

BEAT®50

A New Dimension of Battery Performance

The Long-life Solution for Bus and Coach Travel



En Route to More Power

Buses are a versatile and affordable means of transportation for urban areas, as shuttles and for travel. In Europe, the number of new bus registrations has recently seen steady incline. In order to compete successfully, bus services need to be inexpensive, reliable and also comfortable.

Double Function—Double Strain

Motive batteries serve two functions: starting the engine and providing energy for the electronic systems on board. Buses are usually powered by two 12V lead acid batteries, which still outperform other battery systems in terms of price, cold-cranking ability and reliability. Nevertheless, the increasing demand for amenities and safety put a strain on batteries. They must be replaced every 18 months on the average, while they can theoretically last for much longer. Coaches may even have four batteries, which are usually also replaced much sooner, namely after about six months.

On-board Electronics

A multitude of technological innovations, from powerful ventilation and air conditioning systems to monitors, video surveillance, wifi and coffee makers, make travel safer and more convenient. Fulfilling these additional tasks drains battery capacity. Some electronic innovations consume energy even when the bus is switched off.

Charge Cycles

The immense power demand can lead to deep discharge. At the same time, bus batteries often experience incomplete charging during short runs. Both effects reduce the reaction site within the lead acid battery. The battery becomes weaker, which in turn affects the generator. Although generators are built to last for 400,000 km, they only last for between 150,000 km and 250,000 km respectively two to three years. The purchase of a new generator accounts for € 400 to € 550 plus man hours and down time.

Starter Problems

After weekends, batteries often lack enough energy to start the engine. One reason is electronic equipment that consumes energy in stand-by mode. Another problem is cold weather, which reduces battery capacity. Many bus companies report that as a rule of thumb, a bus needs starting assistance once a week. If battery failure occurs abroad, it causes delays as well as service costs of about € 1,350.

As a preventive measure, many new buses are equipped with a second set of two 12V batteries that serve as starter batteries only, while the other battery pack caters to the various electronic systems. At about € 150 per battery, installing a second set of batteries results in considerable costs.

BEAT®50 counters all of these challenges. Discover the technology that puts you in control.

Crystal Control Technology[®] at a Glance

Crystal Control Technology[®] leads to significant improvements in battery capacity and life span by manipulating the electrochemical processes in lead acid batteries. It enables surface control of the electrodes and increases the reaction sites.

Lead batteries store energy by means of a chemical reaction between lead and lead dioxide at the electrodes and sulphuric acid. The different electrode surface materials generate voltage. The most detrimental effects on battery capacity and useful life are the growth of lead sulphate crystals on both electrodes, which destroys the imbalance of the surfaces, and a lack of density in lead dioxide crystals on the positive electrode, which reduces the energy density.

During charging, lead sulphate is dissolved and the lead dioxide layer is renewed, but not completely. With every cycle, the unwanted crystals form an increasingly impenetrable barrier while lead dioxide crystals tend to bind to existing crystals in a heap instead of distributing evenly across the electrode surface. Over time, the battery loses its capacity.

Crystal Control Technology[®] slows down battery ageing by using overvoltage pulses to manipulate the charging process. This creates more overvoltage at the battery

electrodes and the additional energy in electrolyte helps to increase the movement of the ions with three beneficial effects:

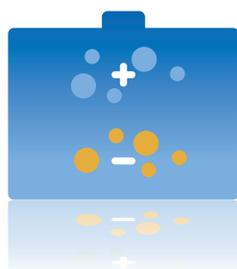
- Residual lead sulphate is more effectively dissolved from both electrodes, increasing battery life span
- Lead dioxide forms a more even coating on the positive electrode, increasing battery capacity
- Increased charge efficiency

Independent research institutes have tested BEAT[®] and verified its effectiveness. It has been validated by MIRA Ltd. (UK), SINTEF Materials and Chemistry (Norway) as well as various battery manufacturers, and is already successfully employed around the globe.



