

Industrial Batteries / Motive Power

TENSOR



»The **high performance battery** for demanding requirements and maximum efficiency«

TENSOR

The unique high power battery for maximum economic efficiency

TENSOR – Power that pays

The increasing demands of modern trucks require batteries which comprise high performance and energy efficiency. Based on many years extensive experience of producing high performance batteries (e.g. for submarines), GNB has now developed the next generation of lead-acid batteries.

The core benefits of TENSOR are the increases in performance, capacity and energy efficiency.

Advantages over conventional traction batteries:

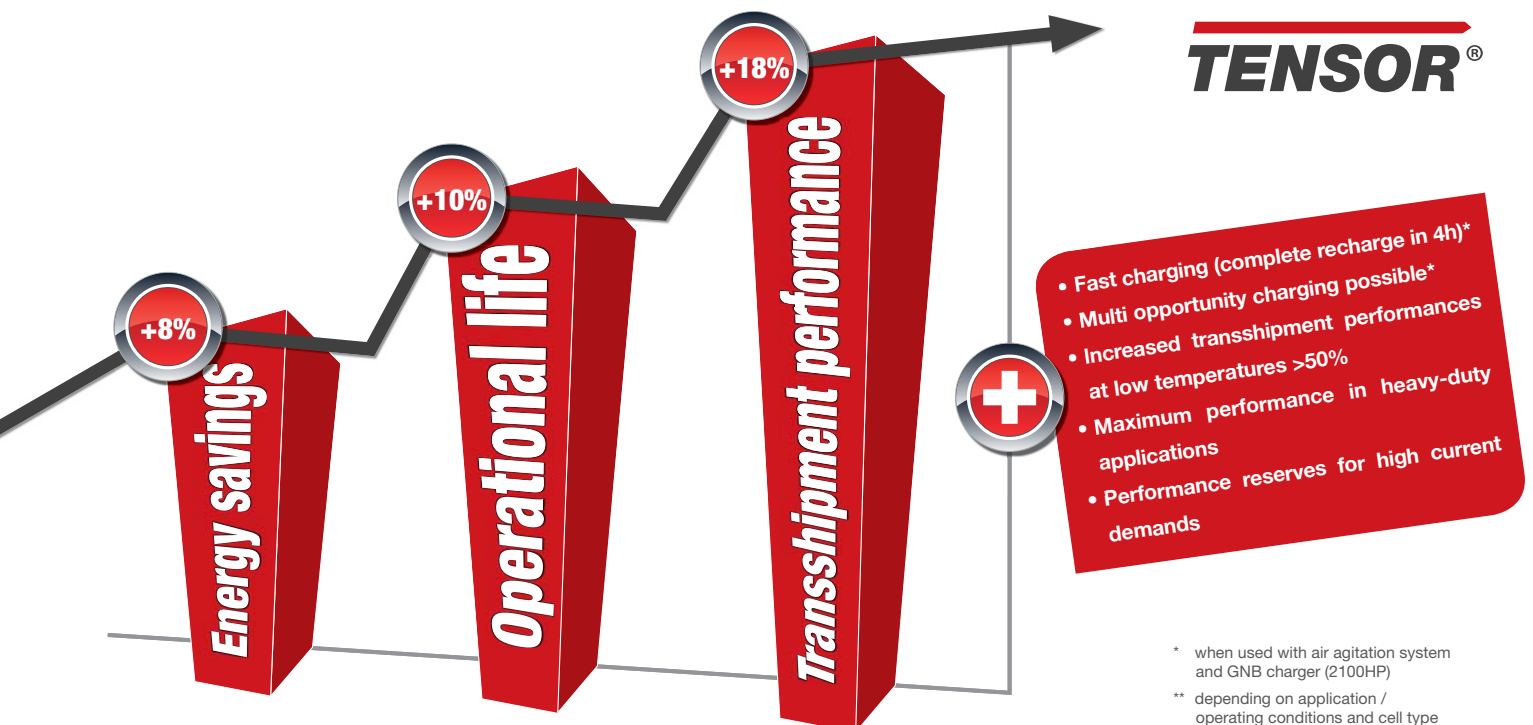
- > **Increased performance** due to high power density
- > **Increased running times** due to high energy content and efficient energy recovery
- > **Longer operational life** due to low operating temperature
- > **Higher energy cost savings** due to excellent energy efficiency
- > Suitable for **fast charging** and **multi opportunity charging***

Benefits

TENSOR batteries can increase the operating time of materials handling trucks. Concurrently, TENSOR batteries have a significantly lower operating temperature which has a positive effect on the operational life. Additionally, the excellent energy efficiency ensures decreased energy costs and avoids carbon dioxide (CO₂) emissions. Compared to conventional traction batteries, an advantage of approximately 36% can be expected.**

Moreover, TENSOR provides unique properties in environments where maximum performance is required. In cold storage applications, for example, TENSOR exceeds the transshipment performance of standard traction batteries by more than 50%. This characteristic at low temperatures makes TENSOR also ideally suited for heavy-duty trucks which are operated outdoors throughout the year.

