

## WEC HYBRIDS 2016 — LMP1-H

The WEC hybrids have Energy Recovery Systems (ERS) that store energy for the Motor Generator Units (MGU). The WEC Technical Regulations allow hybrids to have a great degree of freedom on how they may be designed but at the moment are a combination of both kinetic (recovering their energy from braking) and heat (from the turbo), and this energy is stored in Lithium-ion batteries.

There are three 2-car teams in the LMP1-H category — **Porsche #s 1 & 2; Toyota #s 5 & 6; Audi #s 7 & 8**. The item that distinguishes these cars from all of the other cars on track is the addition of high voltage being carried on-board, and the possibility of a short rendering the vehicle “live”.

### HYBRID LIGHTS AND MASTER SWITCHES

To warn approaching marshals/fire fighters of the status of the systems there are **hybrid lights and Master Switch buttons are on both sides of the car within 350 mm of the A-pillar (i.e. less than 14 inches):**

#### Green Light:

- ◆ If the hybrid light is green then the car is safe to touch.
- ◆ With a green light and no fire, the Master Switch button should be pressed (with safety gloves is recommended) and the driver can exit the car and/or the car can be removed to a safe position.
- ◆ With a green light and a fire or heavy smoke, the Master Switch button should be pressed if possible (with safety gloves is recommended), and the on-board extinguisher hook (marked with the red letter “E”) pulled. The driver should exit the car as soon as possible. In the meantime the corner workers should be standing by with their fire extinguishers and use them if necessary.

#### Red Light or No Hybrid Light Illuminated:

- ◆ If the hybrid light is red, or is not illuminated, then the car must be presumed to be “live” with high voltage, and be considered to have a hybrid system failure and therefore be **unsafe** to touch.
- ◆ With a red light, or the hybrid light is not illuminated, and no fire, someone **with safety gloves** should press the Master Switch button. There will be no “imminent danger” to the driver if he should still be in the car. Race Control will have been informed of the situation and will have dispatched people with additional gear to assist in getting the driver out safely.
- ◆ With a red light, or the hybrid light is not illuminated, and a fire or heavy smoke, someone **with safety gloves** should press the Master Switch button if possible, and the on-board extinguisher hook (marked with the red letter “E”) should be pulled (by someone wearing safety gloves and/or with a non-conductive hook). Race Control will have been informed of the situation and will have dispatched people with additional gear to assist in getting the driver out safely, but in the meantime the corner workers should be standing by with their fire extinguishers and use them if necessary.

### **Master Switch:**

As is normal in motorsport, pressing the Master Switch button, marked with the universal symbol of a red spark within a blue triangle and with the point of the triangle pointing to the button, cuts all electric supply (including the electrical fuel pump) and will turn off the IC engine. The Audis are diesel hybrids and will use a system where all injectors are fired by an electrical pulse from the engine control module, so cutting the power to the injectors will stop the engine. If diesel fuel is on fire then it will burn but not explode in the same way that petrol/gas will.

### **Lithium-ion Batteries:**

These batteries can catch fire in two ways:

- 1) by being exposed to an adjacent fire; and
- 2) through a thermal runaway in the battery itself.

Especially with a thermal runaway there will be a physical expansion of the battery and the energy stored on board could be released suddenly, and quite violently. For this reason it is imperative that the battery pack(s) be cooled as quickly as possible.

One way to cool these battery packs is to flood the container with water. Obviously, there is a possible problem of using water on a lithium-metal fire. The firefighters will have already familiarised themselves with the safest ways to handle the hybrid cars so it would be best to allow them perform their jobs.

If a lithium-ion battery fire cannot be extinguished then it (the battery pack if it can be easily removed, or the complete car if battery removal is not possible) should be put in a safe and controlled area and be allowed to burn itself out. In the latter case, additional care would be needed to ensure that the fuel (petrol or diesel) in the car would not contribute to the problem.

### **HIGH VOLTAGE COMPONENTS**

All high voltage looms will be of orange colour and the standard “High Voltage” symbol (black triangle around yellow background with black lightning bolt) will be visible on all boxes containing HV components and on the main components themselves. During an accident, no HV should become exposed from the interconnection of units. This is not limited to storage devices and applies to components both inside and outside of the survival cell.

The following are examples of symbols/decals used for (in order from left to right): High Voltage, Master Switch, and Extinguisher. Symbols used by different national sporting authorities may differ slightly but they are easily recognisable.

