

INFORMATION FOR FIRST AND SECOND RESPONDERS RESCUE AND TRAINING MANUAL

HIGH VOLTAGE (HV) LITHIUM-ION BATTERIES

IN AN HYBRID (HEV), PLUG-IN HYBRID (PHEV) , FULL ELECTRIC VEHICLE (EV)
AND FUEL CELL ELECTRIC VEHICLE (FCEV)



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Note:

First responders: Fire Fighters, Police, Medical personal, Emergency Medical Transporters.

Second responders: Towing and maintenance personnel,...

**INFORMATION FOR FIRST AND SECOND RESPONDERS
TRAINING MANUAL
HIGH VOLTAGE (HV) LITHIUM-ION BATTERIES**

**IN AN HYBRID (HEV), PLUG-IN HYBRID (PHEV), FULL ELECTRIC VEHICLE (EV)
AND FUEL CELL ELECTRIC VEHICLE (FCEV)**

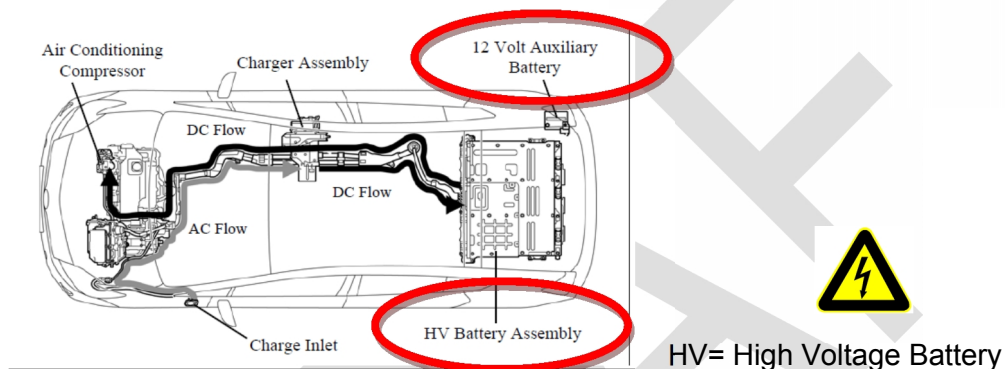
BRAND/TYPE OF VEHICLE

Manufacturer vehicle : **XXX**
Info in case of emergency: **XXX**


Version: **01/08/2014**

1. GENERAL INFORMATION : type of battery and vehicle

A) Picture of the location of the HV battery in the vehicle (example
ILLUSTRATIVE EXAMPLE ONLY



HV= High Voltage Battery

High voltage battery		Place : XXX	Info: XXX
1. Hybrid Electric Vehicle (HEV) Battery Assembly	Cargo Area 	346 Volt Lithium-ion (Li-ion) battery pack consisting of 3.6 Volt cells connected in a series-parallel circuit.	
Low Voltage Auxiliary battery		Place : XXX	Info: XXX
2. 12 Volt Auxiliary Battery	Right Side of Cargo Area	A lead-acid battery that supplies power to the low voltage devices.	

B) General considerations in the event of damage to or fire involving an electric vehicle (EV) or hybrid-electric vehicle (HEV):

- Always follow the "safety considerations" about the specific vehicle.(training manual, rescue sheet, emergency response guide,...) as supplied by the car manufacturer.
- Warn all responders and dispatch/inform that an electric, hybrid-electric or fuel cell vehicle is involved.
- Always assume that the high voltage (HV) battery and associated components are energized and fully charged.
- Exposed electrical components, (orange) wires, and HV batteries present potential HV shock hazards even when the battery is partially or fully discharged.
- Physical damage to the vehicle or HV battery may result in immediate or delayed release of toxic and/or flammable liquids and gases with a risk of fire.
- Venting/off-gassing HV battery vapours are potentially toxic and flammable, they could contain toxic Fluor-based substances.
- Leaking electrolyte from **Li-ion batteries** gives a typical sweet/ether-like odour.

- When **Li-ion batteries** have been mechanically damaged there is a risk of fire as a result of a rapid temperature elevation in the battery due to e.g. an internal or external short circuit.
- As with any vehicle fire, the by-products of combustion can be toxic and all individuals should be directed to move to a safe distance upwind and uphill from the vehicle fire and out of the way of oncoming traffic.
- When individual(s) are trapped in a vehicle with damaged batteries, it is necessary to give them, immediately fresh air coming from a SCBA gear.
- **other info: XXX**

C) Classification

Lithium-Ion Batteries are classified as Dangerous Goods for Transportation under **UN 3480**
UN 3481



Class of Hazard: **Class 9 (others).**

NFPA Code: **XXX**

D) General first aid measures:

- Inhalation: take victim directly in to fresh air.
- Skin/clothing contact: remove affected clothing and rinse skin for at least 25 min with water
- Eye contact: rinse eye (s) plenty with water for at least 20 min.
- Ingestion: immediate medical assistance is needed, do not induce vomiting, gently wipe or rinse mouth with water.
- Always contact medical assistance and shown them the training manual / BIF or (M)SDS sheet of the battery!

