

As the EU's Joint Research Centre and EUROBAT detail below, battery testing continues to be integral to the development of electric vehicles

# Moving battery testing forward

Safe and sustainable battery technologies are key constituents for the successful commercialisation of electric vehicles (EVs) in Europe. Already, the four battery families represented within EUROBAT's membership provide a number of emission-reducing functions in cars, buses, trams and trains:

- Start-Stop systems in Micro-Hybrid EVs;
- Regenerative braking in Mild-Hybrid EVs;
- Part electric functionality in Full Hybrid EVs and Plug-in Hybrid EVs;
- Full electric functionality in full EVs.

With the electrification of transport remaining a central component of Europe's transition towards a low-carbon and resource-efficient economy, demand for such technologies will increase significantly over the next decade.

In the path to bringing all types of electric vehicle to the European mass-market, government and industry must collaborate to develop testing procedures that ensure the safety, performance and environmental sustainability of internal components. Over the last year, international co-operation has brought about several standards and type approval regulations for the different battery technologies used in EVs, which will guarantee their safety and sustainability for European consumers.

In 2012, this framework continues to develop, with EUROBAT and the European Commission's Joint Research Centre (JRC) beginning mutual



Alfons Westgeest



Dr Lois Brett



Dr Andreas Pfrang

co-operation to remove remaining regulatory barriers and to ensure that standardisation keeps pace with technological innovation.

## The importance of battery testing for safety and environmental impact

Before new technologies of any type are introduced to the market, testing and standardisation requirements are crucial to identify and rectify any safety, performance or environmental issues that could impact on consumers. Such tests are especially important for batteries in EVs.

Performance, endurance, reliance and abuse tests help to identify potential hazards – for example overheating or short-circuiting – that a battery could be susceptible to under strenuous conditions. These are undertaken in a controlled environment, and allow regulators or manufacturers the opportunity to identify whether further safety improvements are needed before commercialisation.

Given that EVs have been prioritised as a 'green' solution to decarbonise Europe's transport sector, it is also important for pre-commercialisation tests to measure their environmental impact over their entire lifecycle. Testing of batteries can identify how to prolong calendar and cycling life in addition to establishing the potential for reuse or recycling at end-of-life, thereby informing regulators of appropriate standards that should be set to maintain environmental performance.

## State of affairs for European (and international) battery testing procedures

These testing procedures are first of all set at an international level, with targeted standards introduced through the International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO), and type approval requirements formulated through the United Nations





Economic Commission for Europe's Working Party 29 (UN-ECE WP.29).

Several IEC and ISO standards already exist to give safety and test specifications for batteries used in EVs:

- IEC 62660-1, 2: Secondary batteries for the propulsion of electric road vehicle. Part 1: performance. Part 2: reliability;
- IEC 61982: Secondary batteries (except lithium) for the propulsion of electric road vehicles – performance and endurance tests;
- IEC 62485-3: Safety requirements for secondary batteries and battery installations. Part 3: traction batteries;
- ISO 6469-1, 2, 3: Electrically propelled road vehicles – safety specifications. Part 1: on-board rechargeable energy storage system (RESS). Part 2: vehicle operational safety means and protection against failures. Part 3: protection of persons against electric shock;

- ISO 12405-1, 2: Electrically propelled road vehicles – test specification for lithium-ion traction battery packs and systems. Part 1: high power applications. Part 2: high energy applications.

Complementary standards – for example on battery dimensions and marking – are currently in development, with the accumulative framework ensuring that EV batteries are only put onto the market after achieving an acceptable level of safety and reliability. Most of these international standards have been transposed into European standards (EN) by the European Standardisation body, CEN/CENELEC, where EUROBAT acted as co-convenor of the batteries team within the focus group on e-mobility in order to maintain industry input.

This standardisation framework is complemented by the UN-ECE WP.29's international type approval requirements for EVs, which certify that a particular car is roadworthy and comply with globally agreed safety criteria. The UN-ECE WP.29 allows industry experts – including EUROBAT – to input on the decisions of international regulators, and last year finalised a study on rechargeable energy storage systems (RESS) to supplement general requirements for electric vehicle functional safety under Regulation 100 (binding under EU law). It has also launched two further informal working groups in 2012: the first again on the development of global technical regulations for EV passenger safety, and the second on aspects related to environmental performance.

