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Technical Proposal for Medical Equipment

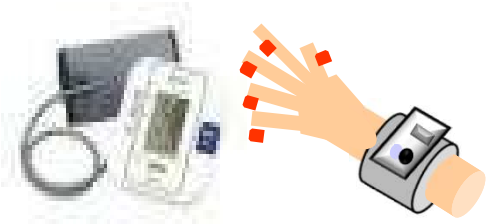
July, 2025

Technical Support Department
Ni-MH Battery Division
FDK CORPORATION

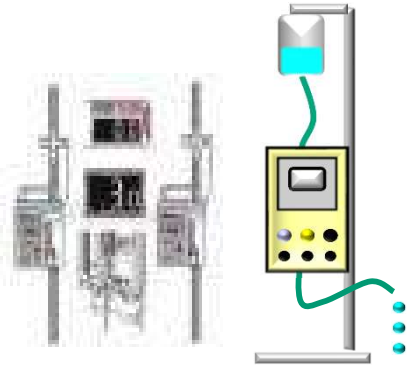
Required item for medical application battery

■Medical Application

Monitor



Sphygmomanometer



Pump

Batteries are required because medical devices need to be driven while moving.

Required item for medical application battery

- Can it work
- Safety
- Reliability
- Durability

Secondary battery will need safety and reliability.

We suggest FDK's high durability Ni-MH.

・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.

Structure Comparison with Chemical Battery

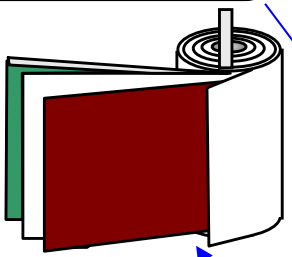
	Pb	Ni-MH	Li-Ion
Possibility of burning	No	No	Yes
Environmental friendly	No	Yes	Yes

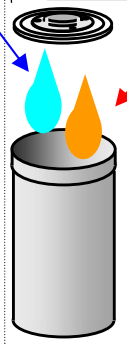
Electrolyte
Acid Aqueous Solution
(water-base)

Electrolyte
Alkaline Aqueous Solution
(water-base)

Electrolyte
Li salt
(Containing organic solvent)

It does not catch fire





Structure
Containing Pb

Structure
Hg, Cd, Pb Free

Energy density of Li-ion are higher than Ni-MH, but Ni-MH have the merit of no burning.

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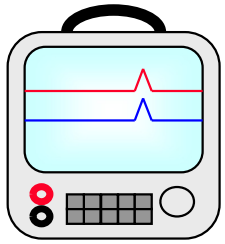
For Medical Device

Fundamental Requirement for Medical Application

Reliability

Required Characteristics

Bedside monitor

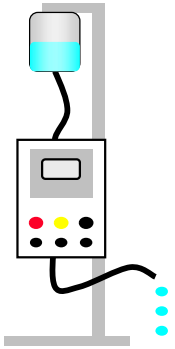


- High reliability
- Long life
  at continuous charge condition

Recommended models

High Durability Model
Middle ~ Large size models

Infusion pump

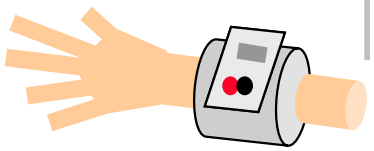


- High reliability
- Long cycle life

High Durability Model
All models

Sphygmomanometer

(Blood pressure meter)



- High reliability
- Small size
- Low self-discharge

High Durability Model
Small size models

Dry Cell Compatible Model
HR-3UTG , HR-4UTG,
HR-3UQ, HR-4UQ

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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Feature of High Durability Model

Feature Suitable battery for Medical equipment

Superior service life at low-rate charging and charge/ discharge cycles.

➡ It is possible to use simple charge detection.

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・Specific values included in this material are intended to describe performance. They are not guaranteed.

High Durability Ni-MH Batteries

For emergency lights, emergency exit lights, security equipment, communication base stations, medical equipment, ATMs, POSs, traffic road studs and various backup power supplies.

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	1050	1000	14.2	49.0
HR-AATU New	1280	1200	14.5	50.0
HR-AAUT	1580	1500	14.2	50.0
HR-4/5FAUPT	1650	1500	18.1*4	43.2*4
HR-AUT	2200	2000	17.0	50.0
HR-5/4SCUT	3250	3000	23.0	50.0
HR-4/3FAUT	3700	3500	18.0	67.5