A particular strength of the TENSOR battery is its excellent charge efficiency. Thus, TENSOR batteries can be fully recharged within 4 hours and efficient opportunity charging means battery changes can be avoided.*



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Areas of Application & Available Cell Types

Preferred Areas of Application for TENSOR Batteries

The increase in power and capacity as well as the excellent performance at low temperatures and the fast charging capability make TENSOR the perfect solution for the following applications:



High-rack facilities / Narrow aisle



Cold storage / Outdoor applications



Accessory equipment / Additional electrical consumers



Heavy duty applications



24/7 applications



Seasonal business / Activity peaks

Available TENSOR Cells

| Standard | Cell dimensions* | |
|--------------|----------------------------------|-----------------|
| | Height h1 [mm] Height h2 [mm] | Length (l) [mm] |
| 3 EPzS 270 | 463 / 493 | 65 |
| 4 EPzS 360 | 463 / 493 | 83 |
| 5 EPzS 450 | 463 / 493 | 101 |
| 6 EPzS 540 | 463 / 493 | 119 |
| 7 EPzS 630 | 463 / 493 | 137 |
| 8 EPzS 720 | 463 / 493 | 155 |
| 9 EPzS 810 | 463 / 493 | 173 |
| 10 EPzS 900 | 463 / 493 | 191 |
| 3 EPzS 375 | 573 / 603 | 65 |
| 4 EPzS 500 | 573 / 603 | 83 |
| 5 EPzS 625 | 573 / 603 | 101 |
| 6 EPzS 750 | 573 / 603 | 119 |
| 7 EPzS 875 | 573 / 603 | 137 |
| 8 EPzS 1000 | 573 / 603 | 155 |
| 9 EPzS 1125 | 573 / 603 | 173 |
| 10 EPzS 1250 | 573 / 603 | 191 |
| 3 EPzS 465 | 713 / 743 | 65 |
| 4 EPzS 620 | 713 / 743 | 83 |
| 5 EPzS 775 | 713 / 743 | 101 |
| 6 EPzS 930 | 713 / 743 | 119 |
| 7 EPzS 1085 | 713 / 743 | 137 |
| 8 EPzS 1240 | 713 / 743 | 155 |
| 9 EPzS 1395 | 713 / 743 | 173 |
| 10 EPzS 1550 | 713 / 743 | 191 |

| TENSOR | | | | |
|----------------|--------------------|-----------------------|------------------------|-----------------------|
| TCSM cell type | Cell weight** [kg] | Nominal capacity [Ah] | Energy content*** [Wh] | Running time plus**** |
| 585 TCSM | 17.3 | 300 | 585 | +20% |
| 730 TCSM | 22.0 | 375 | 730 | +13% |
| 1025 TCSM | 27.0 | 525 | 1025 | +27% |
| 1170 TCSM | 31.0 | 600 | 1170 | +20% |
| 1315 TCSM | 36.1 | 675 | 1315 | +16% |
| 1610 TCSM | 41.0 | 825 | 1610 | +24% |
| 1755 TCSM | 45.6 | 900 | 1755 | +20% |
| 2050 TCSM | 50.3 | 1050 | 2050 | +27% |
| 760 TCSM | 20.1 | 390 | 760 | +13% |
| 975 TCSM | 25.0 | 500 | 975 | +9% |
| 1285 TCSM | 33.1 | 660 | 1285 | +15% |
| 1520 TCSM | 38.0 | 780 | 1520 | +13% |
| 1715 TCSM | 44.5 | 880 | 1715 | +9% |
| 2030 TCSM | 50.7 | 1040 | 2030 | +14% |
| 2195 TCSM | 56.9 | 1125 | 2195 | +9% |
| 2570 TCSM | 63.0 | 1320 | 2570 | +15% |
| 955 TCSM | 25.5 | 495 | 955 | +16% |
| 1235 TCSM | 31.7 | 640 | 1235 | +12% |
| 1620 TCSM | 41.7 | 840 | 1620 | +18% |
| 1910 TCSM | 48.6 | 990 | 1910 | +16% |
| 2190 TCSM | 53.6 | 1135 | 2190 | +13% |
| 2545 TCSM | 63.6 | 1320 | 2545 | +16% |
| 2835 TCSM | 71.3 | 1475 | 2835 | +15% |
| 3240 TCSM | 79.9 | 1680 | 3240 | +18% |

