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**Special Crash Investigations:  
On-Site Non-Crash Vehicle  
Fire Investigation;  
Vehicle: 2017 Chevrolet Volt;  
Location: California;  
Incident Date: November 2018**

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**Special Crash Investigations  
On-Site Non-Crash Vehicle Fire Investigation  
Office of Defects Investigation  
Case Number: DS18031  
Vehicle: 2017 Chevrolet Volt  
Location: California  
Incident Date: November 2018**

## **Background**

This report documents the investigation of a non-crash-related vehicle fire involving a 2017 Chevrolet Volt (Figure 1) that caught fire while traveling in extended range (combination battery and gas-engine power) mode. The investigation was intended to determine the cause of the fire, its area of origin, and to identify affected components. The investigation was initiated by the Office of Defects Investigation (ODI) group of the National Highway Traffic Safety Administration in response to a notification. The Special Crash Investigations (SCI) group assigned the case to Dynamic Science, Inc., in December 2018. The SCI team obtained the fire incident report and permission to inspect the vehicle. The inspection was completed in February 2019 with representatives from General Motors (GM) present. Based on the vehicle inspection by SCI and GM, and information provided by GM, the root cause of the fire was unknown.



*Figure 1. 2017 Chevrolet Volt*

The fire occurred during the afternoon in November 2018 in California. The incident site was the southbound lanes of a State highway. Conditions were daylight, clear, and dry. The Chevrolet was driven by a 20-year-old belted female at a driver-estimated speed of 104 km/h (65 mph) with the vehicle operating in extended range mode with cruise control activated. The driver smelled smoke in the occupant compartment. In response, she turned on the air conditioner and closed the windows, at which time smoke visibly entered the occupant compartment through the ventilation system. She brought the vehicle to a controlled stop on the roadside and placed a phone call to her father. She then noticed flames emanating from the engine compartment. She exited the vehicle and called 911. The fire department responded 9 minutes after notification, at which time the vehicle was fully engulfed in flames. The fire was extinguished and the scene cleared in 50 minutes. The vehicle was towed due to damage and declared to be a total loss. The driver was not injured.

## Summary

### Incident Site

The incident site was a three-lane, southbound, divided State highway (Figure 2). The surface was asphalt, the lanes were separated by dashed white painted stripes, and the roadway was bordered by a solid yellow painted fog line on the left edge and a solid white painted fog line on the right. The roadway was configured with paved shoulders on the left and right edge, and a median divider on the left edge. The lanes measured 3.7 m (12.0 ft) in width. The section of roadway where the incident occurred was straight and level. Conditions at the time of the incident were daylight, clear, and dry. A weather history recorded at the nearest reporting station reported winds at 8-10 km/h (5-6 mph). The fire report estimated winds at the incident site were 16-24 km/h (10-15 mph) and gusting. The posted speed limit was 104 km/h (65 mph). An incident diagram is included at the end of this report.



*Figure 2. Incident site, looking south*

### Pre-Incident

The Chevrolet was traveling southbound in the left lane with cruise control activated at a driver-estimated speed of 104 km/h (65 mph). The vehicle was operating in extended range mode combining battery and gasoline engine power. The driver indicated she was approximately 5 minutes into her trip when she first noticed the odor of smoke in the occupant compartment. In response, she turned on the air conditioner and closed the windows, after which smoke visibly entered the occupant compartment through the ventilation system, primarily on the passenger side. The driver indicated cruise control seemed to have disengaged and the vehicle acceleration power became weak. She brought the vehicle to a controlled stop on the right roadside shoulder, placed a phone call to her father, and exited the vehicle unassisted through the left front door. The driver stated she believed she shut the engine off manually.

### Vehicle Fire Incident

After stopping the vehicle, the driver observed flames emanating from the right aspect of the engine compartment. She called 911, which dispatched the fire department. The fire department sent two units and six personnel, arriving 9 minutes after notification. Upon their arrival the fire had spread to the interior and the vehicle was fully engulfed in flames. The driver estimated approximately 5 minutes passed from when she first smelled smoke until she first observed flames, and another 5 minutes passed until the fire spread from the engine compartment to the front row of the occupant compartment. Firefighters deployed a hose line and extinguished the fire using approximately 1,325 liters (350 gallons) of a water and foam mixture. The scene was

cleared approximately 50 minutes after their arrival. The fire incident report indicated the fire most likely began in the right aspect of the engine compartment near the right wheel well. Their conclusion was based on the following evidence:

- firefighter statements indicating the most active and intense area of fire during extinguishment was at the right engine compartment;
- driver statements indicating flames emanated from under the hood in the area of the right engine compartment;
- concentration of damage caused by fire and heat including loss of mass; and
- burn patterns to sheet metal.

