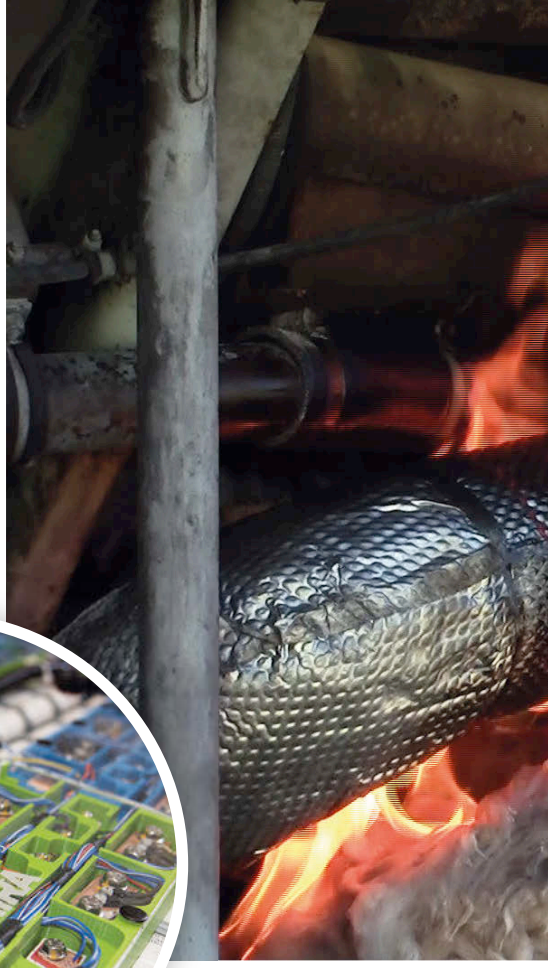
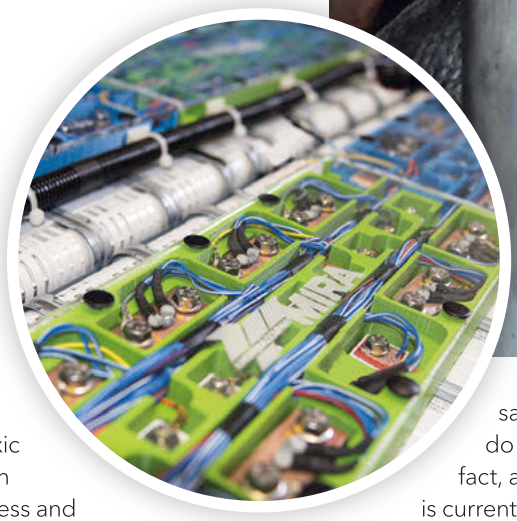


Assault and battery



When electric vehicles' battery units suffer a short circuit or fluid fire, fire suppression systems play a crucial role in protecting passengers and the vehicles involved, finds Brian Wall

Even without an engine, electric vehicles are still susceptible to fire. Their battery units can short circuit, resulting in a blaze that puts those on board – and the vehicle itself – at risk. Such fires can be highly volatile and hard to control.

Opinions differ about the fire risks that they pose. According to Tim Melton, managing director of Firetrace, EV batteries are normally lithium-based, which is a class D metal. "A lithium fire can achieve a 'thermal runaway' condition where it produces oxygen and extreme heat. The current criterion for EV protection is to try to deal with any incident quickly to avoid the thermal runaway scenario."

However, Argos Fire Protection contends that the fire risk from the batteries comes from the electrolyte, not the solid elements. It argues that lithium-ion compounds in EV batteries do not actually contain lithium metal, so are class A (combustible materials) from the point of view of firefighting, but with the caveat that one mustn't use plain water. It states: "Every battery uses a different electrolyte solution, but many contain fluorine, which readily combines with the hydrogen found in water used for firefighting to make hydrogen fluoride. This is a highly toxic gas which can cause blindness and respiratory failure."

Melton also argues against water mist for fighting fires on EVs because it is conductive, which could be risky around high-voltage and high-current circuits prevalent on many such vehicles. Dry powder is the other substance commonly used. (Firetrace testing is shown main image and at right).

