



Sanyo Rechargeable  
CADNICA Batteries

# Cadnica®



URL <http://www.sanyo.co.jp/energy/>

SEB-036

## (CADNICA® Batteries Handling Precautions)

Carefully read this entire instruction manual before using CADNICA batteries for the first time. Important: For your safety and that of your customers observe all cautionary information provided in this manual. Save this manual for future reference. The following information is intended to highlight potential safety hazards that can be associated with the misuse, misapplication or damage to CADNICA batteries. Please carefully evaluate the information in this section when using CADNICA batteries (single cell or packed cells) or when designing or manufacturing equipment incorporating CADNICA batteries.



### **DANGER!**

Failure to carefully observe the following procedures and precautions can result in battery leakage, heat generation, bursting and serious personal injury!

- Never dispose of CADNICA batteries in a fire or expose to high temperatures.
- Do not connect the positive (+) and negative (-) terminals of CADNICA batteries together with electrically conductive material, including lead wires. Do not transport or store CADNICA batteries with their uncovered terminals or connected with a metal necklace or other conductive material.
- Only charge CADNICA batteries using those special chargers that satisfy Sanyo's specifications. Only charge batteries under the conditions specified by Sanyo. Failure to follow proper charging procedures can result in damage to the CADNICA batteries.
- Never disassemble, modify or reconstruct CADNICA batteries.
- Never solder lead wires directly on to CADNICA batteries.
- Special order CADNICA batteries, manufactured in accordance with the customer's equipment specifications, are packed by selected type and the number of assortments. Only use special order batteries in equipment for which they were specified.
- The positive (+) and negative (-) polarities of CADNICA batteries are predetermined. Do not force the terminal connection to a charger or equipment. If the terminals cannot be easily connected to the charger or equipment, check if the (+) and (-) terminals are correctly positioned.
- Do not directly connect CADNICA batteries to a direct power source or the cigarette lighter outlet in a car.
- The gas release vent is located at the positive (+) section of CADNICA batteries. Never deform this section or cover or obstruct the gas release vent is located at this section.
- When designing the battery case, or structure for the equipment, the positive cap shall not be deformed or damaged by the case ribs, or other parts, in the event of applying pressure, shock, dropping or any other mechanical stress to the case or battery.

CADNICA batteries contain the strong colorless alkali liquid. The alkali is extremely corrosive and will cause skin damage. If any liquid from a CADNICA battery comes in contact with a user's eyes, they should immediately flush their eyes with clean water enough and consult a doctor. The strong alkali can damage eyes and lead to permanent loss of eyesight. When CADNICA batteries are to be incorporated in equipment or housed within a case, avoid sealed structures as this may lead to the equipment or case being damaged or may be harmful to users.

Contact Sanyo before inserting a CADNICA battery into a waterproof housing or case. Accumulated gases from the battery with spark or ignition from parts may cause rupture.



### **WARNING!**

Do not apply water, seawater or other oxidizing agents to CADNICA batteries, as this can cause rust and heat generation. If a battery becomes rusted, the gas release vent may no longer operate, and can result in bursting.

Never use CADNICA batteries if they are leaking, deformed, discolored, damaged or otherwise differ from their normal condition. External damage to the batteries can be a sign of a malfunction.

Do not damage or remove the external tube of CADNICA batteries, as this may cause leakage, heat generation or bursting.

Do not over-charge CADNICA batteries by exceeding the predetermined charging period specified by the battery charger's instructions or indicator. If CADNICA batteries are not fully charged after the battery charger's predetermined charging period has elapsed, stop the charging process. Prolonged charging may cause leakage and heat generation and bursting. Be sure to handle recharged batteries carefully as they may be hot.

Strong alkali in the electrolyte may cause burns and be harmful if it comes in contact with skin. If so, wash the affected area with clean water immediately.

Do not connect more than 20 CADNICA batteries in series, as this may cause electric shock, leakage or heat generation. Consult Sanyo if designing a battery pack containing more than 20 cells.

When the usage time for a CADNICA battery becomes extremely short after charging, its operating life has ended and it should be replaced.

Keep the equipment or batteries out of the reach of small children, in order to avoid them to swallow batteries. In the event the batteries are swallowed, consult a doctor immediately.

When assembling CP series of the Cadnica models except for CP-3600CR, please avoid electrical welding of lead plates on the center projection area of the can bottom.

This may cause a crack in the can bottom and electrolyte leakage.

This manual is no substitute for your independent evaluation of equipment incorporating CADNICA batteries. Customers incorporating CADNICA batteries into their equipment must assure that their completed product has been properly designed, manufactured and tested. End users of equipment incorporating CADNICA batteries should also be provided with sufficient warnings and instructions on their safe operation. As appropriate, some or all of the following warnings and information should be incorporated by you into the instruction manual accompanying your equipment.

## CAUTION!

If CADNICA batteries do not perform or function well with certain equipment, refer to the instruction manual or warnings of the subject equipment.

Do not strike or drop CADNICA batteries. Sharp impacts or concussions to CADNICA batteries may result in leakage, heat generation and bursting.

