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ŚKODA ELECTRIC



# Commercial Vehicle and Rail Battery Systems

High-performance, European-made lithium-ion battery systems for commercial vehicle and rail applications.





- We believe that zero emissions technologies should be the "mainstream solution" to power transportation – not just an alternative.
- Globally, transportation is responsible for 24% of direct CO<sub>2</sub> emissions from fuel combustion. Three quarters of this is from on-road vehicles – cars, trucks, buses and two- and three-wheelers.<sup>1</sup>
- Electrifying trains and commercial vehicles contributes to a notable reduction of CO<sub>2</sub> emissions, while also offering performance improvements, operational efficiencies and significant fuel and maintenance savings.

## How?

- We are one of the world's leading providers of high-quality lithium-ion battery systems which are ideally suited to fulfill the requirements of all commercial vehicle and rail applications.
- Our goal is to build long-lasting partnerships with major stakeholders in the industry to further the electrification of transportation.

## What?

- We engineer and produce our own lithiumion cells in our state-of-the-art European production facility.
- Safety is engineered into our solutions at all levels from cells to complete battery systems.
- Our industry leading cell cycle-life allows for long-lasting solutions that reduce the total cost of ownership.



<sup>1</sup> https://www.iea.org/reports/tracking-transport-2020

## Commercial Vehicle and Rail Battery Systems

Leclanché offers two types of battery systems for ground vehicles: the INT-39 Energy system for road, off-road, construction and agricultural machines, and the INT-53 Energy system for trains and locomotives. Should it be required, our experienced team of engineers and electro-chemists are able to design tailormade battery systems to suit any specific requirement.

#### INT-39 Energy Pack

#### B Leclanché Module

• Available with 60Ah Leclanché G/NMC high energy cell

#### Battery Management Unit (BMU)

• The BMU features multiple cell temperature sensors for maximum safety.

#### Liquid-cooling plate

- Installed between each module.
- Connected to IP65 enclosure to avoid leakage.
- Avoids hotspots and prolongs battery life.

#### Subpack

• Comprises of two or three modules.

The battery management system (BMS) is fitted within the pack enclosure.



## **Benefits and Advantages**



#### Performance

In-house designed and manufactured G/NMC and LTO lithium-ion cells with class leading energy density and cycle-life.



#### Reliability

Proven battery systems that meet customer needs across all ground transport segments.



#### Configuration

Standardized off-the-shelf battery systems which are configurable to meet any ground transport client.specifications.



#### Safety

Intrinsic safety from cell to pack level. Supplementary safety features can also be integrated if required.



#### Certification

Type-approved battery systems means our packs are ready for operation immediately. \*



#### Manufacturing

High capacity state-of-the-art automated cell and module production facilities based in Europe.

## Leclanché INTEGRATED Systems



A Battery enclosure

B Subpack (protection unit)

C Module with Leclanché 60Ah G/NMC Energy Cell

#### Certifications

- Road: ECE R-100 rev 2\*
- Rail: EN 50657 Safety
- Rail: IEC 62928
- Rail: IRIS ISO/TS 22163

## High voltage battery systems for commercial vehicle and rail applications

- Batteries and BMS all integrated into one pack
- Configurable for a large range of energy requirements
- Liquid-cooling and thermal hazard protection in every pack
- Real-time access to battery status, performance and diagnostic data via a comprehensive user interface
- Switch box and pre-charge circuit controlled by proprietary Leclanché BMS
- Stainless steel or aluminum pack enclosures
- Fully self-supported high strength pack structure (can be end mounted only if required)
- Standard CAN bus communication for system connectivity
- Expandable by integrating multiple packs using a multistring controller
- Up to 1000 VDC pack capacity
- Packs capacities from 39 to 53 kWh
- Systems capacities of up to 840 kWh
- G/NMC Industry-leading cycle-life: 8,000 cycles at 80% DoD (4,500 at 100% DoD)
- G/NMC Charge Rate: 120A (2C) continuous, 180A (3C) for 20s pulse
- G/NMC Discharge Rate: 180A (3C) continuous, 300A (5C) for 20s pulse