* width (w) 198mm
 ** filled and charged // tolerance +/-5%
 *** average discharge voltage 1.95Vpc
 **** according to the GNB driving profile

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The Fast Charging Battery



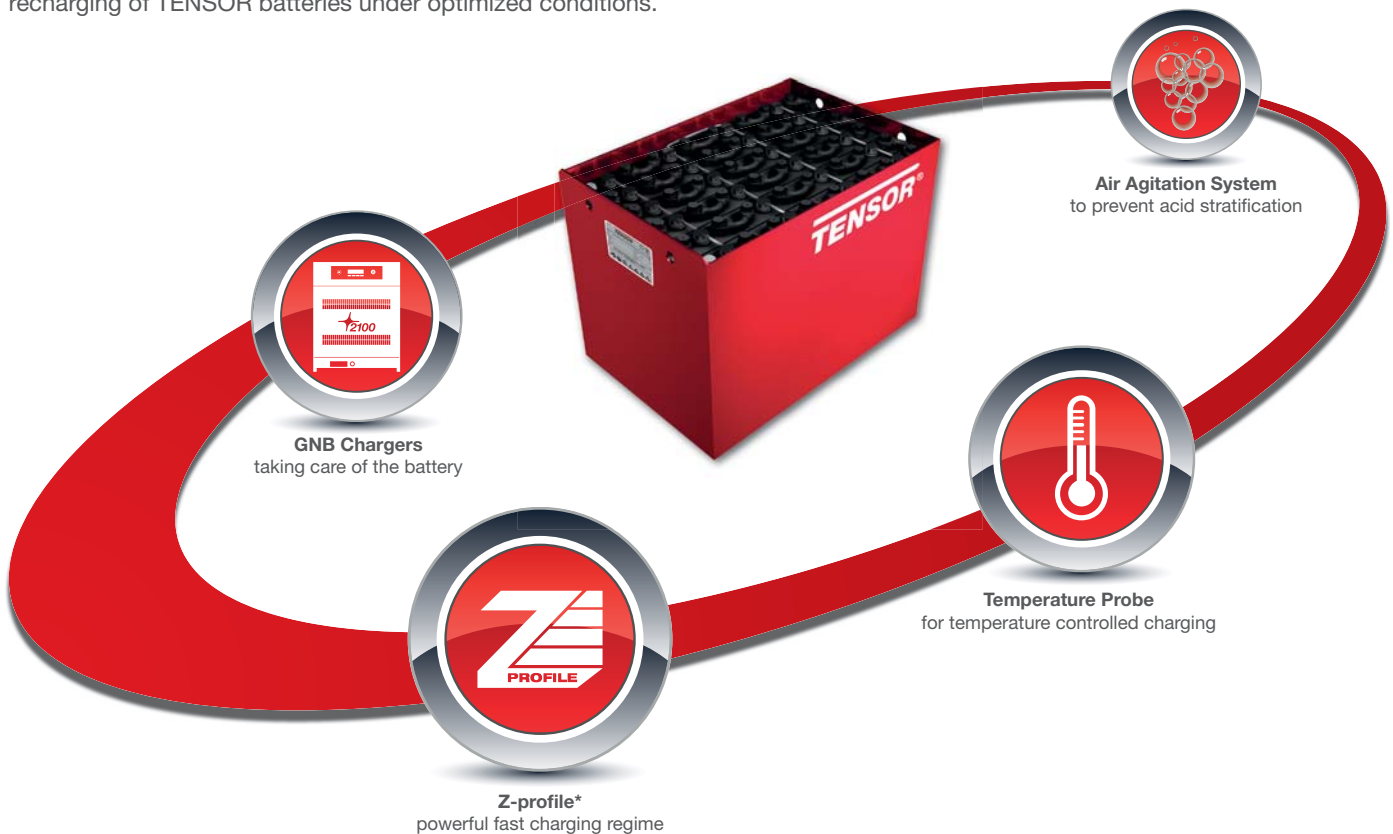
Fast charging of TENSOR batteries

TENSOR batteries are designed to significantly decrease downtimes, therefore these batteries allow a full recharge from 80% depth of discharge in just 4 hours. This is

possible due to the excellent charge acceptance of TENSOR batteries and the high efficiency, which leads to a cooler battery and very low energy losses.

