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Technical Proposal for Tracking Devices/Loggers

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Technical Support Department
Ni-MH Battery Division
FDK CORPORATION

How tracking devices/loggers are used

■ Solar charging type

Charged via solar panel

* Hybrid models with both solar and USB charging are also available.

Battery pack example :

3HR-4/3FAUT-3 (3S3P: Min.9400mAh)

3HR-AAULT-3 (3S3P: Min.2650mAh)

■ External power charging type

Charged with an external power source (AC, USB, etc.)

Battery pack example :

10HR-AUT (Min.1850mAh)

5HR-AAULT (Min.890mAh)

Tracking devices/loggers are assumed to be mounted on the outside of the container.

Expected usage

Solar charging type is expected to become mainstream. It is assumed that it will be installed on the outside of the container for ease of installation and efficient charging and communication.

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
・Specific values included in this material are intended to describe performance. They are not guaranteed.

Temperature range for tracking devices/loggers

Temperature Range: -40°C to +70°C

As Tracking devices/loggers and their batteries travel across diverse global routes—by sea, land, and air—they are exposed to extreme environmental conditions. Therefore, they must offer reliable performance across a broad temperature range.

Why Nickel Metal Hydride?

Nickel metal hydride (NiMH) batteries are ideally suited for this application due to their excellent performance stability across wide temperature conditions.

➡ Details on key benefits are provided on the next page.

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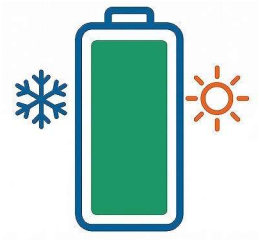
Key benefits of Ni-MH battery



Wide Temperature Range

- Operates reliably even in extreme temperature environments encountered during global shipping.

Discharge Capability

- Provides stable discharge output, optimized for GSM pulse transmission.

Durability

- Withstands repeated use under harsh conditions
（No battery replacement required during device lifecycle）

Safety

- Water-based electrolyte ensures low fire risk, enhancing safety for logistics and transport use.

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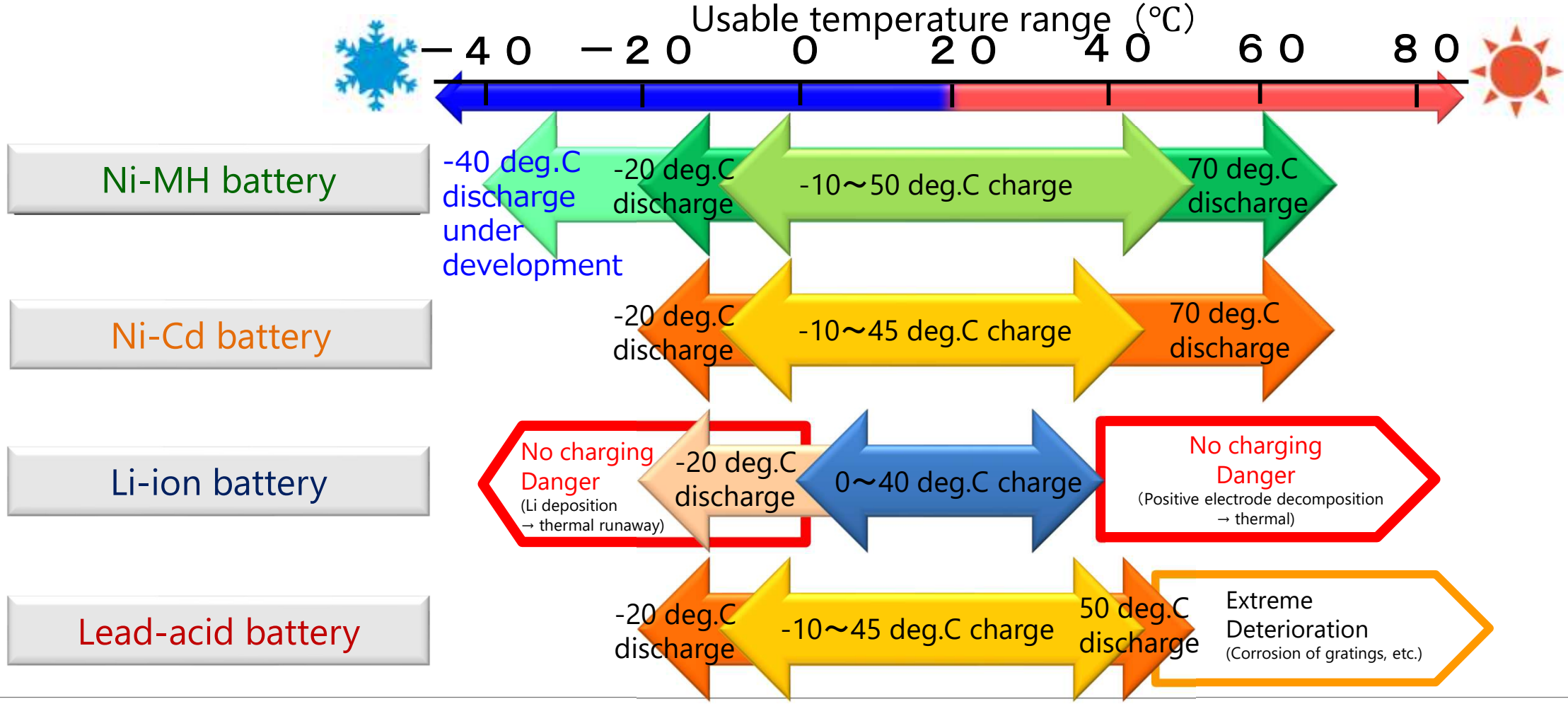
Wide Temperature Range