Do not mix charged and discharged CADNICA batteries together as this may cause leakage or heat generation.

Do not use old batteries with new ones as this may cause leakage or heat generation.

Do not use CADNICA batteries with any other battery type, including dry cell, or with those of different capacity or brand. Mixed-matching of batteries may result in leakage, heat generation and bursting.

When more than two batteries are to be used together, charge them simultaneously prior to use.

Do not connect CADNICA batteries in parallel as this may cause leakage, heat generation and bursting.

Children should not use CADNICA batteries unless they have been carefully instructed on the contents of this instruction manual and their parents or guardians have confirmed that the children understand and appreciate the proper usage and safety hazards presented by the batteries. Store CADNICA batteries out of the reach of small children. Ensure that small children cannot remove the batteries from the charger or equipment. There is no substitute for proper adult supervision.

Always follow the specified charging temperature ranges (refer to the rating table in the catalog). Failure to observe the temperatures indicated, may cause leakage, heat generation and a decrease in performance or operating life of CADNICA batteries.

For the recommended charging method for CADNICA batteries, read the battery charger's instruction manual carefully. Do not charge CADNICA batteries beyond the recommended time described in the instruction manual for charger or equipment. Over charging cause leakage and heat generation.

Do not carry the batteries by the connector or their lead wires as this may damage the batteries.

**Spent Ni-Cd batteries are precious resources. Please cooperate with recycling without scrapping them after you take them out from the product and insulate them by pasting a tape on the (+) terminal because they are used again. As for the details, ask to our company office or the selling agent.**

Be sure to turn off the equipment after use of CADNICA batteries, as this may result in leakage.

After they have been removed from equipment, store CADNICA batteries in a dry place and within the recommended storage temperature range. This will help preserve the batteries' performance and durability and to minimize the possibility of leakage or corrosion. (For the indicated storage temperature range, refer to the rating table of this catalog. Sanyo recommends a temperature range from 10 °C (50 °F) to 30 °C (86 °F) for longer product life).

If the CADNICA battery terminals become dirty, clean them with a soft dry cloth prior to use. Dirt on the terminals can result in poor contact with the equipment, loss of power, or inability to charge.

If corrosion, heat generation or other abnormalities are detected when using (new) CADNICA batteries, immediately stop using them and return them to the store that they were purchased from.

If you have specific questions about CADNICA batteries, do not hesitate to contact Sanyo at the addresses provided below.

### Regarding to recycle

In some countries or regions, you may be obliged by law, to make marking for indicating that disposal of Ni-Cd batteries is prohibited or/and that they should be recycled, or to collect used batteries from the market.

In such a case, please follow the law.

Please contact Sanyo's office in your region for details.



**Internationally renowned for quality, compact dimensions and lightweight design, Sanyo CADNICA batteries accommodate space-saving requirements perfectly.**

The development of Sanyo CADNICA batteries represents a major breakthrough in battery technology. In 1963, based on the company's proprietary technology, Sanyo succeeded in the commercialization of sealed rechargeable nickel cadmium batteries under the brand name "CADNICA". Over the years, CADNICA batteries have gained considerable renown for their outstanding technological features and excellent quality. Sanyo Electric Co., Ltd. has received ISO9000s accreditation for its industrial sealed Ni-Cd battery, an international quality guarantee standard. CADNICA batteries are designed to withstand continuous overcharging and overdischarging in a sealed environment. Moreover, their excellent performance is approved even in the field of space development for satellite applications. The Company's efforts towards increasing capacity and reducing size and weight have made possible an extensive lineup of Sanyo CADNICA batteries consisting of over 64 models with ratings from 45mAh to 20,000mAh. This means there is a CADNICA battery to suit a wide range of applications, even when only a very small space is available.



## ISO9000 Series:

1. Quality activities to assure the product quality
2. Organization for the quality activities
3. Standardization and documentation of the quality activities
4. Quality control over the manufacturing process and finished product
5. Evidence of implementation under the standard

**The ISO9000 series prove the well established quality control and effective quality activities.**



## (Theory and Structural Design) of CADNICA Batteries

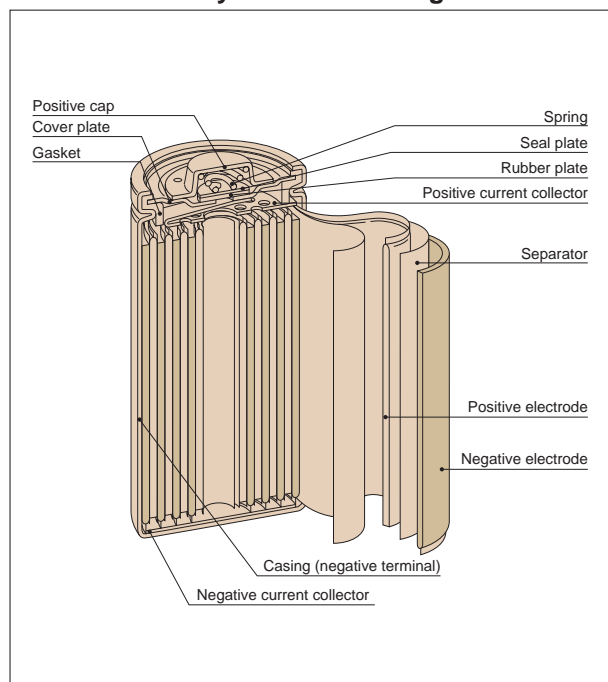
Generally, it is very difficult to overcharge or overdischarge sealed secondary batteries. Using electrode plates developed through the integrated effort of its engineers, Sanyo succeeded in developing a simplified process for electrochemical control over the gas generating reaction. In respect of this advance, Sanyo has obtained 325 patents and utility design patents in Japan, as well as 74 patents abroad (including patents pending).

