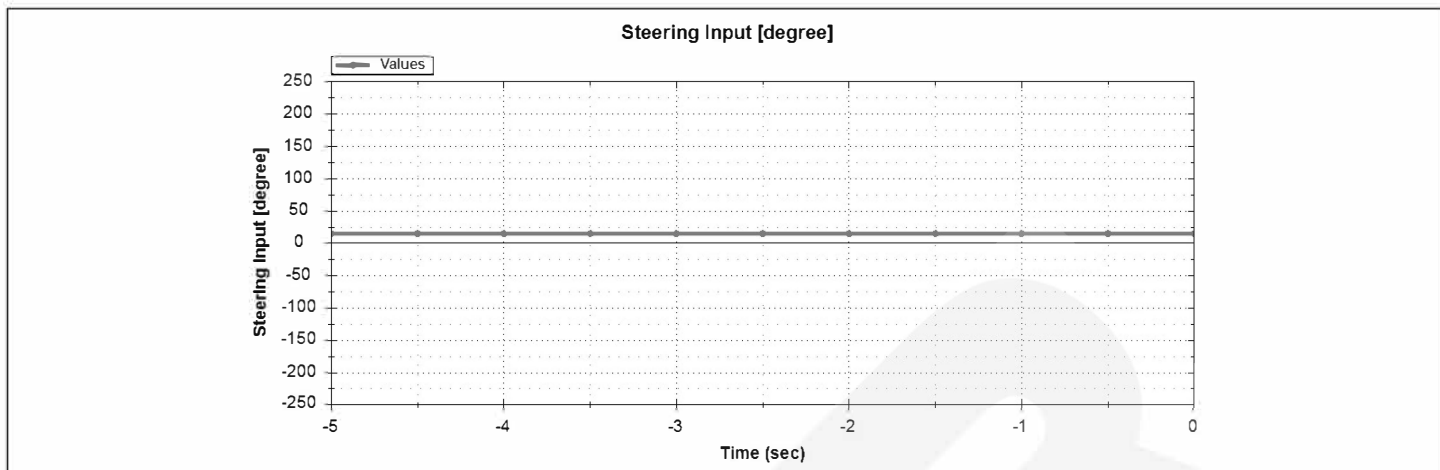
## ABS Activity

Num	Time (sec)	ABS Activity [on/off]
1	-5.0	OFF
2	-4.5	OFF
3	-4.0	OFF
4	-3.5	OFF
5	-3.0	OFF
6	-2.5	OFF
7	-2.0	OFF
8	-1.5	OFF
9	-1.0	OFF
10	-0.5	OFF
11	0.0	OFF

## Stability Control

Num	Time (sec)	Stability Control [on/off/engaged]
1	-5.0	ON
2	-4.5	ON
3	-4.0	ON
4	-3.5	ON
5	-3.0	ON
6	-2.5	ON
7	-2.0	ON
8	-1.5	ON
9	-1.0	ON
10	-0.5	ON
11	0.0	ON

## < Event 1 > Steering Input



Num	Time (sec)	Steering Input [degree]
1	-5.0	15
2	-4.5	15
3	-4.0	15
4	-3.5	15
5	-3.0	15
6	-2.5	15
7	-2.0	15
8	-1.5	15
9	-1.0	15
10	-0.5	15
11	0.0	15

Note) Positive value(CCW), Negative value(CW)

## < Event 1 >

### System Status at Event

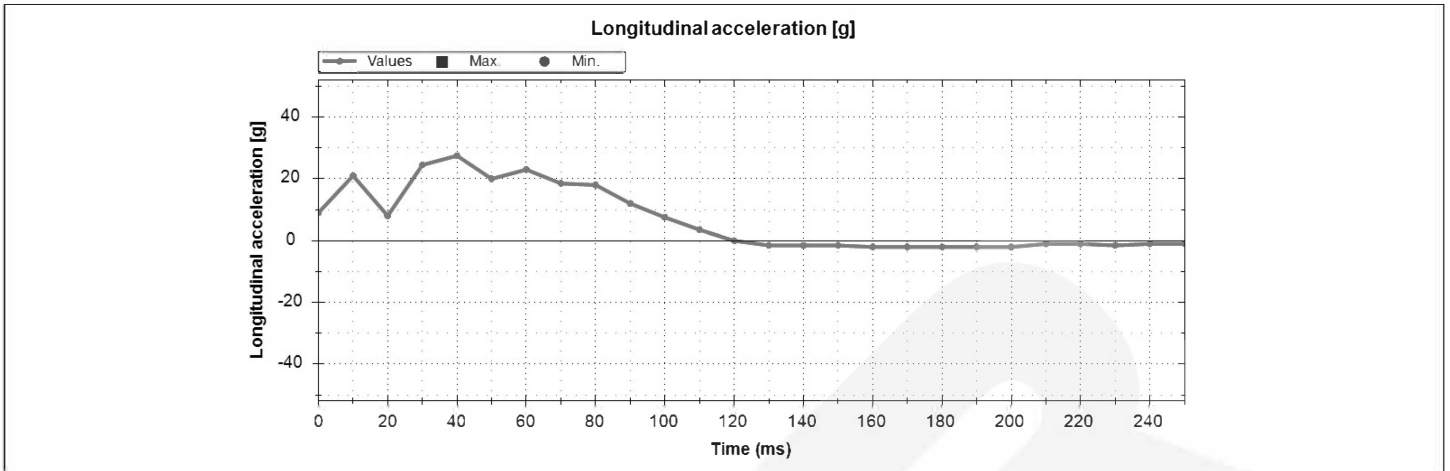
Airbag warning lamp on/off	OFF
Safety seat belt status, driver	ON
Safety seat belt status, passenger	ON
Seat track position switch foremost status, driver	Not Supported
Seat track position switch foremost status, passenger	Not Supported
Occupant size classification, driver (5% female or larger)	Not Supported
Occupant size classification, passenger (child)	NO

### Deployment Command Data at Event

Front airbag deployment time, driver (first stage) [msec]	No deployment
Front airbag deployment time, passenger (first stage) [msec]	No deployment
Front airbag deployment time, driver (second stage) [msec]	No deployment
Front airbag deployment time, passenger (second stage) [msec]	No deployment
Front airbag deployment time, driver (third stage) [msec]	Not Supported
Front airbag deployment time, passenger (third stage) [msec]	Not Supported
Front airbag disposal deployment, driver (second stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (second stage) (Yes or No)	NO
Front airbag disposal deployment, driver (third stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (third stage) (Yes or No)	NO
Front side airbag deployment time, driver [msec]	51
Front side airbag deployment time, passenger [msec]	51
Curtain airbag deployment time, driver [msec]	51
Curtain airbag deployment time, passenger [msec]	51
Seat belt pretensioner deployment time, driver [msec]	51
Seat belt pretensioner deployment time, passenger [msec]	51

< Event 1 >

Longitudinal crash pulse\_acceleration (g, 0 ~ 250msec)

