

TITLE OPERATIONS MANUAL	STANDARD INSTRUCTION 02		DEPARTMENT FIRE-RESCUE
SUBJECT ELECTRIC VEHICLE EXTRICATION	SECTION 14	PAGE 1 of 7	EFFECTIVE DATE June 23, 2025

I. PURPOSE

The purpose of this policy is to establish operational guidelines for the safe and effective extrication of occupants from electric vehicles (EVs) involved in collisions or emergencies.

II. SCOPE

This policy shall apply to all sworn San Diego Fire-Rescue Department (SDFD) personnel, excluding Lifeguard personnel.

III AUTHORITY

The Fire Chief authorizes this policy.

IV. POLICY

A. Hazards and Considerations

1. [High Voltage Systems](#)

- i. High-voltage electric shock risk to personnel, patients, and bystanders
- ii. [Stranded energy](#)
- iii. Potential for [thermal runaway](#) in lithium-ion batteries

2. Battery Fire or Explosion

- i. Potential for fires due to thermal runaway in batteries, especially after a collision
- ii. Risk of hazardous chemical exposure, including toxic fumes
- iii. Hybrid Vehicles ([HEV](#)) contain fuel in addition to batteries. This may include compressed explosive and flammable gases such as Hydrogen (CH₂) or Natural Gas (CNG)

3. Mechanical Hazards

- i. Potential for vehicle to move unexpectedly
- ii. Compressed gas systems in hybrid or plug-in vehicles (e.g., hydrogen, natural gas, airbag systems, carbon dioxide or nitrogen canisters) can become projectiles or subject to catastrophic failures
- iii. Supplemental Restraint System (SRS) airbags and curtain airbags may deploy unexpectedly

B. Personal Protective Equipment (PPE)

- 1. Wear self-contained breathing apparatus (SCBA) in the presence of fire or smoke/gas
- 2. Wear structural firefighting gear

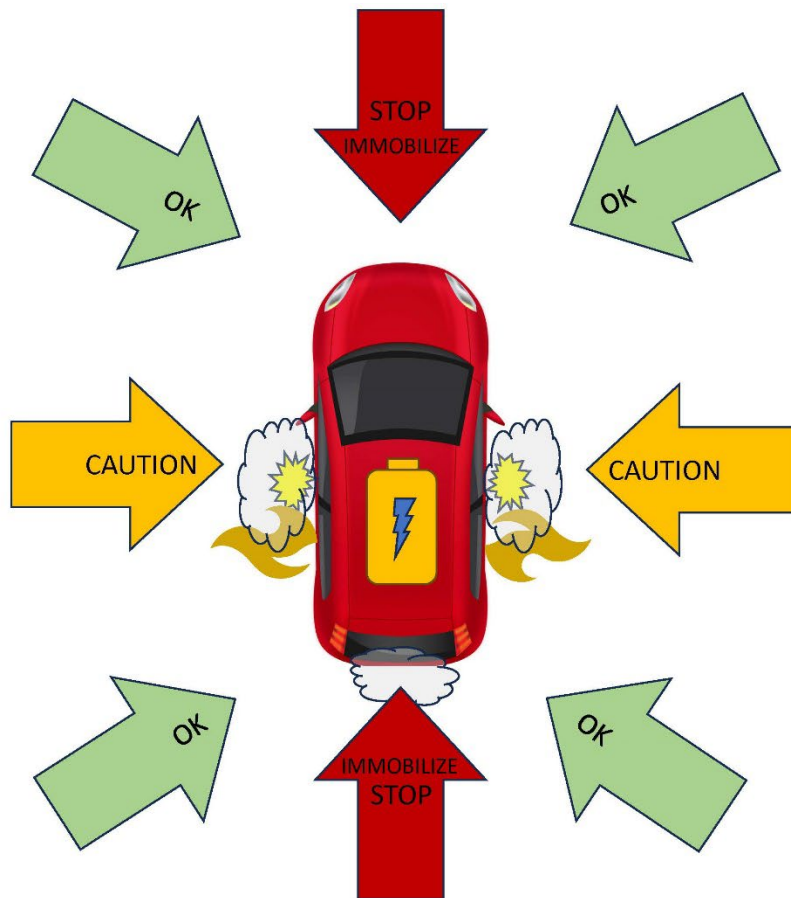
C. Procedure

1. Scene Assessment and Size-Up

- i. Stage apparatus 100 feet away upwind and uphill if possible.
- ii. Wear full structure fire PPE and a donned SCBA when operating around the incident.