### INT-39 Energy

#### High energy battery system

Application	Commercial Vehicles
M2 Module Configuration	20s1p
Pack Nominal Voltage (V)	657
Pack Nominal Capacity (Ah)	60
Nominal Energy (kWh)	39.4
Maximum Continuous Discharge Power (kW)	118
Dimensions H x W x D (mm)	407 x 612 x 1266
Weight (kg)	372
Energy Density (Wh/kg)	106
Energy Density Wh/litre	125.6
Enclosure Material	Stainless steel





## MSM-G2-GRT

#### Multi-String Manager

An MSM is required when more than one battery is used in parallel.

Application	INT-39 Energy battery systems
Quantity of battery packs per MSM	1 - 8
Maximum System energy (KWh)	315
Dimensions H x W x D (mm)	166 x 254 x 373
Weight (kg)	3.7
Communication protocol	CANbus (classic CAN)
Hardware	Bosch
Software	Leclanché
Remote data-logging type (option)	GSM / Wifi

## INT-53 Energy

### High energy battery system

Application	Rail
M2 Module Configuration	20s1p
Pack Nominal Voltage (V)	876
Nominal Energy (kWh)	52.6
Maximum Continuous Discharge Power (kW)	158
Dimensions H x W x D (mm)	409 x 612 1631
Weight (kg)	505
Energy Density (Wh/kg)	104
Energy Density Wh/litre	118.9
Enclosure Material	Aluminium





## **Operation Modes**

Integrating a Leclanché battery system offers you a variety of significant benefits whether on fully-electric or hybrid trains and vehicles.

- Improved operational efficiency
- Lower running costs
- Substantial maintenance savings typically 50% lower than diesel vehicles
- Quiet, odorless and zero-emissions
- Contributing to the transition towards cleaner mobility solutions



#### Hybrid Traction

Achieve substantial fuel consumption savings by electrifying the drive-system for vehicles or trains.



### Regenerative Energy

Store and use energy regenerated from different sources, such as workload handling or regenerative braking, in full or hybrid-electric vehicles and cranes.

#### Peak Shaving

«Shave» off operational load peaks and re-use stored energy. Allow a diesel engine to perform an optimal constant average load. This improves effi-

ciency and reduces vehicle's wear and tear.



### Strategic Loading

Switch from diesel to electrical power for auxiliary power units: tipping, refuse compacting, crane load handling, refrigerating and many other commercial vehicle and rail operations at port, etc.



### Zero Emission Operation

Leclanché's commercial vehicle battery systems power your fully electric vehicle. No emissions, no fuel consumption and quiet operation.



# Technology

- At Leclanché, we pride ourselves on being in control of the entire battery system's development process, from cell design and manufacturing to complete solutions which incorporate our own dedicated battery management systems.
- Our experienced R&D team strives continually to develop cutting-edge, high energy

G/NMC & high power LTO lithium-ion cells, which also deliver class-leading cycle life.

- · We are working to a clear roadmap that sees continual improvements to the performance of our cells.
- Based on our R&D technology roadmap we will be delivering cell energy densities of 680 Wh/litre by 2023.



### Energy Density (Wh/litre) vs Cycle Life



#### CELL CAPACITY ROADMAP

## Leclanché Manufacturing Sites

An environmentally conscious manufacturing company:

- Cell manufacturing facility 100% powered by renewable energies.
- Conventional cell manufacturing involves the use of harmful solvents. Leclanché is the only company that manufactures all cell electrodes using patented waterbased binder technology.
- Automated cell production at our state-of-the-art facility in Germany.

Our production and engineering facilities are accredited with the highest international quality standards including ISO 9001, ISO 14001 and ISO/TS 22163 (IRIS). **Germany** Willstätt

**Switzerland** Yverdon-les-Bains



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### WE ARE ENABLING THE ENERGY TRANSITION