**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 heat shrink tube. *4.Including paper tube / heat shrink tube.*

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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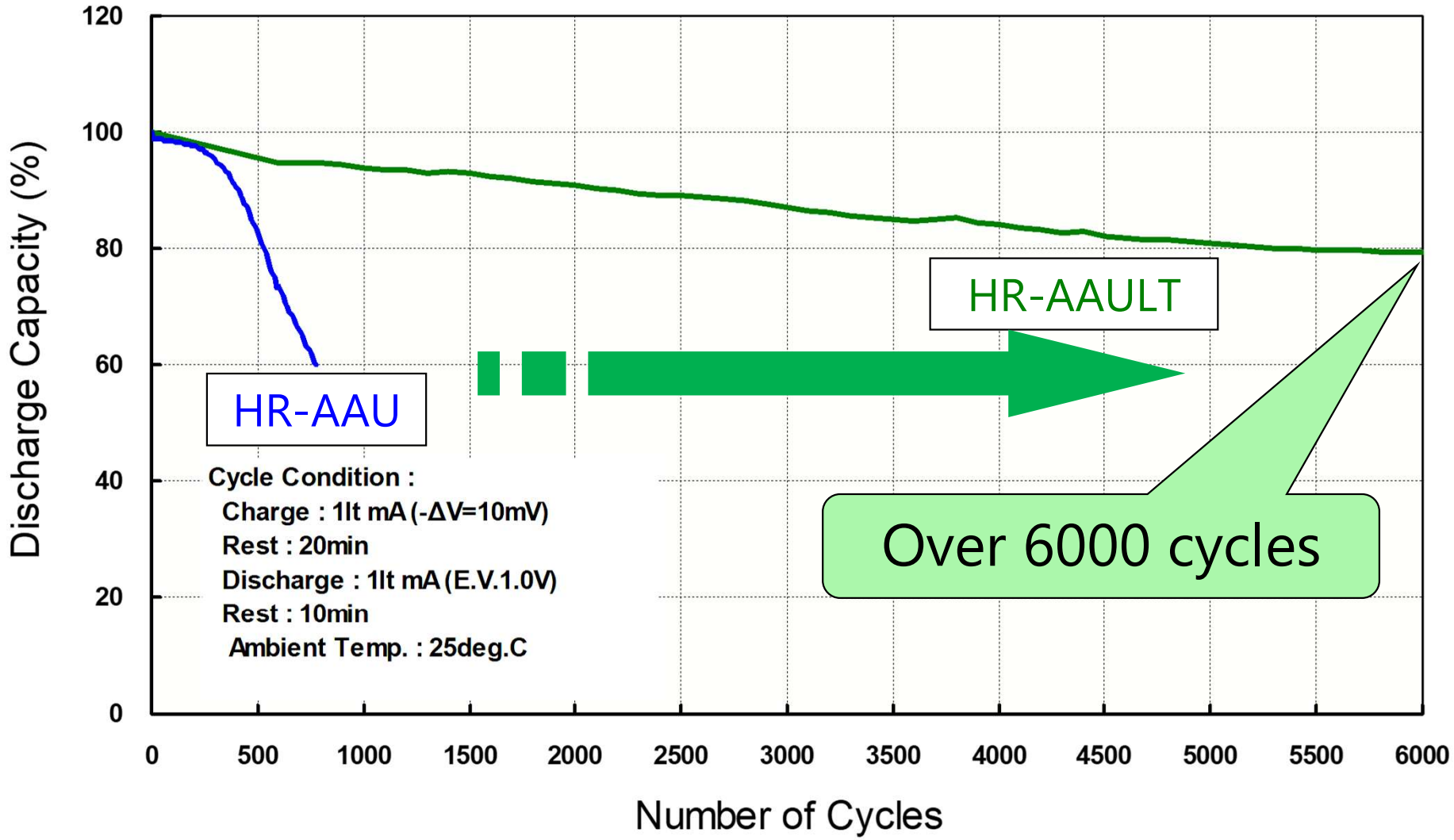
Cycle Characteristics of High Durability Models

Superior long cycle life performance !!



・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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Dry Cell Compatible Ni-MH Batteries

For digital cameras, PDAs, audio equipment, remote controls, clocks, radio-controlled, hobby items, 2-way radio.

Model No.	Capacity(mAh)		Dimensions(mm)*3	
	Typ.*1	Min.*2	Diameter	Height
HR-4UQ	600	550	10.5	44.5
HR-4UTG Long Life type	800	750	10.5	44.5
HR-4UTG	800	750	10.5	44.5
HR-4UTGX	1000	930	10.5	44.5
HR-3UQ	1000	950	14.2	50.4
HR-3UTG Long Life type	2000	1900	14.35	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 label / heat shrink tube.

