

# MAHLE

*Powertrain*



## Battery Development Centre

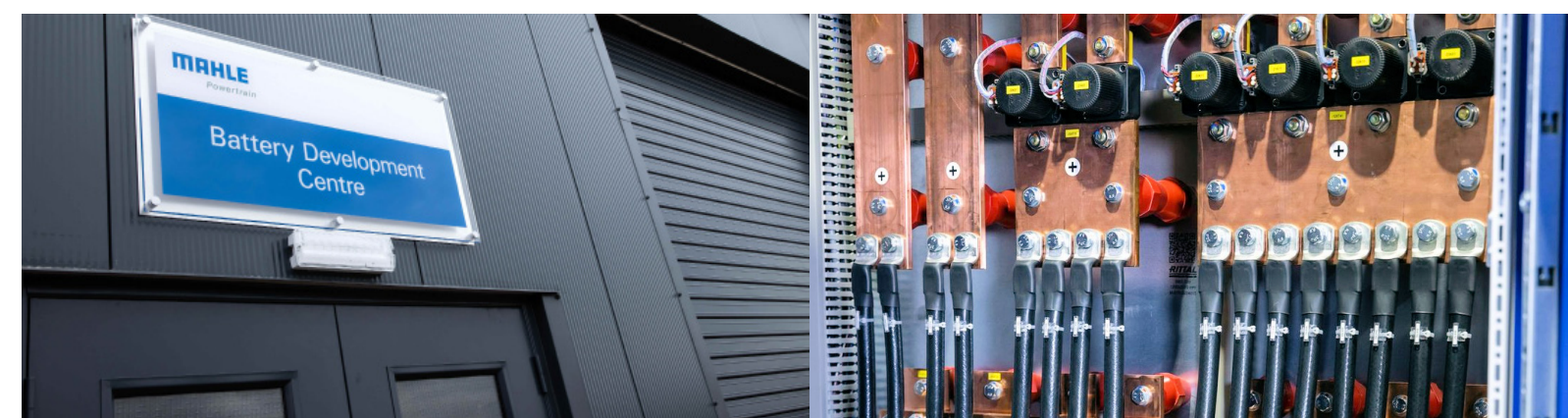
World's leading testing and development facility at the centre of our end-to-end battery development process

# Battery Development Centre

MAHLE Powertrain's state-of-the-art Battery Development Centre is fully equipped to support our customers with every aspect of development for the future of mobility.

The result of a multi-million pound investment programme in the UK, our purpose-built facility is the foundation of our end-to-end development process, backed by unrivalled expertise and an extensive range of engineering services – from the selection, simulation and testing of individual cells, through to the design and validation of assembled modules and complete battery packs.

This state-of-the-art centre incorporates climatic test chambers that can precisely mimic a variety of real-world conditions in temperature- and pressure-controlled environments. In Northampton, a dedicated National Grid connection with its own substation delivers up to 1MW of electrical power across each test chamber. Specially designed handling and storage systems ensure safe management at all stages, while full fire protection and rapid-response safety capabilities mitigate risk during the development process.



MAHLE Powertrain's facility in Northampton, UK, enable the full characterisation of individual cells, assembled modules and complete battery packs. Everything from steady-state testing of open circuit voltage, storage capacity assessments, and thermal characteristics can be tested and explored, including more complex tests such as voltage response under high discharge, thermal behaviour and internal resistance. Testing can be performed under full drive-cycle conditions, helping to evaluate the performance of battery systems in the context of real-world driving behaviour, even under extreme environmental conditions that would ordinarily necessitate an expensive and gruelling international testing regime.

Our infrastructure enables the safe disassembly of battery packs, supporting both the strip-down and inspection of post-test modules from field trials, as well as the assembly of new prototype units

The modular design of our facility ensures flexibility, with a breadth of capability that covers applications from small e-bikes to large electric trucks. The versatile design of our infrastructure also makes the BDC suitable for use by the off-highway, industrial and marine sectors, while allowing the fast yet cost-effective expansion of support in response to changing customer demand.

# Battery Testing

Our purpose-built facility forms a key part of the automotive industry's electrification strategy. We cover the entire battery development process, from simulation and analysis in the virtual world through to initial prototyping, small-scale production, real-world testing and verification. Our focus on the advanced understanding of battery architectures, control systems, charge rates and thermal management is central to our battery optimisation work.

## Key customer benefits:

Highly versatile - The only commercially available 1MW battery test chamber in the UK, making it suitable for a wide range of applications from on/off highway, industrial to marine sectors.

Reduced risk - The rapid-response safety capabilities of the test chambers mitigate the risk of thermal events during early prototype phases.

Faster to market - Faster to market - Utilising our full battery engineering team supports the analysis, design and development in the facility, streamlining and simplifying the product development process for customers.

