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Each crash represents a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

16. Abstract

This report documents the investigation of a crash involving a 2018 Hyundai Kona that caught fire following an impact with another vehicle. The crash occurred during the afternoon hours in September 2018 in Arizona.
The crash site was a five-lane undivided north/south roadway just south of the intersection with an east/west roadway. The three vehicles involved in the crash were heading northbound toward the intersection in the right lane. The lead vehicle, a 2000 Toyota Camry driven by a belted 67-year-old female, was stopped at a red traffic signal. Stopped behind the Toyota was a 2006 Chevrolet Impala driven by a belted 36-year-old female and occupied by 9-year-old and 3-year-old females. The 2018 Hyundai Kona was driven by a belted 70-year-old male at an unknown speed. The Hyundai driver did not stop and struck the back plane of the Chevrolet (Event 1), displacing the Chevrolet in a forward trajectory and causing its front plane to impact the back of the Toyota (Event 2). Following the crash, the Hyundai driver proceeded to turn right at the intersection and came to rest in the eastbound lanes. The Hyundai caught fire (Event 3) from an unknown source and was fully involved when firefighters arrived. The Hyundai driver sustained a minor injury and was transported by ambulance to a local hospital. The driver of the Chevrolet complained of pain and declined to be transported. None of the other occupants were injured or transported. The other vehicles were not damaged by the fire. The Hyundai and Chevrolet were towed due to damage, and the Toyota was driven from the scene.

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vehicle fire, air bag, deployment, injury	The document is available to the public from the National Technical Information Service, www.ntis.gov.

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Special Crash Investigations
Vehicle Fire Investigation
Office of Defects Investigation
Case Number: DS18030
Vehicle: 2018 Hyundai Kona
Location: Arizona
Crash Date: September 2018

BACKGROUND

This report documents the investigation of a crash involving a 2018 Hyundai Kona (**Figure 1**) that caught fire following impact with another vehicle. The investigation was intended to examine the origin and cause of the fire, and sought to determine whether any air bags deployed in the crash. A notification from the vehicle's insurer indicated that no air bags deployed. The fire incident report indicated the area of the fire's origin was "engine area, running," and the heat source was identified only as "other." Burn damage to the vehicle's interior destroyed all the vehicle's air bags preventing their examination. The investigation determined that the driver's frontal air bag probably deployed during the crash. The police report indicated an unspecified driver air bag deployed and the driver's EMS report stated the driver complained of pain to his chest where he struck the air bag and included the statement, "air bags deployed." The investigation was initiated by the Office of Defects Investigation group of the National Highway Traffic Safety Administration in response to the insurance company notification alleging the Hyundai caught fire following the crash and the driver's frontal air bag did not deploy. The Special Crash Investigations (SCI) group assigned the case to Dynamic Science, Inc., in November 2018. The SCI team obtained the police report and the fire incident report and field inspections were completed in December 2018. The Hyundai's supplemental restraints system control module (SRSCM) was supported by the Global Information Technology (GIT) readout tool and was removed during the vehicle inspection and sent to NHTSA for imaging. A communication error between module and tool prevented the imaging of data, possibly due to module damage caused by the vehicle fire.

Figure 1. The 2018 Hyundai Kona.

This crash occurred during afternoon hours in September 2018 in Arizona. Conditions were daylight, clear, and dry. The crash site was a five-lane undivided north/south roadway just south of the intersection with an east/west roadway. The three vehicles involved in the crash were heading northbound toward the intersection in the right lane. The lead vehicle, a 2000 Toyota Camry driven by a belted 67-year-old female, was stopped in observance of a red traffic signal. Stopped behind the Toyota was a 2006 Chevrolet Impala driven by a belted 36-year-old female and occupied by 9-year-old and 3-year-old females. The 2018 Hyundai Kona was driven by a belted 70-year-old male at an unknown speed. The Hyundai driver did not stop, and the front

plane of the Hyundai struck the back plane of the Chevrolet (Event 1), displacing the Chevrolet in a forward trajectory and causing its front plane to strike the back plane of the Toyota (Event 2). Following the crash, the Hyundai driver proceeded to turn right at the intersection and came to rest in the eastbound lanes. The Hyundai caught fire (Event 3) from an unknown source and was fully engulfed when firefighters arrived. The Hyundai driver sustained a minor injury and was transported by ambulance to a local hospital. The driver of the Chevrolet complained of pain and declined to be transported. None of the other occupants were injured or transported. The other vehicles were not damaged by the fire. The Hyundai and Chevrolet were towed due to damage and the Toyota was driven from the scene.