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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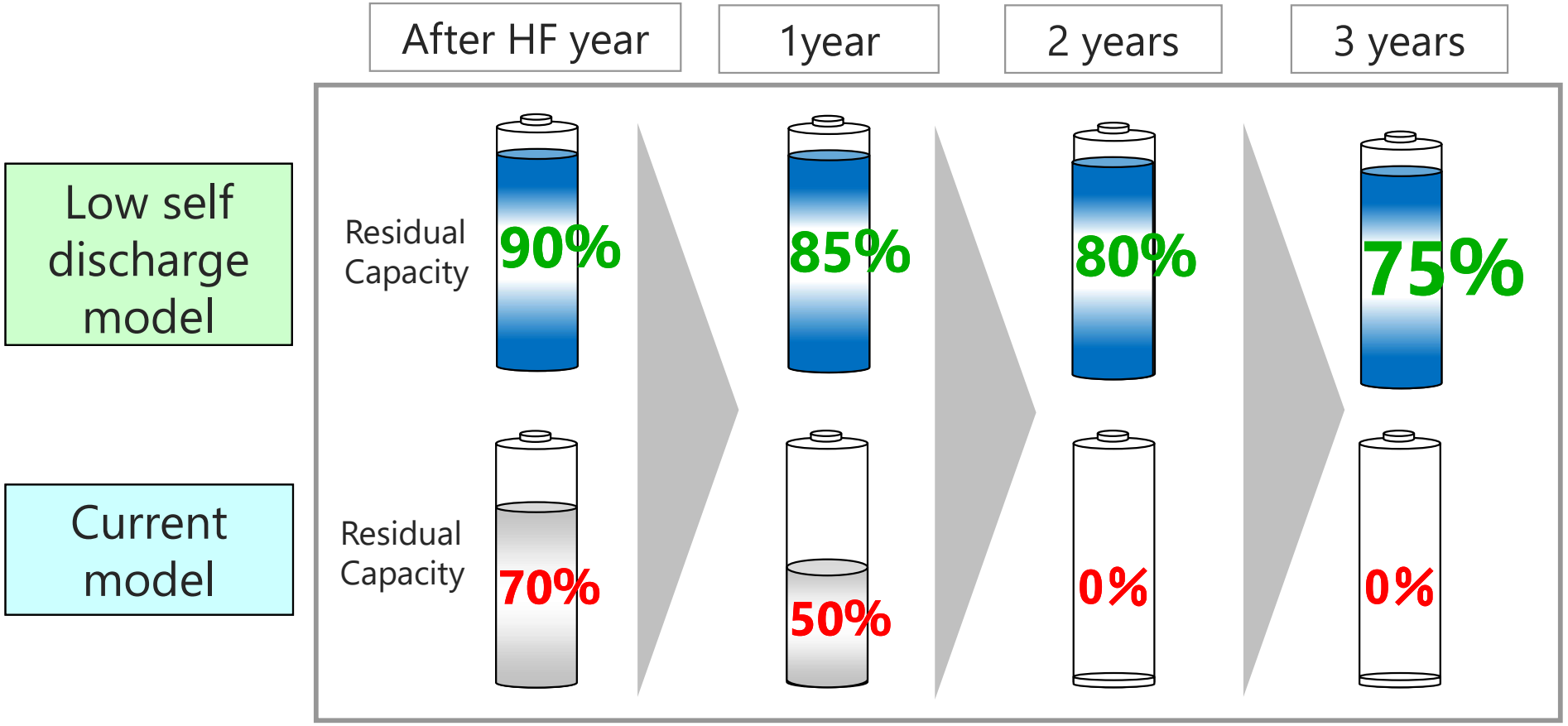
Feature of low self-discharge model

Superior low self-discharge performance!!

Even though 3 years past after full-charged, ※1 this model can remain 75% capacity! Ready to Use!



※1：Ambient Temp. 20deg.C
Discharge current : 740mA,E.V.=1.0V/cell

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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Advantage of Low Self-discharge Model

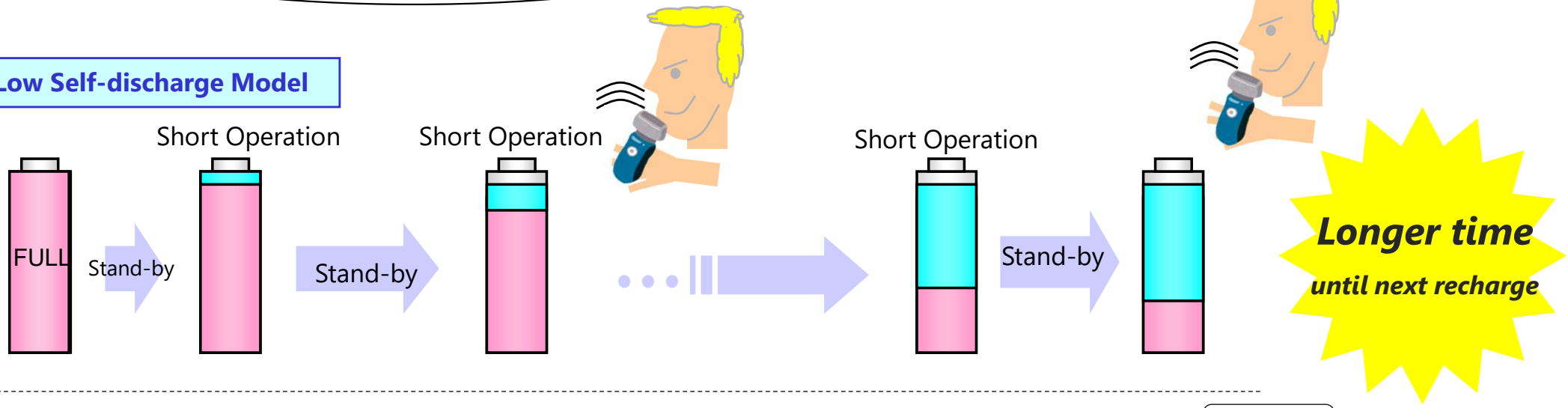
Longer Time until next recharge!

