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INNOVATIVE LITHIUM-ION



Leading Lithium-ion Forklift Manufacturer

Making Material Handling Easier
SINCE 1956



INNOVATIVE SOLUTIONS NEW POWER NOW



Lithium-ion technology (Lithium Iron-Phosphate), was developed jointly by HANGCHA and CATL for use in material handling equipment applications. These innovative and reliable battery cells and modules are manufactured to the highest standard by CATL exclusively for HANGCHA's forklift line.



WHY PARTNER WITH US?

HANGCHA HAS OVER 65 YEARS EXPERIENCE IN
THE MATERIAL HANDLING INDUSTRY

HC Forklift America is part of Hangcha Group. Hangcha Group is a global leading full line forklift developer, manufacturer, and supplier. Hangcha is the largest Chinese forklift exporter for the last 14 consecutive years and has specialized in engineering and manufacturing high quality forklifts and warehouse equipment since 1956.

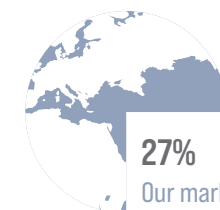
HC Forklift America is Hangcha's U.S. Headquarters. Located in Charlotte, NC, our team of dedicated industry specialist are focused on providing support, products, and parts to our dealers and customers.



200,000
We produce more
than 200,000
units annually.



150
We export to
150 Countries



27%
Our market
share in China
is over 27%



12%
Our global
market share
is 12%.

LITHIUM POWERED

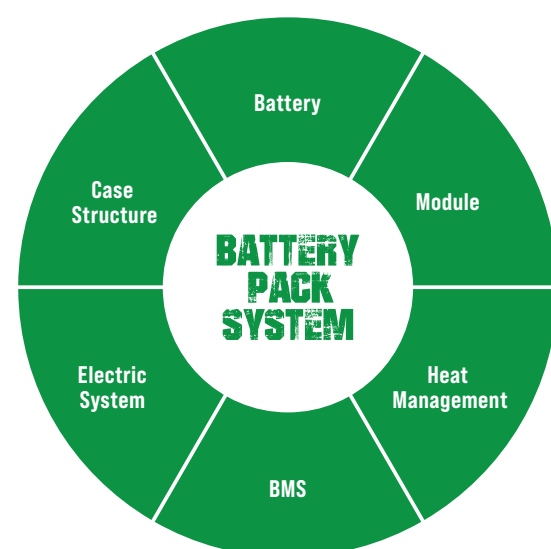
THE FUTURE IS NOW

SUPERIOR PERFORMANCE, INNOVATIVE TECHNOLOGY, & an ECONOMICAL SOLUTION.

- >> / Long Service Life
- / Maintenance-Free
- / High Energy Density
- / Energy Saving
- / Fast Charging
- / Compact Chassis
- / Safe and Reliable