SUMMARY

Crash Site

The crash occurred in the northbound lanes of a four-leg intersection (**Figure 2**). The intersection consisted of an undivided north/south roadway and an undivided east/west roadway controlled by three-phase overhead traffic signals. The north/south roadway consisted of the three northbound lanes and two southbound lanes separated by a double yellow painted stripe. The northbound lanes were separated by solid white painted stripes and bordered on the right edge by a dashed white painted stripe, a bike lane and a raised curb. Each travel lane measured 3.4 m (11.2 ft) wide, and the bike lane measured 2.0 m (6.6 ft) wide. The roadway was straight and level. The posted speed limit was 72 km/h (45 mph). Conditions at the time of the crash were daylight, clear, and dry. A crash diagram is included at the end of this report.

Figure 2. Crash site looking north.

Pre-Crash

The 2000 Toyota Camry was stopped at the intersection in the first northbound lane from the right in observance of a red traffic signal. The 2006 Chevrolet Impala was stopped behind the Toyota. The 2018 Hyundai Kona was traveling northbound at an unknown speed in the same lane approaching the stopped vehicles. The Hyundai driver stated to police that prior to the crash he “looked down for a second” and didn’t remember anything after that.

Crash

For unknown reasons, the Hyundai driver did not stop for the red traffic signal and the front plane of the Hyundai struck the back plane of the Chevrolet (Event 1), displacing the Chevrolet in a forward trajectory and causing its front plane to impact the back plane of the Toyota (Event 2). The Toyota was displaced in a northbound trajectory and came to rest just north of the westbound lanes. The Chevrolet came to rest within the intersection. Following the crash the Hyundai driver proceeded to turn right at the intersection and came to rest in the eastbound lanes. The fire department was notified approximately 1 minute after the crash and arrived approximately 6 minutes after the crash to find the vehicle fully involved in fire (Event 3).

For the Hyundai in Event 1, the “damage with CDC only” algorithm of the WinSMASH program calculated a total delta V of 54 km/h (33 mph), longitudinal delta V of -54 km/h (-33 mph),

lateral delta V of 0 km/h and a barrier equivalent speed (BES) of 26 km/h (16 mph). The WinSMASH results appear reasonable but the reconstruction was considered borderline because it is likely the three involved vehicles were engaged simultaneously.

For the Chevrolet in Event 1, the "damage with CDC only" algorithm of WinSMASH calculated a total delta V of 44 km/h (27 mph), longitudinal delta V of 44 km/h (27 mph), lateral delta V of 0 km/h and a BES of 61 km/h (38 mph). The WinSMASH results appear reasonable but the reconstruction was considered borderline.

Post-Crash

The driver stated during the interview that approximately three minutes after the crash the Hyundai was emitting black smoke from an undetermined source. The fire department was notified of the incident approximately one minute after the crash and arrived approximately six minutes after the crash to find the vehicle fully involved with fire. The last fire unit was cleared from the scene 1 hour and 25 minutes after the crash. The Hyundai driver was transported by ambulance to a local hospital for treatment of a minor injury. He stated to police that prior to the crash he "looked down for a second" and didn't remember anything after that. The Chevrolet driver complained of pain but declined to be transported. No other occupants were injured or transported. The Hyundai and Chevrolet were towed due to damage and the Toyota was driven from the scene.

2018 HYUNDAI KONA

Description

The 2018 Hyundai Kona was a 4-door sport utility vehicle (SUV) identified by the Vehicle Identification Number (VIN) KM8K22AA1JUxxxxxx. The date of manufacture and odometer reading were unknown due to fire-related damage. The vehicle manufacturer recommended size 215/55R17 tires with a recommended pressure of 32 psi (221 kPa) for the front and rear. It was equipped with Nexen NPRIZ tires of the recommended size manufactured in 2017. The left front tire was burned and missing. The right front tire was de-beaded and flat. The Hyundai was configured with two rows of seating for five occupants. The front row was equipped with bucket seats and adjustable head restraints. The driver's seat track position was middle distance from the steering wheel.