For Short Operation / Long Stand-by Applications

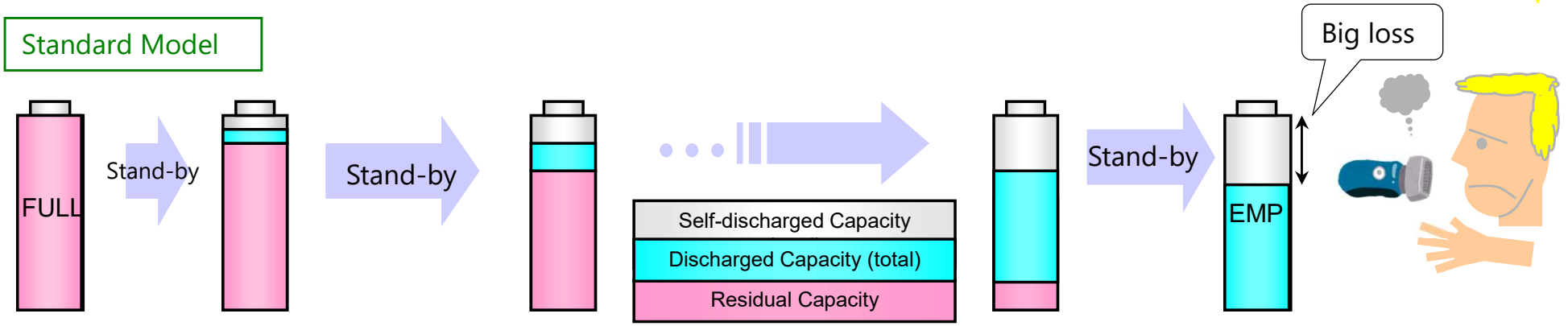
Example of Application
- Electric Razor
- Electric toothbrush

etc.

Low Self-discharge Model



Standard Model



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High-Rate Discharge Ni-MH Batteries

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For power tools, vacuum, cleaners, Electric motor application and various High-Rate applications.

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

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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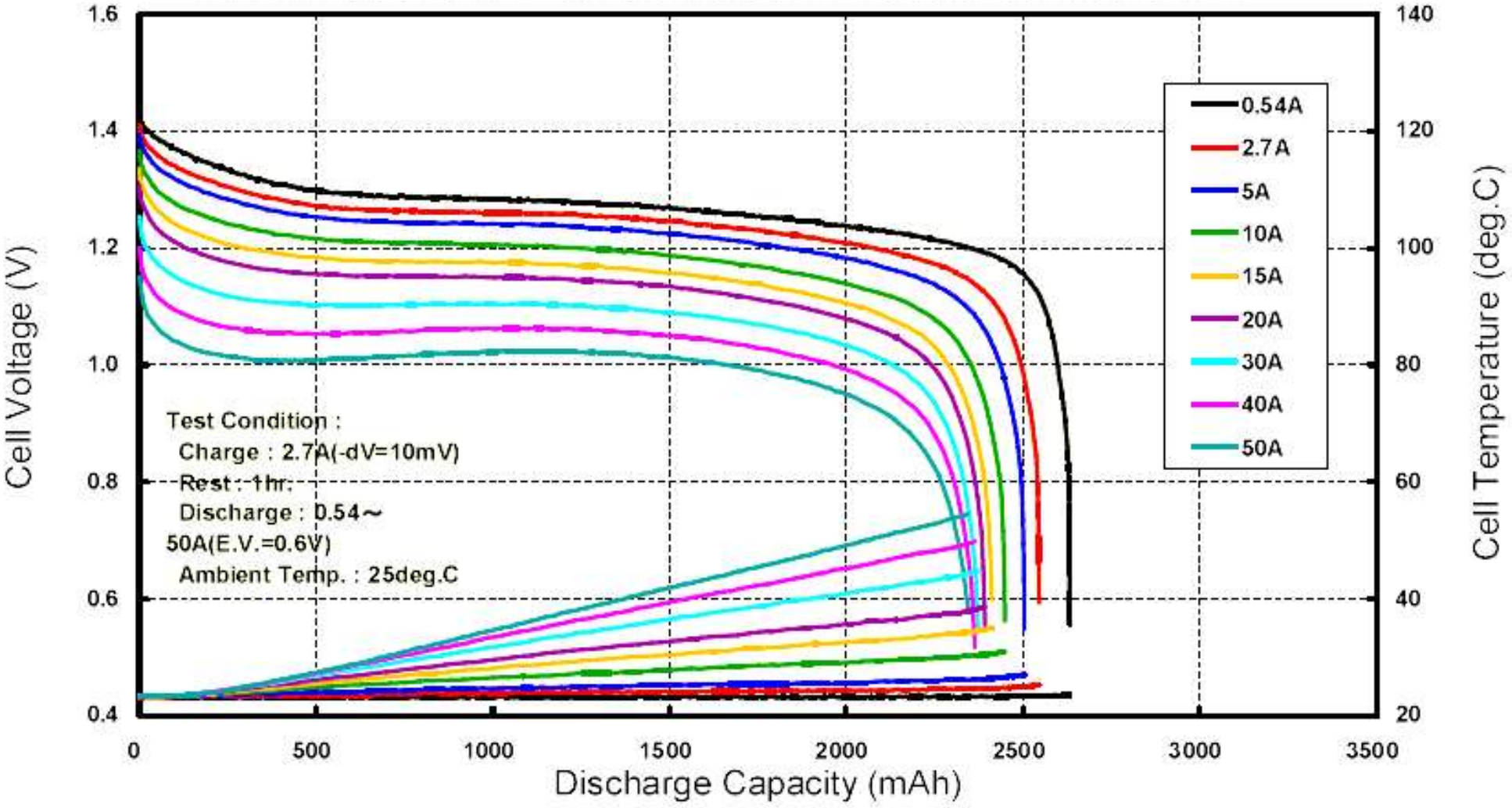
Discharge Rate Characteristics of HR-4/3FAUHPC