- Nickel-metal hydride batteries offer reliable performance across a wide operating temperature range, making them ideal for tracking device in container
- Lithium-ion batteries have strict charging temperature limitations, which can pose safety concerns in harsh environments.
- Lead-acid batteries are prone to accelerated degradation and reduced lifespan when charged at high temperatures, making them less suitable for outdoor and high-heat conditions.



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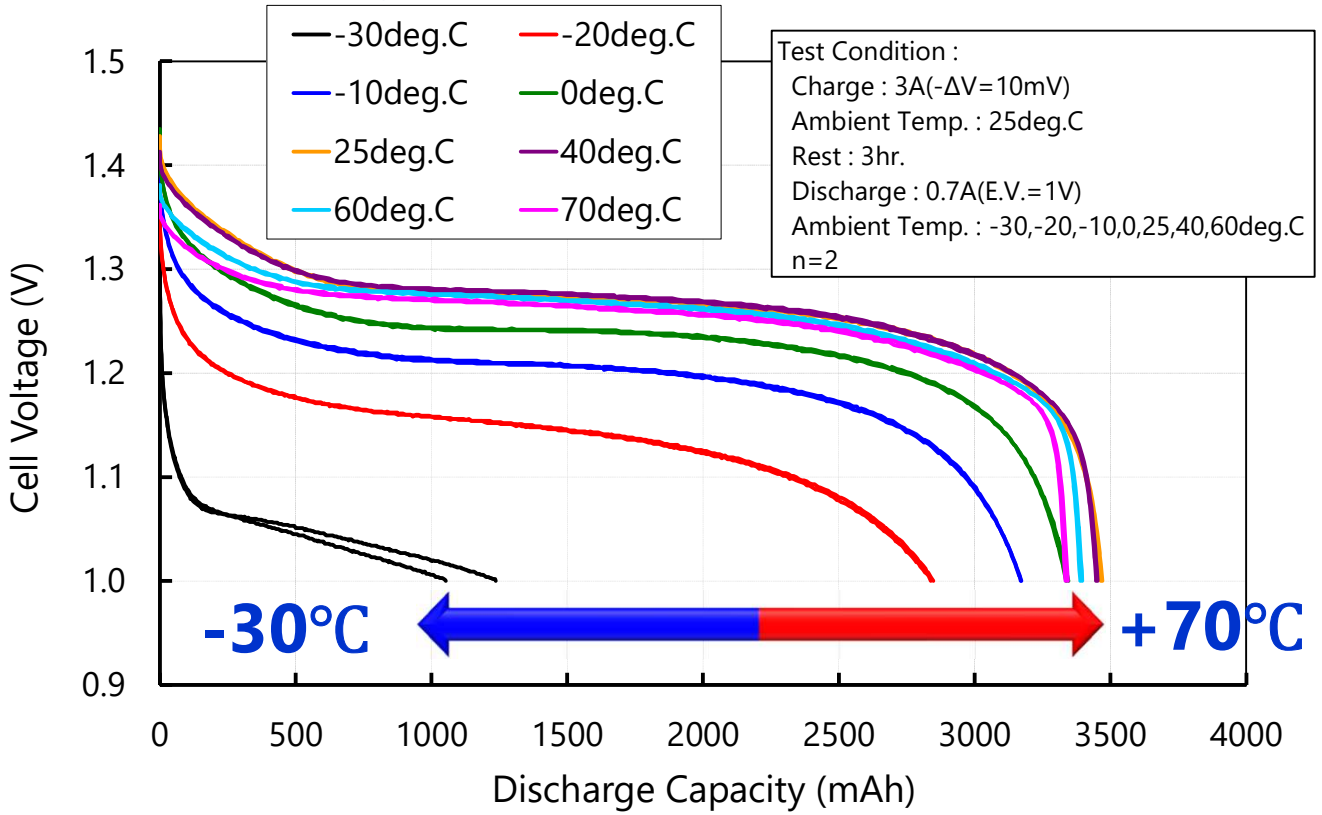
Wide Temperature Range

