



# LASH FIRE



## **LASH FIRE GUIDELINES**

Guidelines for firefighting gear,  
equipment and tactics considering APV.

DEVELOPED FOR SHIP OPERATORS

# INTRODUCTION

Most vehicle fires do not start in the energy storage, APV and ICE conventional vehicles can most often be fought by the same means. Hazards related to any vehicle fire are heat, smoke, and toxic gases. Additional hazards are related projectiles because of small explosions from for example dampers, tires, or airbags.

For APVs there is a risk of jet flames and for EVs reignition. The presence of jet flames due to the activation of a pressure relief valve or the trigger of a thermal runaway are inherent to APV, therefore these new vehicles pose for extra firefighting routines, equipment, tactics, and training.

Water is an excellent coolant and fire extinguishing agent. This also applies to fires in APVs. A thermal runaway may be hard to extinguish but water application can control the fire.

All vehicle fires emit hazardous gases. One component that is often mentioned with EV is HF, which occur in higher concentrations with these vehicles, compared to ICE cars when the battery is on fire.

The purpose of these guidelines is to support the manual firefighting operations considering APV on board ro-ro vessels, developing the right tactics, gear, and equipment.



*The project has received founding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 81497. The Agency (CINEA) and the members of the consortium of LASH FIRE are not responsible for any use that may be made of the information in this guideline.*

# 1

## Firefighting PPE



### INSTRUCTIONS

- To protect well from all vehicle fire gases including those of Lithium-Ion batteries such as HF, an EN 469:2020 X2 Y2 Z2 fire suit, or similar, should be worn in accordance with the instructions.
- The fire suit should be worn with a flash-hood, and long-sleeved undergarment
- Maximum total exposure time in a full developed toxic smoke environment is 40 minutes



## Conditions for intervention:

Fixed fire fighting system is the main tool to suppress fires in electric vehicles. However, in some cases manual firefighting operations may be considered on a ro-ro vessel:

- To save lives
- As a proactive measure in the event of increased fire risk
- If it is a clearly safe and reasonable alternative
- **If needed as a supplement to fixed firefighting systems or if these do not work**
- During stable conditions after the fire

# 2

## Manual firefighting equipment

In the table below, firefighting equipment is summarized with regard to during what conditions it is most efficient. There is no one tool to all conditions. The tactic and equipment for a certain manual intervention will depend on the fire conditions:

Equipment	Plus	Minus
CO2 4Kg portable extinguisher	<p>Suppression of the fire is possible in the very early stage of the fire.</p> <p>It is clean and does not compromise the visibility of the area</p>	<p>Limited cooling effect on the battery</p> <p>Very limited effectiveness when the fire is fully developed</p>
Dry powder 9Kg portable extinguisher	<p>Limits the fire growth and fire development, extinguishing at early stages of the fire.</p> <p>Most common fire equipment at hand</p>	<p>Battery pack is well hidden, so effectiveness is limited.</p> <p>Powder cloud may hinder firefighting operations due to poor visibility</p>
Foam 6 liters portable extinguisher	<p>Quite effective, as the liquid state helps to reach hot hidden zones when media is applied.</p> <p>Good cooling effect</p>	<p>Not very common to find in ro-ro cargo spaces.</p> <p>Fluorine products will cause environmental issues.</p>
Fire blanket 6x8m	<p>Good efficiency for general car fire, in particular for engine/passenger/hood compartment fires.</p> <p>Large size, typically 6x8 m, allows safe approach with adjacent vehicles as heat/flame barrier, as long as these are not on fire also.</p> <p>Contains energy bursts in case of reignition.</p> <p>Reduces amount of smoke in space and no additional steam generation.</p> <p>Stabilizing psychological effect due to fire/car not visible.</p> <p>Short crew heat/smoke exposure time.</p> <p>Good option, if water system supply is not operative</p>	<p>A fully parked scenario with great cargo variation can jeopardize the effective blanket deployment.</p> <p>As firefighters need to be close to the car to apply blanket, it is not possible to do it with a fully developed fire, without previous suppression by water.</p> <p>Captures smoke underneath at time of application and may temporary direct it towards crew members.</p> <p>Require manual activities on all sides of fire scene, challenging tactical ventilation.</p> <p>Requires 2 crewmembers for application plus, in a developed fire state, 2 protective hose operators if water shield is needed for application and return.</p> <p>Limitation with roof racks and high vans to deploy the blanket smoothly</p>
Water mist lance	<p>Good shield/blockage effectiveness</p> <p>Can penetrate surfaces and be left inside enclosures for efficient extinguishing/cooling.</p> <p>Enables one directional approach and exit.</p> <p>Short crew heat/smoke exposure time</p>	<p>Unlikely but dangerous possibility of penetration of the battery pack</p> <p>No open/close valve on the nozzle</p> <p>Tight parking may hinder hose preparation.</p> <p>If water shield protection or return is needed, this must be provided by additional hose/crew.</p>