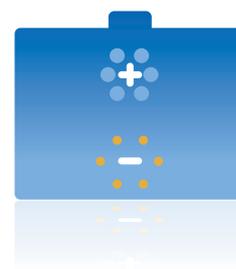
Find out more about
Crystal Control Technology[®]

Ageing process in untreated batteries



- At the positive electrode, lead dioxide crystals form heaps that reduce the reaction site
- Lead sulphate crystals are not effectively dissolved and form a physical barrier on the negative electrode

Renewal with Crystal Control Technology[®]



- Lead dioxide forms an even coating on the positive electrode to renew the reaction site
- The increased ion movement effectively rids the negative electrode of lead sulphate crystals

BEAT[®]50—the Innovation for More Energy

Make the most of your batteries by using BEAT[®]50. Especially designed for high stability and durability, BEAT[®]50 delivers improved performance and significant savings. It employs WaveTech's patented Crystal Control Technology[®], which benefits batteries in various ways.



Increased Life Span

The useful life of a battery varies depending on its operating conditions. Stop-start-systems and extreme cold reduce battery capacity to the point of provoking battery failure within just a few months. Heat, in contrast, can about double the ageing rate.

Crystal Control Technology[®] has proved to double the useful life of a battery under the harshest conditions. Even when applied to worn batteries, BEAT[®] has stopped the ageing process. Batteries that last twice as long cut battery costs in half.



Higher Capacity

The progressive reduction of the reaction site and the lack of lead dioxide crystals within the battery causes its capacity to dwindle. This results in shorter discharge times and a decrease in discharge current, both of which affect battery reliability and operating costs.

Batteries treated with Crystal Control Technology[®] show improved capacity retention. Even after repeated charge cycles their capacity is 340% higher than that of untreated batteries. Already weak batteries show restored performance by reaching higher voltages and discharging more slowly than before.



BEAT[®]50 is a light-weight, hand-sized add-on that is easily attached to the battery by means of its flexible connecting cables



Improved Energy Output

Numerous electronic systems on board buses and especially coaches have caused energy consumption to surge. It becomes increasingly difficult for batteries to keep pace with all the innovations for more comfort, entertainment and security.

Due to a considerable capacity increase with BEAT[®]50, batteries produce a steady flow of high voltage to provide more power.



Reduced Downtime

System breakdowns are an important cost factor for bus and servicing companies. Not only do they need to purchase and store sufficient spare parts. They also have to keep back offices that are available 24/7 as well as a network of easily accessible service stations to remedy problems swiftly.

BEAT[®]50 lends batteries added mechanical stability, optimises energy acceptance as well as output and alleviates harmful influences. Less downtime helps bus companies keep their schedules, and service contractors save costs.



Optimised Charging Process

If the engine provides power for a longer stretch of time, battery capacity is sufficiently restored. Short runs, however, lead to inefficient charging.

Due to higher capacity retention with BEAT[®]50, batteries need less frequent recharging and charge about 14% faster. It also requires 20% less current, because the batteries accept higher voltages.



Less Sensitive to Extreme Temperatures

Batteries are hardly protected against ambient temperature let alone the heat radiation from the engine. Climatic conditions are the most important factor for both, battery failure and ageing.

BEAT[®]50 renders batteries less sensitive to extreme temperatures. Batteries have demonstrated improved stability and a longer life span under extreme climate conditions ranging from -20°C to +50°C.



Higher Stability

The active material within the lead acid battery suffers from deep discharge, undercharge and other consequences of incorrect treatment.

Since BEAT[®]50 controls the electrochemical processes that renew the reaction sites, it strengthens the battery against such effects. The result is a reliable power supply that keeps the voltage stable and reduces the strain on batteries.



Good for the Environment

Countries all over the world are enforcing standards limiting the emission of greenhouse gases. Eco-friendliness has therefore become a common requirement in the procurement of bus routes.

CO₂ emissions from battery manufacturing and recycling amount to 57.71 kg CO₂eq. By prolonging battery life with BEAT[®]50 they are reduced by 67%, not to speak of the much higher indirect emissions caused by roadside assistance cars, spare parts logistics etc., which decrease as well. In addition, output voltage and battery uptime are improved, which necessitates less fuel consumption. BEAT[®]50 thereby helps your company minimise its ecological footprint by saving resources, fuel and CO₂ emissions.

An Investment that Pays off

Discover how a onetime investment translates into long-term savings. BEAT[®]50 combines a short payback period with a useful life of ten years to provide an effective solution for various battery challenges as demonstrated by actual customer experience.