Exterior Damage

The Hyundai sustained minor severity damage to the front plane in Event 1. Several components were displaced or destroyed by fire including the front bumper fascia, grille, and headlamps. The backing bar was used for the purpose of measuring crush. Direct damage to the front plane was distributed across the length of the backing bar and measured 106 cm (41.7 in). Twelve crush measurements were taken in 10 cm (3.9 in) increments using a Nikon Total Station and the Faro Blitz program computed six crush measurements as follows: C_1 = 3 cm (1.2 in), C_2 = 7 cm (2.8 in), C_3 = 15 cm (5.9 in), C_4 = 15 cm (5.9 in), C_5 = 9 cm (3.5 in), and C_6 = 1 cm (0.4 in) (**Figure 3**). Maximum crush was located 20 cm (7.9 in) right of the longitudinal centerline and measured 15 cm (5.9 in). The Collision Deformation Classification (CDC) for the Hyundai in Event 1 was

12FDEW1. Exterior damage caused by the fire began at the leading edge of the front plane and extended rearward beyond the left B-pillar.

Figure 3. Front plane damage, the 2018 Hyundai Kona.

Event Data Recorder

The Hyundai's supplemental restraints system control module was supported by the GIT readout tool. It was removed during the vehicle inspection and sent to NHTSA for imaging. A communication error between module and tool prevented the imaging of data, possibly due to module damage caused by the vehicle fire.

Vehicle Fire Discussion

The Hyundai sustained a major severity fire combining the engine and occupant compartments, undercarriage, and tires. Exterior burn damage was present on the front, left, right, top and bottom planes and interior damage was present in the front and second rows. The burn damage flow suggested the fire originated in the engine compartment (**Figure 4**) and spread rearward to the occupant compartment. The fire damage included components of the fuel system but did not extend to the vehicle's fuel tank (**Figure 5**) or filler cap. The cause of the fire was not determined.

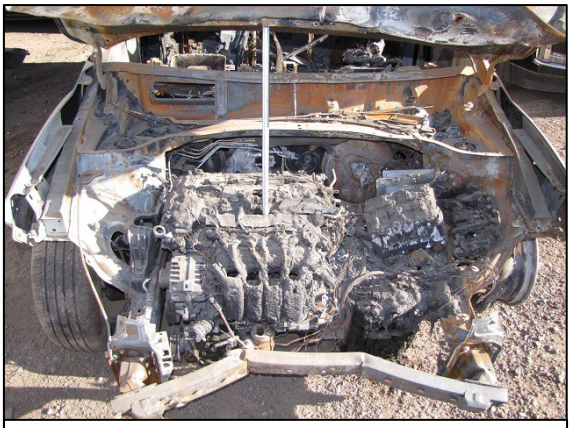


Figure 4. Engine compartment, the 2018 Hyundai Kona.

The fire incident report was obtained. The report stated that 14 personnel and eight apparatus arrived on-scene to find the vehicle fully involved with fire. They extinguished the fire using tank water and foam. The Ignition section of their report indicated the area of fire origin was "engine area, running." The heat source was identified only as "other." The item first ignited was "undetermined." Cause of ignition was "under investigation." Factors contributing to ignition were "undetermined/none." Human factors contributing to ignition were "none." The limited available data suggested the fire probably originated in the engine compartment and was caused by an undetermined source.

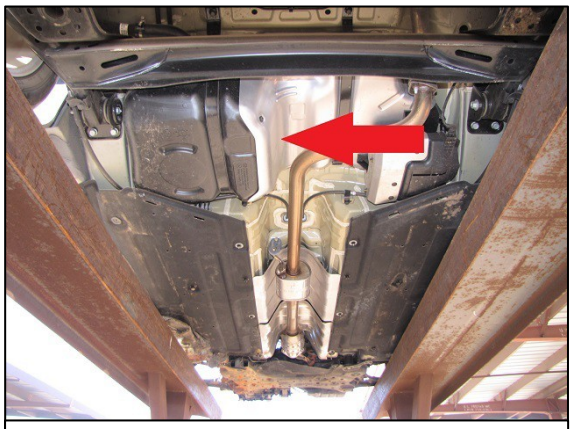


Figure 5. Fuel tank, the 2018 Hyundai Kona.

Interior Damage

The Hyundai's front row was completely destroyed in the fire (**Figure 6**). The instrument panel, seats, carpet, trim, roof header, center console, seat belts, and air bags were destroyed. The

windshield and the front row side glass were disintegrated. The second row sustained significant burn damage less severe than the front row. The side glass was disintegrated. All the doors remained closed and operational. Some post-crash integrity loss and other damaged is suspected but not confirmed.

Figure 6. Interior damage, the 2018 Hyundai Kona.