Equipment	Plus	Minus
Manual water nozzle and hose	<p>Versatile tool for manual firefighting</p> <p>Can offer extinguishing from a distance.</p> <p>Can offer heat protection.</p> <p>Approach with a wide cone of water alternate with the click setting as felt necessary and, if possible, at an angle of approx. 45° measured from the centre line of the vehicle.</p> <p>Smaller hoses e.g. 25 mm can be easier to maneuver and pull between vehicles avoiding stuck</p> <p>Enables one directional approach and exit</p>	<p>Tight parking may hinder hose preparation.</p> <p>Requires continuous presence of crew</p> <p>At least 4 members are needed for a dynamic fire strategy.</p> <p>Smaller hoses are lighter but offer large pressure drop.</p>
Boundary Cooling nozzle	<p>Enables one directional approach/exit, and if pushed in place by a rod, avoiding close contact with car on fire.</p> <p>Short time crew heat/smoke exposure.</p> <p>Allows for engagement at developed fire stage.</p> <p>Enables low level approach.</p> <p>Protective water shield provided by device itself on the way in.</p> <p>Can be used to cool gas tanks with open mounting.</p> <p>Equally usable with varying cargo configuration.</p> <p>Suppresses energy bursts in case of reignition.</p>	<p>Two devices needed to protect from fire in one car.</p> <p>Will not extinguish shielded fire inside vehicle.</p> <p>Requires 2 crewmembers for application plus, in a developed fire state, 1 protective hose operator, if water shield on return is needed.</p> <p>Tight parking may hinder hose preparation.</p> <p>Heavier in maneuver than hose or fognail.</p> <p>Decrease local visibility and work environment.</p>
IR camera	<p>Good to confirm the presence of fire or hot spots.</p> <p>Necessary to monitor the evolution of the fire behavior taking periodic measures</p>	<p>You need one hand busy to carry the device.</p> <p>Adding extra equipment will reduce the comfort of the firefighter in an stressful situation</p>



# 3

## Manual firefighting tactics



### INSTRUCTIONS

- Most fires do not involve battery or gas tank, so first response can be performed as usually.
- Mechanical or natural ventilation can be used to push smoke and heat, improving visibility for firefighters and reducing the risk of flashover.
- Keep a safe distance because of the risk of jet flames and violent ignition of vented gases.
- Consider use of equipment according to table above and fire conditions.
- If a pressurized gas tank is located in the vehicle on fire or close to it is highly valuable to cool the tank to prevent gas release or explosion.
- Water should never be flushed towards the pressure relief valve of liquified cryogenic gas tanks such as LNG since water then may freeze and block it.
- Monitoring the fire with IR camera and take regular notes to the temperature and "post fire" procedure will be needed after manual intervention.
- Be prepared for additional manual measures in case EV specific events like reignition.
- Contaminated fire suits: Fire suits are almost certainly contaminated after a fire. Before SCBA is removed, it is important to take off the suits and place the contaminated PPE in airtight bags, avoiding skin or inhalation contact and performing this outside.



# References

LASHFIRE has developed a series of APV manual firefighting short training movies.

Link: [The LASH FIRE project proudly presents the crew training videos series on Effective Manual AFV Firefighting! | lashfire.eu](https://www.lashfire.eu)

## Definition of terms

APV	Alternative Powered Vehicle
BA	Breathing apparatus
BEV	Battery Electric Vehicle
DG	Dangerous Goods
EV	Electric Vehicle
HF	Hydrogen Fluoride
ICE	Internal Combustion Engine
Li-Ion	Lithium-ion
PPE	Personal Protective Equipment
Ro-ro	Roll-on/roll-off



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