The fire incident report indicated no leaking fuel or oil was found in the area of extinguishment. It stated a possible contributing factor in the severity and spread of the fire was a prevailing wind out of the northwest at 16-24 km/h (10-15 mph) and unspecified gust conditions.

### **Post-Incident**

The driver of the Chevrolet was not injured. The vehicle was towed due to damage and declared to be a total loss.

## 2017 Chevrolet Volt

### Description

The 2017 Chevrolet Volt was a 5-door hatchback identified by the Vehicle Identification Number 1G1RD6S55HUxxxxxx. The VIN placard was destroyed by fire and the date of manufacture was unknown. The estimated odometer reading at the time of the incident was 23,013 km (14,300 mi). The Chevrolet was equipped with a 4-cylinder, 1.5-liter, gasoline-powered engine, high-voltage traction power inverter, electrified transaxle, a high-voltage lithium-ion battery pack, charge port receptacle, and charging and accessory power modules. The vehicle was equipped with the following crash avoidance systems: forward collision warning, forward automatic braking, lane keeping assist, blind spot assist, rear cross traffic alert, and adaptive cruise control with full speed automatic braking and rear-vision camera. The vehicle manufacturer recommended size 215/50R17 tires with a recommended pressure of 36 psi (248 kPa) for the front and rear. It was equipped with Michelin Energy Saver tires of the recommended size manufactured in 2017. The left front tire was burned and missing, the right front tire was burned and de-beaded and the rear tires were undamaged. The vehicle 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 was adjusted to the middle position.

A vehicle history report indicated the driver leased the vehicle new and operated it for approximately 15 months prior to the incident. The report indicated three service history records, including scheduled maintenance, was performed at GM dealerships. No prior crashes or exterior damage was reported. The driver stated that prior issues with the cruise control and audio systems were corrected.

### Exterior Damage

The Chevrolet sustained fire damage distributed to all planes (Figure 3), the engine compartment, and passenger compartment. Sheet metal was largely intact while paint, glazing, plastic, rubber and other composite components were destroyed, including the grille, front bumper, headlamps, front tires, and left front wheel. The vehicle sustained unspecified post-incident damage during fire extinguishment including removal of the hood.



*Figure 3. 2017 Chevrolet Volt*

## Vehicle Fire Discussion

An on-site joint vehicle inspection of the Chevrolet was conducted with a GM investigator present for the purpose of identifying the cause of the fire, its area of origin, and examination of the affected components. Based on the vehicle inspection and information provided by GM, the root cause of the fire was unknown. Exterior burn damage was present on the front, back, left, right, top and bottom planes, engine compartment, and interior front and second rows. Statements made by the driver and data included in the fire incident report suggested the fire likely began in the right aspect of the engine compartment (Figure 4). The engine compartment was examined and the following components were identified: 1.5 liter gas-fuel combustion engine, gas fuel lines, high-voltage traction power inverter, high-voltage cables, low-voltage fuse block, catalytic convertor, master cylinder, and ABS module. The GM investigator noted the presence of visibly exposed copper wiring harnesses in the engine compartment and interior instrument panel where the harness insulation had burned and melted away from the copper strands. He noted that copper wiring has a relatively high melting temperature and much of the wiring exhibited “beading” on the melted ends indicating a high temperature burn. In the occupant compartment, the beading was present on the interior fuse block located in the left instrument panel, on coaxial cables, and on various other exposed wiring in the instrument panel. The GM investigator indicated that, in this particular instance, evidence of high temperature and “beading” do not necessarily indicate high voltage involvement since the copper wiring was connected to low-voltage components.



*Figure 4. Engine compartment, 2017 Chevrolet Volt*

The fuel line connections in the engine compartment were present and intact. In response to the apparent integrity of the fuel lines, The GM investigator did not entirely rule out the possibility that a gas leak caused the fire. The possibility existed because the driver was operating the vehicle in gas fuel mode at the time of the incident.

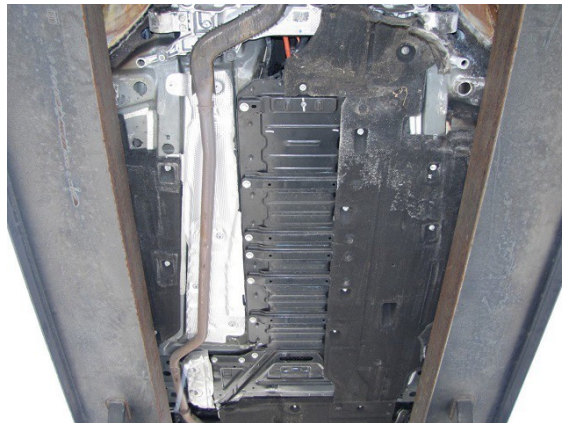
Underhood components damaged by heat generated by the fire included the engine cover, engine reservoirs, low-voltage battery, electronics cooling systems, fuse block, wiring harnesses, rubber hoses, and most other non- metallic (plastic, rubber, etc.) components. Melted aluminum was present in some areas where copper wiring harnesses were still in place. The GM investigator noted that no magnesium was present in the engine compartment.