- FDK have lineup what it's possible to discharge at wide temperature from low temperature (-30deg.C) to high temperature (60deg.C).
- The graph shows the actual test data for the 4/3FA size high durability model.

Discharge Temperature Characteristics



***Depending on the discharge conditions, it can withstand temperatures of -40℃**

✓Possible to discharge 0.2It continuously at -30 to +70℃*

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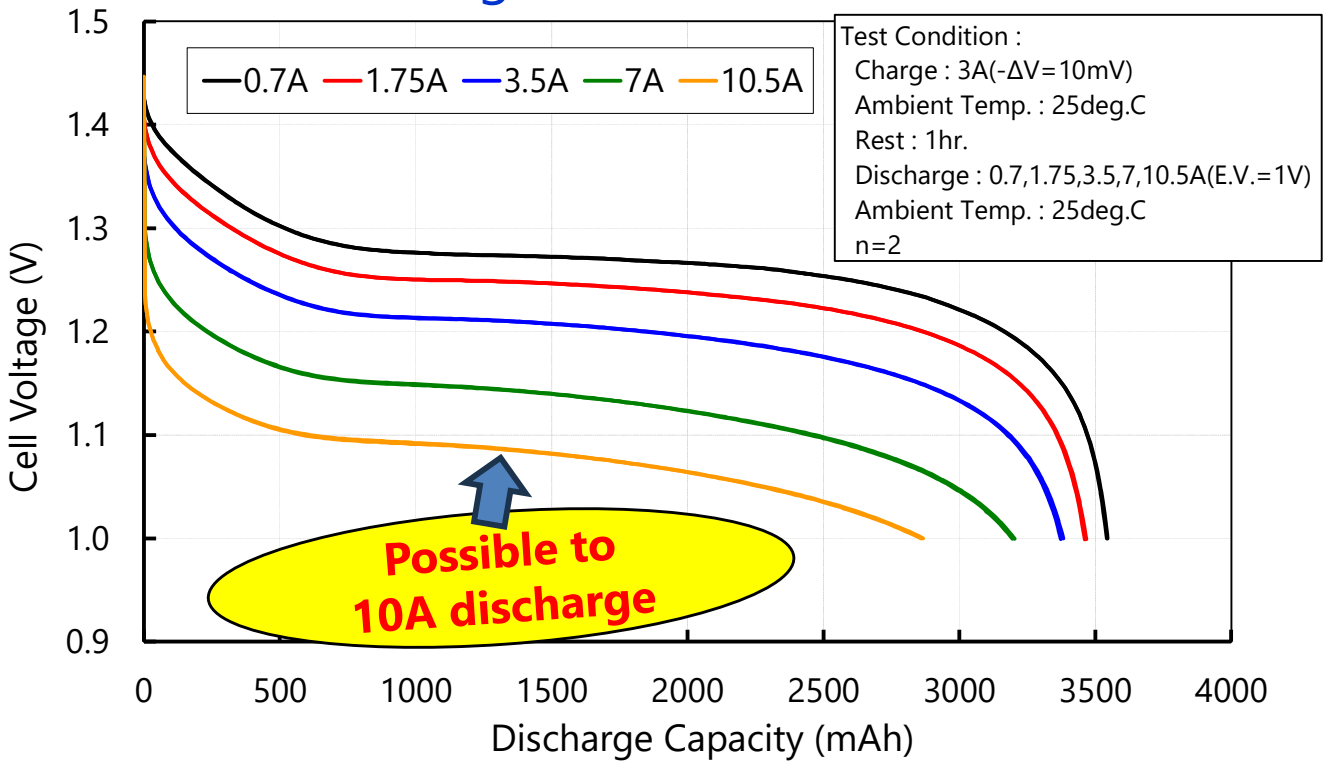
Discharge Capability

- FDK have lineup what it's possible to discharge at max.3It.
- The graph shows the actual test data for the 4/3FA size high durability model.