The reaction of ordinary batteries can be expressed by the formula :  $2\text{Ni}(\text{OH})_2 + \text{Cd}(\text{OH})_2 \rightarrow 2\text{NiOOH} + \text{Cd} + 2\text{H}_2\text{O}$ . Nickel is used as the active material for the positive electrode and cadmium as the active material for the negative electrode. Potassium hydroxide is usually used as the electrolyte.

The following diagram shows the interior of a CADNICA battery. The positive and negative electrodes usually consist of sintered plates wound in a roll and insulated from each other by a separator, with nearly all space inside the cell casing occupied by this roll. This results in the highest possible energy density, as well as excellent charge/discharge and thermal characteristics.

The cell casing is made of rigid steel. Although CADNICA batteries are designed for complete internal consumption of the gas generated within their castings during overcharging, a resealable gas release vent to discharge internal gas is provided to guard against increased internal gas pressure.

### CADNICA Battery Structural Design



## (Features of CADNICA Batteries)

### Extended service life and superior economy

Despite discharge capacity that is virtually equal to that of conventional Alkaline and Manganese batteries, Sanyo CADNICA batteries feature minimal internal resistance and exhibit excellent discharge characteristics under high-rate discharge current conditions.

With output power much higher than that of dry cells, CADNICA batteries can withstand over 500 repeated charge/discharge cycles, as well as offering outstanding economy. In addition, even though the batteries are stored for a long time, the original capacity is recovered by repeated charging/discharging, offering excellent storage characteristics.

### Wide-ranging lineup and interchangeability with dry cells

A host of Sanyo CADNICA batteries are available to satisfy a wide diversity of needs. There are 77 standard models with capacities ranging from 45 to 20,000mAh, and customized assembled batteries tailored to specific equipment space requirements are also available. Sanyo offers the following CADNICA batteries which are interchangeable with dry cells, N-1D, N-1U, N-2U, N-3US, N-3U and N-4U. When the dry cells in current equipment are used up, simply replace them with charged CADNICA batteries.

### Excellent high-rate discharge performance and overcharge/overdischarge capability

Sanyo's original electrode plate manufacturing process and current collectors minimize internal resistance, which in turn enables high-rate discharging and guarantees stable discharge voltage. Sanyo CADNICA batteries are designed to withstand overcharging and overdischarging. Additionally, to ensure extra safety, they are provided with a resealable gas release vent that discharges internal gas.

### Improved reliability with wide operating temperature and humidity ranges

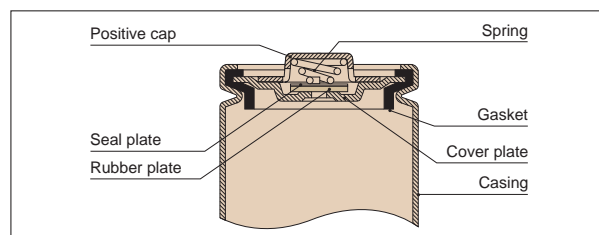
In addition to displaying only minimal variation in performance over a wide temperature range, their totally-sealed construction gives CADNICA batteries high resistance to humidity. Sanyo CADNICA batteries are manufactured under strict quality control conditions, and undergo 100% inspection before shipment. This assures superior reliability.

### Simple to maintain and strong

The special sealed construction eliminates the need to replenish the electrolyte, for easier maintenance. As Sanyo CADNICA batteries may be installed in any direction in equipment, they are exceptionally easy to handle. Moreover, CADNICA batteries employ a rigid metal casing for superior resistance to shock and vibration.

**Vibration resistance: 4mm amplitude, 1000CPM frequency**  
**Shock resistance: 100G**

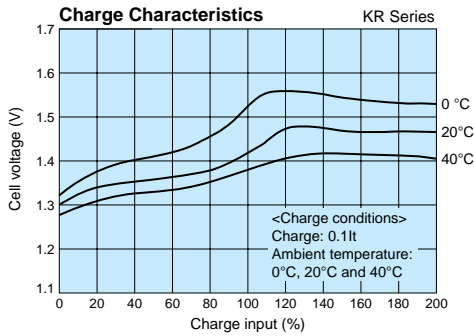
### Structure of the Gas Release Vent



# (General Characteristics of CADNICA Batteries)

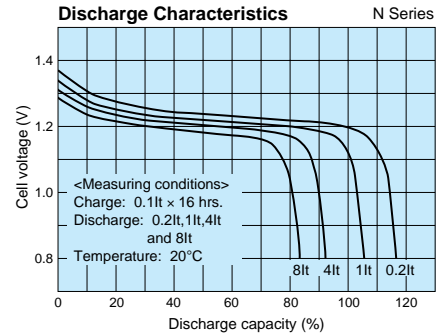
## Charge characteristics

During charging, the cell voltage of CADNICA batteries increases as charging proceeds. It then decreases slightly in the final stage due to heat generation within the cell, eventually reaching an equilibrium. The cell voltage also varies widely according to the ambient temperature.



