

**BEAT<sup>®</sup>50**

# A New Dimension of Battery Performance

The Long-life Solution for Safe Refrigeration



# Reliable Power for Timely Transport

Refrigerated transport has improved our everyday life by providing fresh food and other temperature sensitive goods in a safe way. The challenge of transporting perishable freight over long distances has inspired innovation in cooling units, vehicles and even battery technology. WaveTech's revolutionary BEAT®50 is an add-on that improves battery reliability and performance to make refrigeration even safer.

## Battery Powered Refrigeration

Batteries in refrigerating units serve as power supply and starter battery for the cooling engine that turns on when the temperature inside the trailer rises. These batteries experience many short runs, but also long stand-by periods during which the refrigerating engine generates power. At times, the whole refrigerating systems is not used for several days. All of these factors as well as harsh outside conditions take their toll on the battery.

## Extreme Temperatures

At times, a single trip takes refrigerating trucks through regions with very different climate, for example, from arctic Norway to the warm Mediterranean. Every climate zone poses different challenges on battery performance. Cold weather reduces the capacity and can cause starting difficulties, while heat accelerates the ageing process. As a result, the battery of a refrigerating unit has to be replaced one to four times a year. In a severe winter, batteries can even fail within a few weeks of their installation. At this replacement rate, service contracts for 1,400 refrigerating systems require about 2,000 to 2,500 batteries every year.

## Taxing Operating Conditions

Frequent starts and stops of the cooling system due to temperature variations within the trailer put a strain on the battery. Short hits for pulses of energy drain its capacity, while the engine does not run long enough in between to fully restore the amount of energy the battery is giving off. In these cases, charging is inefficient, while the refrigerating system has to rely solely on the battery, when the truck is parked. If the battery is too weak to provide sufficient power during this time, the freight can be at risk. At the same time, batteries show starting problems when the truck or the refrigerating system have not been running for several days.

## Battery Downtime

Not always can battery failure be anticipated and the battery exchanged in time. When replacement becomes necessary during a trip, an expensive process is set in motion encompassing service stations, logistics and battery costs for the service contractor. For the trucking company every battery failure also leads to downtimes that endanger punctual delivery. Improved battery reliability helps limiting service and warranty cost while providing extra safety for satisfied customers. Discover how BEAT®50 puts you in control of wear and tear to reduce costs and battery failure.

# 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:

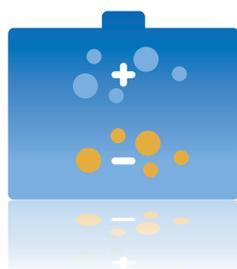
- Residual lead sulphate is more effectively dissolved from both electrodes, increasing battery life span
- Lead dioxide forms a more even coating on the positive electrode, increasing battery capacity
- Increased charge efficiency

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.



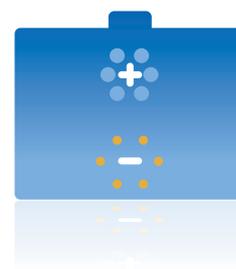
Find out more about  
Crystal Control Technology®

## 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<sup>®</sup>50—the Innovation for More Energy

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



## Durability

The useful life of a battery varies depending on its operating conditions. Frequent short runs 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<sup>®</sup> has proved to double the useful life of a battery under the harshest conditions. Even when applied to worn batteries, BEAT<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup>50 is a light-weight, hand-sized add-on that is easily attached to the battery by means of its flexible connecting cables



## Reduced Downtime

System breakdowns causing downtime are an important cost factor for 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<sup>®</sup>50 lends batteries added mechanical stability, optimises energy acceptance as well as output and alleviates harmful influences. The result is less downtime caused by battery failure, which helps trucking companies keep their timings and service contractors save costs.



## Optimised Charging Process

If the diesel 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<sup>®</sup>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 in refrigerated trucking units are hardly protected against ambient temperature let alone the heat radiation from the engine respectively the airflow while driving. Climatic conditions are the most important factor in both battery failure and ageing.

BEAT<sup>®</sup>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 as well as from mechanical vibrations.

Since BEAT<sup>®</sup>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, for example, by means of penalty payments.