Possible to discharge at 50A!!



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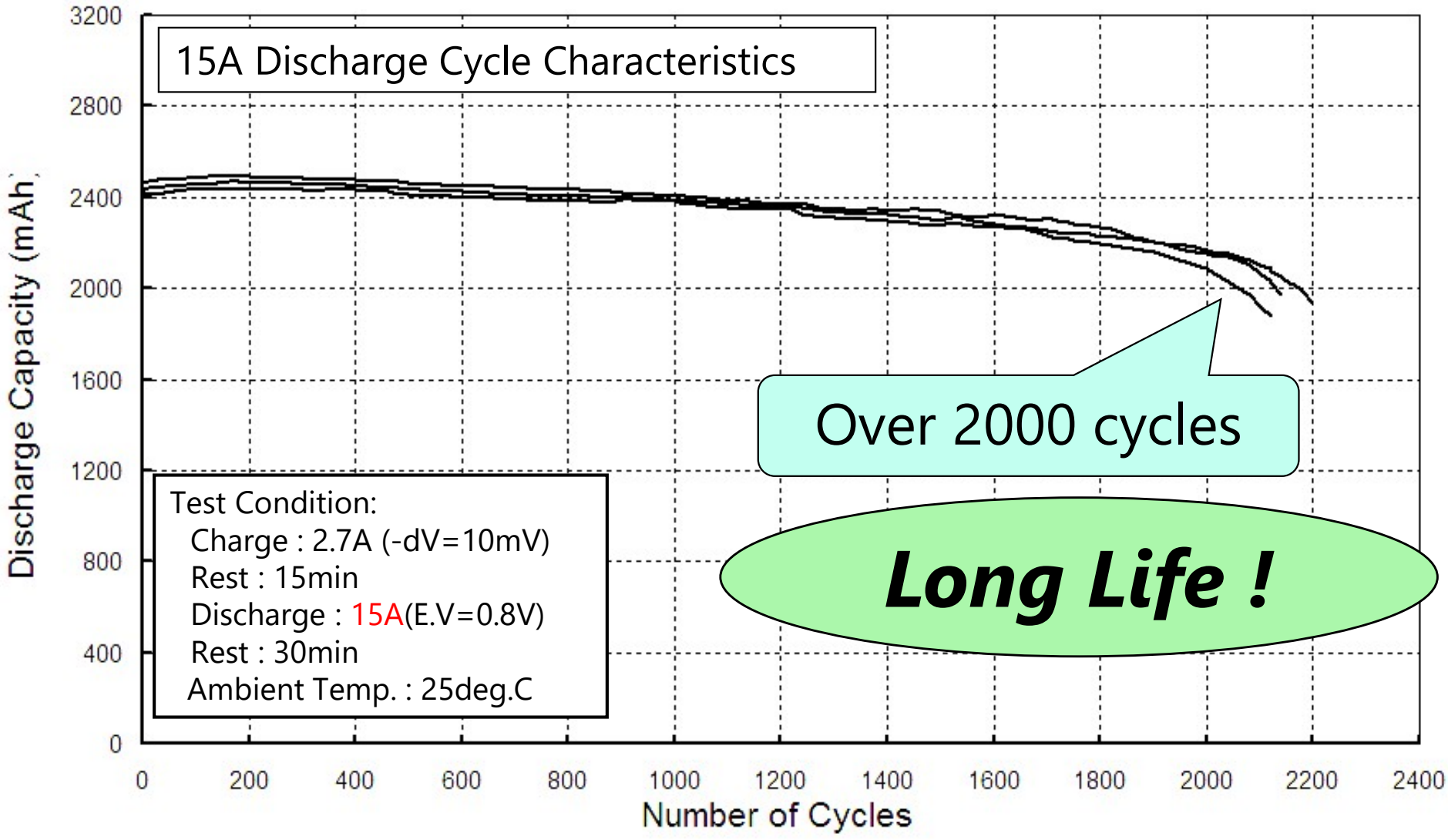
Cycle Characteristics of HR-4/3FAUHPC



・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.