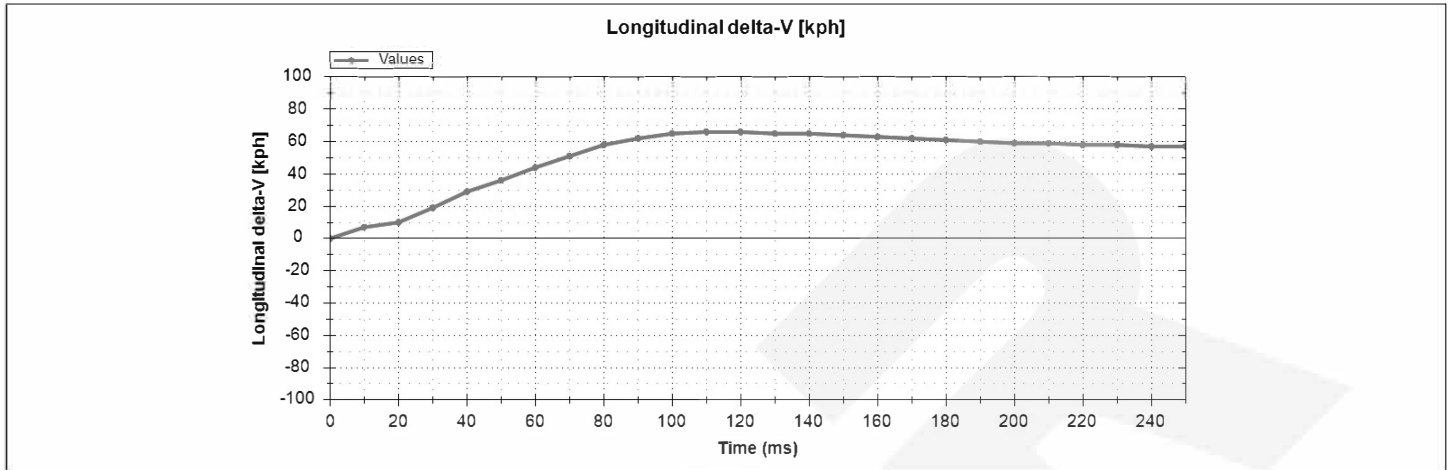


Num	Time (ms)	Longitudinal acceleration [g]
1	0.0	9.0
2	10.0	21.0
3	20.0	8.0
4	30.0	24.5
5	40.0	27.5
6	50.0	20.0
7	60.0	23.0
8	70.0	18.5
9	80.0	18.0
10	90.0	12.0
11	100.0	7.5
12	110.0	3.5
13	120.0	0.0
14	130.0	-1.5
15	140.0	-1.5
16	150.0	-1.5
17	160.0	-2.0
18	170.0	-2.0
19	180.0	-2.0
20	190.0	-2.0
21	200.0	-2.0
22	210.0	-1.0
23	220.0	-1.0
24	230.0	-1.5
25	240.0	-1.0
26	250.0	-1.0

< Event 1 >

Longitudinal crash pulse\_delta-v (kph, 0 ~ 250msec)

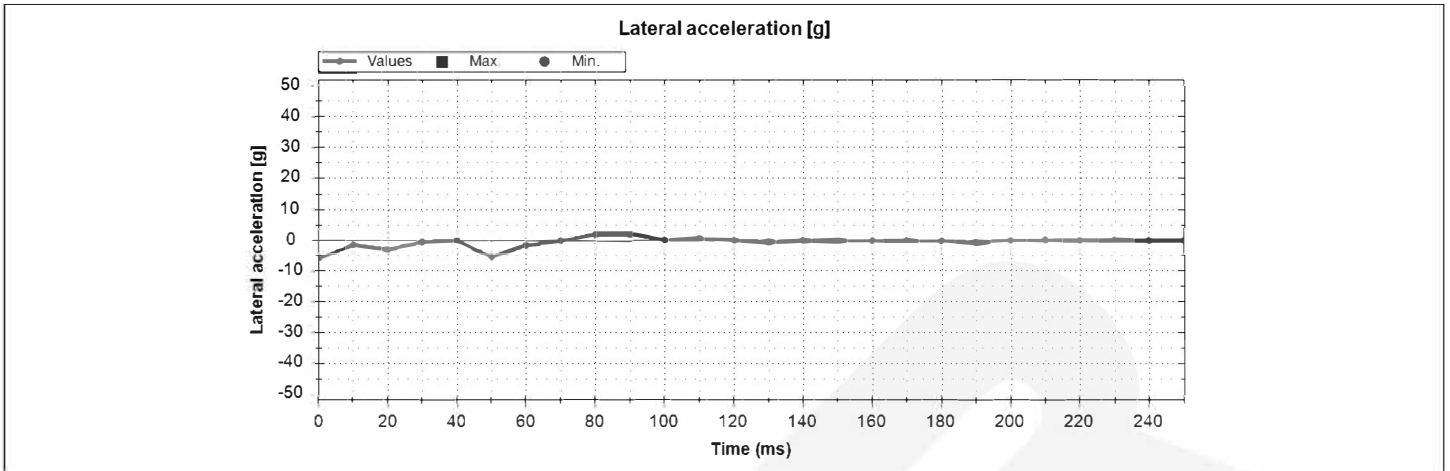
Max. delta-V [kph]	66
Time, Max. delta-V [msec]	115.0



Num	Time (ms)	Longitudinal delta-V [kph]
1	0.0	0
2	10.0	7
3	20.0	10
4	30.0	19
5	40.0	29
6	50.0	36
7	60.0	44
8	70.0	51
9	80.0	58
10	90.0	62
11	100.0	65
12	110.0	66
13	120.0	66
14	130.0	65
15	140.0	65
16	150.0	64
17	160.0	63
18	170.0	62
19	180.0	61
20	190.0	60
21	200.0	59
22	210.0	59
23	220.0	58
24	230.0	58
25	240.0	57
26	250.0	57

< Event 1 >

Lateral crash pulse\_acceleration (g, 0 ~ 250msec)