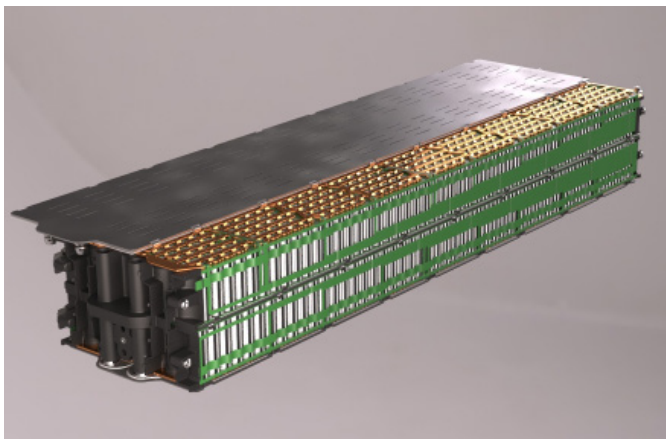
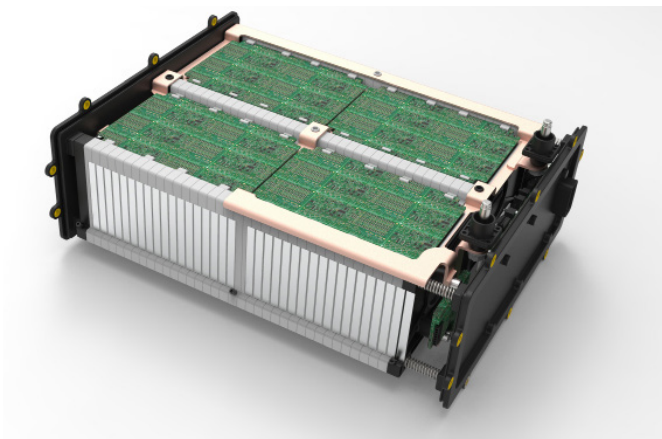
## Typical Programmes and Services

- Performance evaluation
- Charging / discharging at extreme rates
- Automated aging and real world cycles
- Battery cooling system optimisation
- Cell characterisation
- Pack verification

| Battery Test Facility Specifications |                      |
|--------------------------------------|----------------------|
| Max battery pack size:               | 2500 x 1600 x 500 mm |
| Max pack test current:               | 2400A                |
| Max pack test power:                 | 1 MW                 |
| Max pack test voltage:               | 1200V                |
| Test temperature range:              | - 40°C to + 90°C     |
| Humidity control:                    | 10% - 95%            |

## Additional Specifications

- Fire detection and suppression to BS 5839:2019
- Remote chamber control
- Bi-directional power supply for module testing with cycling control software and control of environmental chamber
- Dynamic test cycles possible as well as steady state characterisation