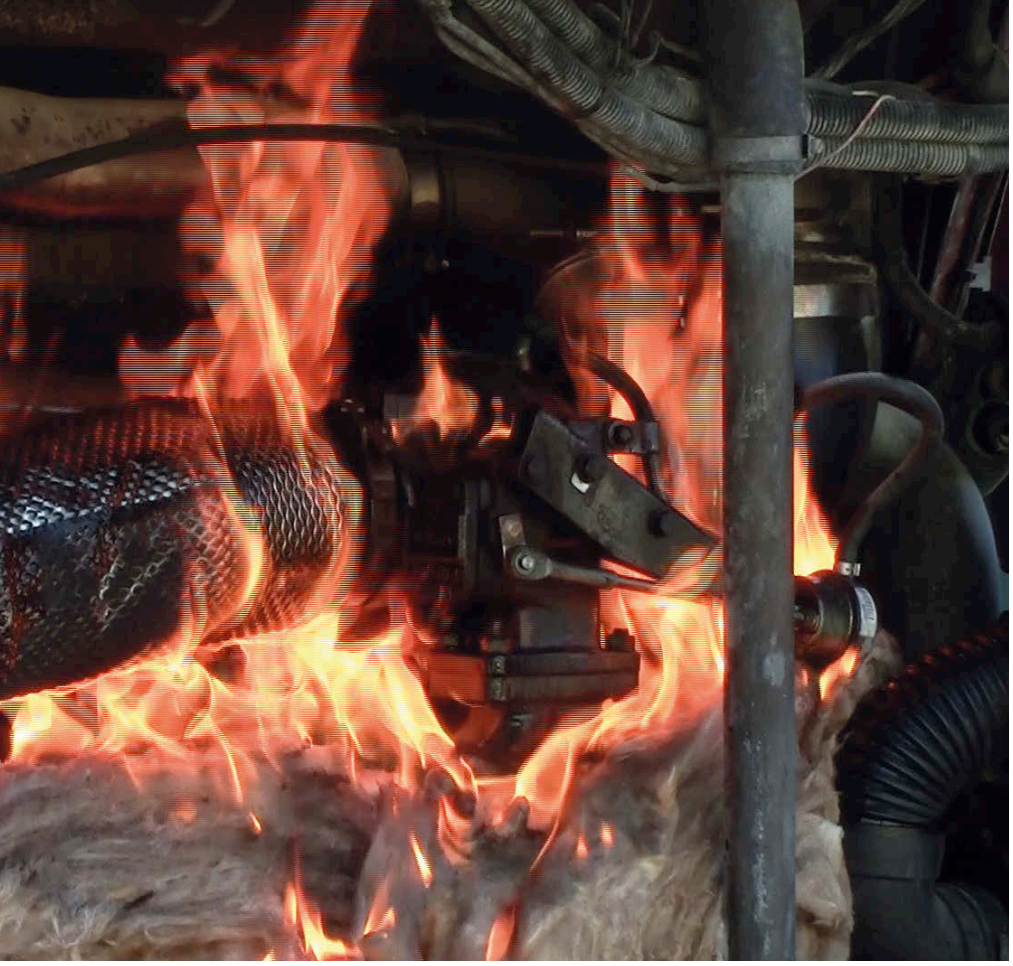
Current standards don't clarify the situation. The standard governing the usage of fire suppression systems for buses is United Nations Economic Commission for Europe (UNECE) R107 and the primary test house the Swedish RISE institute, with the notified body being the Swedish Transport Authority. This regulation requires a vehicle OEM and relevant fire suppression company to carry out a risk assessment and joint sign-off. While R107 stipulates that the installation of automatic fire suppression for class III vehicles (coaches) is now mandatory (from July 2019) and that this will also pertain to class I and II vehicles (buses of all types) from September 2021, there are no such specific regulations in force governing vehicles in the UK, including trucks. Moreover, says Melton, "the tests do not cover EVs and, in fact, an all-electric vehicle is currently exempt from the regulation".

Not that R107 hasn't been appropriated for EVs, too. "We are seeing R107 systems used on EVs purely to appease an authority, rather than to suit the risk," says Melton. "The enclosed risks of an EV differ greatly from the highly ventilated diesel enclosure, and there is little relation between the R107 test and the EV vehicle."

Swedish firm Dafo Vehicle Fire Protection argues that regulations and standards are to some extent lagging behind developments in the market. As a result, it is participating in several research projects on how to deal with the fire risk of Li-ion batteries in vehicles and to reduce the risks and consequences of a thermal incident in HEVs and EVs such as buses and trucks.

DETECT AND CONTAIN

Meanwhile, Horiba MIRA is working within a consortium on the Innovate UK 'Project DETAIN', as part of the Faraday Battery Challenge, with the government investing up to £246 million to develop batteries that are cost effective, high quality, durable, safe, low weight and



recyclable (pictured, inset, opposite). As part of that project, Horiba MIRA is also assessing the feasibility of implementing an algorithm within the BMS (battery management system) to enable early detection and warning of a thermal runaway event – that is, before any fire starts – to enable the driver and passengers to safely exit the vehicle.

"It may also be possible to use the BMS to monitor other measurements or data messages being seen in the battery pack that could indicate an impending issue," states Martin Brown, test support services improvement consultant, Horiba MIRA. "For example, using gas detection techniques to see if gases given off at an early venting state may warn of a potential serious problem."

At present, the exact composition of the gas and chemical compounds released in the event of a thermal event is incomplete, and varies with different battery chemistries, further hindering the development of a single effective fire suppression method. "We are planning to conduct tests to collect and analyse gas, ash and soil samples during a thermal event to assess potential health and environmental hazards, the results of which may also contribute to early detection by implementing sensors to detect specific gases that might be released before a fire occurs," he adds.

RAPID DETECTION

However the fire is fought, there are two means of detecting it: resistance wire and linear tube. In the former, a fire melts the insulation separating the pair of wires and causes a short circuit, which raises an alarm. "In the latter case, when the heat melts the pressurised hollow plastic tube, pressure escapes, pneumatically activating a valve," adds Melton. "It seems to be agreed that spot protection has minimal effect, so a linear detector provides much better coverage of the entire risk area. Both can be monitored. One needs external power; the other doesn't."

Bus and coach aftermarket supplier Alliance Transport Technologies has also launched an R107-compliant system that delivers dry powder using a pressurised pneumatic circuit. Developed with manufacturer Reacton Fire Suppression, the system is marketed through a new division, Alliance Fire Suppression.

Also offering the linear tube option is the R107 Fire Suppression System from Forman Vehicle Services, again with dry powder. Matthew Malewski, research and development project leader of corporate sister DAB Fire Engineering, argues in favour of powder, calling it "the most effective solution when measured against liquid-based systems". It also offers the most favourable compromise between the volume of suppression agent employed and storage space required, he contends.

Malewski concludes: "It is imperative that public transport vehicles have a fire suppression system installed, as not only does it mitigate damage to the vehicle, but also gives the passengers and driver valuable time to evacuate the vehicle." TE