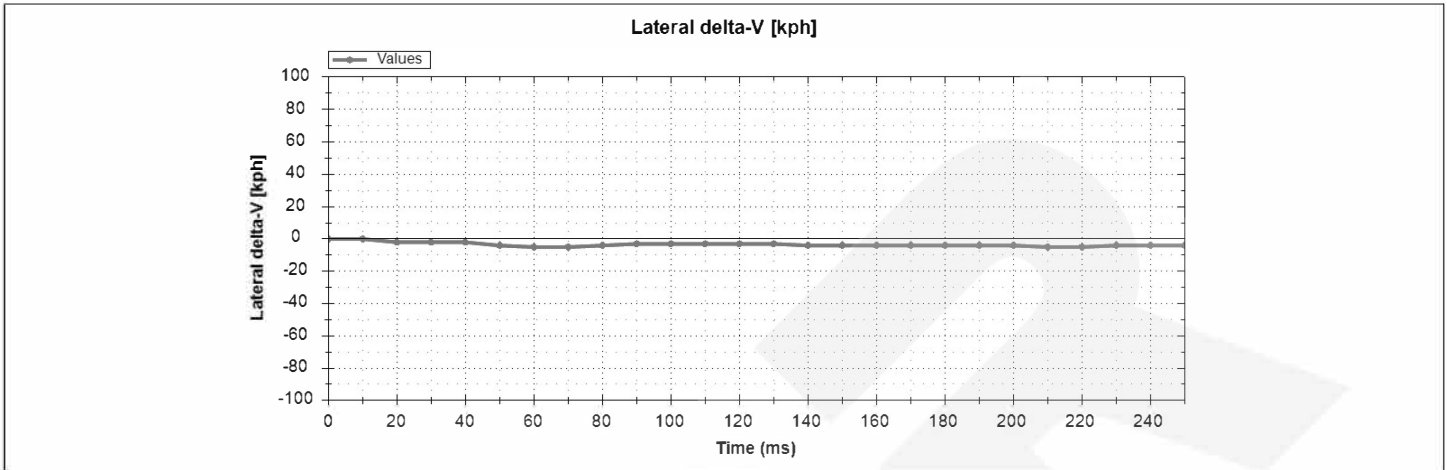


Num	Time (ms)	Lateral acceleration [g]
1	0.0	-6.0
2	10.0	-1.5
3	20.0	-3.0
4	30.0	-0.5
5	40.0	0.0
6	50.0	-5.5
7	60.0	-1.5
8	70.0	0.0
9	80.0	2.0
10	90.0	2.0
11	100.0	0.0
12	110.0	0.5
13	120.0	0.0
14	130.0	-0.5
15	140.0	0.0
16	150.0	0.0
17	160.0	0.0
18	170.0	0.0
19	180.0	0.0
20	190.0	-0.5
21	200.0	0.0
22	210.0	0.0
23	220.0	0.0
24	230.0	0.0
25	240.0	0.0
26	250.0	0.0

< Event 1 >

Lateral crash pulse\_delta-v (kph, 0 ~ 250msec)

Max. delta-V [kph]	-5
Time, Max. delta-V [msec]	65.0



Num	Time (ms)	Lateral delta-V [kph]
1	0.0	0
2	10.0	0
3	20.0	-2
4	30.0	-2
5	40.0	-2
6	50.0	-4
7	60.0	-5
8	70.0	-5
9	80.0	-4
10	90.0	-3
11	100.0	-3
12	110.0	-3
13	120.0	-3
14	130.0	-3
15	140.0	-4
16	150.0	-4
17	160.0	-4
18	170.0	-4
19	180.0	-4
20	190.0	-4
21	200.0	-4
22	210.0	-5
23	220.0	-5
24	230.0	-4
25	240.0	-4
26	250.0	-4

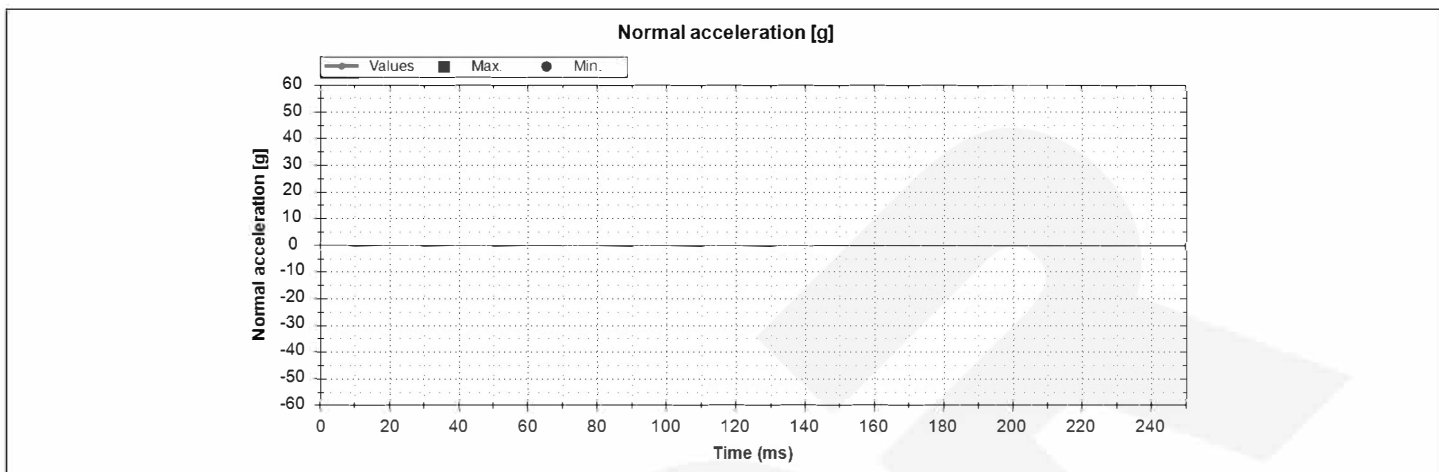


< Event 1 >

Crash pulse Resultant, Time\_Max. delta-V resultant (0 ~ 300 msec)

Time, Max. delta-V, resultant [msec]	117.5
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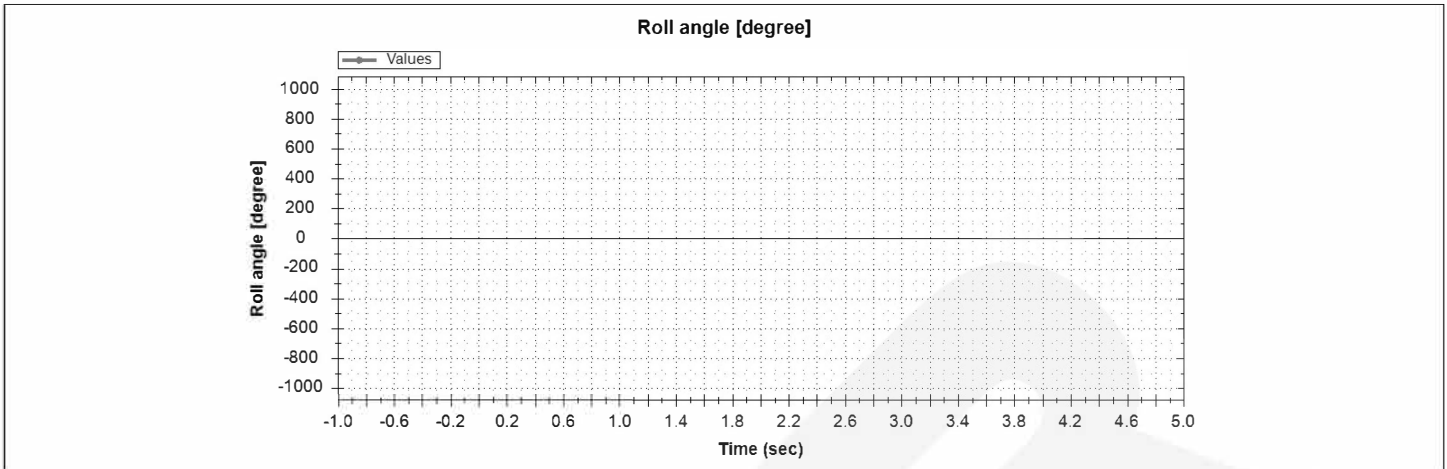
Normal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Normal acceleration [g]
1	0.0	Not supported
2	10.0	Not supported
3	20.0	Not supported
4	30.0	Not supported
5	40.0	Not supported
6	50.0	Not supported
7	60.0	Not supported
8	70.0	Not supported
9	80.0	Not supported
10	90.0	Not supported
11	100.0	Not supported
12	110.0	Not supported
13	120.0	Not supported
14	130.0	Not supported
15	140.0	Not supported
16	150.0	Not supported
17	160.0	Not supported
18	170.0	Not supported
19	180.0	Not supported
20	190.0	Not supported
21	200.0	Not supported
22	210.0	Not supported
23	220.0	Not supported
24	230.0	Not supported
25	240.0	Not supported
26	250.0	Not supported

