



TECHNOLOGIES for Transformation

## FROM EXHAUST TECHNOLOGY TO NEW PRODUCTS AND NEW MANUFACTURING TECHNOLOGIES!

As a specialist in exhaust technology, the Boysen Group has been driving the technological transformation decisively since 2016.

With new product groups such as battery cases, hydrogen tank systems, control elements and electronic components, we are writing the next chapter in our more than 100-year company history - and offering our premium customers in the automotive and commercial vehicle sectors an outstanding variety of innovative manufacturing technologies.

Other elements of our future strategy are the production of energy storage systems (redox flow battery systems) and fuel cells as well as basic and product development in the field of hydrogen technology.

We are continuously growing on this strong basis: in the 2022 financial year, the Boysen Group, which currently employs around 5,200 people at 27 locations worldwide, achieved a turnover of 3.31 billion euros.



### TECHNOLOGIES for Transformation













### **READY FOR EURO 7!**

Our roots lie in silencer technology - exhaust technology is our core business. Leading automotive and commercial vehicle manufacturers rely on our expertise in development, production and logistics.

With high-tech and passion, we are constantly approaching our vision of "zero emissions". Proof of our innovative spirit is the wide range of new developments with a focus on Euro 7. In order to meet the high requirements of the new emissions standard, it is particularly important to bring the catalytic converters to the optimum operating temperature as quickly as possible during the cold start phase and thus to achieve the best possible exhaust treatment performance.

For **gasoline engines**, we offer suitable solutions with product innovations such as the electric heating disc and the Rapid Catalyst Heater (RCH). Further optimization possibilities are opened up by increasing the catalytic surfaces by means of additional or finer substrates, which are controlled via increased use of sensor technology (lambda sensors and temperature sensors).



In the case of **diesel engines**, in addition to electric heating discs and additional sensors (lambda sensors as well as  $NH_3$  -,  $NO_x$  and temperature sensors), we are also focusing on the increased use of double SCR systems as well as optimized urea processing within these systems in order to further minimize nitrogen oxide emissions.

Other important approaches to reducing fuel consumption and the CO<sub>2</sub> balance are in the areas of lightweight construction and backpressure optimization. And with the modular Boysen exhaust flap, the vehicles of our premium customers also fully meet the current acoustic requirements.









### STARTING IN 2025 WE WILL GO INTO SERIES PRODUCTION!

The battery is the heart of an electric vehicle - the battery case is the protective shield. The requirements for this protective shield vary depending on the battery cell and vehicle concept.

As part of the transformation process within the Boysen Group, our engineers have built up extensive expertise in the development and manufacture of battery cases for e-vehicles. The goal is to provide maximum protection for the most expensive and sensitive component, especially with regard to crash safety and fire protection.

#### Highest competence in materials ...

For this reason, we have mastered the entire spectrum of different construction methods from extruded aluminium profiles and die-cast components, from joined deep-drawn sheets, from steel and especially stainless steel - and also the mixed construction methods, for example from deep-drawn aluminium and steel sheets.





#### Process technologies ...

Essential for corrosion protection and tightness requirements are the corresponding surface technologies such as cathodic dip coating (CDC), powder and PVC coating. Equally necessary is a high degree of know-how in corresponding joining processes such as semi-tubular riveting and adhesive bonding, as well as in the sealing of joining components, such as PVC seam sealing.

#### ... and sustainable manufacturing!

These technologies are brought to perfection in our two new production plants in Hungary and southern Germany, which we operate 100 per cent with green electricity based on state-of-the-art energy concepts. Starting in 2025, we will produce up to 1,000 battery cases per day for the next vehicle generations of two German premium car manufacturers.







# From case to completion and upgrading:

Building on this, we also open up customized solutions for our customers in the completion and upgrading of battery systems for e-vehicles of all kinds: from automobiles and commercial vehicles to off-road applications.



### THE BEST SOLUTION: TECHNOLOGY OPENNESS!

The hydrogen-powered fuel cell offers enormous potential for operating commercial vehicles economically and in an environmentally friendly way. Currently, applications with liquid hydrogen (sLH2) and gaseous hydrogen (CGH2) are mainly being discussed. In accordance with the technology openness, Boysen is developing suitable tank systems for both applications. The first prototypes are currently being tested. The tanks are to be approved by the Federal Motor Transport Authority from 2024.



#### COMPARISON OF STORAGE TECHNOLOGIES:

#### sLH2-tank (16 bar)

Liquid hydrogen has a higher storage density than gaseous hydrogen. As a result, sLH2 tank systems have the advantage of a higher storage mass with a smaller footprint. We see our sLH2 tank system as the solution for long-haul trucks and non-road applications with increased power requirements.

#### **Challenges:**

The storage of liquid hydrogen takes place at -246 degrees Celsius and places high demands on the insulation. The tank system developed by Boysen consists of an inner and an outer tank. Between them is a minimal gap in high vacuum, which is filled with multi-layer insulation. In this way, we manage to minimize the heat input decisively. To prevent excessive pressure forces within the system, Boysen is currently testing a safety system (Boil-off Management System) that allows the hydrogen to react with oxygen and drains the resulting water in a controlled manner.