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- a) Throughout the incident, make every attempt to remain upwind of the incident, even during the recovery phase.
- iii. Approach the scene cautiously and from a 45-degree angle to the vehicle, maintaining a 360-degree awareness of hazards (e.g., downed power lines, traffic, battery smoke/gas, etc.).



- iv. Identify the vehicle as an HEV/Plug-in Hybrid Electric Vehicle ([PHEV](#))/Fully Electric Vehicle ([BEV](#)) through:
 - a) Badging/Logos (e.g., Tesla, Nissan Leaf, Rivian, Lucid, F150 Lightning, etc.)
 - 1) "Zero Emission"
 - 2) "Electric"
 - 3) "Plug-In Hybrid EV"
 - 4) "Fuel Cell"
 - b) Lack of exhaust system or air intake grill
 - 1) Some aspects will still be present in HEVs and PHEVs
 - 2) Some may still be present in converted or retrofitted vehicles
 - c) Presence of a charging port

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- d) Orange high-voltage cables visible under the hood or chassis
- e) Ask the driver
- f) Other identifiers may consist of, but are not limited to:
 - 1) Specialized license plates
 - 2) Colored bumpers (e.g., transit buses, school buses, etc.)
 - 3) Color coding and labels
- v. Establish a safety perimeter (minimum 50 feet) and restrict access to non-essential personnel. If smoke/gas or fire is present, increase the perimeter to a 100-foot hot zone.
- vi. Evacuate non-emergency personnel to 330 feet in all directions.
- vii. Contact Technical Rescue Team (TRT) early to assist in vehicle identification and assistance in researching the vehicle's Emergency Response Guidelines ([ERG](#)) recommended procedures.

D. Hazard Identification

1. Electrical Hazards
 - i. Locate high-voltage components (battery, cables, motor) using the vehicle's ERG or visible orange cabling
2. Fire Hazards
 - i. Assess for smoke, heat, or flames from the battery pack. Lithium-ion battery fires produce explosive, flammable, and toxic gases (e.g., hydrogen, carbon monoxide, hydrogen fluoride, etc.)
3. Structural Hazards
 - i. Note reinforced materials (e.g., boron steel) that may resist standard cutting tools
4. Communicate findings to the IC and relay all findings to TRT/Rescue Group
5. Request additional resources (e.g., HazMat) if battery off-gassing, on fire, or if loose/dislodged batteries are present

E. Vehicle Stabilization

1. Vehicles have potential to move with little or no warning.
2. Chock wheels and crib the vehicle to prevent movement. Avoid placing stabilization equipment near high-voltage components
3. If the vehicle is on its side or roof, use additional cribbing or struts to secure it. Utilize EV Rescue Application or other resource to access ERG for areas safe to stabilize
4. Do not rely solely on parking brakes, as they may fail in an EV crash
5. Reference the ERG for lifting and stabilization point designated areas on the vehicle's undercarriage where first responders can safely lift and stabilize the vehicle during emergency situations, always avoiding high-voltage components. **Consider consulting with TRT for additional incident-specific stabilization recommendations**