< Event 1 >

Roll angle (degree, -1 ~ 5sec)



Num	Time (sec)	Roll angle [degree]
1	-1.0	Not supported
2	-0.9	Not supported
3	-0.8	Not supported
4	-0.7	Not supported
5	-0.6	Not supported
6	-0.5	Not supported
7	-0.4	Not supported
8	-0.3	Not supported
9	-0.2	Not supported
10	-0.1	Not supported
11	0.0	Not supported
12	0.1	Not supported
13	0.2	Not supported
14	0.3	Not supported
15	0.4	Not supported
16	0.5	Not supported
17	0.6	Not supported
18	0.7	Not supported
19	0.8	Not supported
20	0.9	Not supported
21	1.0	Not supported
22	1.1	Not supported
23	1.2	Not supported
24	1.3	Not supported
25	1.4	Not supported
26	1.5	Not supported
27	1.6	Not supported
28	1.7	Not supported
29	1.8	Not supported
30	1.9	Not supported
31	2.0	Not supported

32	2.1	Not supported
33	2.2	Not supported
34	2.3	Not supported
35	2.4	Not supported
36	2.5	Not supported
37	2.6	Not supported
38	2.7	Not supported
39	2.8	Not supported
40	2.9	Not supported
41	3.0	Not supported
42	3.1	Not supported
43	3.2	Not supported
44	3.3	Not supported
45	3.4	Not supported
46	3.5	Not supported
47	3.6	Not supported
48	3.7	Not supported
49	3.8	Not supported
50	3.9	Not supported
51	4.0	Not supported
52	4.1	Not supported
53	4.2	Not supported
54	4.3	Not supported
55	4.4	Not supported
56	4.5	Not supported
57	4.6	Not supported
58	4.7	Not supported
59	4.8	Not supported
60	4.9	Not supported
61	5.0	Not supported

## < Event 2 >

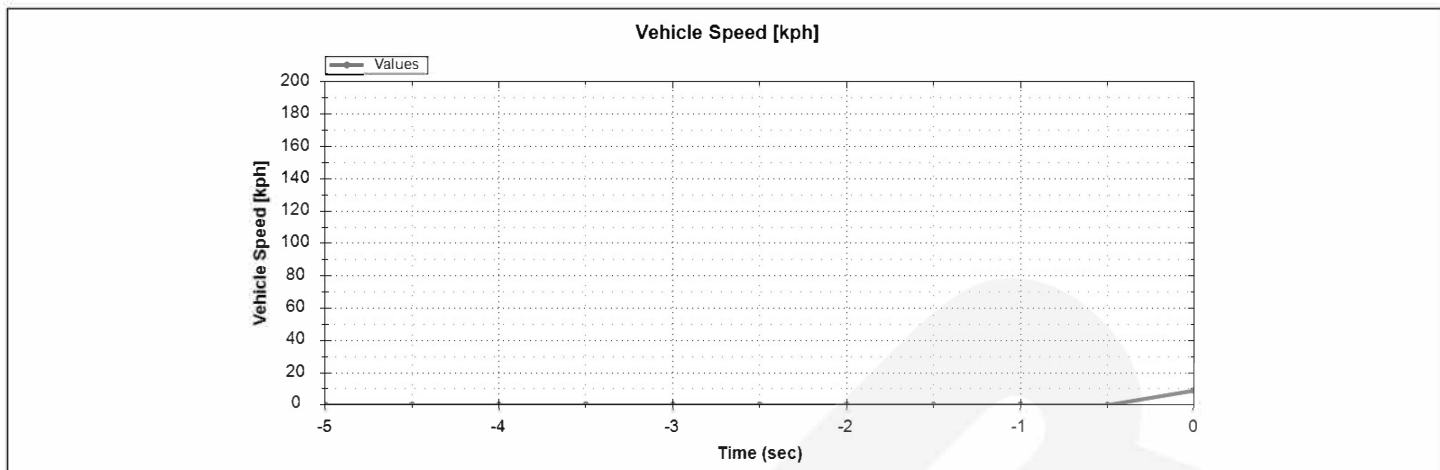
### Event Status at Event

Multi-event, Number of Event (1 or 2)	2 event
Time from Event 1 to 2 [msec]	200
Completed File Recorded (Yes or No)	YES
Ignition cycle, crash [cycle]	14523
Ignition cycle, download [cycle]	14524

### Pre-Crash Information (-5 ~ 0 sec)

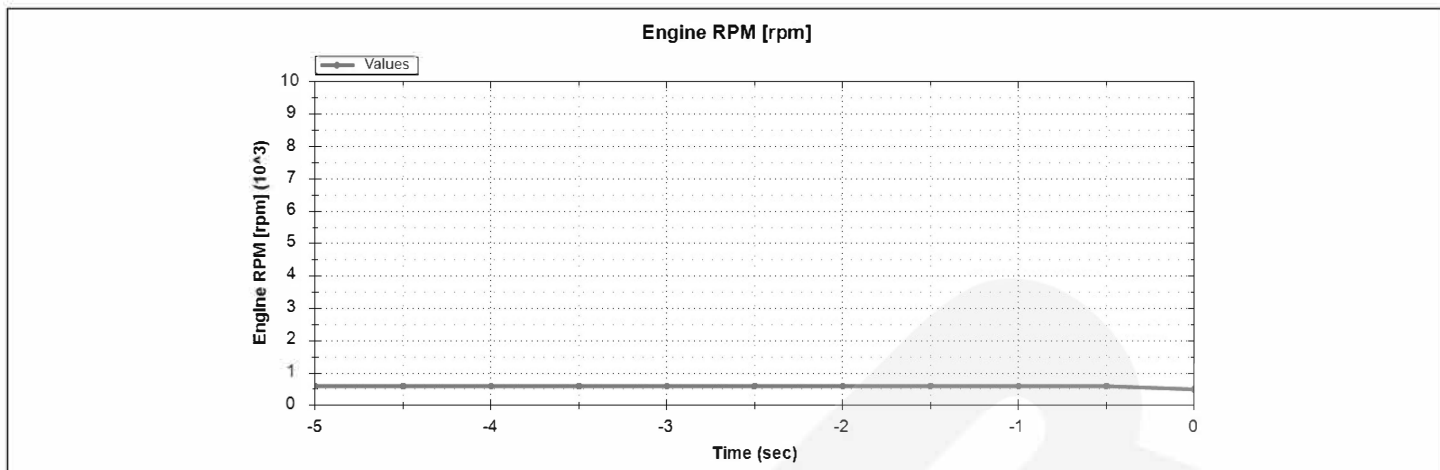
Time (sec)	Vehicle Speed [kph]	Engine RPM [rpm]	Engine Throttle [%]	Service Brake [on/off]	ABS Activity [on/off]	Stability Control [on/off/engaged]	Steering Input [degree]
-5.0	0	600	0	ON	OFF	ON	15
-4.5	0	600	0	ON	OFF	ON	15
-4.0	0	600	0	ON	OFF	ON	15
-3.5	0	600	0	ON	OFF	ON	15
-3.0	0	600	0	ON	OFF	ON	15
-2.5	0	600	0	ON	OFF	ON	15
-2.0	0	600	0	ON	OFF	ON	15
-1.5	0	600	0	ON	OFF	ON	15
-1.0	0	600	0	ON	OFF	ON	15
-0.5	0	600	0	ON	OFF	ON	15
0.0	9	500	0	OFF	Invalid data	Invalid data or Not Supported	15

