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On-Site Vehicle Fire Crash Investigation;
Vehicle: 2013 Volkswagen Passat;
Location: Missouri;
Crash Date: March 2020

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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 vehicle(s) 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 crash and resulting major fire of a 2013 Volkswagen Passat after it struck a wooden fence and large tree. The fire resulted in fatal injury to the 26-year-old male driver. The crash occurred on the property of a storage facility. The Volkswagen was a 4-door sedan occupied only by the driver. Due to the total burn of the vehicle, it is unknown if his seat belt was in use. The vehicle was initially traveling north on a two-lane, undivided roadway where the left front wheel struck a mountable curb (Event 1) at the end of the roadway cul-de-sac. The Volkswagen continued into the storage facility area and at the back of the lot the Volkswagen's front plane struck a wooden fence (Event 2) and a large tree (Event 3) immediately behind the fence. A fire developed in the engine compartment (Event 4) and consumed the entire vehicle. The driver was not able to exit the vehicle and was pronounced deceased at the crash scene.

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Table of Contents

Special Crash Investigations
On-Site Vehicle Fire Crash Investigation
Office of Defects Investigation
SCI Case No: CR20016
Vehicle: 2013 Volkswagen Passat
Location: Missouri
Crash Date: March 2020

Background

This report documents the crash and resulting major fire of a 2013 Volkswagen Passat (Figure 1) after it struck a wooden fence and a large tree. The fire resulted in fatal injury to the 26-year-old male driver. The crash occurred in March 2020 and was investigated by a local police agency. The family of the driver notified the National Highway Traffic Safety Administration of the crash in March 2020 and the investigation was assigned to the Special Crash Investigations (SCI) team at Crash Research and Analysis, Inc., in April 2020. The team contacted the tow yard holding the vehicle as well as the driver's family, and established cooperation to inspect the vehicle. Due to COVID-19 pandemic travel restrictions, inspections of the vehicle and scene were placed on a temporary hold. The SCI investigator completed vehicle and scene inspections in May 2020. An interview with a relative of the driver was also completed at that time.

Figure 1. 2013 Volkswagen Passat

The crash occurred on the property of a storage facility. The Volkswagen was a 4-door sedan occupied only by the driver. The vehicle was initially traveling north on a two-lane, undivided roadway. The left front wheel struck a mountable curb (Event 1) at the end of the roadway cul-de-sac and the Volkswagen continued into the storage facility. At the back of the lot the front plane of the Volkswagen struck a wooden fence (Event 2) and a large tree (Event 3) immediately behind the fence. A fire developed in the engine compartment (Event 4) after an extended period and consumed the entire vehicle. The driver was not able to exit the vehicle and was pronounced deceased at the crash scene.

The Volkswagen had certified advanced 208-compliant frontal air bags, front-seat-mounted side impact air bags, inflatable curtain (IC) air bags and front row seat belt retractor pretensioners. Due to the complete consumption of the vehicle by fire, it could not be determined if any of the

Volkswagen's manual safety systems were used or if supplemental safety systems deployed/actuated as a result of the crash.

The SCI on-site investigation consisted of inspection of the Volkswagen to measure its exterior and interior damage. The engine compartment and undercarriage were documented but no interior components survived the fire. The Volkswagen's event data recorder (EDR) was not supported by the Bosch Crash Data Retrieval tool software. The crash site was photographed and mapped by the Nikon total station during the SCI inspection.

Through the course of the SCI investigation, it was determined that the driver likely became unconscious or incapacitated due to crash force sustained in the crash but succumbed to smoke inhalation as the vehicle was consumed by fire.

Summary

Crash Site

This crash occurred during the pre-dawn morning in the dark, under artificial lighting. The environmental conditions were cloudy skies with winds from the northeast at 24 km/h (15 mph) and a temperature of 4 °C (40 °F), according to local weather reports. The storage facility was at the north end of a cul-de-sac on a two-lane undivided roadway (Figure 2). The driving area surface of the storage facility was dry, level bituminous; with a negative 9.3 percent cross-slope to the east. There were no pavement markings. A crash diagram is included at the end of this report.

Figure 2. Overhead view of the Volkswagen's northerly travel path from roadway into the storage facility (image source; Google Maps ©2022 Maxar Technologies)

Pre-Crash

Surveillance video from the storage facility was analyzed by the police and provided to the SCI team. Based on the police report supplements, the Volkswagen turned from a major roadway onto the two-lane roadway at 0218 hours. The driver steered off the roadway to the left and stopped for 44 minutes. At 0302 hours, the driver resumed travel north, but at a very slow speed, and drove onto the right curb, making a stop out of the camera view. He remained there for one hour and 55 minutes. At 0457 hours, the vehicle accelerated and proceeded north, veering to the left, then back right as it passed through the cul-de-sac and into the storage facility property (Figure 3).