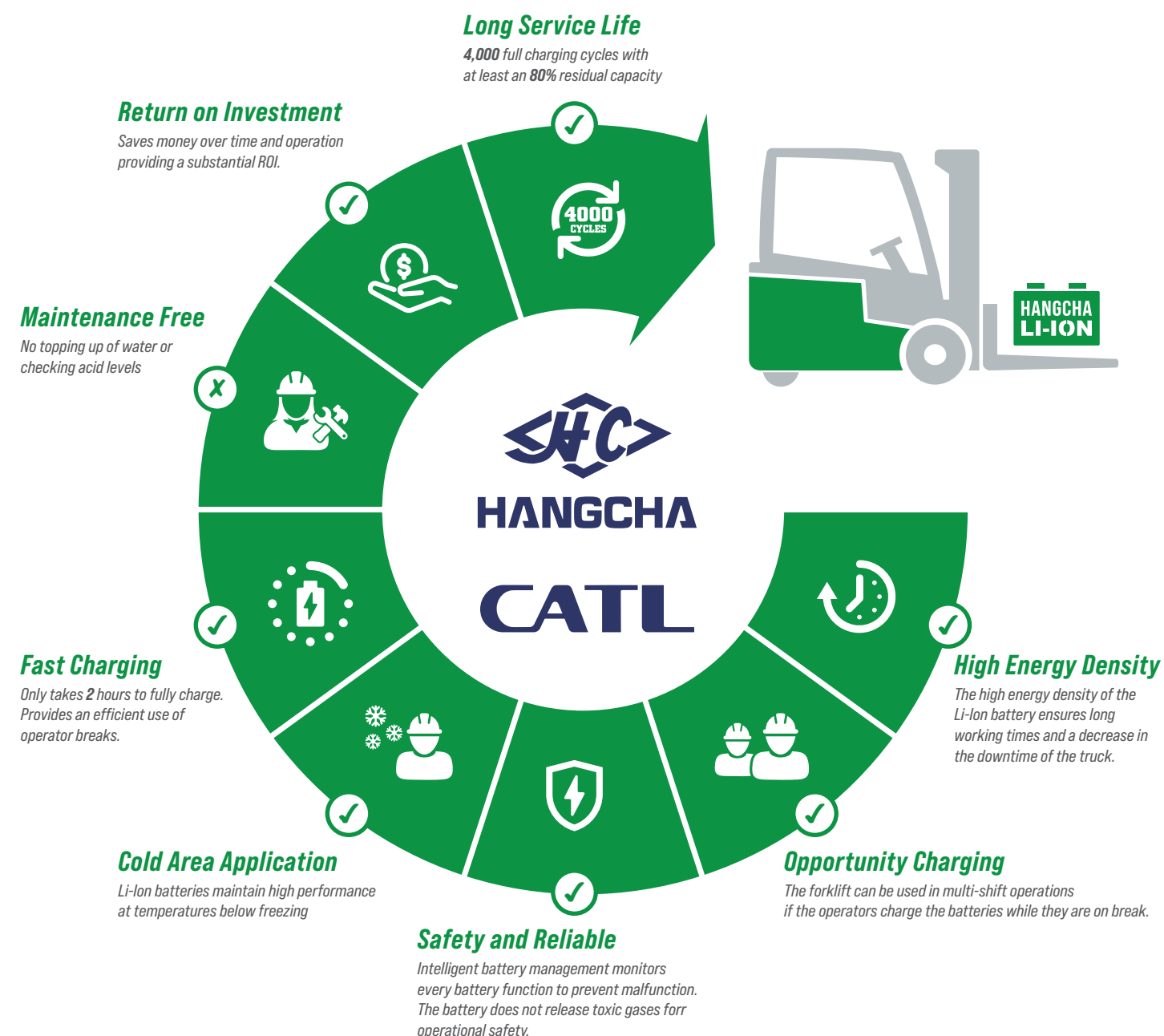
LITHIUM BATTERY ADVANTAGES

- / **Battery Technology:** We use square lithium iron phosphate batteries. These are the same type of batteries used in new electric vehicles.
- / **Design:** The module uses a sturdy and lightweight aluminum alloy frame. It is also designed to provide excellent heat dissipation.
- / **Safe and Effective:** Charging efficiency as high as 98% and the thermal runaway temperature is at 600 °C and above.
- / **Adapted to Low Temperatures:** Comes standard with an electrical heating feature, ensuring normal operation in low temperatures.
- / **Quick Charging:** Fully charges in 2 hours.
- / **Efficient:** Can use opportunity charging to allow for continuous use in multi-shift operations.
- / **Long-Lasting:** 4000 charging cycles with a capacity retention greater than 80%.
- / **Maintenance-Free:** Lithium-ion batteries do not require manual maintenance such as watering.
- / **Green and Clean:** The batteries are pollution-free, release zero emissions, and are recyclable.