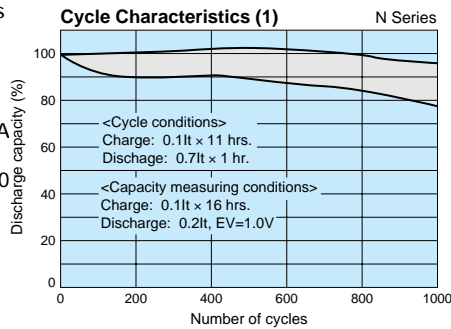
## Discharge characteristics

Although the operating voltage of CADNICA batteries varies slightly depending on the discharge current, it is maintained at approximately 1.2V for 90% of the discharge period.



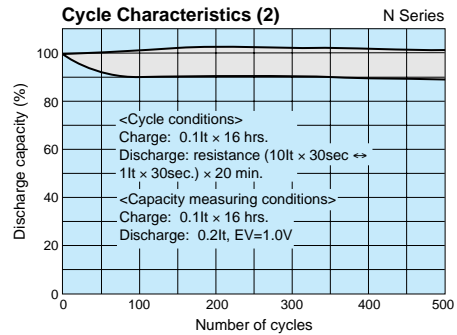
## Cycle characteristics (1)

It is difficult to correctly measure the service life of a battery since this depends on the conditions of use. However, under normal usage conditions, standard CADNICA batteries can withstand over 500 charge/discharge cycles.



## Cycle characteristics (2)

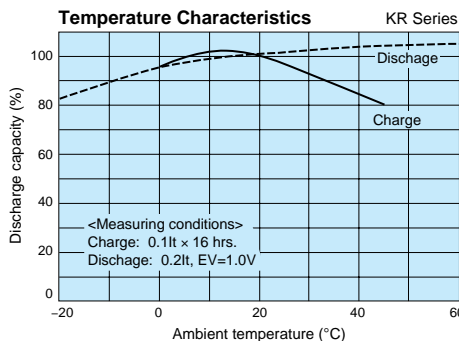
CADNICA batteries can be expected to provide a long service life of over 500 cycles, even under high-rate pulse discharge conditions, similar to actual use conditions of radio control units, power tools, etc.



## Temperature characteristics

Sanyo CADNICA batteries can be used over an wide temperature range. As cell characteristics vary slightly depending on the temperature, use within the temperature range given below in order to obtain optimum performance.

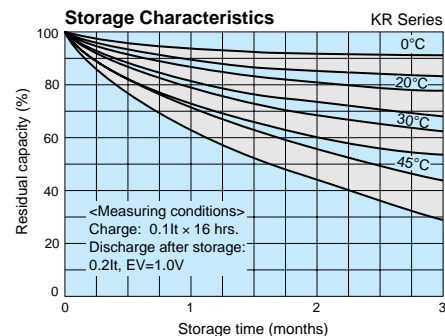
Charge:  
0 ~ +45  
Discharge:  
-20 ~ +60  
Storage:  
-30 ~ +50  
(-30 ~ +35 for long periods)



\* Although the above figure shows the relationship between the cell capacity and temperature, the difference in capacity due to temperature change is temporary, and the original performance is restored when the temperature returns to normal.

## Storage characteristics

The cell voltage and capacity of ordinary dry batteries are usually reduced after storage. With Sanyo CADNICA batteries, self-discharge accelerates as the temperature increases. However, CADNICA batteries have minimal deterioration in battery performance even after long-term storage. Moreover, the cell capacity decreased through discharging during storage can easily be restored to its original level by recharging.



\*{ It } is a standard shall be express as:

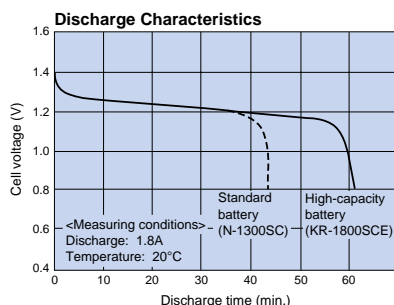
$$It(A) = C_s(Ah) / 1(h)$$

$C_s$  is the rated capacity of the cell or battery, in ampere-hours.

