U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA

DOT HS 813 507

August 2023

Special Crash Investigations: On-Site Electric Vehicle Fire Investigation; Vehicle: 2019 Chevrolet Bolt EV; Location: Florida; Incident Date: October 2020

DISCLAIMER

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Crash Research & Analysis, Inc. (2023, August). *Special Crash Investigations: On-site electric vehicle fire investigation; Vehicle: 2019 Chevrolet Bolt EV; Location: Florida; Incident Date: October 2020* (Report No. DOT HS 813 507). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 813 507		

4. Title and Subtitle	5. Report Date
Special Crash Investigations: On-Site Electric Vehicle Fire Investigation; Vehicle: 2019 Chevrolet Bolt EV; Location: Florida Incident Date: October 2020	August 2023
	6. Performing Organization Code

7. Author	8. Performing Organization Report No.
Crash Research & Analysis, Inc.	CR20035

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Crash Research & Analysis, Inc. PO Box 302 Elma, NY 14059	11. Contract or Grant No. 693JJ919C000004

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590	Technical Report
	14. Sponsoring Agency Code

15. Supplementary Notes

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 submitted.

16. Abstract

This report documents the on-site inspection of a fire in a parked 2019 Chevrolet Bolt EV. The fire reportedly began during the morning in the driveway of the owner's residence. The owner was loading personal items into the Chevrolet when she noticed the vehicle was smoking and called the fire department. The owner, her spouse, and their children began removing items from the vehicle when it burst into flames, resulting in a major fire. The fire appeared to have originated under the second-row seat in the high-voltage lithium-ion battery pack. The root cause is unknown. There were no injuries.

17. Key Words	18. Distribution Statement
fire, electric vehicle, lithium-ion battery, Li-ion	Document is available to the public from the DOT, National Highway Traffic Safety Administration, National Center for Statistical Analysis, https://crashstats.nhtsa.dot.gov

19 Security Classif. (of this report)	20. Security Classif. (of this page)	21 No. of Pages	22. Price
Unclassified	Unclassified	13	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Table of Contents

Special Crash Investigations
On-Site Electric Vehicle Fire Investigation
Office of Defects Investigation
Case Number: CR20035
Vehicle: 2019 Chevrolet Bolt EV
Location: Florida
Incident Date: October 2020

Background

This report documents the on-site inspection of a fire in a parked 2019 Chevrolet Bolt EV (Figure 1) during the morning in the driveway of the owner's residence. The owner was loading personal items into the Chevrolet when she noticed the vehicle was smoking and called the fire department. The owner, her spouse, and their children began removing items from the vehicle when it burst into flames, resulting in a major fire. There were no injuries.

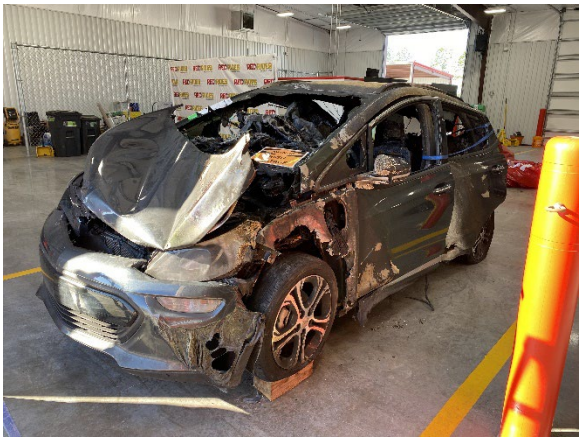

Figure 1. Involved 2019 Chevrolet Bolt

The vehicle manufacturer notified the National Highway Traffic Safety Administration of the potential risk for fires developing with the electric vehicle's battery system in August 2020. NHTSA opened a preliminary evaluation (PE20016) on October 9, 2020. Research since that time led to a recall (NHTSA campaign number 20V701000) of select 2017–2019 Chevrolet Bolt EVs on November 13, 2020. In the identified cases, the fire damage appeared to be concentrated in the battery compartment of the EV with penetration into the passenger compartment from under the second-row seat. The root cause of the fire is unknown.

NHTSA's Special Crash Investigations (SCI) group assisted with further research in conjunction with representatives from General Motors (GM) in December 2020. The owners of the Chevrolet were in attendance for the inspection as well. This inspection documented the potential origin of the fire and the damage to the vehicle. A complete interview has not been obtained due to legal proceedings.