Figure 3. North view, entrance into the storage facility

Crash

The front left wheel struck the mountable curb (Event 1) at the end of the cul-de-sac, denting the wheel rim. The Volkswagen continued north for 44 m (144 ft) in between the two storage buildings and the front plane struck a wooden fence (Event 2, Figure 4). It penetrated the fence and struck a 63 cm (24.8 in) diameter tree (Event 3, Figure 5) located 110 cm (43.3 in) behind the fence. The vehicle did not rebound significantly and came to rest facing north, with the front plane against the tree. Video evidence did not show the vehicle at the point of impact, as the camera was positioned approximately 150 m (492 ft) away and the view was blocked by one of the storage buildings. According to the police report supplement, the post-crash fire (Event 4) began at 0522 hours, 25 minutes after the crash, and grew into a large fire. Given that the vehicle is not in camera view and flames can only be seen from a distance 25 minutes after impact, it is likely that the fire began prior to the appearance of these visible flames.

Figure 4. North view, impact with wooden fence (replaced)

Figure 5. North view, tree impact

Post-Crash

The police supplement stated the first 911 call came in at 0529, though the police crash report stated the police were notified at 0524. The supplement further stated that the primary officer arrived on scene at 0530. Fire and rescue personnel also responded. The driver was not able to exit the vehicle. A fence post adjacent to the left front door (Figure 6) could have impeded the driver from exiting the vehicle. The fire consumed the entire vehicle and the driver was extensively burned. He was pronounced deceased at the scene, removed from the vehicle, and taken to a medical examiner.

Figure 6. Fence post adjacent to left front door of the Volkswagen at final rest

2013 Volkswagen Passat

Description

The Volkswagen was a front-wheel-drive, 5-passenger, 4-door sedan with the VIN 1VWAP7A31DCxxxxxx. It had a 2.5-liter, 5-cylinder engine, a 6-speed automatic transmission, 4-wheel antilock brakes, emergency braking assist, electronic brakeforce distribution, stability control, and traction control. The wheelbase was 280 cm (110.2 in) and the curb weight was 1,436 kg (3,159 lb). The vehicle's gross vehicle weight rating (GVWR) was 2,010 kg (4,431 lb). Front and rear weight ratings could not be determined. The vehicle manufacturer's recommended tire size was P235/45R18. All tires were consumed by the fire.

Exterior Damage

The Volkswagen sustained direct damage to the left wheel during contact to the mountable curb (Event 1, Figure 7). The WinSMASH program could not be used since wheel impacts are out of scope for the program. The collision deformation classification (CDC) for this event was 12FLWN3.

Figure 7. LF rim damage from curb impact

The front plane struck the wooden fence (Event 2) between fence posts. The bumper fascia and hood were directly involved in the contact. The WinSMASH program was not used for this due to the yielding properties of the impact and the overlapping damage from the subsequent tree impact. The CDC assigned to this impact was 12FDE91.

The Volkswagen sustained front plane damage from the impact with the tree (Figure 8), which measured 63 cm (24.8 in) in diameter. The bumper beam, bumper fascia, grille, and hood were directly damaged. The direct damage began 34 cm (13.4 in) right of the left end of the bumper beam and extended 50 cm (19.7 in) to the right. The crush measurements were documented on the front bumper beam and the Field L was 79 cm (31.1 in). The crush values were C1 = 15 cm (5.9 in), C2 = 25 cm (9.8 in), C3 = 54 cm (21.3 in), C4 = 60 cm (23.6 in), C5 = 53 cm (20.9 in), C6 = 24 cm (9.4 in). The maximum residual crush was 60 cm (23.6 in) and was located 66 cm (26.0 in) left of the left end of the bumper beam.

Figure 8. Front plane damage from tree impact

The damage algorithm of the WinSMASH program was used to calculate the severity of the crash. The Volkswagen‘s total delta V was 65 km /h (40 mph). The longitudinal and lateral velocity changes were -65 km/h (-40 mph) and 0 km/h, respectively. The collision fits the model and the results appeared reasonable. The CDC for the front plane impact was 12FYEW3 (0 degrees).

The post-crash fire (Event 4) resulted in severe damage to the entire vehicle. All combustible materials in the engine compartment, as well as the exterior and interior of the vehicle, were completely consumed in the fire.

Interior Damage

The Volkswagen interior was completely consumed by fire (Figure 9). No glazing remained. None of the doors operated properly due to the fire. No discernable crash damage was noted. All four doors were considered closed and operational at the time of the crash. The left front door was forced open by the first responders. All combustible material in the vehicle’s interior, including the seat coverings and cushions, polymer trim panels/fascia, door and floor coverings, headliner, and all other interior components were consumed by the fire. Only a small area of the driver’s seat cushion, protected by the presence of the driver, remained. Charred remnants of the various materials covered the floor of the vehicle. All vertical and upper surfaces of the vehicle’s interior were burned clean to the underlying metal structure. Soft metals with low combustion temperatures were melted and/or consumed by the intense fire.