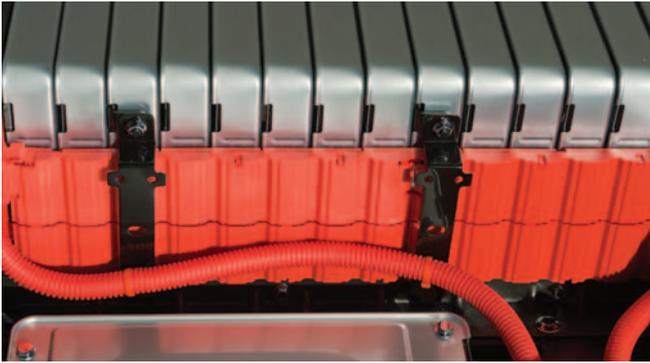
EUROBAT and the Joint Research Centre share the conviction that commercialisation of EVs will only be achieved if batteries are manufactured and implemented under the same optimised standards worldwide. There are several benefits of internationally harmonising safety and environmental testing processes:

- Interoperability of EVs;
- Increased administrative efficiency;
- Increased research collaboration and reduced testing overlap;
- Optimised tests through pooling of resources.

EUROBAT works alongside EU institutions to raise awareness of these advantages at a bilateral and international level. For example, the association took part in formal meetings between European and Chinese regulators and industry representatives, which have brought increased commitment from both parties towards the UN-ECE's international leadership and an agreement to reduce R&D overlap.

### Case study – Transatlantic Business Dialogue (TABD)

A prime example of how bilateral co-operation can induce mutual advances in electric vehicle and battery testing is the Transatlantic Economic Council (TEC)'s Transatlantic Business Dialogue (TABD) between European and American regulators and industry – including both the European Commission (including the JRC) and EUROBAT. TEC was established in 2007 as a political forum to guide and accelerate government-to-government co-operation and advance economic integration between the European Union and the United States of America. As a key topic of the TEC, a work plan on e-mobility was submitted in May 2011 by TABD, with the motivation to prevent



regulatory and standardisation barriers between countries that could impede the broad commercialisation of EVs.

As a direct result of this work plan, in November 2011 the JRC signed a letter of intent for closer co-operation with the US Department of Energy (DoE) on EVs and smart grids during the TEC meeting. The letter of intent facilitates the establishment of two Electric Vehicle-SmartGrid Interoperability Centres (EV-SG ICs), one at Argonne National Laboratory (ANL) and the other at the JRC-Institute for Energy and Transport (IET). This promotes a common approach between the EU and US on testing of relevant electric vehicle and smart grid equipment, and prioritises standardisation at a global level. The letter also addresses interoperability issues between e-vehicles, smart grids and recharging systems, including connectivity and communication capabilities.

Within this framework, the JRC-IET is establishing three new activities related to the electrification of transport:

- Electric vehicle performance testing – in Ispra, Italy;
- Interoperability & integration of smart grids – in Petten, Netherlands, and Ispra;
- EV battery energy storage testing – in Petten.

JRC's battery energy storage testing for safe electric transport (BESTEST) activity will provide impartial and balanced scientific evidence to ensure that European standardisation supports legislation and policies on clean transport which will ultimately facilitate the transition to a low-carbon and resource-efficient economy. BESTEST's role in the transatlantic letter of intent is to accelerate the electrification of transport by contributing to the development of harmonised testing methodologies and global standards specifically related to EV batteries. True to its mission, JRC-IET will channel particular attention to battery

BATTERY TECHNOLOGIES	CHARACTERISTICS
Lead-based (Pb)	Proven in application, low production cost
Nickel-based (Ni)	Proven off-shore & harsh environments, long life
Lithium-based (Li)	High energy density, small and light
Sodium-based	High energy density, light

performance, reliability and safety issues in the interest of the public and sustainability.

BESTEST activity will establish firm relations between the JRC and relevant European industries and their representative associations. Resultantly, JRC-IET and EUROBAT are currently formalising their joint collaboration, which is foreseen to include:

1. Streamlining pre-normative research activities on battery performance and safety testing and evaluation to best meet the priorities of European battery manufacturers and component suppliers;
2. Contributing to European and international standardisation and regulation by ensuring a sound scientific and technical basis for robust legislation and policies on clean, efficient and safe electricity storage particularly for transport.

Such mutual co-operation helps to highlight pertinent issues facing the European battery industry concerning battery testing (e.g. performance evaluation methods, need for independent evaluation, abuse tests, safety issues, etc.), and will ensure that, when appropriate, these issues are addressed in BESTEST's battery testing activities.

EUROBAT and the JRC-IET believe that mutual co-operation between Europe's battery industry and government will optimise the BESTEST programme's results, which in the framework of the TABD can feed into international level efforts to harmonise EV testing procedures within the UN-ECE WP.29 and IEC/ISO. The establishment of an internationally harmonised standardisation framework for EV/HEV batteries will facilitate the global commercialisation of EVs, and thereby accelerate Europe's transition to a low-carbon economy.

**Alfons Westgeest**  
Secretary General  
EUROBAT

**Dr Lois Brett, Scientific Officer**  
**Dr Andreas Pfrang, Scientific Officer**  
European Commission DG Joint  
Research Centre  
Institute for Energy and Transport,  
Cleaner Energy Unit

browse [www.eurobat.org](http://www.eurobat.org)  
<http://iet.jrc.ec.europa.eu/>

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