Standard Ni-MH Batteries

FDK

For audio / video equipment, information / communication devices, lighting equipment, measuring instruments , home applications, toys.

Model No.	Capacity(mAh)		Dimensions(mm)*3	
	Typ.*1	Min.*2	Diameter	Height
HR-AAAUC Long Life type	700	650	10.5	44.5
HR-AAUC Long Life type	1200	1100	14.2	50.0
HR-AAUE	1400	1250	14.2	50.0
HR-AAU	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

**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 label / heat shrink tube.*

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Regarding to International safety standard IEC62133-1 for medical equipment

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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IEC60601-1

Medical electrical equipment Part 1: General requirements for basic safety and essential performance

15.4.3.4 Lithium batteries

Lithium batteries used in ME EQUIPMENT that could become a HAZARD shall comply with the requirements of IEC 60086-4. See also 7.3.3.

Primary lithium batteries shall comply with the requirements of IEC 60086-4. Secondary lithium batteries shall comply with the requirements of IEC 62133. See also 7.3.3.

NOTE Batteries includes both single cells and assemblies of cells, i.e. battery packages.

Compliance is checked by inspection of the battery design documentation or by performance of the tests identified in IEC 60086-4 for primary lithium batteries and IEC 62133 for secondary lithium batteries.

Above sentence is quoted from IEC60601-1 Ed.3.1 2012-08.

- In the above sentence, it is not described safety contents regarding to alkaline batteries. It is described only Primary lithium batteries and Secondary lithium batteries.
- It is not also described that batteries need certification of IEC62133 by third party.

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FDK has the battery which conforms to IEC62133-1

Comparison of IEC 62133-1 and FDK's safety test result (e.g. HR-4/5AU)

Test Item	Test Condition		Standard	Results(FDK Test Condition)		
	IEC62133	FDK		Fire	Exprosion	Leakage
4.2.1 Continuous Charge	Cell Condition : Charged State Charge : 210mA for 28days	Cell Condition : Charged State Charge : 210mA for 28days	IEC	No	No	No
4.2.2 Vibration	Cell Condition : Charged State Amplitude : 0.76mm Cycle : 10～55～10Hz(1Hz/min) Direction : Three Directions ×90min	Cell Condition : Charged State Amplitude : **0.8mm** Cycle : 10～55～10Hz(1Hz/min) Direction : Three Directions ×90min	IEC(*1)	No	No	No
4.2.4 Temperature Cycling	Cell Condition : Charged State Cycle : 75～20～-20～20deg.C(5times)	Cell Condition : Charged State Cycle : 75～20～-20～20deg.C(10times)	IEC	No	No	No
4.3.2 Short Circuit	Cell Condition : Charged State External Resistance : <100m ohm	Cell Condition : Charged State External Resistance : **<20m ohm**	IEC(*1)	No	No	(No Requirement)
4.3.3 Free Fall	Cell Condition : Charged State Hight : 1m Cycle : 3times	Cell Condition : Charged State Hight : 1m Cycle : **5times**	IEC(*1)	No	No	(No Requirement)
4.3.4 Mechanical Shock	Cell Condition : Charged State Peak acceleration : 125～175gn	Cell Condition : Charged State Peak acceleration : 125～175gn	IEC	No	No	No
4.3.5 Thermal Abuse	Cell Condition : Charged State Ambient Temp. : 25～130deg.C	Cell Condition : Charged State Ambient Temp. : 25～**150deg.C**	IEC(*1)	No	No	(No Requirement)
4.3.6 Crush	Cell Condition : Charged State Press : 13kN	Cell Condition : Charged State Press : 13kN	IEC	No	No	(No Requirement)
4.3.7 Low Pressure	Cell Condition : Charged State Pressure : <11.6kPa	Cell Condition : Charged State Pressure : <11.6kPa	IEC	No	No	No
4.3.8 Over Charge	Cell Condition : Discharged State Charge : 2.5It(5.4A) for 1h(250%)	Cell Condition : Discharged State Charge : **4.7It(10A)** for 1h(470%)	IEC(*1)	No	No	(No Requirement)
4.3.10 Forced Discharge	Cell Condition : Discharged State Discharge : 1It(2.15A) for 90min(150%)	Cell Condition : Discharged State Discharge : **4.7It(10A)** for 45min(350%)	IEC(*1)	No	No	(No Requirement)

(*1) We did the test under tougher condition than IEC 62133.
(*)The above data shows only the evaluate results and does not represent guaranteed performance.

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IEC 62133-1 CoA document

Since IEC62133-1 is an international standard, we can issue Certification of acknowledge based on self evaluation.

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Certification of acknowledgement of IEC 62133-1

This is to certify that

FDK CORPORATION recognizes the requirements of International standard IEC 62133-1 (2017-2) and that HR-*** is capable of satisfying the requirements of this standard.