Focus on Battery Performance

A leading European bus and coach manufacturer sought ways to prolong battery life and minimise starting problems. His aim was to increase customer satisfaction and reduce expenditure during warranty periods.

The electronic systems of one bus type in particular used so much energy in stand-by mode that the battery failed to start the engine when the bus had not been used for a few days. Battery life span was limited to an average of 1.5 years for buses in public transport, while coaches often required battery replacement after only six months.

Since the increasing power demand of electric entertainment and safety systems weakened batteries quickly, the company detected harmful effects on generators. Recharging strained batteries taxed them so much that they usually had to be replaced every two to three years after reaching 250,000 km at most instead of lasting for 400,000 km.

Battery Failure as a Cost Factor

Considering the battery and generator replacement rates the customer experienced, it follows that a bus operating on two 12V batteries requires four new batteries and a new generator within three years. Considering acquisition as well as related costs the three-year expenses break down as shown in the table.

Battery acquisition cost (four 12V batteries)	€ 640
Workshop hours (two hours)	€ 190
Roadside assistance	€ 200
Generator replacement	€ 400
Back office, logistics, storage space	€ 70
Total costs over three years	€ 1,500
Annual costs	€ 500

Accordingly, poor battery performance and failure accounts for annual costs of € 500 per bus. Aside from that, battery-related downtime causes delays that jeopardize schedules and customer satisfaction.

No Replacement in Two Years

For two years, the customer monitored the impact of BEAT[®] on metropolitan buses as well as coaches, which are usually equipped with more amenities. Not a single battery or generator had to be replaced during this period.

More interestingly, the batteries never failed to start the engine, even though they operated under the same conditions as before including stand still for several days, at times very cold weather and high power consumption by electronic systems during operating and stand-by hours. Instead of requiring starting assistance every week, the tested buses did not need it once. The batteries also showed increased capacity due to optimised charge behaviour.

BEAT[®]50 Offers Savings Potential

By doubling the useful life of batteries and tripling their capacity measured over the lifetime, BEAT[®]50 cuts costs in half. The annual savings in battery related costs amount to € 250.

The payback period for BEAT[®]50 is less than 12 months, while it has a useful life of 10 years. Over this time span, BEAT[®]50 enables accumulated savings of about € 2,500.

Operational Benefits

A manufacturer of batteries for buses and trucks measured the product's influence on life span and capacity. It had never been possible to reach a target of 250 charge cycles before the capacity dropped below 75%. After the installation of BEAT[®], batteries maintained this level for 345 cycles. Thereby, they even surpassed the requirement of 300 charge cycles that many battery customers in the automotive sector now demand by 15%.

During a three-year trial period on motive batteries, one customer experienced that the average life was almost tripled from seven to 20 months. Some of the batteries were even used for over 31 months.

The technology demonstrably slows down the ageing process and provides more energy over a longer time. The same holds true for the individual charge cycles. Due to improved capacity retention, discharge time can be tripled.

With Crystal Control Technology[®], battery performance reaches new dimensions to meet the demands of today's transportation. Save costs on service or warranty and add extra reliability to motive batteries for a power supply that surpasses expectations.





For batteries that

- last twice as long
- have three times as much capacity
- work reliably and efficiently even under extreme conditions
- charge more rapidly and economically
- and reduce your ecological footprint

Take battery performance to
the next level with
BEAT[®]50

For the Best Connection

Contact our experts at WaveTech for more information on how your company will benefit from BEAT[®]50.

We will be happy to advise you according to your special requirements!

WaveTech GmbH Deutschland
Marie-Curie-Str. 5
53359 Rheinbach, Germany
Fon +49 (0) 2226 871550
Fax +49 (0) 2226 871559
post@wavetech.de
www.wavetech.de



WaveTech was founded in 2003 with the ambition to take battery efficiency to a higher level. Expert knowledge and innovative strength paved the way for the development of Crystal Control Technology[®], which forms the basis for the BEAT[®] product family. With a clear focus on research and quality, the German-based company provides solutions for a broad range of battery applications in the telecommunications, automotive, power storage and other sectors.