## < Event 2 > Vehicle Speed



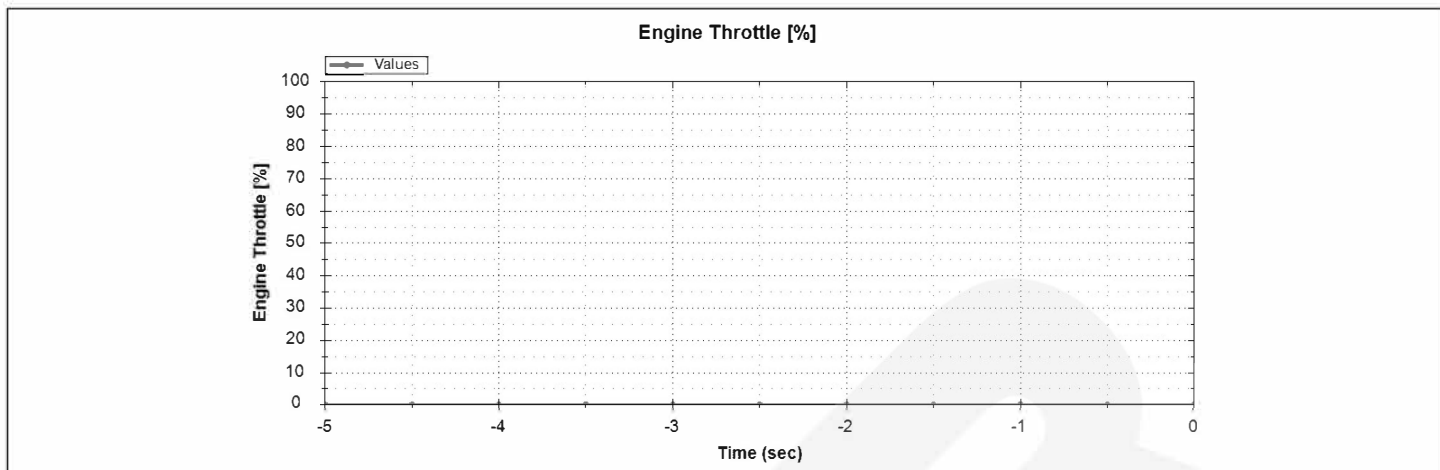
Num	Time (sec)	Vehicle Speed [kph]
1	-5.0	0
2	-4.5	0
3	-4.0	0
4	-3.5	0
5	-3.0	0
6	-2.5	0
7	-2.0	0
8	-1.5	0
9	-1.0	0
10	-0.5	0
11	0.0	9

## < Event 2 > Engine RPM



Num	Time (sec)	Engine RPM [rpm]
1	-5.0	600
2	-4.5	600
3	-4.0	600
4	-3.5	600
5	-3.0	600
6	-2.5	600
7	-2.0	600
8	-1.5	600
9	-1.0	600
10	-0.5	600
11	0.0	500

## < Event 2 > Engine Throttle



Num	Time (sec)	Engine Throttle [%]
1	-5.0	0
2	-4.5	0
3	-4.0	0
4	-3.5	0
5	-3.0	0
6	-2.5	0
7	-2.0	0
8	-1.5	0
9	-1.0	0
10	-0.5	0
11	0.0	0

## < Event 2 > Service Brake

Num	Time (sec)	Service Brake [on/off]
1	-5.0	ON
2	-4.5	ON
3	-4.0	ON
4	-3.5	ON
5	-3.0	ON
6	-2.5	ON
7	-2.0	ON
8	-1.5	ON
9	-1.0	ON
10	-0.5	ON
11	0.0	OFF

## ABS Activity

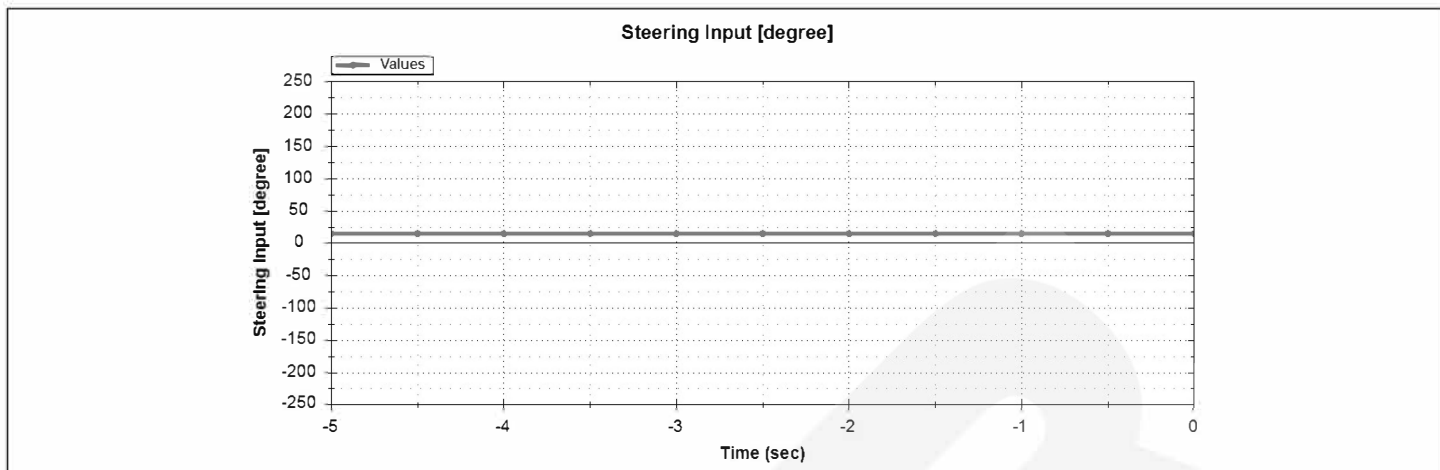
Num	Time (sec)	ABS Activity [on/off]
1	-5.0	OFF
2	-4.5	OFF
3	-4.0	OFF
4	-3.5	OFF
5	-3.0	OFF
6	-2.5	OFF
7	-2.0	OFF
8	-1.5	OFF
9	-1.0	OFF
10	-0.5	OFF
11	0.0	Invalid data