The TENSOR fast charging package

All components of the GNB fast charging package for TENSOR batteries are working together perfectly with one goal – fast recharging of TENSOR batteries under optimized conditions.



* Multi-charging characteristic Z-profile

The highly sophisticated charging regime (Z-profile) in combination with air agitation and a temperature probe supports the excellent fast charging characteristics of TENSOR. At the same time this TENSOR fast charging setup enables frequent fast opportunity charging

of TENSOR batteries during available pauses. The air agitation effectively prevents the acid stratification effect and ensures that the TENSOR battery stays powerful and healthy.

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Fast Charging & Opportunity Charging

Multi-shift applications

For standard batteries in multi-shift applications, changing of batteries is normally required. TENSOR can, depending on the application, decrease the number of battery changes in multi-shift applications or avoid battery changing completely:

Scenario 1

**TENSOR fulfils two shifts -
No changing of batteries required**

Scenario 2

**TENSOR opportunity charging model -
No changing of batteries required**

Scenario 3

**TENSOR works more -
Less changing of batteries required**

Fast (Opportunity) Charging of TENSOR Batteries

Chargers from GNB's 2100HP series can be ordered with the Z-profile which enables fast charging and very effective opportunity charging of TENSOR cells. The following table clearly shows the correct charger type depending on the voltage and capacity of the TENSOR battery.

Charger allocation TENSOR / Z-profile

| TENSOR cell types | | | | | | | |
|-----------------------|--------------------|--------------------|---------------------|---------------------|---------------------|----------------------|----------------------|
| Battery Voltages* [V] | 760 TCSM 390 Ah | 975 TCSM 500 Ah | 1285 TCSM 660 Ah | 1520 TCSM 780 Ah | 1715 TCSM 880 Ah | 2030 TCSM 1040 Ah | 2570 TCSM 1320 Ah |
| 24 | HP24T160Z | HP24T200Z | HP24T270Z | HP24T300Z | HP24T300Z | HP24T300Z | HP24T300Z |
| 48 | HP48T160Z | HP48T200Z | HP48T260Z | HP48T260Z | HP48T260Z | HP48T260Z | on request |
| 80 | HP80T160Z | HP80T200Z | HP80T200Z | HP80T200Z | HP80T200Z | on request | on request |

| TENSOR cell types | | | | | | | |
|-----------------------|--------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|
| Battery Voltages* [V] | 955 TCSM 495 Ah | 1235 TCSM 640 Ah | 1620 TCSM 840 Ah | 1910 TCSM 990 Ah | 2190 TCSM 1135 Ah | 2545 TCSM 1320 Ah | 3240 TCSM 1680 Ah |
| 24 | HP24T200Z | HP24T260Z | HP24T300Z | HP24T300Z | HP24T300Z | HP24T300Z | on request |
| 48 | HP48T200Z | HP48T260Z | HP48T260Z | HP48T260Z | HP48T260Z | on request | on request |
| 80 | HP80T200Z | HP80T200Z | HP80T200Z | HP80T200Z | on request | on request | on request |