## (Characteristics of Special Purpose Batteries)

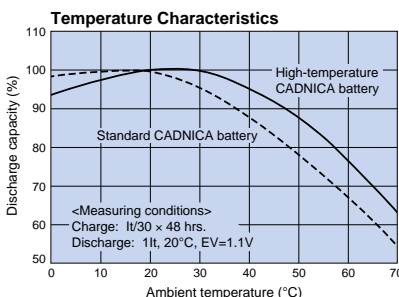
### High-capacity CADNICA batteries (E Series)

High-capacity CADNICA batteries feature a capacity almost 40% higher than conventional CADNICA batteries, thanks to the use of high-density electrode plates and a new design concept. This results in more energy density compared to batteries of the same size.



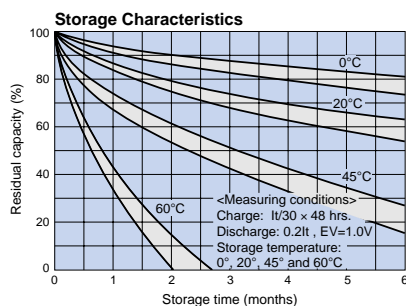
### High-temperature CADNICA batteries for trickle charge use (H Series)

With considerably improved trickle-charge characteristics at high temperatures, high-temperature CADNICA batteries feature superior charge efficiency and discharge capacity, in addition to an impressively increased service life.



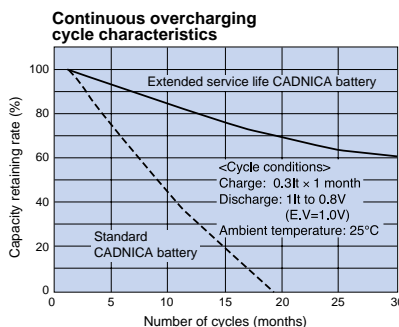
### Memory-Backup CADNICA Batteries (S Series)

In comparison with conventional CADNICA batteries, memory-backup CADNICA batteries feature minimal self-discharge during storage, thus enabling memory retention over long periods of time. (This becomes clear when the characteristics of memory-backup CADNICA batteries are compared with those of conventional CADNICA batteries shown on page 5.)



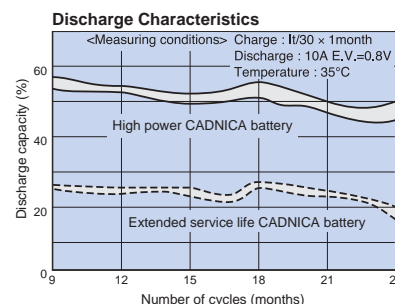
### Extended service life CADNICA batteries (C Series)

Incorporating newly developed separator, these batteries exhibit superior performance for a long period in the continuous charging and cycle modes. They achieve significantly longer service life when compared to conventional batteries.



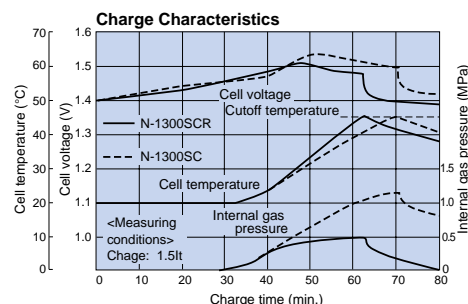
### High power CADNICA batteries for back-up use (B series)

We have new Cadnica B series which were improved from Extended service life C series. Cadnica. B series are suitable for high power back-up applications.



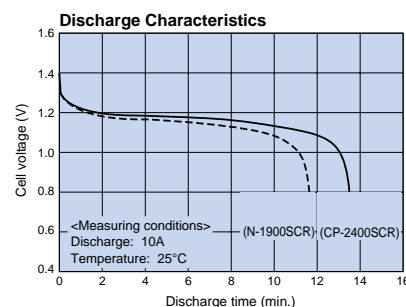
### Fast-charge CADNICA batteries (R Series)

Fast-charge CADNICA batteries can be charged in just one hour. Because the charger employs a temperature sensor to detect the temperature increase that occurs after the battery has been fully charged, these CADNICA batteries have significantly improved gas recombination in comparison with conventional CADNICA batteries. Moreover, the sharp cell temperature rise makes detection simple.



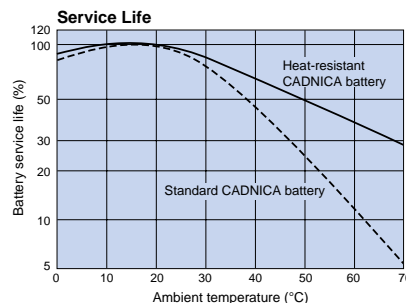
### Fast-charge CADNICA batteries (CP Series)

Cobalt Power Series have been improved on the basis of usual R type. They are the batteries which we have accomplished to raise their capacity much higher by combining the original technology such as the adoption of the new way of adding cobalt compounds and the new development about the way of processing and the parts.



### Heat-resistant CADNICA batteries for cycle use (K Series)


Heat-resistant CADNICA batteries are specially designed for superior durability under the severe conditions of fast charging (three-hour rate charge without any limitation) at temperatures as high as 70 °C.





