Burlington Fire Department
136 South Winooski Avenue
Burlington, Vermont 05401-8378
(802) 864-4554 • (802) 658-2700 (TTY)
Business Fax (802) 864-5945 • Central Station Fax (802) 865-5387

Section: 01 - Suppression	
SOG Number: 01.90	**Effective Date: March 23, 2018**
Subject: Vehicle Fires	
By Order of Fire Chief Steven A. Locke	

I. Purpose:

This guideline identifies the operational tactics for handling motor vehicle fires by the Burlington Fire Department.

II. Scope:

This guideline applies to all Burlington Fire Department personnel who respond to motor vehicle fires. As with any emergency, the authority to deviate from this guideline rests with the Incident Commander or Chief Engineer.

III. Definitions:

All-Electric Vehicles (EV): A vehicle which uses a battery pack to store the electrical energy that powers the motor. EV batteries are charged by plugging the vehicle in to an electric power source. (*All-electric*, 2021)

Boiling Liquid Expanding Vapor Explosion (BLEVE): Rapid vaporization of a liquid stored under pressure upon release to the atmosphere following major failure of its containing vessel. Failure is the result of over-pressurization caused by an external heat source, which causes the vessel to explode into two or more pieces when the temperature of the liquid is well above its boiling point at normal atmospheric temperature. (*Essentials*, 2018, p.890)

Compressed Natural Gas (CNG): Natural gas compressed to less than 1 percent of its volume at standard atmospheric pressure. To provide adequate driving range, CNG is stored onboard a vehicle in a compressed gaseous state at a pressure of up to 3,600 pounds per square inch. (*Natural gas*, 2021)

Diesel: Diesel fuel is the common term for the petroleum distillate fuel oil sold for use in motor vehicles that use the compression ignition engine. (*Diesel*, 2021)

Energy Absorbing Bumper: A bumper which consists of gas and fluid-filled cylinders that when heated during a fire can develop high pressures that may result in the sudden release of the bumper assembly.

Ethanol: Ethanol is a clear, colorless liquid renewable fuel made from various plant materials. More than 98% of U.S. gasoline contains ethanol, typically E10 (10% ethanol, 90% gasoline). In addition, E15 (10.5%-15% ethanol) and E85 Flex Fuel (51%-83% ethanol) are also distributed and used in internal combustion engines. (*Ethanol*, 2021)

Gasoline: Gasoline is a fuel made from crude oil and other petroleum liquids. Gasoline is mainly used as an engine fuel in vehicles. (*Gasoline*, 2021)

Hybrid Electric Vehicle (HEV): A vehicle which is powered by an internal combustion engine and an electric motor, which uses energy stored in batteries. An HEV cannot plug in to off-board sources of electricity to charge the battery. Instead, the vehicle uses regenerative braking and the internal combustion engine to charge. (*Hybrid electric*, 2021)

Liquefied Natural Gas (LNG): Natural gas that has been cooled to a liquid state, at about -260 degrees Fahrenheit. The volume of natural gas in its liquid state is about 600 times smaller than its volume in its gaseous state (*Natural gas explained*, 2021). LNG must be kept at cold temperatures and is stored in double-walled, vacuum-insulated pressure vessels. LNG is suitable for trucks that require longer ranges because liquid is denser than gas and, therefore, more energy can be stored by volume. (*Natural gas*, 2021)

Liquefied Petroleum Gas / Propane (LPG): Propane is stored onboard a vehicle in a tank pressurized to about 150 pounds per square inch as a colorless, odorless liquid. As pressure is released, the liquid propane vaporizes and turns into gas that is used in combustion. An odorant, ethyl mercaptan, is added for leak detection. (*Propane*, 2021)

Plug-In Hybrid Electric Vehicle (PHEV): A vehicle which uses batteries to power an electric motor, as well as another fuel, such as gasoline or diesel, to power an internal combustion engine or other propulsion source. PHEVs can charge their batteries through charging equipment and regenerative braking. (*Plug-in*, 2021)

Vehicle: Passenger and freight road vehicles, such as, cars, trucks, motorcycles, recreational, industrial, agricultural and construction vehicles.

IV. Guidelines:

A). Response Considerations

1. The response assignment for a single vehicle fire is two (2) engine companies. If more than one vehicle is involved, the response assignment will include a ladder company and the Shift Commander. In addition, vehicle fires with a life or property exposure will require a modified response according to the risk.
2. Apparatus should be placed uphill and upwind of the incident to minimize exposure of hazardous/combustible liquids and smoke.
3. Apparatus should be utilized to shield the incident scene from traffic hazards.
4. All warning lights should be operating while on the incident scene. Scene lighting should be used to illuminate the incident scene ensuring that the vision of motorists is not affected.