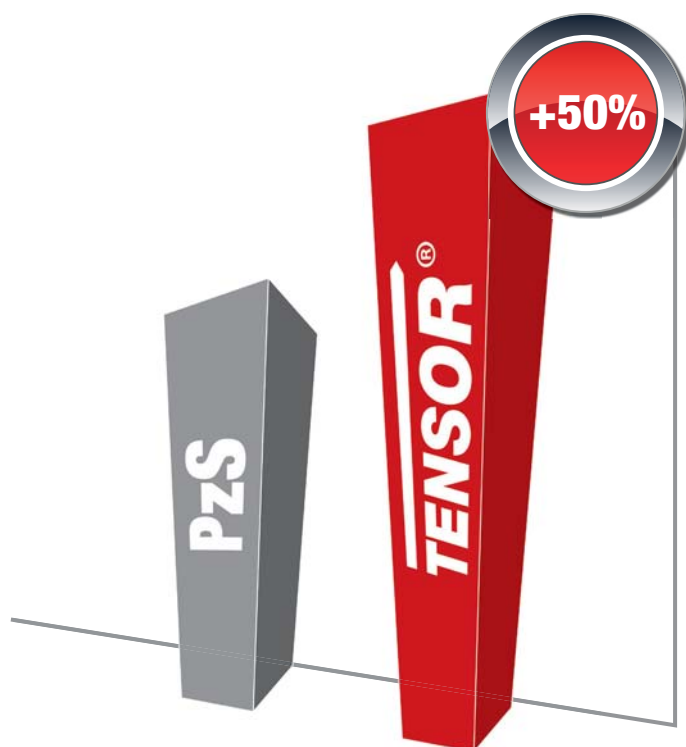
* other battery voltages also available

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The Battery for Cold Environments

Cold store

Naturally the temperatures in cold stores are below 0°C. Batteries operated in such cold environments suffer from significant loss in performance and capacity. However, TENSOR batteries remain as powerful as a polar bear when working in these low temperatures.



Extended running time at low temperatures

The capacity loss of standard traction batteries at freezing temperatures is remarkable and leads to decreased operating time.

This factor causes constraints in the logistic flow, because the batteries must be recharged more often. The impact of low temperatures on TENSOR batteries is much more moderate resulting in significantly longer operating times compared to standard batteries.



Outdoor applications

Batteries powering industrial trucks in outdoor applications use are exposed to a wide temperature range – high temperatures in summertime and freezing temperatures in wintertime. TENSOR batteries are showing lower average charging

and discharging temperatures; additionally this battery type stays powerful even at low temperatures. Therefore TENSOR batteries are the right choice for outdoor applications to minimize the negative impacts of variations in temperature.

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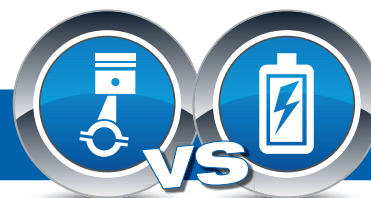
The environment-friendly Power Battery

Robust and powerful

The TENSOR technology was especially developed for modern trucks (three-phase motors, energy recovery system) and for all tough applications. Standard batteries have already reached their limitations in these fields. Therefore a new battery technology was

required combining the robustness of the well proven lead-acid battery and excellent performance. TENSOR is the perfect fusion of these attributes and represents a successful battery evolution.

Combustion Engine vs. Battery Power



The usual choice of an electric powered truck for light duty and an IC powered truck for heavy duty is no longer the case. In fact more and more battery powered trucks for heavy applications are released to the market place. Reasons for that are the strict exhaust emission regulations,

the reduction of carbon dioxide, but also the comfortable drive of electric trucks. Naturally a heavy duty truck needs a high performance power source. TENSOR, the high performance battery, is the right choice for all heavy duty trucks.

Reduce emissions



Carbon dioxide (CO₂), soot particles and noise are emissions which must be significantly reduced for environmental protection and for health reasons. With the change to electrical powered trucks these goals can easily be achieved. To avoid or minimize a performance loss by changing from

trucks with combustion engine to battery powered trucks the choice of the battery is essential. The future oriented TENSOR technology fulfils all the requirements on traction batteries demanded by modern trucks.

Environment-friendly Battery



Outdoor applications TENSOR batteries enable the operator to handle more goods during their life cycle compared to standard traction batteries. Additionally the charging and discharging process is much more efficient. These advantages result in an excellent total cost of ownership as well as significantly reducing the impact on the environment.

Due to the fact that TENSOR batteries are based on lead acid technology they are fully recyclable, a further advantage over other battery technologies. Long life, high energy efficiency and ease of recycling make the TENSOR battery a green choice option.



Exide Technologies, with operations in more than 80 countries, is one of the world's largest producers and recyclers of lead-acid batteries. Exide Technologies provides a comprehensive and customized range of stored electrical energy solutions. Based on over 120 years of experience in the development of innovative technologies, Exide Technologies is an esteemed partner of OEMs and serves the spare parts market for industrial and automotive applications.

GNB Industrial Power – A division of Exide Technologies – offers an extensive range of storage products and services, including solutions for telecommunication systems, railway applications, mining, photovoltaic (solar energy), uninterrupted power supply (UPS), electrical power generation and distribution, fork lifts and electric vehicles.

Exide Technologies takes pride in its commitment to a better environment. An integrated approach to manufacturing, distributing and recycling of lead-acid batteries has been developed to ensure a safe and responsible life cycle for all of its products.

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