DESIGN PHILOSOPHY

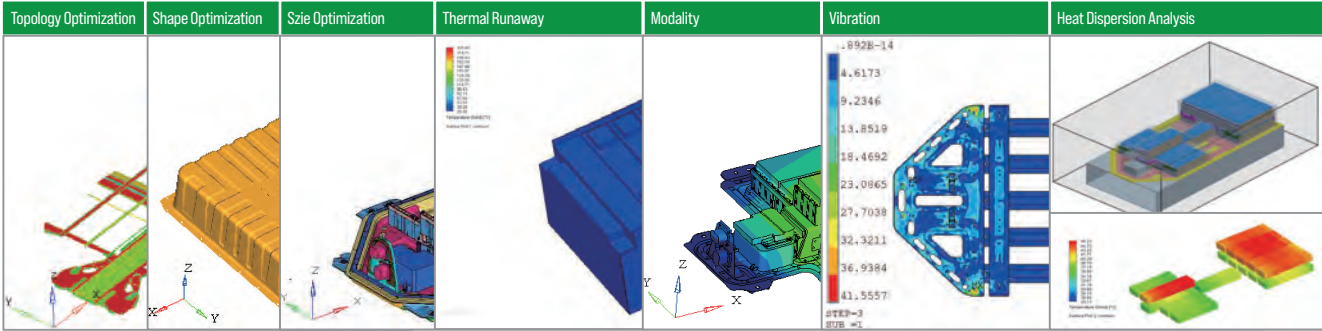
After seeing the benefits that Lithium-ion battery technology has when compared to traditional lead-acid batteries, Hangcha Group realized the material handling industry would be the perfect beneficiary for this technology. This technology would give material handling equipment the ability to run longer, more reliably, and require less maintenance. Hangcha Group worked closely to CATL to develop lithium-ion technology specifically for this industry. Hangcha then redesigned our material handling equipment around this technology. The result is a line of fast charging, long lasting, maintenance-free forklifts with the ability to run efficiently in multi-shift operations.



Safety

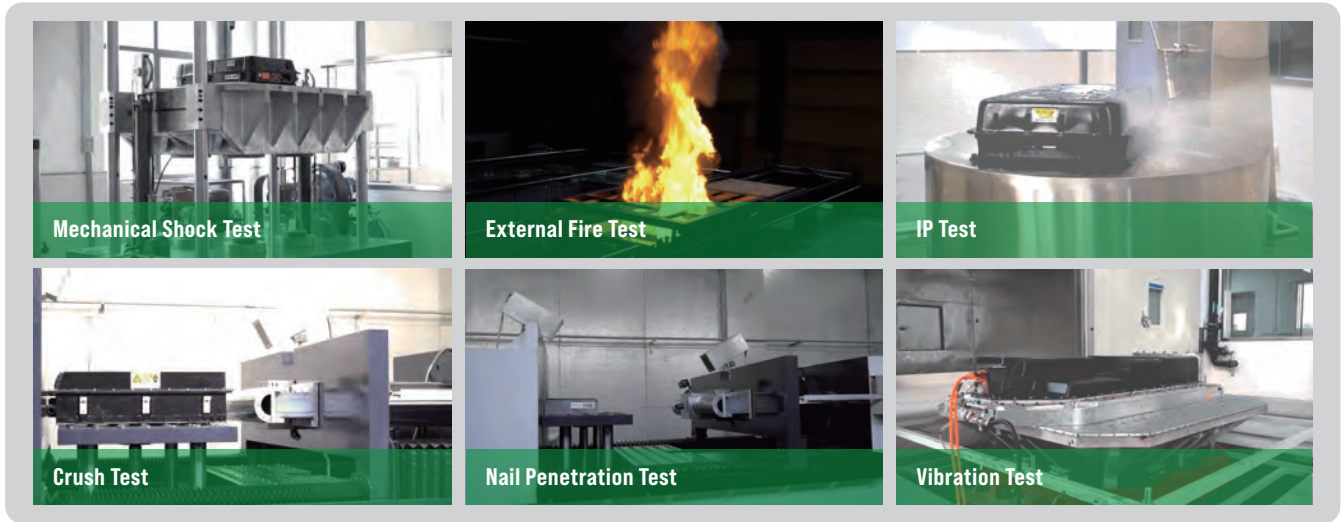
While designing the lithium-ion technology for Hangcha's material handling equipment, safety was of our top concerns. We wanted a system that was not only efficient, but also safe for the operators and surrounding employees. In fact, CATL's batteries have caused 0 safety accidents. Between 2014 and 2017, the number of passenger cars using CATL batteries exceeded 95,000. Even with the amount of batteries being used, CATL products still caused 0 safety accidents. After designing the system, Hangcha and CATL performed over 48 safety tests to make sure that the battery packs could safely handle the harsh environments that our users operate their equipment in. The result was a line of lithium-ion battery systems that passed all of our tests and are safe for extremely safe for our users.