E) Content of chemical products:

- The battery contains the following substances (in % by weight of the battery: **XXX %**).
- Total weight battery : **XXX**

NAME:XXX

UN Nr:XXX

CAS #:XXX

NAME:XXX

UN Nr:XXX

CAS #:XXX

NAME:XXX

UN Nr:XXX

CAS #:XXX

NAME:XXX

UN Nr:XXX

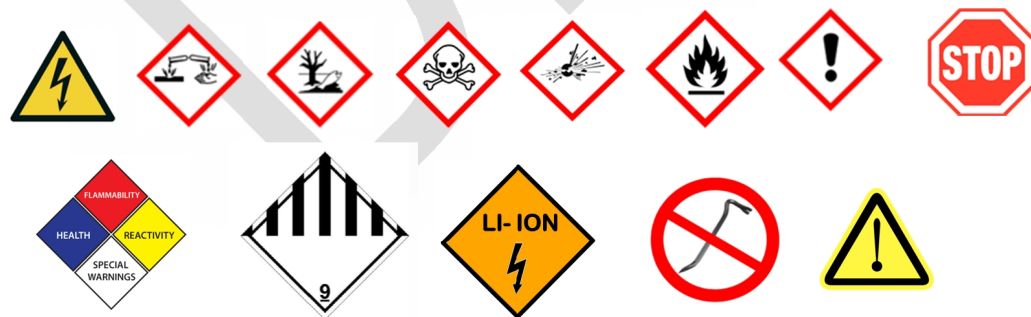
CAS #:XXX

NAME:XXX

UN Nr:XXX

CAS #:XXX

F) General danger symbols:



G) General safety symbols:



2. Danger by spills/leaks (absence of fire)

Under **normal conditions of use**, the battery does not present any risk of exposure to its content.

SPILLS

Specific Attention



- The electrolyte used in the **Li-ion battery** cells contains a flammable organic solvent and a corrosive substance.

Inhalation in non-fire situations

- Contact with organic electrolyte or acidic vapour caused by reaction of the electrolyte with moisture may irritate the eyes, nose, throat, and skin.
- The vapour may contain hazardous fluor-based substances!

Safety Measures



- Wear splash shield or safety goggles.
- Gloves, boots, apron suitable for organic solvents.
- Protective mask for acidic vapours or Self-Contained Breathing Apparatus SCBA.

Absorption/neutralisation see chapter 4: **Environmental aspects.**

3. Hazards Associated with a Lithium-Ion Battery Fire

Under normal conditions of use the battery does not present any risk of exposure to its content.

FIRE

Specific Attention



- If you detect leaking fluids, sparks, smoke, flames, increased temperature, gurgling or bubbling sounds from the HV battery compartment, assume there is a battery fire and ventilate the passenger area (roll down windows or open doors).

Fire in the HV Battery Assembly

- Be alert. There is a potential for delayed fire with damaged lithium-ion batteries.
- When the inside cells of the battery are damaged flammable liquid may be expelled from the battery,
- The battery contains a combustible organic solvent of the type: Dimethyl Carbonate.
- When one cell ignites there is a risk a propagation of the fire to neighbour cells (Thermal runaway).
Parts of the battery(e.g. cells) may be ejected as projectile.

Inhalation in Fire Situations

- Toxic gases are given off as by-products of combustion.
- Vapour emitted in case of a fire contains CO, CO2 and hazardous fluorinated substances!

Safety Measures



- Keep distance from the vehicle and evacuate people upwind from the immediate area.
- Keep any person not involved in the rescue, 15 meters away from the fire zone,
- Wear always full Personal Protective Equipment suitable for organic solvents and Self-Contained Breathing Apparatus (SCBA).
- **To avoid serious injury or death from severe burns or electric shock, never breach or remove the high voltage battery assembly cover under any circumstance.**

1st Objective

- In case of a large fire >>> cool down the battery with an overflow of water with in order to reduce the temperature of the battery.

2nd Objective:

- Shutting off the oxygen supply to the fire: using if possible (dry) sand or other suitable mineral agent.

Offensive attack

- Copious quantities of water with 3% AFFF can be used to cool down burning Li-ion cells and batteries.
- During application, caution should be exercised as flammable particles may be ejected from the fire.
- Possibly one hour duration to fully extinguish.

Defensive attack

- Pull back at safe distance and allow the Li-ion battery cells to burn themselves out.
- Fire crews may utilize a water stream or fog pattern to protect exposures or to control the path of

Extinguish Measures



4. Environmental Aspects

IN ALL CASES

Specific Attention



Safety Measures



Absorbent materials.