The vehicle was placed on an elevated rack and the undercarriage was examined. Burn damage beginning at the leading edge of the engine compartment extended to just slightly aft of the fire

wall (Figures 5 and 6). Burn damage was less severe on the lower half of the engine compartment than it was on the upper half, and in response the GM investigator suggested the fire did not likely originate in the lower engine compartment or undercarriage. The damage flow suggested the fire spread from the upper engine compartment toward the left and lower aspects and from the forward aspect of the engine compartment rearward to the exterior and interior.



*Figure 5. Undercarriage below engine compartment, 2017 Chevrolet Volt*



*Figure 6. Undercarriage and exposed Li-ion battery location, 2017 Chevrolet Volt*

The high-voltage cables and lithium-ion battery appeared unremarkable. The gas fuel system was examined including the filler cap, fuel filler hose leading from the filler cap to tank, and the non-metallic gas tank. None of the components appeared damaged or affected by the fire. The occupant compartment was consumed from roof to floor, including the instrument panel, seats, carpet, roof header, and trim.

Based on evidence gathered during the vehicle inspection, the GM investigator concluded the following.

- The high-voltage system was ruled out as a cause, based on the absence of damage and no visible evidence of electrical activity or arcs on the high-voltage system.
- The specific origin of the fire was undetermined with neither the engine compartment or occupant compartment revealing conclusive evidence. Damage flow suggested the fire began in the upper right aspect of the engine compartment.

## **Electric Vehicle Propulsion System**

The Chevrolet was equipped with a 4-cylinder, 1.5-liter, gasoline-powered engine, high-voltage traction power inverter, electrified transaxle, a high-voltage lithium-ion battery pack, charge port receptacle, and charging and accessory power modules. The system was largely intact. Engine compartment components were present including the gasoline engine, power inverter, and transaxle. The lithium-ion battery and cables in the undercarriage were not damaged. The charge port receptacle was burned but recognizable and the charging and accessory modules in the cargo area could not be accessed.

## **Federal Motor Vehicle Safety Standard No. 305 Compliance**

Federal Motor Vehicle Safety Standard (FMVSS) No. 305: Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection, is the standard applied to vehicles that use working voltages of more than 60 VDC or 30 VAC electricity as propulsion and whose speed on a level paved surface is more than 40 km/h (25 mph). FMVSS No. 305 specified performance requirements of electrolyte spillage, retention of propulsion batteries, and electrical isolation of the chassis from the high-voltage system during a crash event. The manufacturer of the Chevrolet has certified that this vehicle is compliant with FMVSS No. 305. The battery inspection ports were exposed at the time of the inspection. Fire damage, fire extinguishment activities, and post-incident exposure precluded analysis of the cooling system. The battery pack revealed no evidence of damage or movement. The high-voltage cables leading to the battery were unremarkable.

## **Event Data Recorder**

The Chevrolet was equipped with an air bag control module with event data recorder (EDR) capability. The vehicle sustained a non-crash-related event and the EDR was not imaged due to damage caused by the fire.

## **Interior Damage**

The vehicle's interior was completely consumed by fire (Figure 7). Only metal components, framework, and wiring remained recognizable. Synthetic and fabric components were destroyed. All glazing was disintegrated or displaced. The doors remained closed and operational.



*Figure 7. Interior front row damage, 2017 Chevrolet Volt*

### **Manual Restraint Systems**

The vehicle was equipped with a three-point continuous lap and shoulder seat belt for the driver. All manual restraints were destroyed by fire and were not inspected. The driver indicated during the interview that she was using the lap and shoulder belt.

### **Supplemental Restraint Systems**

The vehicle was equipped with frontal, seat-mounted, side impact, and inflatable curtain (IC) air bags for the driver and front row right occupant. No air bags deployed during the incident, nor were they expected to, given the non-crash-related event. The metal canisters for the frontal air bags were present but out of place.

### **NHTSA Recalls and Investigations**

There were no open recalls for the vehicle last queried in November 2020.