F. Preparing for Extrication Operations

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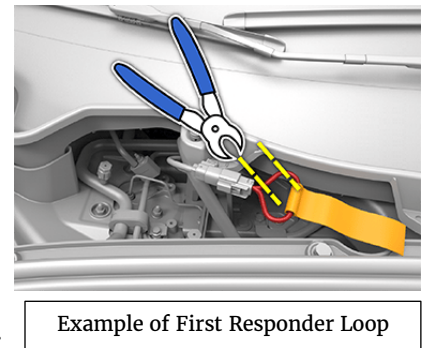
1. **Consider consulting with TRT on incident-specific preparation steps for extrication as additional steps may be required.**
2. Ventilation
 - i. Open, lower, or break windows to allow for natural ventilation to reduce the potential buildup of explosive and toxic gases in the cabin. As a last resort or when all else fails, cut windows.
 - ii. Place a positive pressure ventilation (PPV) fan behind where the extrication team will be working
 - iii. Hydraulic ventilation can be used in the absence of a PPV fan if signs of battery off-gassing are present
3. Rapid Intervention Crew (RIC)
 - i. Establish a staffed, charged hoseline with a firefighter in full PPE and SCBA at the ready position
 - a) Consider a secondary line and additional personnel in full PPE to supplement when possible
 - 1) If a fire occurs during extrication, multiple lines and additional personnel in full PPE including SCBA will be needed to complete the operation.
 - (i) Consider ordering additional resources
 - (ii) Expect toxic and explosive gases to be emitted
 - (iii) Expect propagation to occur within the battery pack
 - a. This could take several minutes or even longer between battery modules inside the pack
 - b. The gap between flare-ups might look like the fire is under control, but it could be just a brief lull
 - b) The RIC firefighter(s) should exercise the following safety responsibilities:
 - 1) Act as a lookout for imminent battery failure or fire
 - 2) Establish a communication plan and agreed upon signals to the rescue crews to identify hazards and to signal an evacuation
 - 3) Provide hydraulic ventilation and/or emergency cooling/extinguishment if fire occurs to protect victims and rescue crews
 - 4) Prepare to take over rescue operations if signs of battery failure are imminent and a full PPE including SCBA rescue is required
4. Power Disconnection
 - i. Attempt to shut down the vehicle:
 - a) **Vehicles powered by electric motors move silently. Never assume they are powered off. Vehicles can move quickly and unexpectedly.**
 - b) Locate the key fob (if available) or manual power switch per the ERG.
 - c) Many modern transmissions require power to change gears. Before disconnecting the low voltage system utilize vehicle power to place the vehicle into PARK or NEUTRAL if moving the vehicle is required.

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- d) Before disconnecting the low voltage system, utilize vehicle power to move powered components to assist in extrication (e.g. seats, steering wheel, pedals, unlock doors, etc.).
- e) High-voltage EV battery packs are equipped with isolation relays and fuses designed to automatically disable the high-voltage lines upon detecting an isolation fault or other critical failures, such as an imminent crash or airbag deployment
 - 1) **DURING AN EMERGENCY ALWAYS ASSUME THE HIGH VOLTAGE LINES ARE ENERGIZED AT ALL TIMES.**
- f) Low-Voltage System (e.g., 12V or 48V) – Some battery management systems (BMS) are powered by the low voltage system. **Disconnecting it should be done only after referencing the vehicle ERG and/or consulting with TRT.**

1) Double cut the First Responder Loop.

- (i) The First Responder Loop disables 12V or 48V power going to the airbag circuit.
- (ii) Cutting of the First Responder Loop also removes 12V or 48V power going to the high voltage contactors inside the high voltage battery pack. This acts like a light switch, turning off all high voltage power and isolating it to the battery pack.
- (iii) Cutting the First Responder Loop may not disable the low voltage system. The negative cable of the low voltage battery may need to be cut as well (check manufacturer ERG for details).
- (iv) These cut-loops will typically be marked and often found under the hood or in the trunk/frunk to disable airbags and discharge high voltage and isolate the battery (if not already isolated due to impact). Check ERG for location.



- (v) Secondary First Responder Loops may be available; check ERG for location.
- (vi) It may take several minutes for the air bag systems to fully deenergize.
- (vii) It may take several minutes for high voltage lines to discharge.

- g) In some models, a service disconnect is identified as a disabling option. Check ERG for location and procedure if applicable.
- h) **DO NOT** cut any high-voltage orange cables.

G. Extrication Operations

- 1. Plan cuts and spreads based on the ERG to avoid high-voltage components and reinforced areas.