Figure 9. Completely burned front row

Manual Restraint Systems

The Volkswagen was originally equipped with manual 3-point lap and shoulder seat belts for the five seating positions. Seat belt pretensioners were present at all outboard seating positions. All belt webbing and hardware were consumed by the fire and the driver's seat belt latch plate could not be located. It is unknown if the driver was belted at the time of the crash.

Supplemental Restraint Systems

The Volkswagen was originally equipped with certified advanced 208-compliant frontal air bags, front-seat-mounted side impact air bags, and side impact IC air bags. All the combustible material and components of the air bags were consumed by the fire. It is unknown if any air bags deployed during the crash.

NHTSA Recalls and Investigations

A VIN-based query of NHTSA's recall database (www.nhtsa.gov/recalls) for the 2013 Volkswagen Passat was completed in August 2022 and one unrepaired recall existed for this vehicle, identified by NHTSA Recall #19V389, issued June 11, 2019. This recall pertained to the vehicle's headlights, in which affected vehicles did not have a cap installed on the horizontal adjustment screw. The potential therefore existed for the headlights to not be properly aligned and cause a visibility problem for the driver, increasing the potential for a crash. This recall did not appear to have played any role in the occurrence and/or outcome of this crash.

Post-Crash Fire Discussion

The Volkswagen was consumed entirely by the post-crash fire, which resulted in the death of the driver. SCI investigation of the incident determined that the fire developed as a result of the severe frontal impact with the tree. The fire developed over an extended time period, based on surveillance video from the storage facility where the crash occurred. The vehicle's path of travel toward the fence and tree was observed on the video recording; however, the actual impact was not captured, as the camera's view was obstructed by one of the storage buildings. The video camera was mounted on a building wall, located approximately 150 m (492 ft) from the area of impact. Though flames were first visible on the recording approximately 25 minutes after impact and reached a height of approximately 3 m (10 ft), the fire began prior to this time. The fire continued to develop and proliferate as the video recording continued.

Video surveillance of the Volkswagen revealed that there was no evidence or indication of a fire prior to the crash. Evidence observed by this SCI investigation revealed burn patterns and damage to the vehicle consistent only with a fire that developed in the engine compartment of the vehicle and proliferated under natural fire spread conditions to consume the entire vehicle and all of its combustible material/components. The fire's area of origin was identified as the engine compartment of the vehicle. Due to the level of consumption of materials, the specific cause of the fire could not be determined.

The engine compartment of a vehicle contains volatile/flammable liquids and sources of ignition, including engine/thermodynamic heat and numerous electronic components capable of producing electrical sparks. A review of research documents on the topic revealed that a majority

of post-crash fires in internal combustion engines occur in frontal impacts. An analysis of FARS data found that 64 percent of fatal crashes involving fire were frontal impacts.[1]

The SCI Investigation concluded that no anomaly concerning the Volkswagen relative to the post-crash fire could be determined. The available evidence indicated that the driver was likely rendered unconscious due to crash forces and remained in the vehicle. The post-crash fire developed in the engine compartment as a result of the severe frontal crash and ultimately spread to the rest of the vehicle by natural fire progression characteristics. The driver was likely incapable of exiting the vehicle, even though he had more than sufficient time to exit prior to the expansion of the fire.

[1] Egelhaff, M., & Wolpert, D. (2011, June 13-16). *Post collision vehicle fire analysis* (Paper Number 11-0315) 22nd International Technical Conference on the Enhanced Safety of Vehicles (ESV) Washington, DC. www-esv.nhtsa.dot.gov/Proceedings/22/files/22ESV-000315.pdf

2013 Volkswagen Passat Occupant Data

Driver Demographics

Age/sex:	26 years/male
Height:	178 cm/70 in (source: autopsy)
Weight:	77 kg/170 lb (source: interview w/relative)
Eyewear:	None
Seat type:	Bucket seat with adjustable head restraint
Seat track position:	Unknown
Manual restraint usage:	Unknown
Usage source:	None
Air bags:	Front, seat-mounted and IC air bags, unknown if deployed
Alcohol/drug involvement:	Alcohol, BAC .177 g/dL; positive THC and metabolite
Egress from vehicle:	Fatal before removal
Transport from scene:	Transported to medical examiner

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Lung inhalation injury (heat, particulate matter, caustic or noxious agents) [includes entire airway]-> severe inflammation with friability, copious carbonaceous deposits, bronchorrhea, bronchial obstruction, hypoxemia	419206.5	Isolated IPC: Noncontact Injury | Fire in vehicle	Certain
2	Burn, 2nd or 3rd degree; partial or full thickness including incineration; >=90% TBSA	912032.6	Isolated IPC: Noncontact Injury | Fire in vehicle	Certain