# (Ratings of CADNICA Batteries)


## General-use CADNICA batteries (Standard Series)

	Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Quick charge		Internal resistance (mΩ)	External dimensions				Weight (approx.g)
				Minimum <sup>1</sup> Typical <sup>2</sup>		Current (mA)	Time (hr.)	Current (mA)	Time (hr.)		Including tube		Bare cell		
											Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
		N-50AAA	1.2	50	55	5	14 ~ 16	15	4 ~ 6	55	10.5 <sup>+0.5</sup> <sub>-0.5</sub>	15.8 <sup>+0.1</sup> <sub>-0.1</sub>	10.0±0.2	15.0±0.3	4
		N-110AA	1.2	110	120	11		33		30	14.5 <sup>+0.5</sup> <sub>-0.5</sub>	17.5 <sup>+0.1</sup> <sub>-0.1</sub>	14.0±0.2	16.7±0.3	8
		N-650SCL	1.2	650	700	65				7.5	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	24.5 <sup>+0.9</sup> <sub>-0.9</sub>	22.0±0.3	23.8±0.3	28
		N-1200SCL	1.2	1200	1250	120				6.2	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	34.0 <sup>+0.2</sup> <sub>-0.2</sub>	22.0±0.3	33.0±0.3	42

Operating temperature range; Charge: 0 ~ 45 $^{\circ}$ C (standard), 10 ~ 45 $^{\circ}$ C (quick), discharge: - 20 ~ 60 $^{\circ}$ C, storage: - 30 ~ 50 $^{\circ}$ C (- 30 ~ 35 $^{\circ}$ C for long periods)

Note: Consult Sanyo concerning operating conditions for quick charging of N-1200SCL higher models.

## Standard CADNICA batteries (KR Series)


Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Internal resistance (m $\Omega$ )	External dimensions				Weight (approx.g)
			Minimum <sup>1</sup>	Typical <sup>2</sup>	Current (mA)	Time (hr.)		Including tube		Bare cell		
								Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	KR-600AAL	1.2	600	650	60	14 ~ 16	24	14.3 $\pm$ 0.5	48.9 $\pm$ 0.1	13.8 $\pm$ 0.2	48.2 $\pm$ 0.3	19
	KR-1000SCL	1.2	1000	1100	100		7.6	22.9 $\pm$ 0.1	34.0 $\pm$ 0.2	22.0 $\pm$ 0.3	33.0 $\pm$ 0.3	37
	KR-1200SCL	1.2	1200	1350	120		5.8	22.9 $\pm$ 0.1	34.0 $\pm$ 0.2	22.0 $\pm$ 0.3	33.0 $\pm$ 0.3	39
	KR-1300SC	1.2	1300	1450	130		4.8	22.9 $\pm$ 0.1	43.0 $\pm$ 0.2	22.0 $\pm$ 0.3	42.0 $\pm$ 0.3	45
	KR-1500SCT	1.2	1500	1550	150		5.5	22.9 $\pm$ 0.1	43.0 $\pm$ 0.2	22.0 $\pm$ 0.3	42.0 $\pm$ 0.3	47
	KR-4400D	1.2	4400	4800	440		3.8	33.2 $\pm$ 0.9	61.1 $\pm$ 0.5	32.3 $\pm$ 0.3	60.0 $\pm$ 0.4	146
	KR-7000F	1.2	7000	7700	700		3.4	33.2 $\pm$ 0.9	91.0 $\pm$ 0.4	32.3 $\pm$ 0.3	90.0 $\pm$ 0.4	224
	KR-10000M	1.2	10000	12000	1000		2.6	43.1 $\pm$ 0.1	91.0 $\pm$ 0.4	42.1 $\pm$ 0.3	90.0 $\pm$ 0.4	395

Operating temperature range; Charge: 0 ~ 45 $^{\circ}$ C (standard), discharge: - 20 ~ 60 $^{\circ}$ C, storage: - 30 ~ 50 $^{\circ}$ C (- 30 ~ 35 $^{\circ}$ C for long periods)

Note: When using assembled batteries consisting of KR-4400D or higher model batteries, consideration must be given to the problem of cell temperature increase.

Sanyo can provide assembled batteries that meet your specific conditions of use.