Safety Design



Comprehensive Test & Validation

Hangcha and CATL have a large testing lab devoted to our lithium-ion battery systems. This lab allows us to perform over 273 kinds of tests on the battery pack systems before releasing them to the market. These tests include 100 performance tests, 48 safety tests, and 125 reliability tests. By thoroughly testing the battery pack systems, we can offer up to a 10-year 20,000-hour warranty on our battery packs. The time spent designing and testing translates to a reliable, safe, and efficient battery system designed to increase productivity and eliminate downtime.



FEATURES & BENEFITS

Power

- / The Lithium-ion battery has a high energy density. When compared to an identical volume as a lead-acid battery, the Li-Ion battery contains twice as much energy.
- / Quick opportunity charging equals constant availability.
- / Stable voltage supply throughout the discharging process means that the truck will run longer on a single charge.
- / Li-Ion batteries maintain their performance level at temperatures below freezing making them ideal for use in cold areas.

Precision

- / The truck communicates with the battery controller to precisely control the use of the lithium-ion battery.

Compactness

- / Higher energy density means that the battery can hold the store about of energy in a smaller space.

Safety

- / Intelligent battery management monitors every important battery function.
- / Higher user safety, thanks to an acid-free battery.
- / User friendly thanks to not having to change the battery.
- / The battery does not emit toxic gasses.

Environmentally Friendly

- / These batteries have twice the service life making them environmentally friendly.
- / The batteries also do not contain any acid making them environmentally friendly.
- / The Li-Ion batteries are substantially more efficient when charging and discharging which reduces energy costs and is environmentally friendly.

Ergonomics

- / Because battery changes are not needed, the operator is not physically strained.
- / These batteries are maintenance-free meaning that the user doesn't need to top off the water or check the battery's acid levels.
- / The user doesn't have to perform a pre-work check on the battery.

Warranty

The Integrated Battery Management System (BMS) continually monitors energy management and ensures reliable operation. Because of this reliability, Hangcha provides up to a **10 year** or **20,000 hours** warranty on our lithium-ion battery packs.



BMS Security Strategy

HANGCHA battery management system (BMS) monitors the Li-ion cells at all time. As a result, our Li-ion solution is the most reliable power option.



Battery Safety Management

- Overcharge/over discharge protection
- Overcurrent/over-temperature/low- temperature protection
- Multi-level fault diagnosis protection
- Double fault monitoring



Battery Parameter Detection

- Battery voltage detection and analysis
- Battery current detection and analysis
- Battery temperature detection and analysis



SOC/SOH Detection

- Residual capacity estimates
- Battery health estimates
- High precision capacity integration



High Pressure Safety Management

- High voltage interlock(HVIL)
- High voltage insulation monitoring
- High voltage switch diagnostics



Equilibrium Management

- Equalization based on voltage mode
- Equalization based on time mode
- Equalization based on battery cell SOC
- Active/passive equalization optional