Discharge Rate Characteristics



***Depending on the discharge conditions, batteries other than the high-durability model may also be supported.**

✓Stable discharge even with large current*

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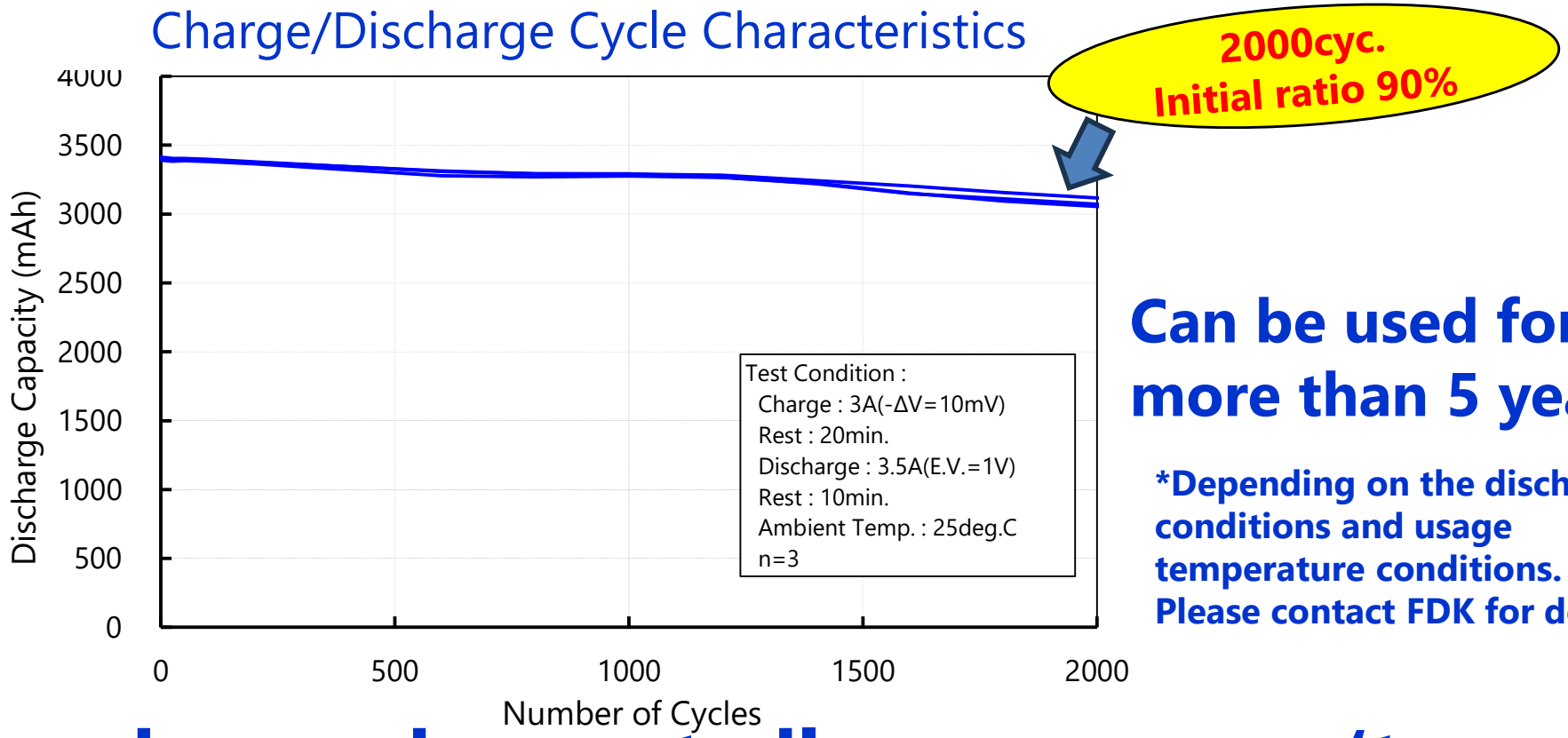
Durability

- FDK have lineup what have long cycle life.
- The graph below shows the actual test data for the 4/3FA size high durability model.



Can be used for more than 5 years *

***Depending on the discharge conditions and usage temperature conditions. Please contact FDK for details.**

✓It can be used repeatedly, so you won't need to replace the batteries for a long time.