## High-capacity CADNICA batteries (E Series / U Series)

Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Internal resistance (m $\Omega$ )	External dimensions				Weight (approx.g)
			Minimum <sup>1</sup>	Typical <sup>2</sup>	Current (mA)	Time (hr.)		Including tube		Bare cell		
								Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	KR-600AE	1.2	600	650	60	14 ~ 16	9.5	17.0 <sup>0</sup> <sub>-0.5</sub>	28.5 <sup>0</sup> <sub>-0.1</sub>	16.5 $\pm$ 0.2	27.8 $\pm$ 0.3	19
	KR-1100AAU	1.2	1100	1150	110		19	14.3 <sup>0</sup> <sub>-0.5</sub>	50.3 <sup>0</sup> <sub>-0.1</sub>	13.8 $\pm$ 0.2	49.5 $\pm$ 0.3	24
	KR-1200AAE	1.2	1200	1300	120		12	14.3 <sup>0</sup> <sub>-0.5</sub>	65.3 <sup>0</sup> <sub>-0.1</sub>	13.8 $\pm$ 0.2	64.5 $\pm$ 0.3	32
	KR-1100AEL	1.2	1100	1200	110		9.0	17.0 <sup>0</sup> <sub>-0.5</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	16.5 $\pm$ 0.2	42.0 $\pm$ 0.3	29
	KR-1200AUL	1.2	1200	1300	120		12	17.0 <sup>0</sup> <sub>-0.5</sub>	43.0 <sup>0</sup> <sub>-0.2</sub>	16.5 $\pm$ 0.2	42.0 $\pm$ 0.3	27
	KR-1500AUL	1.2	1500	1550	150		16	17.0 <sup>0</sup> <sub>-0.5</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	16.5 $\pm$ 0.2	42.0 $\pm$ 0.3	30
	KR-1400AE	1.2	1350	1400	140		10	17.0 <sup>0</sup> <sub>-0.5</sub>	49.5 <sup>0</sup> <sub>-1.2</sub>	16.5 $\pm$ 0.2	48.5 $\pm$ 0.3	34
	KR-1700AU	1.2	1700	1750	170		17	17.0 <sup>0</sup> <sub>-0.5</sub>	49.5 <sup>0</sup> <sub>-1.2</sub>	16.5 $\pm$ 0.2	48.5 $\pm$ 0.3	35
	KR-1800SCE	1.2	1800	1900	180		6.5	22.9 <sup>0</sup> <sub>-1</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	22.0 $\pm$ 0.2	42.0 $\pm$ 0.3	49
	KR-5000DEL	1.2	5000	5400	500		3.5	33.2 <sup>0</sup> <sub>-0.9</sub>	59.5 <sup>0</sup> <sub>-1.5</sub>	32.3 $\pm$ 0.3	58.4 $\pm$ 0.4	152


Operating temperature range; Charge: 0 ~ 45 $^{\circ}$ C (standard), discharge: - 20 ~ 60 $^{\circ}$ C, storage: - 30 ~ 50 $^{\circ}$ C (- 30 ~ 35 $^{\circ}$ C for long periods)

Note: Consult Sanyo concerning 1-hour charge.

When using assembled batteries consisting of KR-5000DEL, consideration must be given to the problem of cell temperature increase.

Sanyo can provide assembled batteries that meet your specific conditions of use.


## Extended service life CADNICA batteries (C Series / EC Series)

Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Quick charge		Internal resistance ( m $\Omega$ )	External dimensions				Weight (approx.g)
			Minimum <sup>1</sup>	Typical <sup>2</sup>	Current (mA)	Time (hr.)	Current (mA)	Time (hr.)		Including tube		Bare cell		
										Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	N-270AAC	1.2	270	300	27	14 ~ 16	81	4 ~ 6	18	14.5 <sup>0</sup> <sub>-0.5</sub>	30.3 <sup>0</sup> <sub>-1</sub>	14.0 $\pm$ 0.2	29.5 $\pm$ 0.3	13
	N-500AC	1.2	500	550	50		150		9.0	17.0 <sup>0</sup> <sub>-0.5</sub>	28.5 <sup>0</sup> <sub>-1</sub>	16.5 $\pm$ 0.2	27.8 $\pm$ 0.3	19
	N-600AAC	1.2	600	650	60		180		12	14.3 <sup>0</sup> <sub>-0.5</sub>	50.2 <sup>0</sup> <sub>-1</sub>	13.8 $\pm$ 0.2	49.5 $\pm$ 0.3	22
	N-700AAC	1.2	700	750	70		210		16	14.3 <sup>0</sup> <sub>-0.5</sub>	50.2 <sup>0</sup> <sub>-1</sub>	13.8 $\pm$ 0.2	49.5 $\pm$ 0.3	23
	N-600AACL	1.2	600	650	60		180		14	14.3 <sup>0</sup> <sub>-0.5</sub>	48.9 <sup>0</sup> <sub>-1</sub>	13.8 $\pm$ 0.2	48.2 $\pm$ 0.3	22
	N-700AACL	1.2	700	750	70		210		16	14.3 <sup>0</sup> <sub>-0.5</sub>	48.9 <sup>0</sup> <sub>-1</sub>	13.8 $\pm$ 0.2	48.2 $\pm$ 0.3	23
	KR-900AAEC	1.2	900	950	90				19	14.3 <sup>0</sup> <sub>-0.5</sub>	50.3 <sup>0</sup> <sub>-1</sub>	13.8 $\pm$ 0.2	49.5 $\pm$ 0.3	23
	N-1200SCC	1.2	1200	1350	120		360		4.2	22.9 <sup>0</sup> <sub>-1</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	22.0 $\pm$ 0.3	42.0 $\pm$ 0.3	52
	N-1700SCC	1.2	1700	1800	170				4.1	22.9 <sup>0</sup> <sub>-1</sub>	42.9 <sup>0</sup> <sub>-1</sub>	22.0 $\pm$ 0.3	42.0 $\pm$ 0.4	57

Operating temperature range; Charge: 0 ~ 45 $^{\circ}$ C (standard), 10 ~ 45 $^{\circ}$ C (quick), discharge: - 20 ~ 60 $^{\circ}$ C, storage: - 30 ~ 50 $^{\circ}$ C (- 30 ~ 35 $^{\circ}$ C for long periods)

Note: Sanyo can provide model N-1700SCC with quick-charge capability depending on your specific conditions of use.