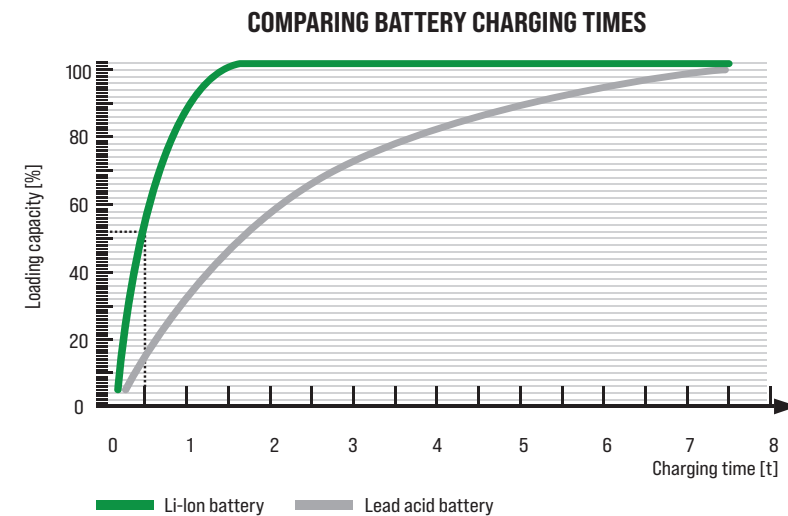
Other Features

- Low cost,low power consumption
- Historical data record
- Flexible cascade expansion
- CRC data validation

CHARGING

Rapid charging and opportunity charging ensure continuous availability of vehicles.

The chargers allow for fast full charging or boost charging (**100 % charge in 2 hours**). The lithium-ion batteries are maintenance free and do not require a battery change when used in multi-shift operations. Instead, the batteries can be charged during user breaks and shift changes which allows the forklift to run continuously during multi-shift operations.