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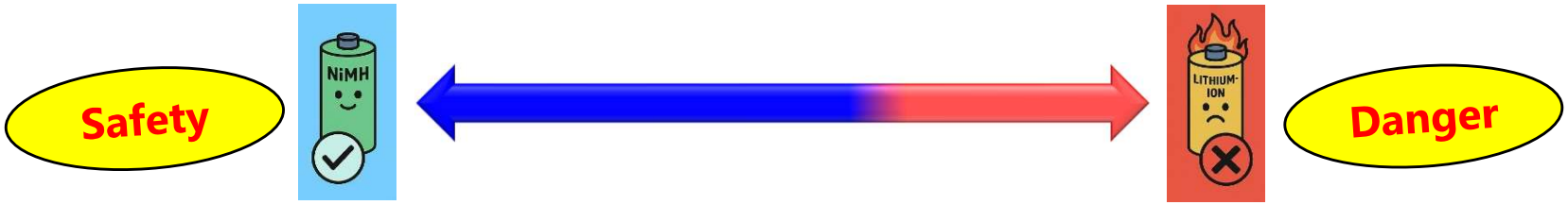
Safety

- Nickel-metal hydride batteries do not use lithium metal or organic solvent-based electrolytes, so they are safer than lithium-ion batteries.
- They use fewer environmentally hazardous substances and are subject to almost no transportation regulations, so they have an advantage in this respect as well.



		Ni-MH Batteries	Ni-Cd Batteries	Lead Acid Batteries	Li-ion Batteries
Voltage		1.2V	1.2V	2.0V	3.6V
Negative Electrode		MH	Cd	Pb	Li
Electrolyte	**Solvent**	Water-base	Water-base	Water-base	Organic Solvent
	Solute	KOH	KOH	H_2SO_4	PC or DMC w/$LiPF_6$
Positive Electrode		NiOOH	NiOOH	PbO_2	$LiXCoO_2$
Recycling rate		★★★	★★★	★★★	★☆☆
Safety		★★★	★★★	★★☆	☆☆☆
Environmentally Friendly		★★★	★☆☆	★☆☆	★★☆
Transportation Regulation		★★★	★★★	★★☆	★☆☆

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FDK battery capacity and size

FDK

*Depending on the device specifications, environmental temperature, etc., batteries other than the high durability model may also be selected.

High durability Ni-MH

FDK's Recommend*

Ideal for replacing nickel-cadmium batteries due to their long life

Model No.	Capacity(mAh)		Dimensions(mm)*3	
	Typ.*1	Min.*2	Diameter	Height
HR-2/3AAAUTU	220	200	10.5	30.0
HR-AAAUTU	500	460	10.5	44.5
HR-AAULTU	780	700	14.2	49.0
HR-AAULT Recommend	1000	950	14.2	49.0
HR-AATU	1280	1200	14.35	50.0
HR-AAUT	1580	1500	14.2	50.0
HR-4/5FAUPT	1650	1500	18.1	43.2
HR-AUT	2200	2000	17.0	50.0
HR-4/3FAUT Recommend	3700	3300	18.0	67.5
HR-5/4SCUT	3250	3000	23.0	50.0

Standard Ni-MH

Excellent energy density achieved by optimizing materials and configuration

Model No.	Capacity(mAh)		Dimensions(mm)*3	
	Typ.*1	Min.*2	Diameter	Height
HR-AAAUC	700	650	10.5	44.5
HR-AAUQ	840	770	14.2	43.0
HR-AAUC	1200	1100	14.2	50.0
HR-AAUE	1400	1250	14.2	50.0
HR-AAU Recommend	1650	1500	14.2	50.0
HR-4/5AU	2150	1950	17.0	43.0
HR-AUE	2700	2450	17.0	50.0
HR-4/3AU	4000	3600	17.0	67.5
HR-4/3FAU	4500	4100	18.0	67.5

High-rate discharge Ni-MH

Small internal impedance allows for high-rate discharge

Model No.	Capacity(mAh)		Dimensions(mm)*3	
	Typ.*1	Min.*2	Diameter	Height
HR-4/5FAUP	1950	1800	18.1	43.2
HR-4/3FAUHPC	2700	2500	18.1	67.0
HR-SCU	3000	2700	23.0	43.5
HR-4/3FAUPC	3200	3050	18.1	67.0
HR-4/3FAUP	4000	3750	18.1	67.0

Dry cell compatible Ni-MH

Can be used with almost all battery-powered devices

Model No.	Capacity(mAh)		Dimensions(mm)*3	
	Typ.*1	Min.*2	Diameter	Height
HR-4UQ	600	550	10.5	44.5
HR-4UTG	800	750	10.5	44.5
HR-4UGX	1000	930	10.5	44.5
HR-3UQ	1000	950	14.2	50.4
HR-3UTG	2000	1900	14.35	50.4
HR-3UTGX	2620	2500	14.5	50.4

*1 : Typical discharge capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16hours.
*2 : Minimum discharge capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16hours. *3 : Including tube.