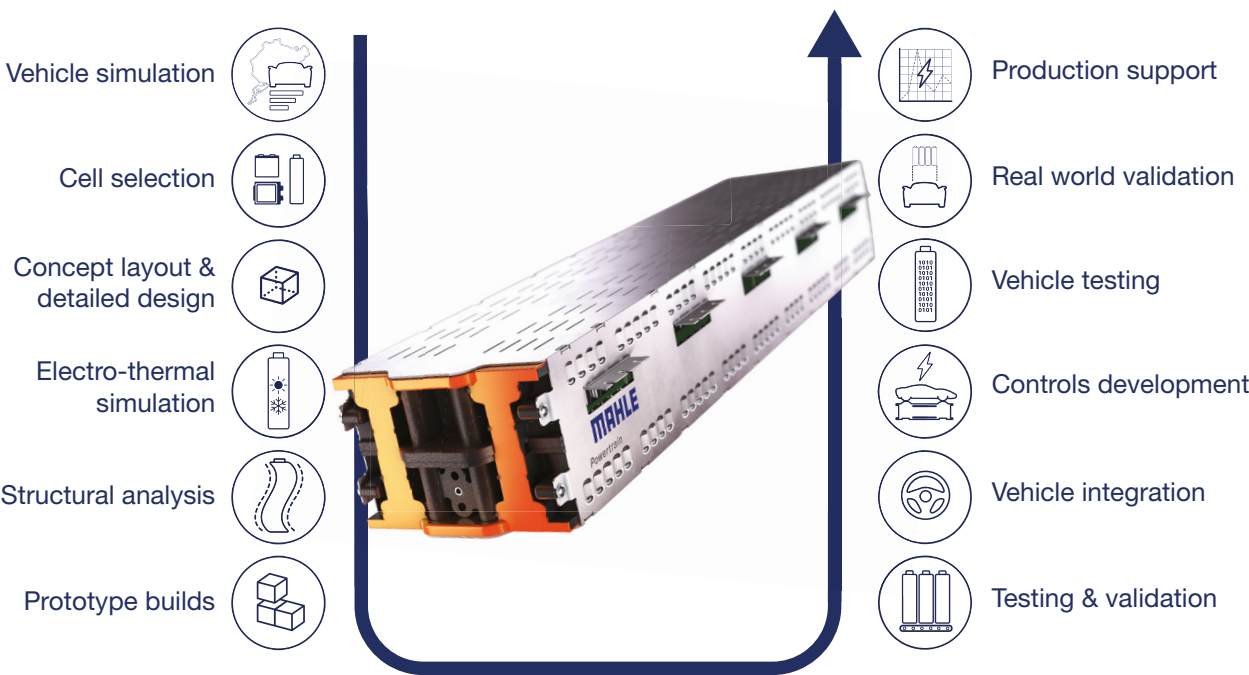
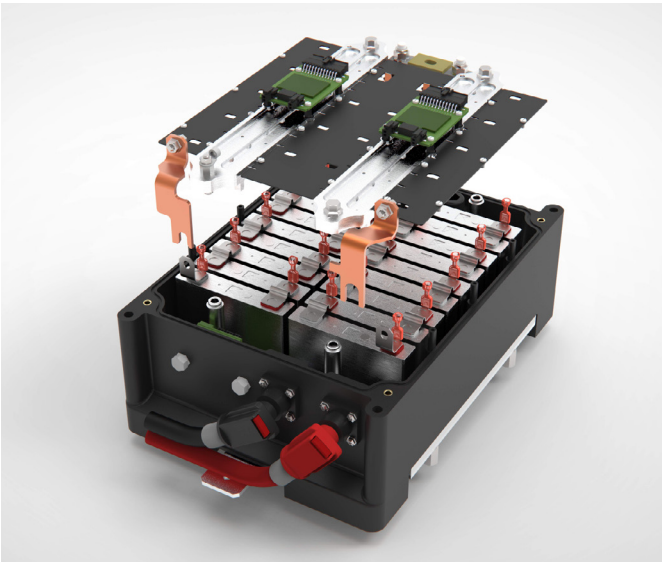
# Expertise to support turnkey battery development and testing

MAHLE Powertrain supports turnkey battery development and testing programmes with our world-leading engineering expertise, offering a comprehensive service that provides support throughout the entire development, test and validation process.

Our engineers can provide a complete testing, design and validation service and are on-hand to guide you through all stages of the development process, advising on interpreting complex data and providing guidance on how to resolve issues quickly and efficiently. This means that your battery test programmes become more efficient, saving you time and ultimately increasing the return on your investment.

The BDC currently runs on a 24/5 basis, with the flexibility to support customer programmes that require shorter turn-around times or a greater volume of in-chamber test cycles.

MAHLE Powertrain's engineers have years of experience in handling all design, test, simulation and calibration processes, freeing your engineering teams to focus on other critical aspects within your own development programme.



# Battery Applications for High Performance Vehicles

When developing battery packs for high performance vehicles, our philosophy is to optimise the battery cell technology to its full potential to deliver sustained high performance and maximise vehicle potential. We focus on advanced thermal management techniques to improve performance and utilise next-generation battery cells and architectures as a basis for our state-of-the-art battery pack solutions.

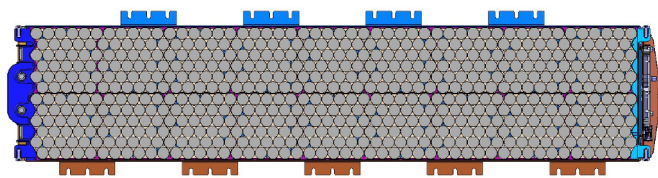
- Battery systems for sustained high performance
- Next generation battery cell technologies
- Target setting, system definition, concept layout and cell selection
- Thermal simulation at cell, module, pack and vehicle levels
- Detailed design with structural analysis
- Design, validation testing and vehicle integration
- Controls systems design and development (with MAHLE Flexible ECU)
- Assembly of prototype battery packs and production support
- Complete turnkey battery development service