### CGH2-tank (700 bar)

350-bar storage systems are currently in use for commercial vehicles. This is another reason why CGH2 tank systems benefit from an already existing filling station infrastructure. However, due to the lower storage density compared to liquid hydrogen, more space is required for storage. We therefore see our CGH2 tank as suitable for distribution trucks and/or buses.

#### **Challenges:**

In contrast to the 350 bar applications already available, Boysen is developing a CGH2 tank with 700 bar pressure. This allows us to increase the storage volume 1.7 times. However, in order to achieve the target range of 1,000 kilometers, an additional frame for further tanks must be installed in the vehicle. In addition, there are special demands on the design, especially since the storage system is exposed to enormous forces at 700 bar: a tank consists of a valve/sensor unit, an outer skin made of carbon fiber material and an inner skin made of plastic. Our engineers are working on designing the CGH2 tank to withstand a burst pressure of 1,750 bar.



OPTIONS

MENU

BACK

### EASE OF USE AT ITS BEST!

With the acquisition of helag-electronic at the beginning of 2020, the Boysen Group has expanded its product competencies to include switches, control panels, controllers, sensor technology and control units.

From the idea to production, we work on the electronic development of control devices based on Asic and controllers, create hand samples and small series with silicone or steel tools. Innovative sensor applications make monitoring and controlling processes simple and efficient. For operating systems and components, we offer a perfect combination of different mechanical and touch-based functions. In short: every challenge becomes a functional, efficient and innovative solution in our halls.

The best example of our innovative spirit is the helag HMI operating concept with high-resolution display and touch-based operating system placed on the steering wheel. The concept enables the driver to intuitively select various functions. Information is clearly displayed and the function selection is immediately confirmed mechanically.

As part of the Boysen Group, helag-electronic has been operating together with Alwa Dekotec, the specialist for plastic injection moulding, since 2021. How synergy effects are optimally used is shown by the example of the control elements in the Ineos Grenadier: the injection moulding and painting parts are predominantly manufactured at Alwa Dekotec, while helag takes 1/15 over the complete electronics assembly with subsequent final OFFROAD assembly.







Member of Boysen Group

### **USE GREEN ELECTRICITY INTELLIGENTLY!**

Safe, durable, powerful: redox flow batteries are ideally suited for storing renewable energies and using them intelligently at the perfect time. The Boysen subsidiary Volterion has taken this technology of the future to the next level and thus made a decisive contribution to the success of the energy transition.

The result of this work can be seen in the stack and thus in the heart of the redox flow battery (RFB): Thanks to a completely new design and manufacturing principle, Volterion stacks do not require leak-prone seals or heavy and cost-intensive end plates made of steel.

Due to the resulting material savings, Volterion stacks are around 50 per cent smaller and 80 percent lighter than conventional stacks.

#### THE ADVANTAGES OF THE VOLTERION STACKS:

- significant material and cost savings through innovative stack design
- high quality due to industrial production processeasy handling due to compact design:
- 28 kg vs. 128 kg for a conventional 4 kW stack
  less effort for installation and maintenance

# From the stade

# From the stack to the complete system:

The sum of all advantages is the Volterion powerRFB, which is ready for immediate connection and operation - and thus the complete energy storage system - available from 4 kW output (13 kWh storage capacity) up to the container solution with 128 kW output (215 kWh storage capacity) for industrial applications.







### SUSTAINABILITY CREATES A LEADING EDGE!

For us as developers and manufacturers of systems and components that ensure a decisive reduction in pollutant and noise emissions in our customers' vehicles, environmental protection is an essential part of our business.

Sustainability was our guiding theme long before it became a trend. As early as 2011, we realised our vision of a CO<sub>2</sub>-optimised factory at our headquarters in Altensteig. Since then, we have been using stateof-the-art energy technology such as ice storage, geothermal energy and natural cooling at Boysen sites. With our photovoltaic systems at all sites, we currently produce more than 40 million kilowatt hours of green electricity per year, which corresponds to an annual CO<sub>2</sub> saving of around 30,000 tonnes.

Since mid-2023, the Boysen Group has been one of the world's first suppliers to manufacture parts of its products from sustainable stainless steel - and thus also decisively optimise the CO<sub>2</sub> balance sheet of its customers. We are setting the new benchmark on the way to green production together with Outokumpu, the global market leader in the stainless steel industry, and thyssenkrupp Materials Processing Europe. Circle Green from Outokumpu is considered the most sustainable stainless steel in the world with a CO<sub>2</sub> footprint up to 92 percent lower than the industry average. No competitor achieves similarly low values in stainless steel production.







And because some developments are not fast enough for us, we take them into our own hands. Proof of this is, among other things, the Boysen Hydrogen Centre in the Northern Black Forest, which we are realising in Simmersfeld with an investment volume of 50 million euros. Here we will decisively advance both basic development (e.g. bipolar, membrane, coating/catalyst) and product development (e.g. fuel cell, electrolysis) in the field of hydrogen technology.







## **LOCATIONS**

#### **RESEARCH AND DEVELOPMENT LOCATIONS**



assenger car & battery casing





**BIN Nagold** 

Com. vehicles & tank systems

Energy storage



Passenger car special projects



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#### **PRODUCTION PLANTS GERMANY**



















#### **INTERNATIONAL PRODUCTION PLANTS**



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Boysen USA, Spartanburg













BSA East London, South Afr