Summary

Incident Site

The incident occurred in the driveway of the owner's residence in a residential area. The driveway was capable of parking two vehicles next to one another. The driveway sustained burn and ash damage from the incident. The Chevrolet was parked on the right side of the driveway. The Chevrolet had its charger cable extended from the garage plugged into a 220-volt outlet that ran to the fuse panel next to the outlet. The owner said the 220-volt outlet was installed by a local electrician when they bought the Chevrolet. Figure 2 shows the charger cable, charger dock, and 220-volt outlet. A case diagram is not included as the vehicle was stationary in its driveway and the sole event was a non-collision fire.

Figure 2. Charger setup for the 2019 Chevrolet Bolt. Image obtained from Chevrolet owner.

Figure 3. 2019 Chevrolet Bolt charge port. Image captured from video provided by owner.

Pre-Incident

On the morning of the incident, around 0700 hours, the owner of the Chevrolet plugged the charger cable into the charge port located on the left front fender (Figure 3). At that time, she began moving items from her other vehicle to the Chevrolet with plans to go to the beach with her children. After moving items from her other vehicle to the Chevrolet she proceeded inside

her residence to wake up the children and feed them breakfast. At approximately 0900 hours, she gathered items that they would need at the beach from the house and started taking those items to the Chevrolet. She made several trips between the Chevrolet and the residence.

Incident

At approximately 0930 hours, the owner noticed smoke coming from the bottom of the Chevrolet and yelled to her husband who was in the house. He looked out the window of his home office and noticed the smoke coming from the bottom of the Chevrolet as well. He ran outside of the residence, unplugged the charger from the Chevrolet, told his wife to call the fire department, and began unloading the Chevrolet with his kids. The female owner called the fire department and reported the incident.

As they were unloading the Chevrolet the owners heard pops and hisses coming from under the vehicle. After approximately 10 minutes of smoke coming from the Chevrolet, the owners opened the rear doors of the Chevrolet and a burst of fire resulted (Figure 4). At that time, the owners and their children moved further away from the vehicle and waited for emergency services to arrive.

Figure 4. 2019 Chevrolet Bolt fire. Image captured from video provided by owner.

Emergency fire and rescue arrived on scene within 10 minutes of receiving the call from the vehicle's owner. At that time, emergency personnel began to extinguish the fire.

Post-Incident

After emergency personnel extinguished the fire, it was concluded that the vehicle was a total loss. Fire and emergency personnel secured the scene until a tow service could arrive. Once the tow truck arrived the vehicle was removed to a local tow yard and later transferred to an insurance vehicle salvage facility. Damage to the incident site included fire and ash damage to the driveway, fire damage to the lawn, and heat damage to the shrubbery.

2019 Chevrolet Bolt

Description

The 2019 Chevrolet Bolt (Figure 5) was manufactured in October 2018 and identified by the Vehicle Identification Number (VIN) 1G1FZ6S06K4xxxxxx. The Chevrolet was a front-wheel drive platform, powered by a permanent magnetic drive motor. It had power-assisted, 4-wheel disc with antilock brakes. The curb weight was 1,625 kg (3,528 lb). At the time of the inspection the Chevrolet had Michelin Energy Saver tires for the left and right front tires. The left and right rear tires were damaged by the fire and not legible. All tires had at least 6 mm (7/32) of tread. Additionally, all tires were burned from the fire with the left front, left rear, and right rear tires deflated.

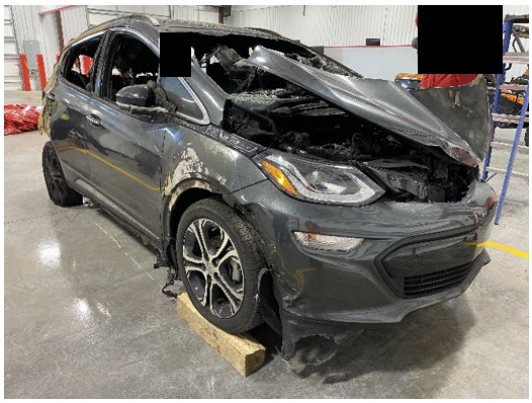

Figure 5. 2019 Chevrolet Bolt

The Chevrolet had seating for five occupants (2/3), with front-row bucket seats and a second-row bench seat (Figure 6) with split forward-folding seatbacks. The right front, left front, left rear, and right rear seating positions all had adjustable head restraints. Manual restraint systems consisted of 3-point lap and shoulder seat belts for all seat positions. Supplemental restraint systems included front seat belt retractors and 10 air bags consisting of the driver's and passenger's frontal, driver and passenger knee, front and rear outboard seat-mounted side impact, and inflatable curtain air bags.