Date:

Yoshikazu Izumi
Senior Manager
FDK CORPORATION
Product Business Group
Ni-MH Battery Division
Technical Support Department

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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Appendix

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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Example of use < application >

■ Typical model of the medical applications and adoption points

Bed side monitor

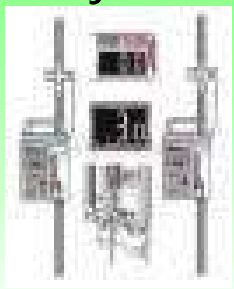
■ Required characteristics
- High reliability
- Long life at continuous charging

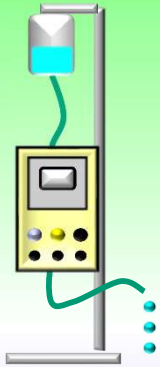
8HR-4/3FAUPC (9.6V/3200mAh)
- Even a compact size, wide range of output characteristics and safety.
- Operated with Optimal control that considered life.

10HR-4/3AU (12.0V/4000mAh)
- High capacity,
- High rate output characteristics.

10HR-AAUC (12.0V/1200mAh)
- Long life.

Infusion pump Injection pump



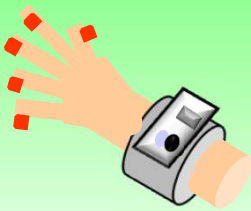


■ Required characteristics
- High reliability
- Long life at continuous charging

2HR-3UTG (2.4V/2000mAh)
- Voltage stability suitable for metering pump.

10HR-AAAUC (12.0V/700mAh)
8HR-AAUC (9.6V/1200mAh)
- Upon replacement for Ni-Cd, there is no need for change control.

Sphygmomanometer



■ Required characteristics
- High reliability
- compact size
- low self-discharge

3HR-3UTG (3.6V/2000mAh)
- It is possible to use long time on one time charging.

2HR-AAAUC (2.4V/700mAh)
- Low cost at cell performance contrast.

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Advantage and characteristics of Ni-MH battery

■ Merits of Ni-MH battery(vs. Other battery series)

	Ni-MH battery	Li-Ion battery	Lead Battery	Ni-Cd battery
Sustainable capacity	Good	Standard	Poor	Good
High rate discharge	Good	Standard	Poor	Good
Heat generation when It was discharged	Good	Poor	Good	Good
Low temperature discharge	Good	Standard	Standard	Good
Safety regulation of transportation	Good ※	Poor	Good	Good
Safety control	Good	Poor	Good	Good
Environmental load	Good	Good	Poor	Poor

※Be careful about sea transportation of single cell

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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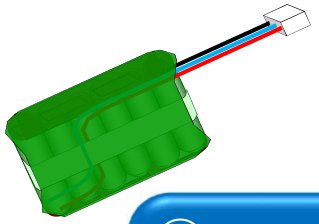
Advantage and characteristics of Ni-MH battery

■ Merits of Ni-MH battery(vs. Li-Ion battery)



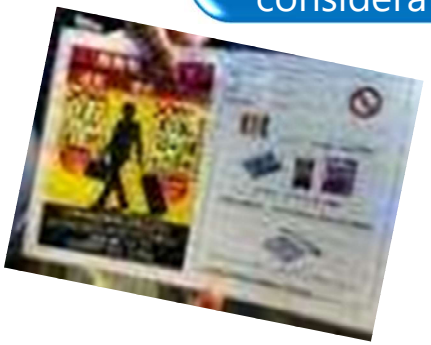
① Stable capacity trend
- After re-using, Battery maintains its capacity over time.

⑥ No initial cost
- Doesn't need protecting circuit board, case and mold, so initial cost isn't applied almost.

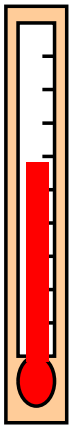
② Quick charge
- Ni-MH battery can be fully charged in less than an hour using suitable charge control.

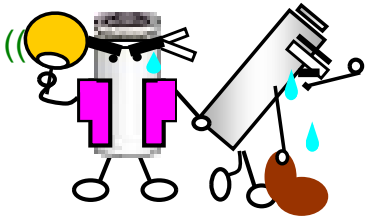
⑤ Few safety regulation during shipping
- Ni-MH battery：Regulated sea transportation only (after 2012. Exclusion regulation is under consideration

③ Low-heat-generation during discharge
- Even a high rate discharge device, battery temperature is hard to rise.



④ Superior low temperature discharge performance
- Enable to use stable any season and area.





69℃～80℃
(Example：60W discharge)