## Stability Control

Num	Time (sec)	Stability Control [on/off/engaged]
1	-5.0	ON
2	-4.5	ON
3	-4.0	ON
4	-3.5	ON
5	-3.0	ON
6	-2.5	ON
7	-2.0	ON
8	-1.5	ON
9	-1.0	ON
10	-0.5	ON
11	0.0	Invalid data or Not Supported



## < Event 2 > Steering Input



Num	Time (sec)	Steering Input [degree]
1	-5.0	15
2	-4.5	15
3	-4.0	15
4	-3.5	15
5	-3.0	15
6	-2.5	15
7	-2.0	15
8	-1.5	15
9	-1.0	15
10	-0.5	15
11	0.0	15

Note) Positive value(CCW), Negative value(CW)

## < Event 2 >

### System Status at Event

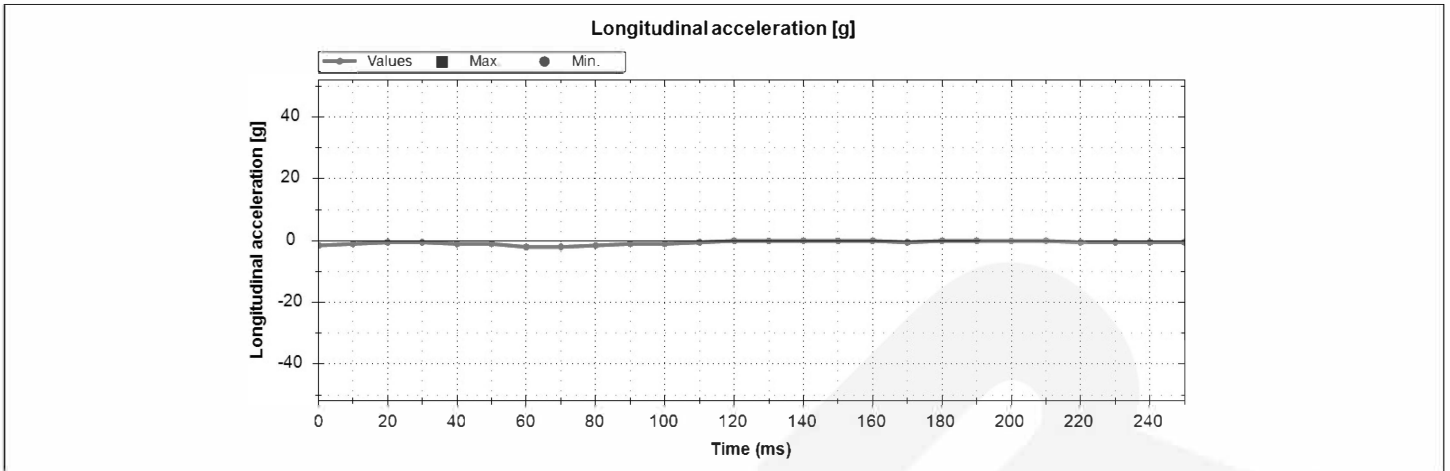
Airbag warning lamp on/off	ON
Safety seat belt status, driver	ON
Safety seat belt status, passenger	ON
Seat track position switch foremost status, driver	Not Supported
Seat track position switch foremost status, passenger	Not Supported
Occupant size classification, driver (5% female or larger)	Not Supported
Occupant size classification, passenger (child)	NO

### Deployment Command Data at Event

Front airbag deployment time, driver (first stage) [msec]	No deployment
Front airbag deployment time, passenger (first stage) [msec]	No deployment
Front airbag deployment time, driver (second stage) [msec]	No deployment
Front airbag deployment time, passenger (second stage) [msec]	No deployment
Front airbag deployment time, driver (third stage) [msec]	Not Supported
Front airbag deployment time, passenger (third stage) [msec]	Not Supported
Front airbag disposal deployment, driver (second stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (second stage) (Yes or No)	NO
Front airbag disposal deployment, driver (third stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (third stage) (Yes or No)	NO
Front side airbag deployment time, driver [msec]	481
Front side airbag deployment time, passenger [msec]	481
Curtain airbag deployment time, driver [msec]	481
Curtain airbag deployment time, passenger [msec]	481
Seat belt pretensioner deployment time, driver [msec]	481
Seat belt pretensioner deployment time, passenger [msec]	481

< Event 2 >

Longitudinal crash pulse\_acceleration (g, 0 ~ 250msec)

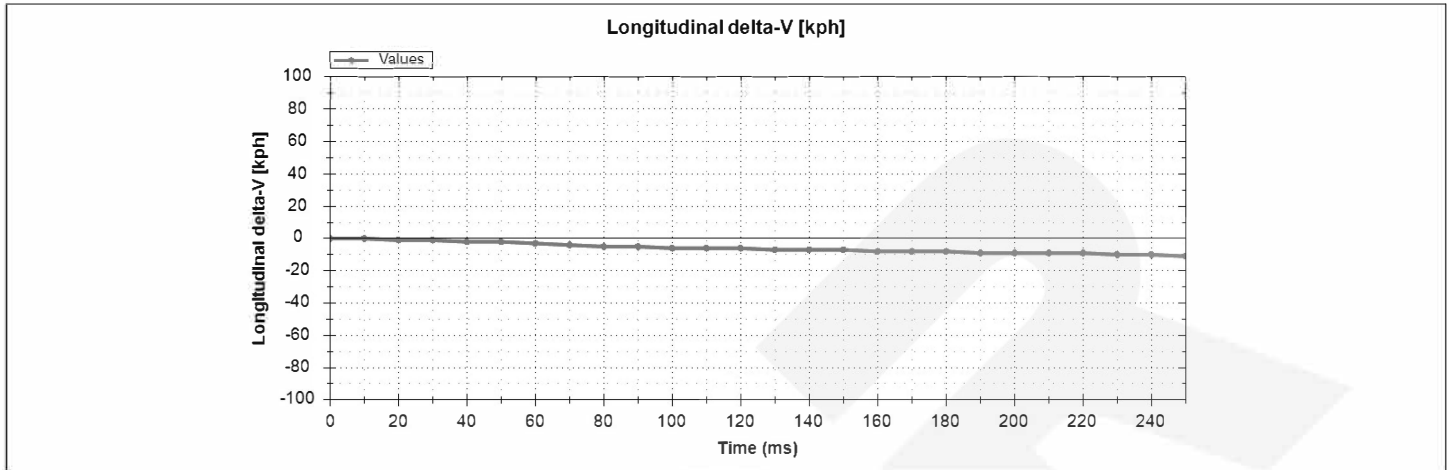


Num	Time (ms)	Longitudinal acceleration [g]
1	0.0	-1.5
2	10.0	-1.0
3	20.0	-0.5
4	30.0	-0.5
5	40.0	-1.0
6	50.0	-1.0
7	60.0	-2.0
8	70.0	-2.0
9	80.0	-1.5
10	90.0	-1.0
11	100.0	-1.0
12	110.0	-0.5
13	120.0	0.0
14	130.0	0.0
15	140.0	0.0
16	150.0	0.0
17	160.0	0.0
18	170.0	-0.5
19	180.0	0.0
20	190.0	0.0
21	200.0	0.0
22	210.0	0.0
23	220.0	-0.5
24	230.0	-0.5
25	240.0	-0.5
26	250.0	-0.5

