HORIBA
Automotive Test Systems

Trends in Lithium-Ion Battery Testing

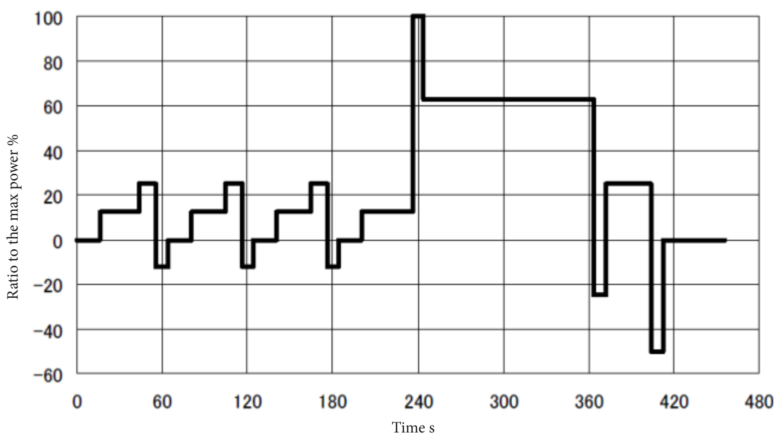
Batteries have gotten larger, more powerful, and far more complex as automotive OEMs expand their electrified fleet to meet impending global GHG (green house gas) regulations. A wide variety of battery platforms, more robust communication requirements, and increased expectations have pushed battery technology far beyond previous test requirements. The technology needed to support vehicle electrification must keep pace with rising expectations—making lower cost batteries with enhanced performance, durability, and abuse tolerance crucial to the vitality of all hybrid/electric vehicle powertrains.

Bigger battery packs require more robust test rigs and support

Facilities with legacy test equipment will need to make considerable logistical upgrades to accommodate new battery pack tests. Over the past few years, battery packs have become exponentially larger and heavier. For example, the PHEV battery in the 2010 Gen 2 Prius weighed-in at just 53 kg (117 lb). In contrast, today's Chevy Bolt BEV battery weighs-in at a whopping 436 kg (961 lb)—nearly a ton. Increasing the size of the DUT (device under test) creates several issues from a mechanical test perspective. Heavier packs require more robust test equipment to support and handle them, more space to store and test them, and increased fire hazard and transportation risk as chemical volumes grow. Larger packs also require larger thermal chambers for required environmental tests, another big investment.

Not only are new battery packs physically more demanding, they also have far more voltage and power—a huge benefit to consumers, but a testing challenge for vehicle and battery OEMs. The 2010 Gen 2 Prius battery provides 200 V and 20 kW at peak. The new 2020 Porsche Taycan, 800 V, 350 kW on-plug charge. That's nearly 18 times more power to accommodate in a test situation.

Testing larger and more powerful batteries using exisiting equipment is problematic. The figure below shows a standard IEC micro cycle for battery electric vehicles. In order to meet the 100% pulse at time 240 s, 350 kW are needed versus 20 kW in the past.



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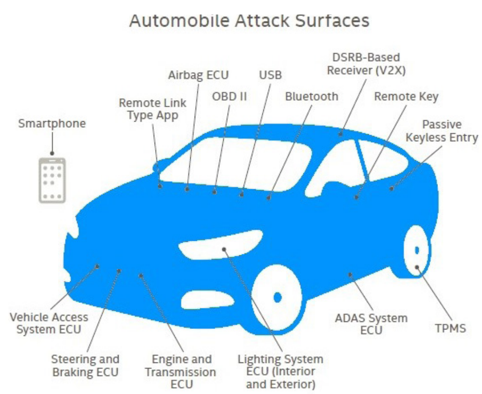
Higher data rates create communications and security concerns

The 300 percent increase in voltage between the 2010 Gen 2 Prius battery and the 2020 Porsche Taycan is also worth noting. The increase in voltage is due to an increase in the series cell count, and the status of each cell must be communicated throughout the vehicle. This is a great example of the increased volume of information that must be communicated by automotive batteries, and an indicator of how future battery requirements could look if trends continue.



With a tidal wave of information moving throughout the vehicle's battery system, **cybersecurity concerns** have moved to the forefront.

The exponential growth in data/information from a high voltage battery needs to be communicated to controllers located throughout the vehicle. All of this traffic requires a much wider and more robust communication highway, and that new highway is called CAN-FD—a communication tool robust enough to handle the demands of a high voltage battery. Yesterday's CAN solution simply cannot keep up with the pace of 8 megabits/second. However, since batteries using standard CAN are still in use, it is important to note that CAN-FD is backwards compatible to standard CAN. However, CAN devices cannot handle CAN-FD on the same network.

For new "mild hybrids", stop/start systems and other low voltage applications (under 50 V), LIN is the preferred data handling solution. LIN is less costly than CAN-FD and designed to handle the lower data requirements of 12 V and 48 V communications.

With a tidal wave of information moving throughout the vehicle's battery system, cybersecurity concerns have moved to the forefront. The potential problem lies at the BMS (battery management system). In the past, a BMS broadcasted all of its data as it talked to the battery and multiple controllers throughout the vehicle—leaving it wide open to hacking. The implications of a hacker taking over a BMS could be catastrophic, so most new BMSs use a call-and-response model that requires authentication. While better for security, closed communication systems can make data access in a testing situation problematic.

A need for harmonized global standards

The industry faces an urgent need for harmonized global battery testing standards. Without global oversite, regulations come from multiple sources resulting in layers of costly duplicate testing. In addition to competing industry bodies, standards come from three main global groups: The U.S. Department of Transportation, The UNECE (The United Nations Economic Commission for Europe), and The Standard Administration of the PRC—all of which have separate requirements. To create a globally sold product, all of these requirements must be satisfied separately.

HORIBA Solutions: HORIBA offers a wide variety of experience and expertise to optimize electrified transportation performance. Battery R&D testing at the cell and module level, complete battery pack testing during powertrain development and optimization, and end-of-line module and battery testing are offered through HORIBA-Fuelcon. A range of battery test services, engineering consultancy, expertise in intelligent mobility, autonomous vehicle, and cybersecurity are offered through our HORIBA-MIRA Engineering Consulting Team.

A business segment of the HORIBA Group, Automotive Test Systems (ATS) has developed global leadership in the fields of battery and fuel cell test stands, data management solutions, driveline test systems, engine test systems, brake test systems, wind tunnel balances, emissions test systems and test facility automation. HORIBA ATS is able to offer its customers complete solutions with full turnkey capability for all industries using electric motors, internal combustion engines and turbines. These include the automotive, heavy-duty, off-road, consumer goods, marine, aerospace and locomotive sectors.