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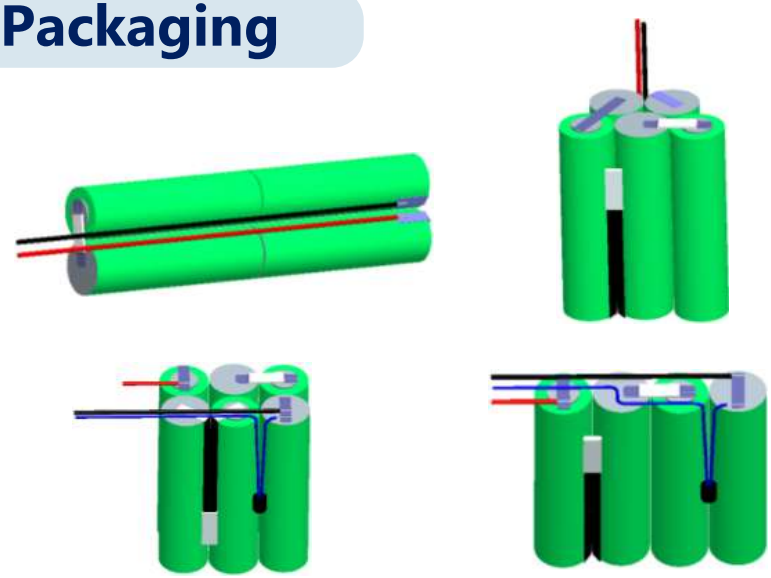
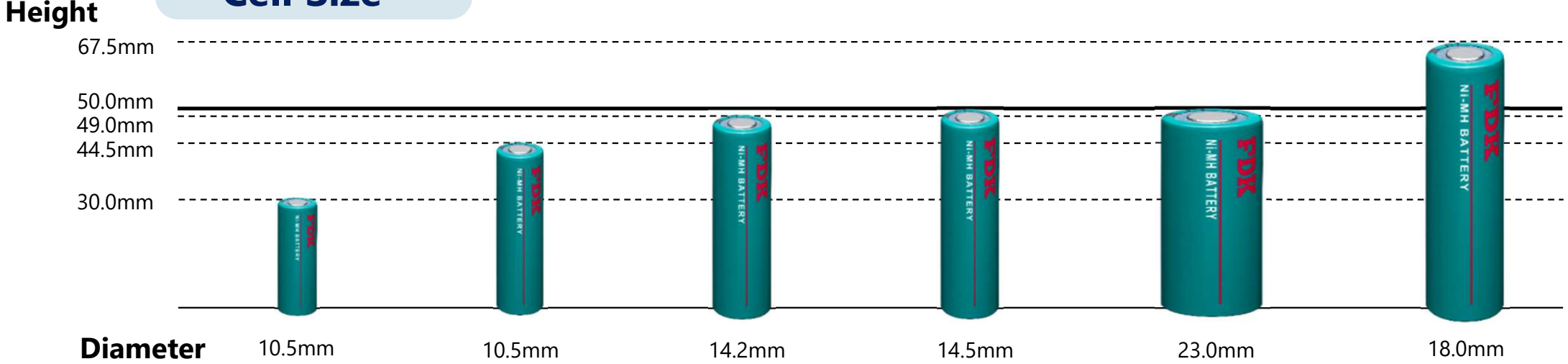
FDK's battery pack design

- We have a wide range of sizes available.
- We can flexibly respond to your capacity and size requests according to your application.

Packaging



Cell Size



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Lastly

- FDK has an extensive battery lineup to support a wide variety of needs.
- We have experience using batteries other than high-durability models, so we can propose batteries that match the specifications of your equipment.
- FDK can support you in obtaining the data necessary for your product development.
- Please contact us regarding obtaining various standards, such as explosion-proof standards.

FDK can do strongly support for your project

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Technology creating a better future