CO<sub>2</sub> emissions from battery manufacturing and recycling amount to 57.71 kg CO<sub>2</sub>eq. By prolonging battery life with BEAT<sup>®</sup>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<sup>®</sup>50 thereby helps your company minimise its ecological footprint by saving resources, fuel and CO<sub>2</sub> emissions.

# An Investment that Pays off

Discover how a onetime investment translates into long-term savings. BEAT<sup>®</sup>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 during a three-year trial period.

## Focus on Battery Reliability

A leading manufacturer of refrigerating systems for trucks identified potential for improvement regarding battery life and reliability. On the one hand, his goal as a manufacturer was to further evolve his products and increase their reliability. As a service provider on the other hand, he also had a strong financial motivation to reduce downtime and increase customer satisfaction.

The company's focus was on trucking in central and northern Europe. As key problems for the given regions, the customer named strong temperature variations causing engine starting problems in cold regions especially in winter and fast ageing in hot climates as well as frequent stops and starts of the cooling system.

## Battery Failure as a Cost Factor

With battery replacement age averaging 7.5 months, 2,000 to 2,500 batteries had to be bought every year amounting to at least € 600,000 in direct battery cost alone. As part of the service contract, the company also covers the expense for logistics to the service station as well as for roadside help, installation etc. The sample calculation is conservatively based on € 95 per man hour, while the price can be much higher if the failure occurs abroad during long hauls. Based on a typical rate of two battery replacements annually, the costs for one refrigerated trucking unit over the course of one year amount to:

Battery acquisition cost (two 12V deep cycle batteries)	€ 620
Service costs (two workshop / man hours)	€ 190
<b>Total</b>	<b>€ 810</b>

## Longer Life for New and Used Batteries

BEAT<sup>®</sup>50 was mounted on 15 batteries, ten of which had already been in operation for an unknown period of time, while the rest were new batteries. The effects were then monitored over a span of 31 months, after which five of the tested batteries were still in use. Three of them had been used before the test started and were accordingly still older. Without Crystal Control Technology<sup>®</sup> in comparison, batteries had lasted a maximum of 12 months, while some were useless after only three months.

Depending on the different conditions the individual batteries were exposed to, the results varied. Nevertheless, the customer experienced improved durability in the face of extreme temperatures, summer and winter alike. The batteries were also less vulnerable to frequent stops and starts, longer inactivity etc. The findings surpassed expectations by far. On the average, the life span increased by 186%. The average rose from seven to 20 months.



## BEAT<sup>®</sup>50 Offers Savings Potential

Calculating conservatively with a doubled life span, BEAT<sup>®</sup>50 cuts the annual costs per refrigerating unit in half and enables savings of € 405. The actual test results as shown here, however, allow a much more optimistic outlook. With an average of 20 months, the common life span is nearly tripled. The annual costs are therefore not only half as high as without BEAT, but only about one third of the original costs. The annual savings accordingly amount to € 525.

The payback period for BEAT<sup>®</sup>50 is about three months, while the typical useful life of a refrigerating system as well as that of BEAT<sup>®</sup>50 is up to 10 years. Grossed up over this period, the accumulated savings—calculated conservatively with a doubled life span—minus product acquisition cost of € 85 amount to about € 4,000. On the basis of 20 months average life span, the savings over ten years accumulate to € 5,250.

## Operational Benefits

Verification tests with various research institutes and companies have proved similar effects. One customer experienced a significant improvement in discharge time and voltage. While untreated batteries had reached minimum voltage after less than two hours, this time span tripled to around six hours with BEAT<sup>®</sup>50. Equipped with Crystal Control Technology<sup>®</sup>, batteries reach new dimensions in terms of life cycle, reliability and capacity.

PAYBACK PERIOD  
**<3 MONTHS**

SAVINGS OVER 10 YEARS  
**>€ 5,250**





## 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<sup>®</sup>50**

## For the Best Connection

Contact our experts at WaveTech for more information on how your company will benefit from BEAT<sup>®</sup>50.

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

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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<sup>®</sup>, which forms the basis for the BEAT<sup>®</sup> 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.