## < Event 2 >

### Longitudinal crash pulse\_delta-v (kph, 0 ~ 250msec)

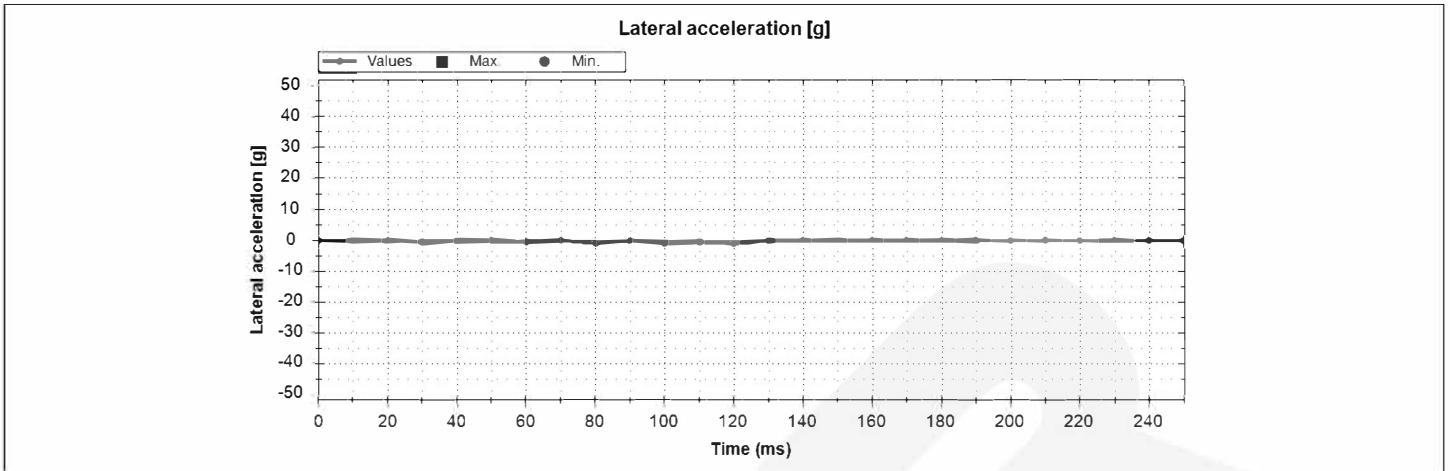
Max. delta-V [kph]	-12
Time, Max. delta-V [msec]	300.0



Num	Time (ms)	Longitudinal delta-V [kph]
1	0.0	0
2	10.0	0
3	20.0	-1
4	30.0	-1
5	40.0	-2
6	50.0	-2
7	60.0	-3
8	70.0	-4
9	80.0	-5
10	90.0	-5
11	100.0	-6
12	110.0	-6
13	120.0	-6
14	130.0	-7
15	140.0	-7
16	150.0	-7
17	160.0	-8
18	170.0	-8
19	180.0	-8
20	190.0	-9
21	200.0	-9
22	210.0	-9
23	220.0	-9
24	230.0	-10
25	240.0	-10
26	250.0	-11

< Event 2 >

Lateral crash pulse\_acceleration (g, 0 ~ 250msec)

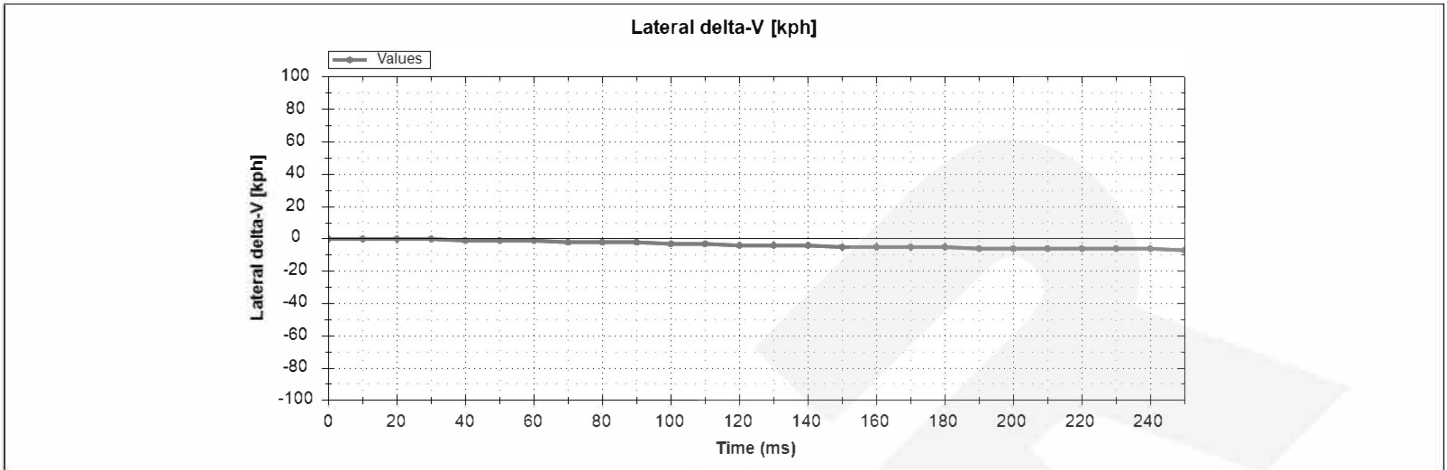


Num	Time (ms)	Lateral acceleration [g]
1	0.0	0.0
2	10.0	0.0
3	20.0	0.0
4	30.0	-0.5
5	40.0	0.0
6	50.0	0.0
7	60.0	-0.5
8	70.0	0.0
9	80.0	-1.0
10	90.0	0.0
11	100.0	-1.0
12	110.0	-0.5
13	120.0	-1.0
14	130.0	0.0
15	140.0	0.0
16	150.0	0.0
17	160.0	0.0
18	170.0	0.0
19	180.0	0.0
20	190.0	0.0
21	200.0	0.0
22	210.0	0.0
23	220.0	0.0
24	230.0	0.0
25	240.0	0.0
26	250.0	0.0

< Event 2 >

Lateral crash pulse\_delta-v (kph, 0 ~ 250msec)