# Battery Development Process

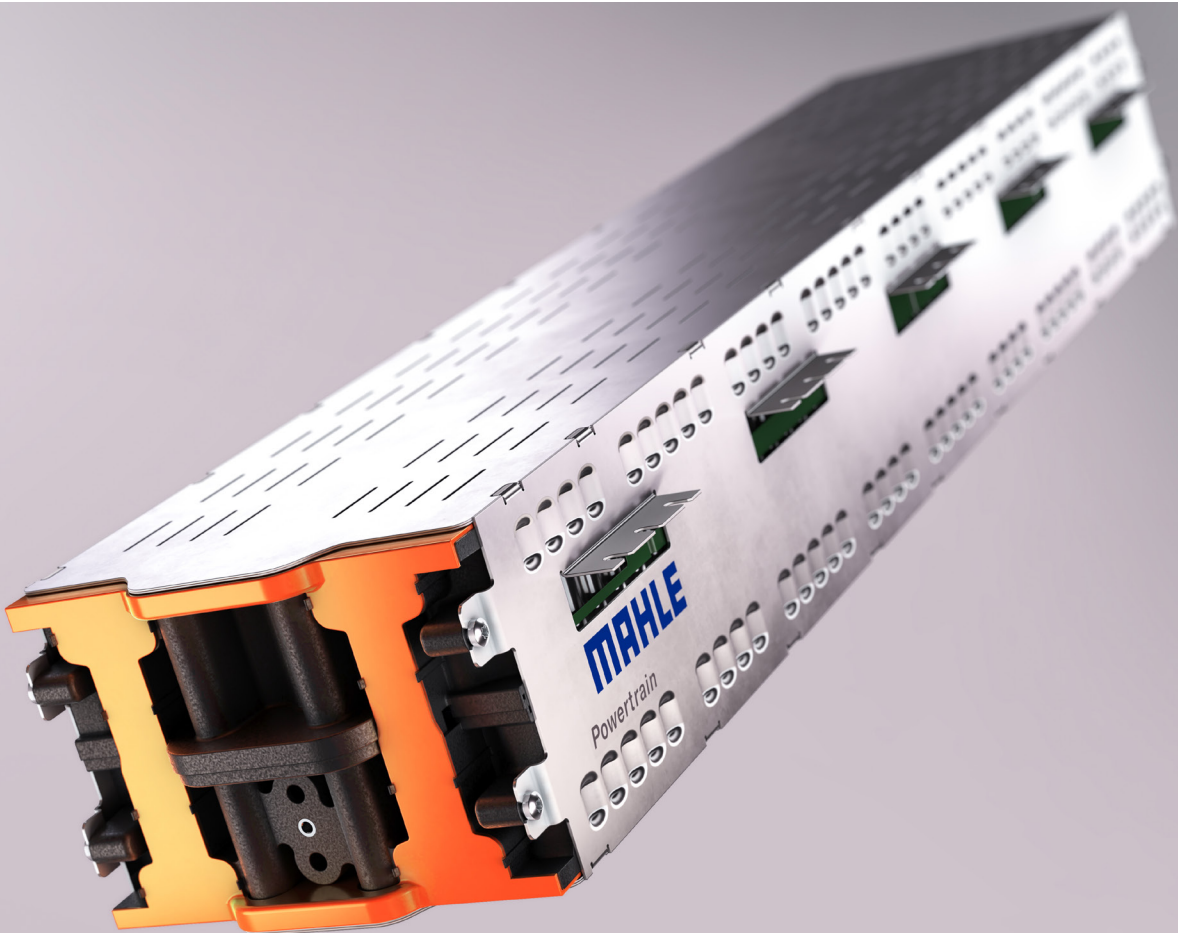
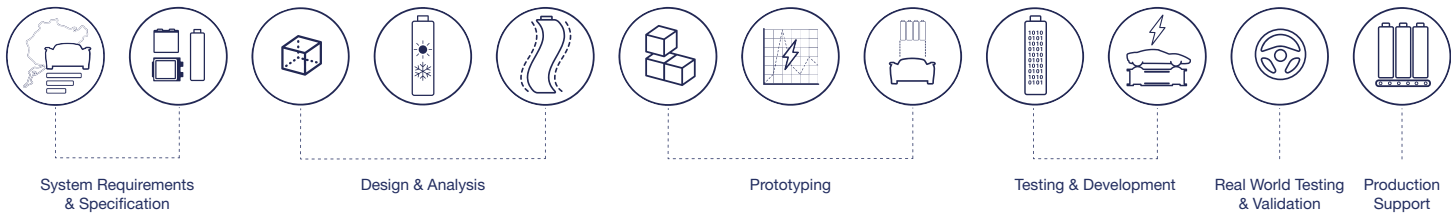
MAHLE Powertrain’s approach to developing new battery packs starts with the requirements of our customers – and even here we can assist with guidance that can lead to a better outcome. Our expertise allows us to provide support at every stage, from initial specification through to design and analysis, prototyping, testing and development, and even production support.

## The full battery development process

Our Battery Development Process is a step-by-step systemised process, covering the full range of development requirements for vehicle-based battery projects.



> Section view of high performance battery module





## Leading the way

With our state-of-the-art Battery Development Centre and unrivalled engineering expertise, MAHLE Powertrain is leading the industry in its adoption of electrified propulsion systems. Contact us today to discuss your battery development and testing requirements.

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MAHLE product information

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