Figure 6. 2019 Chevrolet Bolt second row

Chevrolet Bolt 60 kWh Li-Ion Battery

The Bolt EV had a 60-kWh nickel-rich, lithium-ion high-voltage battery containing 288 individual nickel-lithium-ion cells. Three cells are welded together in parallel and are called a cell group. There are 96 cell groups in the hybrid/EV battery assembly connected in series. Each individual cell group is rated at 3.5 volts, for a nominal system voltage of 344 volts of direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules. There are 8 electrical modules comprised of 10 cell groups and 2 electrical modules comprised of 8 cell groups. Two battery cell modules are physically mounted together to form a section/row. Sections/Rows 1 and 3 are interchangeable while Sections/Rows 2, 4 and 5 are unique to their respective locations. Except for Section/Row 5, the two battery cell modules are not electrically connected in their section/row. The hybrid/EV battery pack contains six battery temperature sensors mounted to certain battery cell modules. The hybrid/EV battery pack also contains a coolant inlet temperature sensor.

Located in the high-voltage hybrid/EV battery pack is the K16 battery energy control module that monitors the temperature, current, and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the end of the battery cell module. A voltage sense harness joins this connector to the battery energy control module that determines when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the K114B hybrid/EV powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for the battery energy control module diagnostic trouble code information.

Battery charging was achieved through a cable connected to a 220-volt outlet. A mobile application connected to the Chevrolet aided the vehicle owner in monitoring the battery’s state of charge.

NHTSA Recalls and Investigations

A December 2020 query of the NHTSA recall database (www.nhtsa.gov/recall) using the VIN for this specific Chevrolet Bolt indicated there was one unrepaired recall issued on July 23, 2021, identified by the manufacture recall number N212343881 and the NHTSA recall number 21V560. Model year 2017–2019 Chevrolet Bolts were affected. The recall indicated that the high-voltage battery in these vehicles may pose risk of fire when the charge of the battery is full or close to full. Additionally, the recall indicated that vehicle dealers will replace the battery packs in the vehicles.

An additional query was made in June 2023. The vehicle manufacturer had issued an additional recall on December 15, 2022, due to the potential of a fire occurring in or near the B-pillar following a crash that causes the pretensioner to deploy. The manufacture recall number was N222383791 and the NHTSA recall number was 22V930.

Fire Damage and Observations

The exterior and interior of the Chevrolet sustained overall damage from the fire. The fire completely melted the rear bumper fascia from the vehicle. The entire interior was consumed by the fire. The second-row bottom seat cushion was still partially intact.

The damage to the rear seat indicated that the fire started under the second-row left seating position. As seen in Figure 7, the underside of the second-row seat cushion shows more fire damage to the left side indicating that the fire originated in the left cells of the battery pack just below the second-row seat cushion.

The second-row bottom seat cushion was removed during the inspection to gain access to the service disconnect indicated in Figure 8 by the red arrow. A voltage test was performed on several parts of the vehicle. The voltage rating on the front of the vehicle ranged from 0–700 millivolts whereas the voltage rating on the rear of the vehicle ranged from 0 to 400 millivolts. The rear voltage testing was done at the service disconnect and to the battery cells that were accessible from the underside of the vehicle.

Figure 7. Underside view of the second-row seat cushion. The left side is indicated by the yellow arrow. The front of the seat cushion is indicated by the blue arrow.

Figure 8. Service disconnect in the second row of the 2019 Chevrolet Bolt after the bottom seat cushion was removed

The Chevrolet was placed on a raised stand to obtain undercarriage evidence during the inspection. This allowed the GM representatives to access a few of the 60 kWh battery cells through the rear of the battery pack where it had been holed. The GM representatives took voltage readings and inspected the cells with the limited access that they had due to the raised stand.

During the fire, due to heat and chemical reaction, pressure built-up within the cells of the battery. This resulted in an expulsion of gases and material content from the rear of the 60 kWh Li-ion battery (Figure 9). Additionally, there were smaller pops and hisses that were reported by the owner. The GM representatives stated that these additional sounds during the fire was the sound of the cells releasing gases due to the extreme heat in a domino-like effect.

Figure 9. Rear view looking forward of the 60 kWh Li-ion battery pack in the involved 2019 Chevrolet Bolt

The GM representatives suspect that the fire began in the left cells of the fifth section/row Li-ion battery based on the damage to the second-row bottom seat cushion. However, the GM representatives stated that an exact determination could not be made at the time of the inspection. No additional evidence could be obtained at the time of the inspection due to the inability to remove the 60 kWh Li-ion battery. The vehicle manufacturer expressed safety concerns about its removal due to risks with handling a damaged battery and its unknown state of charge. The Chevrolet was being stored at a local insurance vehicle salvage facility. At the conclusion of the SCI investigation, there was no further information if the battery was removed from the vehicle for further analyses.

DOT HS 813 507
August 2023

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

16032-082123-v2