Max. delta-V [kph]	-7
Time, Max. delta-V [msec]	300.0



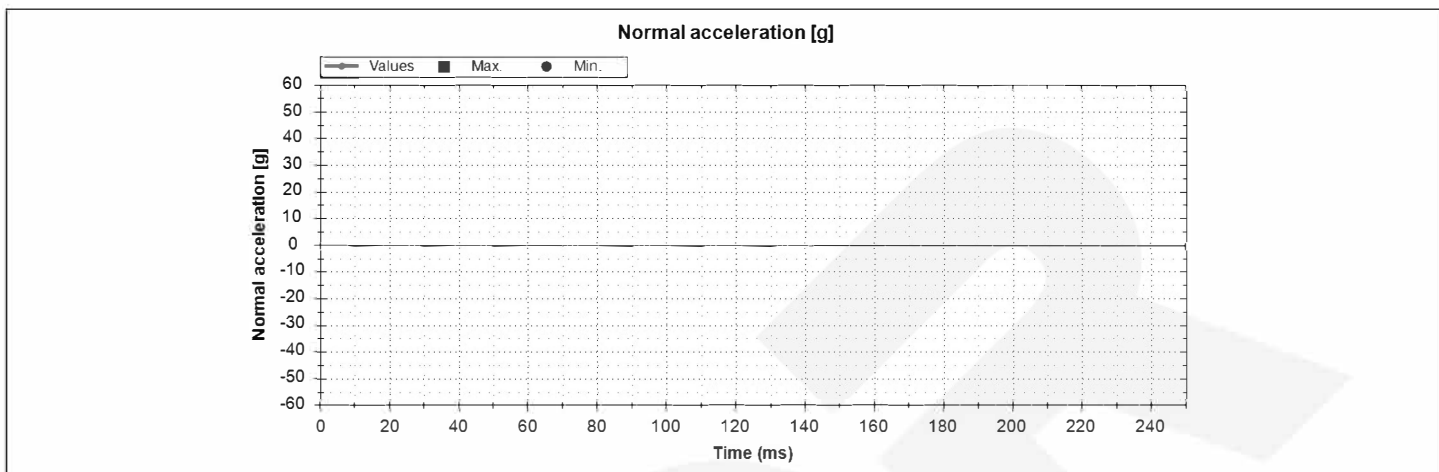
Num	Time (ms)	Lateral delta-V [kph]
1	0.0	0
2	10.0	0
3	20.0	0
4	30.0	0
5	40.0	-1
6	50.0	-1
7	60.0	-1
8	70.0	-2
9	80.0	-2
10	90.0	-2
11	100.0	-3
12	110.0	-3
13	120.0	-4
14	130.0	-4
15	140.0	-4
16	150.0	-5
17	160.0	-5
18	170.0	-5
19	180.0	-5
20	190.0	-6
21	200.0	-6
22	210.0	-6
23	220.0	-6
24	230.0	-6
25	240.0	-6
26	250.0	-7

< Event 2 >

Crash pulse Resultant, Time\_Max. delta-V resultant (0 ~ 300 msec)

Time, Max. delta-V, resultant [msec]	300.0
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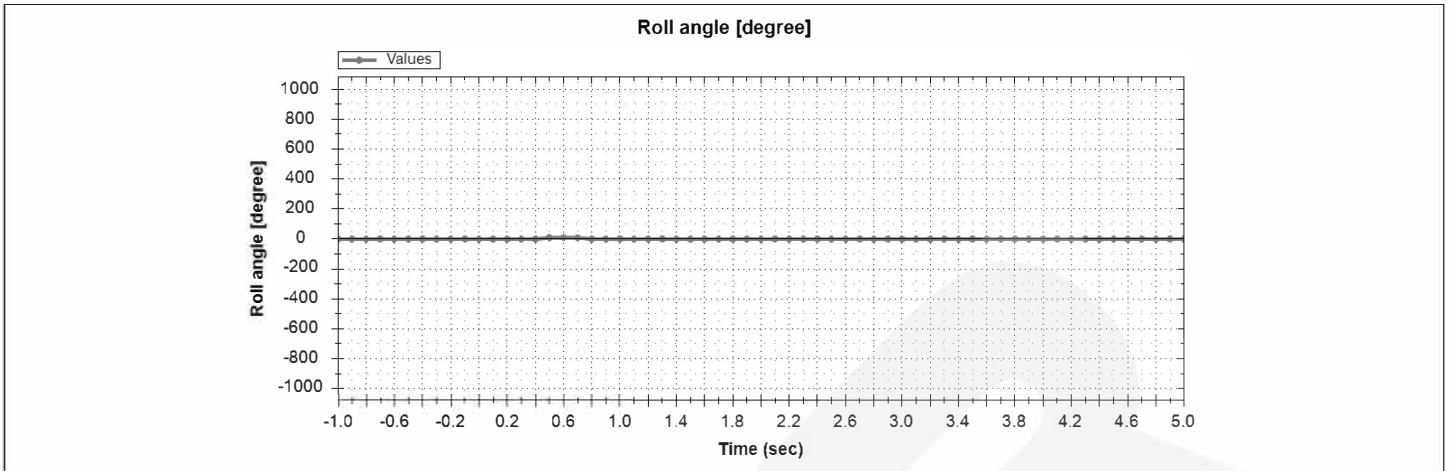
Normal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Normal acceleration [g]
1	0.0	Not supported
2	10.0	Not supported
3	20.0	Not supported
4	30.0	Not supported
5	40.0	Not supported
6	50.0	Not supported
7	60.0	Not supported
8	70.0	Not supported
9	80.0	Not supported
10	90.0	Not supported
11	100.0	Not supported
12	110.0	Not supported
13	120.0	Not supported
14	130.0	Not supported
15	140.0	Not supported
16	150.0	Not supported
17	160.0	Not supported
18	170.0	Not supported
19	180.0	Not supported
20	190.0	Not supported
21	200.0	Not supported
22	210.0	Not supported
23	220.0	Not supported
24	230.0	Not supported
25	240.0	Not supported
26	250.0	Not supported

< Event 2 >

Roll angle (degree, -1 ~ 5sec)



Num	Time (sec)	Roll angle [degree]
1	-1.0	0
2	-0.9	0
3	-0.8	0
4	-0.7	0
5	-0.6	0
6	-0.5	0
7	-0.4	0
8	-0.3	0
9	-0.2	0
10	-0.1	0
11	0.0	0
12	0.1	0
13	0.2	0
14	0.3	0
15	0.4	0
16	0.5	10
17	0.6	10
18	0.7	10
19	0.8	0
20	0.9	0
21	1.0	0
22	1.1	0
23	1.2	0
24	1.3	0
25	1.4	0
26	1.5	0
27	1.6	0
28	1.7	0
29	1.8	0
30	1.9	0
31	2.0	0



32	2.1	0
33	2.2	0
34	2.3	0
35	2.4	0
36	2.5	0
37	2.6	0
38	2.7	0
39	2.8	0
40	2.9	0
41	3.0	0
42	3.1	0
43	3.2	0
44	3.3	0
45	3.4	0
46	3.5	0
47	3.6	0
48	3.7	0
49	3.8	0
50	3.9	0
51	4.0	0
52	4.1	0
53	4.2	0
54	4.3	0
55	4.4	0
56	4.5	0
57	4.6	0
58	4.7	0
59	4.8	0
60	4.9	0
61	5.0	0

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June 2024



U.S. Department  
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**National Highway  
Traffic Safety  
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