Manual Restraint Systems

The Hyundai was equipped with driver and front passenger lap and shoulder seat belts. The driver's belt was equipped with continuous loop belt webbing, a sliding latch plate, an emergency locking retractor (ELR) and a non-adjustable D-ring upper anchor. The front row belts were configured with retractor pretensioners. The driver's seat belt was burned in the fire and not available for inspection. The police report indicated the driver was belted using the lap and shoulder portions and the driver indicated during the interview he was wearing the belt in a correct manner. He sustained an abrasion extending from middle chest to left shoulder consistent with seat belt use.

Supplemental Restraint Systems

The Hyundai's SRS included frontal, seat-mounted side impact, and combination roll-sensing/side impact inflatable curtain (IC) air bags for the driver and front right occupant seat positions. All the air bags were burned in the fire and not available for inspection. The driver's insurance company stated in their notification that their insured had indicated no air bags deployed. The driver stated likewise during the interview. The police report indicated that an unspecified driver's air bag deployed. The driver's EMS report stated the driver's "only complaint is pain to his chest where he struck the air bag." The report indicated in a discussion of injury and safety features that "air bags deployed." Based on the police and EMS reports, the investigation determined the driver's frontal air bag likely deployed at impact with the other vehicle. It was unknown whether other air bags deployed in the Hyundai.

NHTSA Recalls and Investigations

A search in September 2020 using the Hyundai's VIN revealed no open recalls.

2018 HYUNDAI KONA OCCUPANT

Driver Demographics

Age/sex:	70 years/male
Height:	168 cm (66 in)
Weight:	68 kg (150 lb)
Eyewear:	Eyeglasses
Seat type:	Bucket with adjustable head restraint
Seat track position:	Middle track
Manual restraint usage:	Lap and shoulder seat belt
Usage source:	Police report, interview

Air bags:	Frontal air bag deployed; seat-mounted side and IC air bags unknown if deployed
Alcohol/drug data:	None
Egress from vehicle:	Exited unassisted through left side door
Transport from scene:	Ambulance to hospital
Type of medical treatment:	Treated and released

Driver Injuries

Injury. No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Abrasion, chest, extending mid-chest to left shoulder	410202.1	Shoulder seat belt	Certain

Source: medical records.

Driver Kinematics

The belted 70-year-old male driver was seated in an upright posture and operating the vehicle at an unknown speed. At impact with the other vehicle, the driver was displaced forward in response to the 12 o'clock direction of force loading the seat belt. His frontal air bag likely deployed in response to the frontal impact and the driver remained in his seated position. Following the impact, he proceeded to turn right at the intersection and bring the vehicle to a controlled stop in the eastbound lanes. He exited the vehicle unassisted and was transported by ambulance to a local hospital where he was treated and released.

2006 CHEVROLET IMPALA

Description

The 2006 Chevrolet Impala was identified in the police report by the VIN 2G1WD58C769xxxxxx. The date of manufacture was unknown. The vehicle was a 4- door sedan configured with an 8-cylinder, 5.3- liter, gasoline engine, automatic transmission, and front-wheel drive.

Exterior Damage

The Chevrolet sustained back plane damage caused in Event 1 (**Figure 7**) and front plane damage caused in Event 2. The estimated CDC for damage to the back plane was 06BDEW4. The estimated CDC for damage to the front plane was 12F9991. The vehicle was towed due to damage.

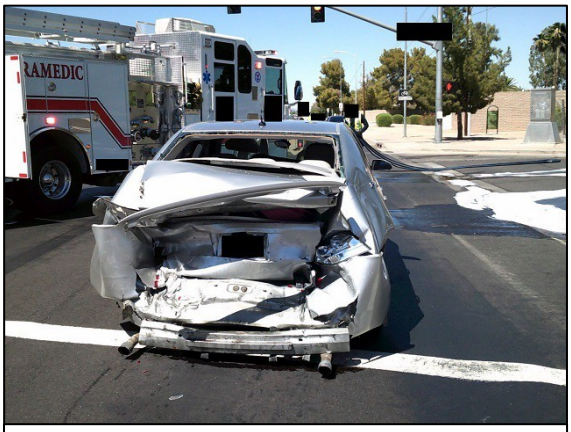


Figure 7. Back plane damage, the 2006 Chevrolet Impala (police photo).

Occupant Data

According to the police report, the Chevrolet driver was a belted 36-year-old female who sustained a possible injury. Additional occupants included a belted 9-year-old female and a 3-

year-old female seated in a child restraint system. According to the police report, the child occupants were not injured, and none of the occupants were transported.

Figure 8. Back plane damage, the 2000 Toyota Camry (police photo).