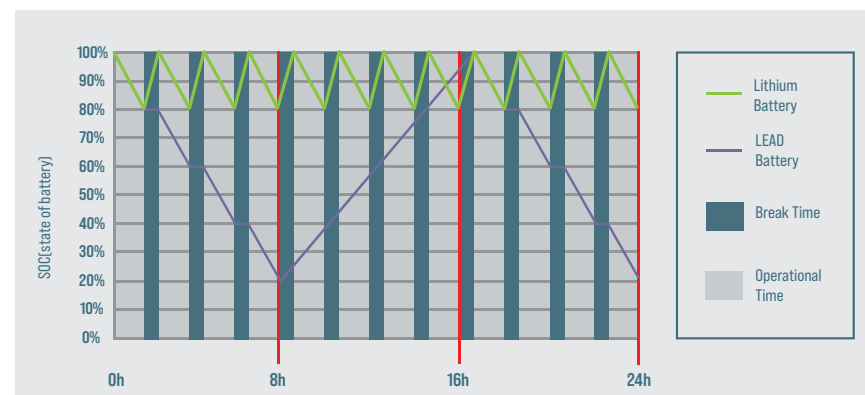
Li-ion battery

VS

Lead acid battery

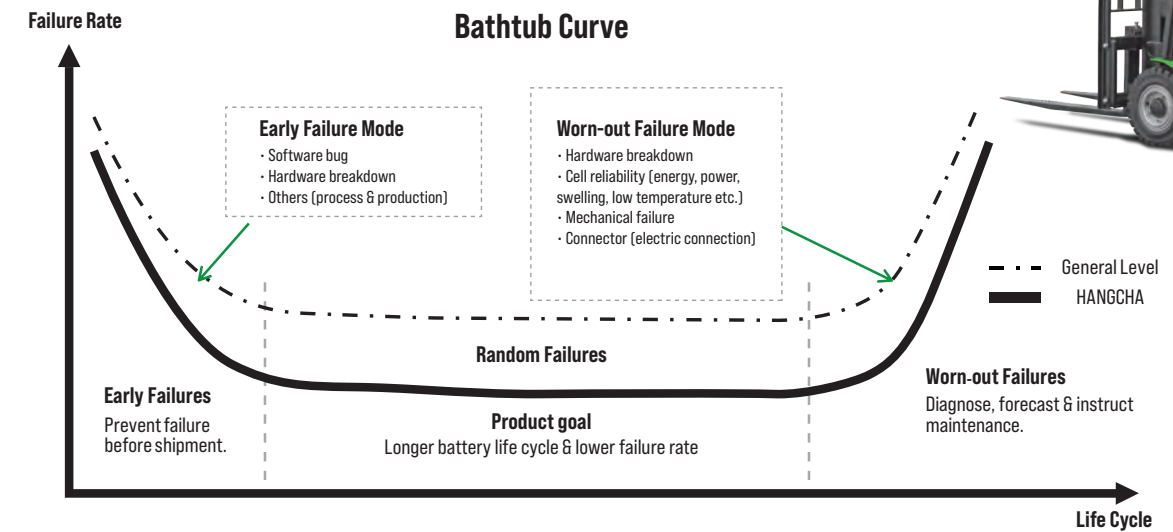
EFFICIENCY

The high-performance lithium-ion technology shines in cases where lead acid batteries are in use and have to be changed in two/three-shift operations. Lithium-ion batteries do not need to be replaced. By quickly charging during downtime, such as during the user's lunch break, the battery can be efficiently used allow the forklift to remain operational throughout all three shifts. This is called **OPPORTUNITY CHARGING**. Intermittently charging also does not affect the battery service life. Lithium-ion technology supplies constant voltage throughout the entire operational time. This means that the operator can work under full power throughout several shifts without having to change a battery or do any kind of maintenance.



RELIABILITY

HIGHLY RELIABLE THROUGHOUT THE BATTERY'S ENTIRE LIFE

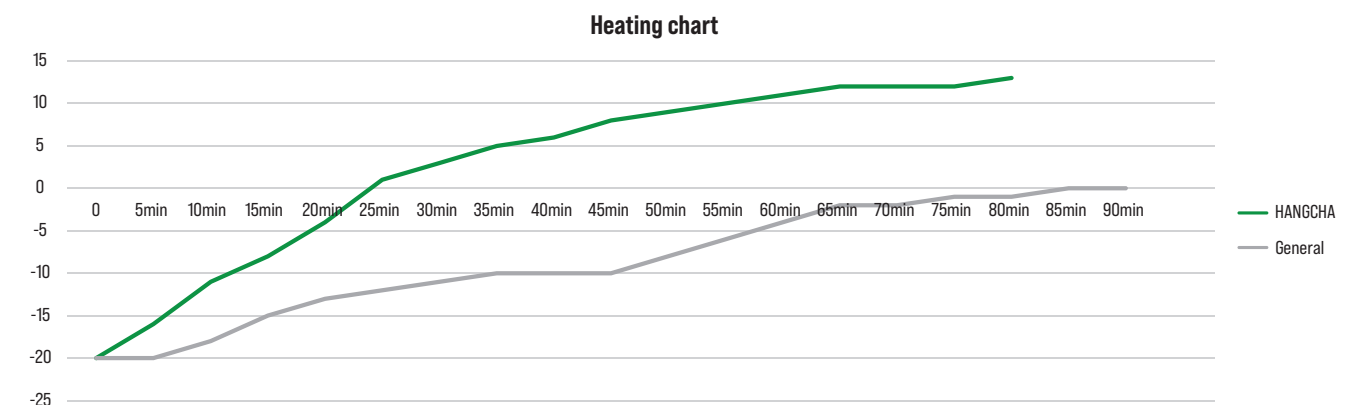


PERFECT PERFORMANCE IN COLD AREA



BATTERY PACK HEAT MANAGEMENT

During the discharge process, HANGCHA's battery pack temperature rises from -4 ℉ to 32 ℉ and only takes **25-30** minutes thanks to its heat management. During the discharge process, a general battery pack's temperature rises from -4 ℉ to 32 ℉ and will take 85-90 minutes. This means that Hangcha's Lithium-ion forklifts are perfect for cold operation applications.



