



ANN ARBOR FIRE DEPARTMENT

Standard Operating Procedures - 3.16 Vehicle Fire



VEHICLE FIRE

Effective: September 3, 2021
Scheduled Review: September 3, 2024
Approved: Fire Chief Mike Kennedy

I. PURPOSE

This procedure identifies operational tactics for safe handling of motor vehicle fires. This SOP shall be used in conjunction with SOP 3.12 Traffic Incident Management.

II. PERSONAL PROTECTIVE EQUIPMENT

- A. Full structural fire-fighting personal protective equipment (PPE) and self-contained breathing apparatus (SCBA) shall be utilized for fighting vehicle fires.
- B. Reflective traffic safety vests shall not be utilized while actively fighting fire.

III. FIRE ATTACK

- A. Prior to initiating fire suppression operations on a vehicle involved in fire, attempts shall be made to determine if the vehicle is powered by an alternative fuel source, e.g., liquefied petroleum gas (LPG), liquified natural gas (LNG), electric, hybrid technologies.
- B. Any vehicle fire that has extended beyond an incipient stage requires a minimum 1 $\frac{3}{4}$ " hoseline.
- C. A working fire involving the interior of the vehicle passenger compartment will damage the vehicle beyond repair. As such, the attack plan should consider the vehicle as a "write off" and a safe and appropriate approach and fire attack must be implemented.
- D. Where patients are trapped in the vehicle, first water should be applied to protect the patients and permit rescue.
- E. When rescue is not a factor, first water should be applied for several seconds to extinguish fire or cool down the area around any fuel tanks or fuel systems. This is especially important if the fuel tanks are LPG or LNG.
At least one member of the attack team must have forcible entry tools in his/her possession to provide prompt, and safe entry into the vehicle.

IV. HAZARD AND SAFETY CONSIDERATIONS

- A. LPG and LNG may be found as fuel for vehicles. Pressure release devices can create a lengthy "blow torch" effect, or should the pressure relief device fail, a BLEVE may occur. Vehicles may not be marked to identify this fuel hazard. If there is flame impingement on a visible LPG/LNG storage tank, take action to control the fire and cool the tank.
- B. If vapors escaping from the storage tank relief valve have ignited, allow the LPG/LNG to burn while protecting exposures and cooling the tank. Flow of gas through piping can be controlled by shutting off the valve at the storage tank.
- C. Energy Absorbing Bumpers - Consist of gas and fluid filled cylinders that, when heated during a fire, will develop high pressures which may result in the sudden release of the bumper assembly. This could result in serious injury to anyone in its path. Bumper assemblies have been known to travel 25 feet.



ANN ARBOR FIRE DEPARTMENT

Standard Operating Procedures - 3.16 Vehicle Fire



- D. Batteries - Explosion hazard due to presence of hydrogen vapors. Avoid contact with battery acid. When the situation is stable, disconnect battery cables (ground cable first).
- E. Combustible Metals - Some vehicles have various parts made of combustible metals, such as engine blocks, heads, wheels, etc. When these metals are burning, attempts to extinguish them with water will usually add to the intensity of the fire. Large quantities of water, however, will cool the metal below its ignition temperature. After some initial intensification, the fire should go out. Dry chemical extinguishers can also be effective.
- F. Trunk/Rear Hatch/Engine Hoods - Hold-open devices may employ, along or in any combination with any of the following: springs, gas cylinders, extending arms, etc. When gas cylinders are exposed to heat, failure or rupture of these devices should be expected. Excessive pressure may develop in lift assists causing a trunk, hatch or hood to fly open with explosive force when the latch mechanism is released. To ensure personal safety, be sure to allow sufficient clearance when releasing latches.
- G. Fires involving the trunk/cargo area should be approached with extreme caution. Contents may include toxic, flammable or other hazardous materials. Expect the worst!
- H. Fuel Tanks - May be constructed of sheet metal or plastic. A rupture or burn-through may occur with these tanks causing a rapid flash fire of the fuel. Do not remove gas cap, as tank may have become pressurized. Do not direct hose stream into tank, as this will cause pressurization of tank, with a possible result of burning fuel spewing from the tank fill opening.
- I. Vehicle Stability - Tires or split rims exposed to fire may explode, causing the vehicle to drop suddenly. Expect exploding rim parts or tire debris to be expelled outward from the sides. Approach from the front or rear of the vehicle for maximum protection from potential flying debris. Some larger vehicles, such as buses, employ an air suspension system. When these systems are exposed to heat or flame, they may fail, causing the vehicle to suddenly drop several inches.
- J. Airbags - To avoid injury, firefighters should attempt to maintain a distance of 20” for un-deployed airbags:

V. ELECTRIC VEHICLE FIRE

Fires in electric vehicles powered by high-voltage lithium-ion batteries pose the risk of electric shock to firefighters from exposure to the high-voltage components of a damaged lithium-ion battery. A further risk is that damaged cells in the battery can experience thermal runaway – uncontrolled increases in temperature and pressure – which can lead to battery reignition. The risks of electric shock and battery reignition/fire arise from the “stranded” energy that remains in a damaged battery.

After the knock down of visible flames, re-ignition is to be expected. This is caused by the thermal runaway at the individual cell level internal to the battery packs. While visible flames from the batteries may be clearly extinguished, temperatures within the batteries may be high enough for thermal runaway of internal cells to occur. Subsequent re-ignition is characterized by “whooshing” or “popping” sounds, followed by off gassing of white smoke and/or electrical arcs/sparks that reignited with visible flames/fire. Typically, this will result in visible flames that can be quickly knocked down by a single hose line.



ANN ARBOR FIRE DEPARTMENT

Standard Operating Procedures - 3.16 Vehicle Fire



The continuous application of water on a localized area of the battery for a prolonged period of time before moving onto another area of the battery can provide faster total extinguishment. In addition, once the main battery fire has been controlled, continuous application of water to the battery with the nozzle set on fog could further cool the exterior of the battery, thereby helping to reduce the temperatures of the internal cells. This will reduce the likelihood of additional off gassing of electrolyte and re-ignition of internal battery cells. Electric vehicle fires have a significant chance for re-ignition hours after extinguishment. Extinguished electric vehicles must be stored away from exposures for at least 24-hours. Re-ignition should be expected. This is a not a failure by suppression crews

Class B foam shall **not** be used on electric vehicle fires. Class B foam is not effective and may cause environmental impact.

Resources

- National Transportation Safety Board's Safety Report 20/01, "[Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles.](#)"
- National Transportation Safety Board's YouTube video, "[Lithium-Ion Battery Fires in Electric Vehicles - Safety Risks to Emergency Responders](#)"
- Fire Protection Research Foundation, "[Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results.](#)"

VI. INVESTIGATION

The fire prevention bureau should be notified of vehicle fires of suspicious circumstances. Depending on the situation and after consultation with the fire investigator, the vehicle may be towed to a secured yard for investigation at a later time.