B). Size-up

1. The first arriving unit shall perform a scene size-up. See SOG 06.21 Brief Initial Report.
2. The Shift Commander should be notified for vehicle fires involving hazardous materials, such as commercial vehicles with placards. Consideration should be given to upgrading the call type to "Hazmat Incident."
3. Alternative Fuel Vehicle Resources:

	Fuels									
Property	Gasoline/E10	Low Sulfur Diesel	Biodiesel	Propane (LPG)	Compressed Natural Gas (CNG)	Liquefied Natural Gas (LNG)	Ethanol/E100	Methanol	Hydrogen	Electricity
Physical State	Liquid	Liquid	Liquid	Pressurized liquid (heavier than air as a gas)	Compressed gas (lighter than air)	Cryogenic liquid (lighter than air as a gas)	Liquid	Liquid	Compressed gas (lighter than air) or liquid	Electricity
Flash Point	-45°F (j)	165°F (j)	212° to 338°F (d)	-100° to -150°F (j)	-300°F (j)	-306°F (k)	55°F (j)	52°F (j)	N/A	N/A
Autoignition Temperature	495°F (j)	~600°F (j)	~300°F (d)	850° to 950°F (j)	1,004°F (j)	1,004°F (k)	793°F (j)	897°F (j)	1,050° to 1,080°F (j)	N/A

(*Fuel properties*. 2021)

   a. National Fire Protection Association (NFPA) Alternative Fuel Response Guides: https://www.nfpa.org/Training-and-Events/By-topic/Alternative-Fuel-Vehicle-Safety-Training/Emergency-Response-Guides
   b. Tesla First Responders Information: https://www.tesla.com/firstresponders

C). Water Supply

1. If the water carried by the first arriving engine company is not sufficient for fire extinguishment, the second arriving engine company should identify and establish a reliable water supply.
    a. If the fire involves the high voltage battery of an EV, HEV or PHEV a water supply shall be established because it can take a minimum of 3,000 gallons of water to achieve extinguishment. (*Tesla*. 2021)

D). Fire Attack

1. Fire attack and rescue personnel shall wear the following structural firefighting personal protective equipment (PPE): helmet, hood, coat, gloves, trousers, and boots. Self-contained breathing apparatus (SCBA) shall be worn and utilized. Personnel not actively engaged in fire attack should utilize the aforementioned PPE and SCBA if they are exposed to smoke or other hazards.
2. Members not active in fire attack shall wear traffic safety vests, in accordance with national highway safety standards, for increased visibility.
3. The first arriving unit should ensure all occupants are out of the vehicle. A primary search of larger vehicles should be conducted in all occupant compartments that are Immediately Deadly to Life and Health (IDLH). Initial fire suppression and exposure protection should protect occupants and allow for their rescue utilizing an attack hose line with a combination nozzle.
4. A vehicle with visible fire will most likely result in damage beyond repair. A defensive fire attack with a safe approach should utilize an attack hose line equipped with a combination nozzle.
    a. From a safe distance, apply water to extinguish visible fire and cool down the area around fuel tanks/systems utilizing a straight stream. This action is especially important if pressurized fuel tanks have been identified. Failure to adequately control fire impingement on these tanks can result in a BLEVE.
    b. A member of the fire attack team should have forcible entry hand tools, including but not limited to, a Halligan bar and ax, and a wheel chock.
    c. Approach to the vehicle should be uphill and upwind at 45-degree angle from the side of the vehicle; this minimizes hazards related to exploding struts/energy absorbing bumpers and leaking liquids. (*Essentials*, 2018, p.696)
    d. While approaching the vehicle, sweep the ground with a straight hose stream in between extinguishing the vehicle fire. This will push debris and leaking liquids back toward the vehicle and away from the fire attack team.

e. Upon reaching the vehicle, the nozzle firefighter will apply water using a moderate fog hose stream for fire extinguishment and provide exposure protection.
f. The forcible entry firefighter will place the wheel chock on the downhill side of a wheel to prevent the vehicle from rolling; then perform forcible entry and overhaul tactics.

5. Fires involving transportation of fuels or hazardous materials may require utilization of firefighting foam. The Incident Commander should request additional resources to support the application of foam streams. (Please reference SOG 01.45 for firefighting foam [in development at the time of publication]).
   a. "Testing conducted by National Foam and others has shown that gasoline blends containing 10% or less methanol or ethanol can be adequately protected with foam concentrates at the same application rates used for the protection of gasoline or other hydrocarbon fuels. Blending higher alcohol contents requires the use of alcohol-resistant foams." (*A firefighter's*, 2002, p. 16)
6. The NFPA recommends water as the extinguishing agent for fires in EV, HEV and PHEV. Members shall exercise caution when working around batteries, the battery compartment, and high voltage wiring.
7. An EV or PHEV that is plugged into a charging station shall be treated as a Class C Fire until the charging station power has been disconnected or confirmed to be shut down.