☆ Note: Battery pack with LiFePO4 features heating management.

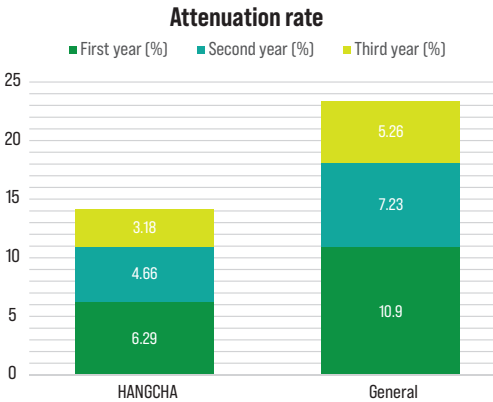
LONG CYCLE LIFE

BATTERY PACK CYCLE LIFE TEST

Attenuation rate comparison
HANGCHA: First year 6.29%, Second year 4.66%, third year 3.18%
Total attenuation 14%
General: First year 10.9%, Second year 7.23%, Third year 5.26%

Total attenuation 23.4%
This means that Hangcha's lithium-ion batteries last longer and hold more energy over time compared to a general battery.

HANGCHA provides the Lithium-ion (LiFeP04) battery with up to a 10 year or 20000 hour warranty.

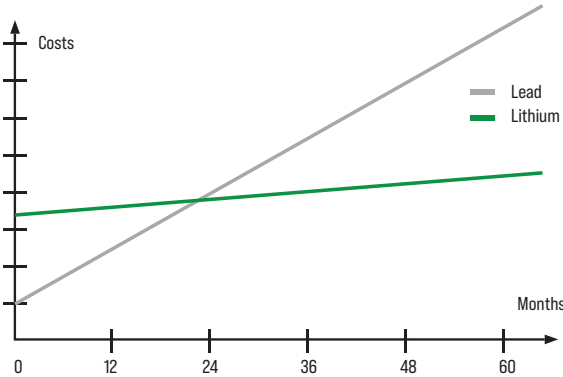


Total Cost of Ownership Comparison

After taking a look at the complete total cost of ownership (TCO), the initial investment of the equipment is more than compensated for by HANGCHA's longer service times and significantly lower operating expenses. This means that the lithium-ion trucks, including the initial cost, will cost the user less over time than lead acid forklifts.

Item	Unit	Lithium Battery	Lead Acid Battery
Voltage	V	48	48
Capacity	Ah	400	500
Battery energy	KW.h	19.2	24
Charge efficiency	%	95%	70%
Annual charge times	Time	300	300
Electricity price	USD/KW.h	0.14	0.14
Annual electric charge	USD	866	1469
Annual maintenance cost	USD	0	1429
Maintenance cost of ten years	USD	8661	28980
Purchase cost of ten years	USD	15714 (1 unit)	25286 (3~4 unit)
Total cost per forklift	USD	24376	54266
Lithium-ion's battery cost reduction is about 55%			

☆ The chart above uses actual data from an operational lithium-ion forklift.