## 2017 Chevrolet Volt Occupant

### Driver Demographics

Age/sex:	20 years/female
Height:	160 cm (63 in)
Weight:	59 kg (130 lb)
Eyewear:	None
Seat type:	Bucket with adjustable head restraint
Seat track position:	Middle track
Manual restraint usage:	Lap and shoulder belt used
Usage source:	Interview
Air bags:	Frontal, seat-mounted, side impact and IC air bags not deployed
Alcohol/drug data:	None
Egress from vehicle:	Exited unassisted through left side door
Transport from scene:	None
Type of medical treatment:	None

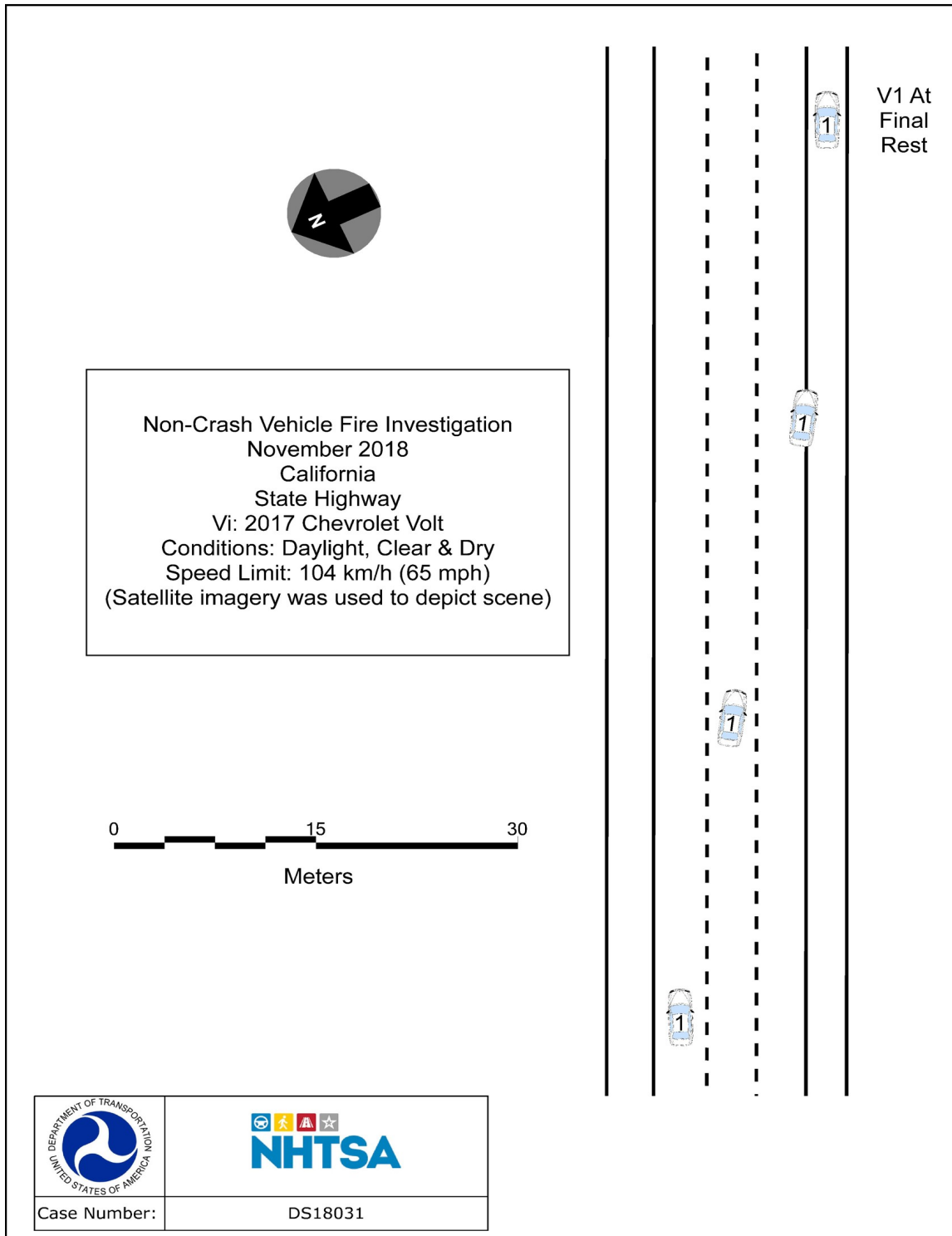
### Driver Injuries

The driver was not injured.

### Driver Kinematics

The female driver was seated in an upright posture and operating the vehicle in cruise control mode at a driver-estimated speed of 104 km/h (65 mph). After smelling smoke she turned on the air conditioning system and closed the windows, at which time visible smoke entered the occupant compartment through the ventilation system. She braked, brought the vehicle to a controlled stop on the roadside, and exited unassisted through a side door. The driver was not injured.

# Incident Diagram



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