・Battery performance and lifespan are greatly affected by usage and temperature conditions.・Test results vary depending on individual batteries.
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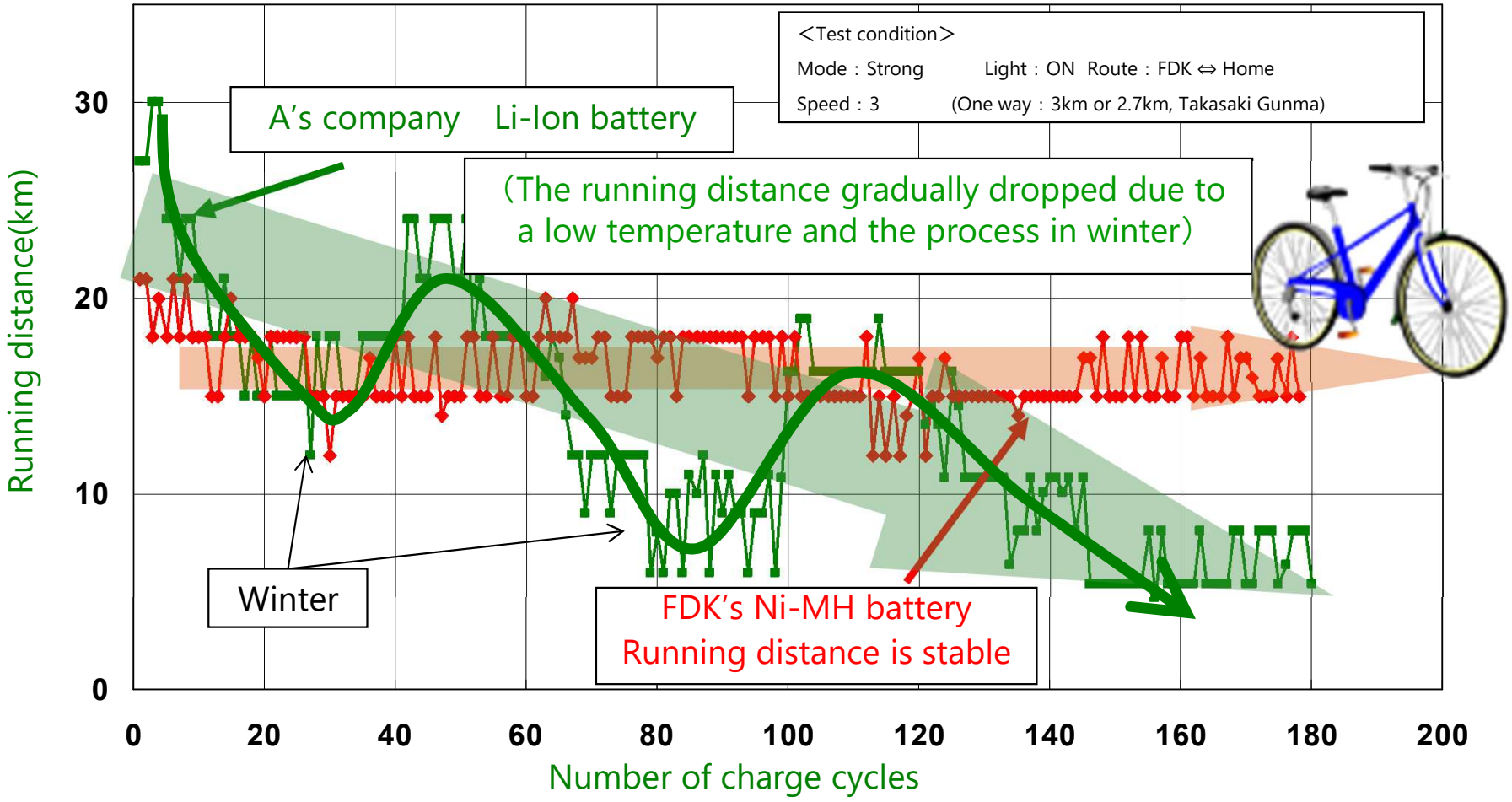
Advantage and characteristics of Ni-MH battery

■ Merits of Ni-MH battery : Stable capacity, and superior performance at low temperature

- Ni-MH battery shows consistent performance under low temperature conditions.
- Ni-MH battery shows stable capacity with charge and discharge cycle.



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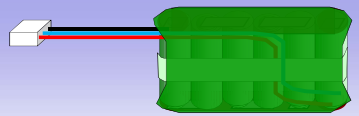
Advantage and characteristics of Ni-MH battery

■ Merits of Ni-MH battery : Ni-MH battery can be a simple packaging

■ Ni-MH battery



- Thermistor
- Breaker or PTC (Positive Temperature Coefficient)
- Thermal fuse

Combination use

The assemblage is selected by charge and discharge test conditions.

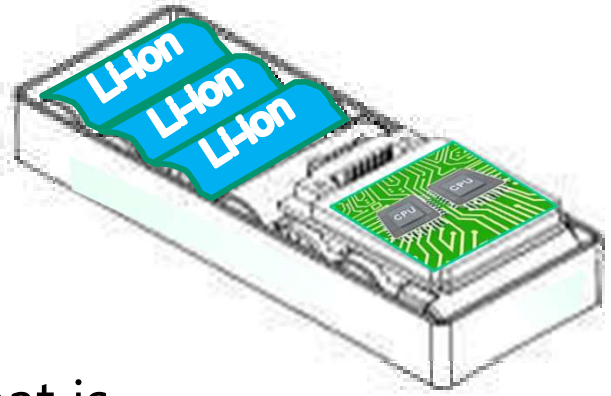
Example of installment

■ Li-Ion battery

- Thermistor
- Breaker
- Thermal fuse etc…

Combination use

- Protecting circuit board



Li-Ion battery needs protection that is more stringent than Ni-MH battery.

・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.

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