2000 TOYOTA CAMRY

Description

The 2000 Toyota Camry was identified in the police report by the VIN JT2BF28K1Y0xxxxxx. The date of manufacture was unknown. The vehicle was a 4-door sedan configured with a 6-cylinder, 3.0-liter, gasoline engine; an automatic transmission; and front-wheel drive.

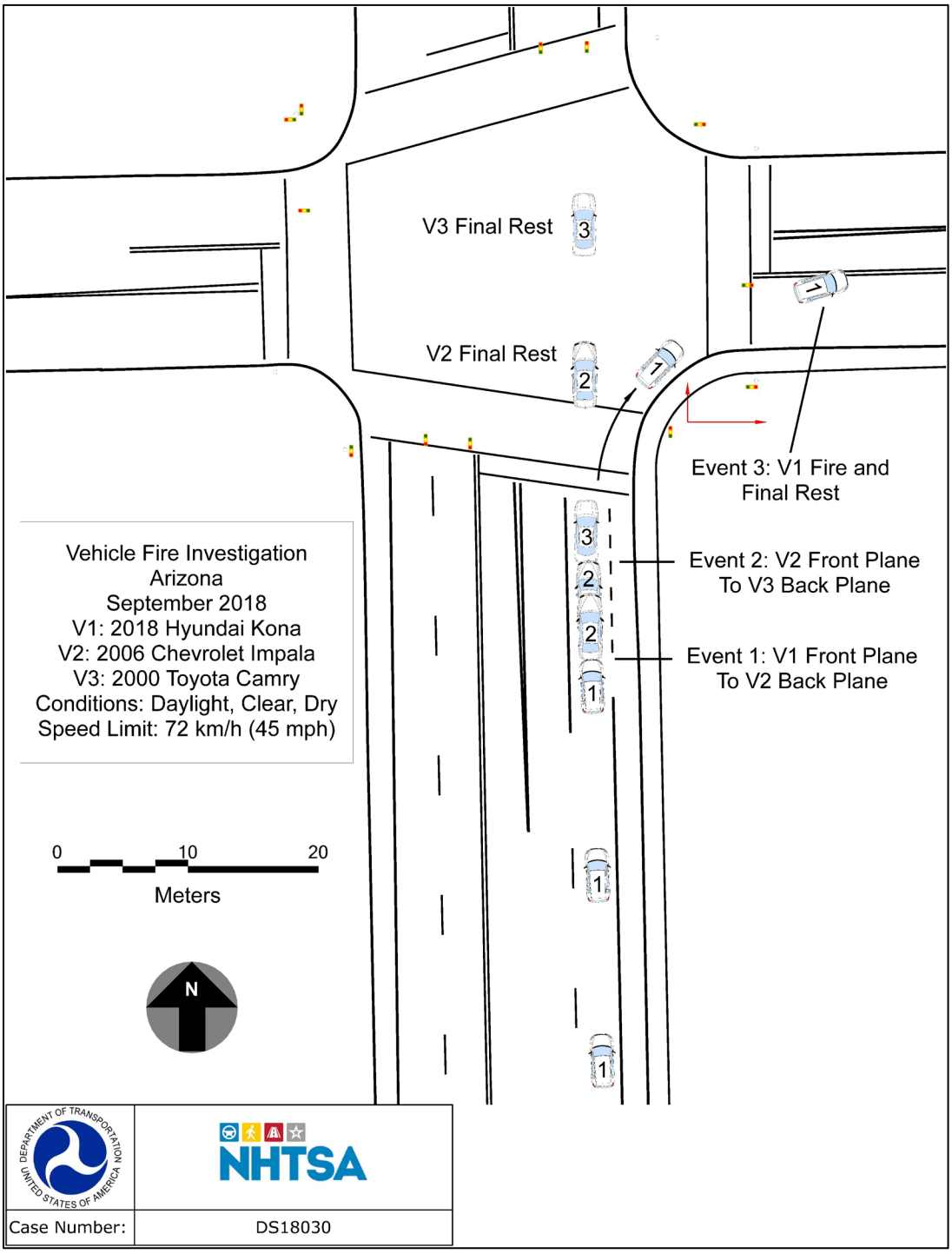
Exterior Damage

The Toyota sustained minor severity damage to the back plane caused in Event 2 (**Figure 8**). The estimated CDC for damage to the back plane was 06BZLW1.

Occupant Data

According to the police report, the driver of the Toyota was a belted 67-year-old female who was not injured or transported.

CRASH DIAGRAM



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