- To confine the spillage of liquids and the fire: use dry materials such as sand or mineral absorbing agents.
- In case of abundant use of water, care should be taken to confine and neutralise the water outflow.
- After intervention, rinse the affected areas with water adequately.
- Handle Li- ion spills using the following personal protective equipment (PPE)
 - Splash shield or safety goggles.
 - Rubber gloves, boots, apron suitable for organic solvents
 - Protective mask for acidic vapours or SCBA.
- Perform gross decontamination by removing affected clothing. Wash skin with water and soap.

Treatment of Waste Water.

- Confine the effluent or the contaminated material and collect it as hazardous waste (water) for appropriate treatment.
- Pick up and transfer to properly labelled containers.
- Dispose of in accordance with local waste management legislation and emissions regulations.

5. Damaged Lithium-Ion batteries: additional precautionary measures – reactivation of the battery.

RE-ACTIVATION OF LI-ION BATTERY

Specific Attention



Heat evolution and fire

- When the car with a damaged Li Ion battery needs to be transported/ stored be aware of the possibility of a reactivation of the fire within a damaged battery.
- During overhaul, immobilize and disable the vehicle if not already done.
- Keep the damaged car with a battery or the damaged battery under supervision and control.

WARNING: There is a possibility for delayed ignition or re-ignition of a lithium-ion battery fire even after it is believed to be extinguished. This may remain an issue until the lithium-ion battery is properly handled/ managed/ conditioned by a qualified person. Re-ignition may appear even after a few days.

The HV battery assembly cover should never be breached or removed under any circumstances including fire. Doing so may result in severe electrical burns, shock, or electrocution.

6. Specific requirements for packaging, storage and transportation of damaged Lithium-Ion batteries.

Safety Measures During Storage and Transport



6.1. When the battery is left in the car.

- Do not store a severely damaged vehicle with a lithium-ion battery inside a building where there are human activities or within 15 meters (50 feet) of any occupied building, other vehicle or flammable liquids.
- Wear splash shield or safety goggles.
- Gloves, boots, apron suitable for organic solvents.
- Protective mask for acidic vapours.
- Keep monitoring any evolution of heat and potential reactivation of fire for 24 hours minimum.
- Store the car and the battery in a place where it is not exposed to rain (humidity) and high temperature (direct sunlight).
- Protect battery from any additional potential damages.
- Keep full monitoring of the vehicle and battery when placed in storage area/tow lot,
- Continue to inspect vehicle for leaking fluids, sparks, smoke, flames, gurgling or bubbling sounds from the HV battery and call fire services if any of these are detected.

..	<ul style="list-style-type: none"> - Use if possible an Infra-Red Camera to control regularly the temperature of the battery, - Ensure that the vehicle (passenger and cargo compartments) remains ventilated (open window, door, or trunk). <p>6.2. When the battery has been removed from the car.</p> <ul style="list-style-type: none"> - When for any reason, the battery has been removed from the car.... - Wear splash shield or safety goggles. - Gloves, boots, apron suitable for organic solvents. - Protective mask for acidic vapours. - Place and store the battery in a remote area, 15 meters (50 feet) away from a building where there are human activities. Store on a floor made of concrete. - Before being offered for transport, the cells or batteries shall be inspected by a qualified person to evaluate its physical status: mechanical integrity, temperature, signs of rupture, venting, disassembly and leakage or open circuit voltage... etc. - Damaged or defective batteries can only be transported according to the UN Regulation for the transport of dangerous goods (UN 3480). - Only trained persons are allowed to offer a damaged or defective battery for transport. - Alternatively place the battery in a metal container, <ul style="list-style-type: none"> - Fill the container to the top with a non-combustible and non-conductive thermal insulation material (sand, vermiculite, glass, mineral agent...) - Store the container with the battery in a safe place for several days. - Maintain monitoring by a qualified person. - Use if possible an Infra-Red Camera to control regularly the temperature of the battery, <p>Remark: Trained personnel (for fire) should always accompany the transport of the damaged vehicle/battery to the safe place.</p>
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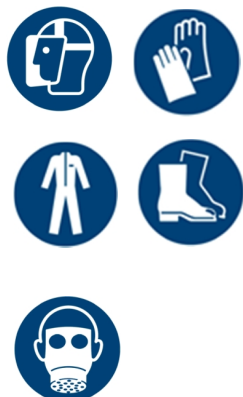
7. Requirements for the auxiliary Lead-Acid battery.

Specific Attention



- The Starting Lighting Ignition (SLI) Battery is normally a sealed Lead-acid Battery.
- It is classified under UN 2794 CAS # 7664-93-9 and is attributed to Class 8 Dangerous Goods.
- When the battery is damaged, has a broken casing and there is a possibility of leaking of the acid electrolyte (sulphuric acid) . Wear full PPE/splash shield or safety goggles, gloves, boots, apron suitable for organic solvents and protective mask for acidic vapours.

Safety Measures



8. Warnings

Author: **XXX**

Sources: **XXX**

Following text may never be deleted!

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The information on this template must be further filled in (XXX) and specific adapted to the type of battery by the car manufacturer!

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