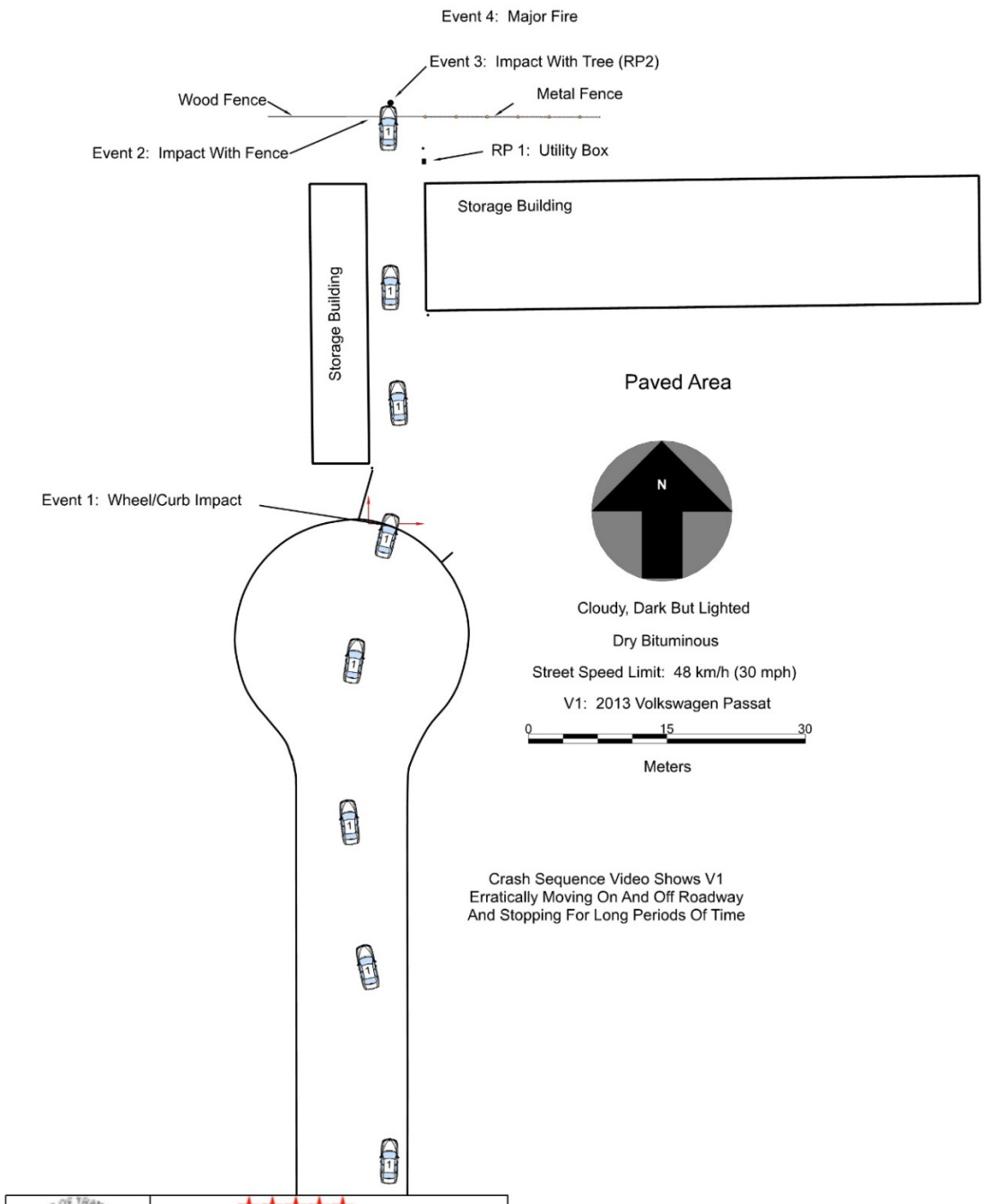
Source: Driver autopsy record

Driver Kinematics

Prior to the crash, the Volkswagen driver spent nearly 4 early morning hours in the vehicle either parked or creeping slowly on the street south of the storage facility. His blood alcohol concentration was .177 g/dL, more than twice the legal limit of .08 g/dL, and he tested positive for marijuana. His seated posture was unknown, as was his seat track position and seat belt usage.

The front plane impact with the fence and tree displaced him forward in response to the 12 o'clock direction of force. He likely loaded the steering assembly and air bag, assuming it deployed. He then likely rebounded back into his seat. Given the severity of the impact, he may have been rendered unconscious. He was unable to exit the vehicle. The autopsy reported no acute injuries but did indicate his airway was lined with gray/black soot. The autopsy stated the cause of death was carbon monoxide intoxication from the fire.

Crash Diagram



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