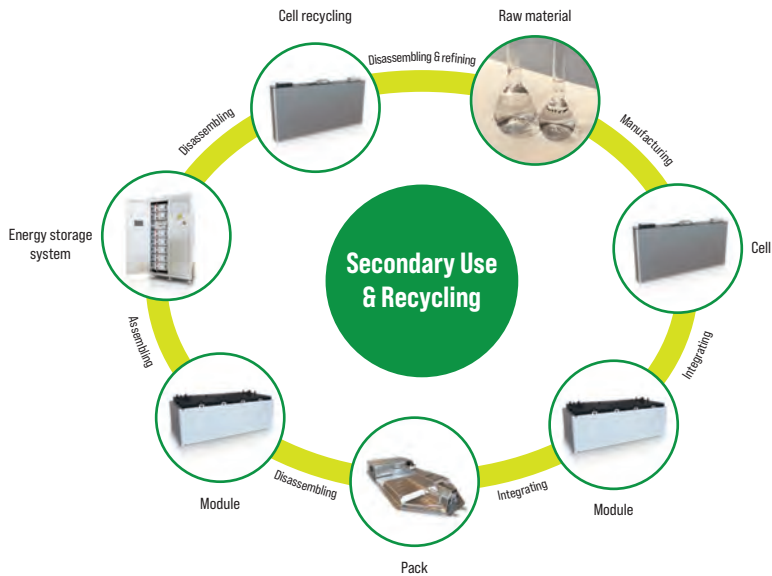


Lithium-ion Battery Recycling Solution

In the future, battery components will not be sourced solely from mining. They will also have to come from recycling. HANGCHA and CATL are committed to improving the secondary use technology needed to properly recycle and refine the recycled batteries back into raw materials. In doing so, we are hoping to protect the environment for future generations.

24/7 Service by Hangcha and CATL

Service Purpose: Leading the way with attentive service.
Service Concept: Results orientation and quick service.



HANGCHA'S LITHIUM-ION PRODUCT LINE

COUNTERBALANCED TRUCKS

X Series 3-W Electric Lithium-ion Forklift

1,000-2,000lbs
24V/240Ah



A Series 3-W Electric Lithium-ion Forklift

3,200-4,000lbs
48V/480Ahv



A Series 3-W Electric Stand-Up Counterbalanced Forklift

3,000-5,000lbs
36V/606Ah, 36V/813Ah



X Series Electric Lithium-ion Cushion Tire Forklift

4,000-6,500lbs
48V/606Ah



XC Series Electric Lithium-ion LITE Pneumatic Tire Forklift

4,000-7,000lbs
80V/202Ah, 80V/271Ah



XC Series Electric Lithium-ion Pneumatic Tire Forklift

4,000-7,000lbs
80V/271Ah, 80V/404Ah, 80V/542Ah



XC Series Electric Lithium-ion Pneumatic Tire Forklift

8,000-11,000lbs





NARROW AISLE TRUCKS

A Series Pantograph Single Reach Truck
3,000-4,500lbs
36V/606Ah, 36V/813Ah



A Series Pantograph Double Reach Truck
3,000-3,500lbs
36V/606Ah, 36V/813Ah



A Series Electric Lithium-ion High Level Order Picker
3,000lbs
36V/813Ah



WAREHOUSE EQUIPMENT

A Series Walkie Pallet Jack
4,500lbs
24V/125Ah, Built-in Charger
Optional External Charger



A Series Walkie Straddle Stacker
2,500lbs
24V/125Ah, Built-in Charger
Optional External Charger



A Series End-Control Rider Pallet Jack
6,000-8,000lbs
24V/404Ah



A Series Center-Control Rider Pallet Jack
6,000-8,000lbs
24V/404Ah



A Series Industrial Walkie Stacker
2,500-4,000lbs
24V/404Ah



A Series Industrial Walkie Reach Stacker
3,000lbs
24V/404Ah



A Series Industrial Walkie Counterbalanced Stacker
6,000-8,000lbs
24V/404Ah





TOW TRACTORS

Tow Tractor
8,000-13,500lbs
48V/202Ah



Heavy Duty Tow Tractor
44,000-70,000lbs
80V/404Ah, 80V/542Ah, 80V/808Ah



HANGCHA Group is the early adopter of lithium-ion technology in material handling equipment. We understood that the benefits of this technology would help to revolutionize the material handling industry. By eliminating required maintenance, increasing efficiency, and reducing equipment downtime, Hangcha is able to drastically increase productivity and significantly lower operating costs for our users. Today we offer a complete fleet of lithium-ion trucks designed for a wide variety of applications.