E). Post Fire Considerations

1. The Incident Commander should identify a preliminary fire cause. Fire losses of significance where a primary fire cause cannot be identified should be referred to the Shift Commander, who may elect to consult a representative from the Fire Marshal's Office.
2. Prior to leaving the incident scene, the Incident Commander shall obtain the following information to be included in the National Fire Incident Reporting System (NFIRS) narrative:
   a. Vehicle make, model, and year
   b. License plate number
   c. Vehicle Identification Number (VIN)
   d. Registered owner
   e. Operator's name at the time of the incident
3. Proper documentation shall occur within the Burlington Fire Department records management software. The NFIRS type codes should match the vehicle description.

a. Mobile property (vehicle) fire. *Excludes mobile properties used as a structure (120 series). If a vehicle fire occurs on a bridge and does not damage the bridge, it should be classified as a vehicle fire.* (*National fire*, 2015. pp.3-22-3-23)
   (1) 131 – Passenger vehicle fire. Includes any motorized passenger vehicle, other than a motor home (136) (e.g., pickup trucks, sport utility vehicles, buses).
   (2) 132 – Road freight or transport vehicle fire. Includes commercial freight hauling vehicles and contractor vans or trucks. Examples are moving trucks, plumber vans, and delivery trucks.
   (3) 133 – Rail vehicle fire. Includes all rail cars, including intermodal containers and passenger cars that are mounted on a rail car
   (4) 134 – Water vehicle fire. Includes boats, barges, hovercraft, and all other vehicles designed for navigation on water.
   (5) 135 – Aircraft fire. Includes fires originating in or on an aircraft, regardless of use.
   (6) 136 – Self-propelled motor home or recreational vehicle. Includes only self-propelled motor homes or recreational vehicles when being used in a transport mode. Excludes those used for normal residential use (122).
   (7) 137 – Camper or recreational vehicle (RV) fire, not self-propelled. Includes trailers. Excludes RVs on blocks or used regularly as a fixed building (122) and the vehicle towing the camper or RV or the campers mounted on pickups (131).
   (8) 138 – Off-road vehicle or heavy equipment fire. Includes dirt bikes, specialty off-road vehicles, earth-moving equipment (bulldozers), and farm equipment.
   (9) 130 – Mobile property (vehicle) fire, other.

b. Additional information in the narrative should include conditions on arrival, actions taken, and disposition of the vehicle.

V. Responsibility:

It is the responsibility of all members to read, understand and follow this Standard Operating Guideline.

VI. References:

Essentials of fire fighting (7th Ed.). (2018). International Fire Service Training Association.

FEMA. (2015). *National fire incident reporting system: Complete reference guide*. U.S. Fire Administration National Fire Data Center

National Foam. (2002). *A firefighter's guide to foam*. National Foam.

Tesla. (2021, April 12). *First responders information*. https://www.tesla.com/firstresponders

U.S. department of energy: alternative fuels data center. (2021, April 12). *All-electric vehicles*. https://afdc.energy.gov/vehicles/electric_basics_ev.html

U.S. department of energy: alternative fuels data center. (2021, April 12). *Ethanol fuel basics*. https://afdc.energy.gov/fuels/ethanol_fuel_basics.html

U.S. department of energy: alternative fuels data center. (2021, April 12). *Fuel properties comparison results*. https://afdc.energy.gov/fuels/properties

U.S. department of energy: alternative fuels data center. (2021, April 12). *Hybrid electric vehicles*. https://afdc.energy.gov/vehicles/electric_basics_hev.html

U.S. department of energy: alternative fuels data center. (2021, April 12). *Plug-in hybrid electric vehicles.* https://afdc.energy.gov/vehicles/electric_basics_phev.html

U.S. department of energy: alternative fuels data center. (2021, April 12). *Natural gas fuel basics*. https://afdc.energy.gov/fuels/natural_gas_basics.html

U.S. department of energy: alternative fuels data center. (2021, April 12). *Propane fuel basics*. https://afdc.energy.gov/fuels/propane_basics.html

U.S. energy information administration. (2021 April 12). *Gasoline explained*. https://www.eia.gov/energyexplained/gasoline/

U.S. energy information administration. (2021 April 12). *Diesel fuel explained*. https://www.eia.gov/energyexplained/diesel-fuel/

U.S. energy information administration. (2021 April 12). *Natural gas explained: liquefied natural gas*. https://www.eia.gov/energyexplained/natural-gas/liquefied-natural-gas.php

Revision History			
Revision Date	Section	Summary	Principal Author
Initial publication	All	No prior SOG existed.	DC Collette
April 2021	All	Edited for Grammar, Usage and Mechanics	SFF Mitchell
April 2021	III	Expanded definitions list and referenced for accuracy.	SFF Mitchell
April 2021	IV A)	Moved size-up considerations to new section. Updated for best practices and response considerations.	SFF Mitchell
April 2021	IV B)	Size-up section added. Upgrade for "Haz-mat" Incidents. Resources for alternative fuel vehicles.	SFF Mitchell
April 2021	IV C) D)	Updated for best practices.	SFF Mitchell
April 2021	IV E)	NFIRS codes defined.	SFF Mitchell
April 2021	VI	Reference section added.	SFF Mitchell