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2. Use hydraulic tools (e.g., spreaders, cutters) suited for high-strength materials.
3. Remove glass (laminated side windows may require sawing) and roof if needed, avoiding airbag inflators.
4. Extract patients using spinal precautions unless immediate life threats (e.g., fire) dictate rapid removal.
5. Reference the ERG prior to identifying lifting and stabilization points.

H. Vehicle Submersion

1. The high voltage vehicle battery is isolated from the vehicle chassis. The body of the vehicle does not pose a risk of electrocution.
2. Vehicles that have been submerged could be at a higher risk of battery failure and fire.
3. Consult the vehicle's ERG for specifics when dealing with submersion.

I. Post-Incident Actions

1. While on scene, gross decontaminate personnel and equipment exposed to battery chemicals or smoke.
2. Bag all PPE and SCBA harnesses per SDFD post incident decontamination procedures and follow Standard Operating Procedures.
3. Document the incident, including EV make/model, hazards encountered, and actions taken.
4. Notify towing services of the EV's status (e.g., high-voltage system intact, battery damage).

- J. All personnel should remain current on all SDFD safety alerts and bulletins related to electric vehicles.

V. **DEFINITIONS**

- A. **Battery Management System (BMS)**: An electronic unit that monitors and controls the performance of the battery pack, ensuring safe and efficient operation by managing parameters like voltage, temperature, and state of charge. [\(RETURN\)](#)
- B. **Fully Electric Vehicle (BEV)**: A fully electric vehicle uses only battery power to operate. [\(RETURN\)](#)
- C. **High-Voltage System**: Components operating at voltages exceeding 60 volts DC or 30 volts AC, typically marked with orange cabling. [\(RETURN\)](#)
- D. **Hybrid Vehicle (HEV)**: Hybrid vehicles are vehicles that use both battery power and some other form of flammable or combustible liquid or gas such as: gasoline, hydrogen (CH₂), compressed natural gas (CNG), etc. [\(RETURN\)](#)
- E. **Low-Voltage System**: Typically operating at 12 volts or 48 volts, powers essential vehicle functions like lights, wipers, and safety systems. This may include the battery management system (BMS). [\(RETURN\)](#)

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- F. Plug-in Hybrid Electric Vehicle (PHEV): A plug-in hybrid electric vehicle (PHEV) is a type of hybrid electric vehicle that combines a gasoline engine with an electric motor and a rechargeable battery. Unlike conventional hybrids, PHEVs have larger batteries that can be charged by plugging into an external power source, allowing for a significant portion of the vehicle's driving range to be covered by electricity alone. [\(RETURN\)](#)
- G. Propagation: The spreading of fire between Lithium-ion battery cells initiated by a thermal runaway. [\(RETURN\)](#)
- H. Stranded Energy: The remaining electrical energy in a battery, especially after a crash, fire, or other damage, that prevents the normal function of the system to safely discharge or control that energy. This can pose safety risks like thermal runaway, reignition, and electric shock. [\(RETURN\)](#)
- I. Technical Rescue Team (TRT): Technical Rescue trained team with additional rescue and extrication tools dispatched on all vehicle rescues (e.g., USAR2, USAR41, USAR63, etc.) [\(RETURN\)](#)
- J. Thermal Runaway: Lithium-ion (Li-ion) battery thermal runaway occurs when a cell, or area within the cell, achieves elevated temperatures due to thermal damage, mechanical damage, internal/external short circuiting, or electrochemical abuse. This elevated temperature releases energy which in turn further increases temperature. It is a phenomenon known as a positive feedback loop in which the lithium-ion cell enters an uncontrollable, self-heating state. [\(RETURN\)](#)

Vehicle Emergency Response Guide (ERG) (link here: <https://www.nhtsa.gov/emergency-response-guides/>):

- K. Specific to each HEV/PHEV/BEV make/model, contains essential safety-related information for first and second responders to assist in quickly and safely responding to incidents involving those vehicles, particularly those involving electric vehicles. [\(RETURN\)](#)
 - 1. EV Rescue – Application available to SDFD to aid in accessing ERGs (note: some makes, models, and specialty vehicles may not be in the database.).
 - 2. Additional internet searches or databases may need to be referenced for the specific ERG needed.