## High power CADNICA batteries for back-up use (B series)

	Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Quick charge		Internal resistance (mΩ)	External dimensions				Weight (approx.g)
				Minimum <sup>1</sup>	Typical <sup>2</sup>	Current (mA)	Time (hr.)	Current (mA)	Time (hr.)		Including tube		Bare cell		
											Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	N-1600SCB	1.2	1550	1700	160	14 ~ 16	480	4 ~ 6	4.1	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	42.9 <sup>+0.2</sup> <sub>-0.2</sub>	22.0 <sup>+0.3</sup> <sub>-0.3</sub>	42.0 <sup>+0.3</sup> <sub>-0.3</sub>	57	
N-2000CB	1.2	2000	2300	200	600		3.3		26.0 <sup>+0.8</sup> <sub>-0.8</sub>	50.0 <sup>+0.3</sup> <sub>-0.3</sub>	25.2 <sup>+0.3</sup> <sub>-0.3</sub>	49.0 <sup>+0.3</sup> <sub>-0.3</sub>	85		

Operating temperature range; Charge: 0 ~ 70 $^{\circ}$ C (standard), 10 ~ 70 $^{\circ}$ C (quick), discharge: -20 ~ 70 $^{\circ}$ C, storage: -30 ~ 70 $^{\circ}$ C (-30 ~ 45 $^{\circ}$ C for long periods)


Note: Sanyo can provide B series with quick-charge capability depending on your specific conditions of use.

1 : Minimum capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16 hours.

2 : Typical capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16 hours.




## Fast-charge CADNICA batteries (CP Series)

	Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Quick charge		1-hour rate charge current (mA)	Internal resistance (mΩ)	External dimensions				Weight (approx.g)
				Minimum	Typical	Current (mA)	Time (hr.)	Current (mA)	Time (hr.)			Including tube		Bare cell		
												Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	CP-1300SCR	1.2	1200	1300	130	14 ~ 16		1950	6.5	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	26.7 <sup>+0.1</sup> <sub>-0.1</sub>	22.0±0.3	26.0±0.3	35		
CP-1700SCR	1.2	1650	1700	170			2550	5.5	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	34.0 <sup>+0.2</sup> <sub>-0.2</sub>	22.0±0.3	33.0±0.3	45			
CP-2400SCR	1.2	2350	2400	240			3600	4.5	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	43.5 <sup>+0.2</sup> <sub>-0.2</sub>	22.0±0.3	42.5±0.4	62			
CP-3600CR	1.2	3450	3600	360			5400	3.9	26.0 <sup>+0.1</sup> <sub>-0.1</sub>	50.0 <sup>+0.2</sup> <sub>-0.2</sub>	25.2±0.3	49.0±0.3	89			


Operating temperature range; Charge: 0 ~ 45 (standard), 10 ~ 45 (quick), 5 ~ 40 (1-hour), discharge: - 20 ~ 60, storage: - 30 ~ 50 (- 30 ~ 35 for long periods)  
 Note: Quick charge: Sanyo can provide to meet specific conditions of use.  
 1-hour rate charge: Contact Sanyo regarding 30-minutes rate charge.

## Fast-charge CADNICA batteries (R Series)

Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Quick charge		1-hour rate charge current (mA)	Internal resistance (mΩ)	External dimensions				Weight (approx.g)
			Minimum	Typical <sup>2</sup>	Current (mA)	Time (hr.)	Current (mA)	Time (hr.)			Including tube		Bare cell		
											Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	N-1250SCRL	1.2	1200	1250	125	14 ~ 16	380	4 ~ 6	1900	5.0	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	34.0 <sup>+0.2</sup> <sub>-0.2</sub>	22.0±0.3	33.0±0.3	43
	N-1300SCR	1.2	1300	1400	130		390		2000	4.0	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	43.0 <sup>+0.2</sup> <sub>-0.2</sub>	22.0±0.3	42.0±0.3	51
	N-1700SCR	1.2	1700	1850	170		2600	4.0	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	43.0 <sup>+0.2</sup> <sub>-0.2</sub>	22.0±0.3	42.0±0.3	55		
	N-1900SCR	1.2	1900	2000	190		2900	4.0	22.9 <sup>+0.1</sup> <sub>-0.1</sub>	42.9 <sup>+0.2</sup> <sub>-0.2</sub>	22.0±0.3	42.0±0.4	58		
	N-3000CR	1.2	3000	3200	300		4500	3.4	26.0 <sup>+0.8</sup> <sub>-0.8</sub>	50.0 <sup>+0.2</sup> <sub>-0.2</sub>	25.2±0.3	49.0±0.3	86		
	N-4000DRL	1.2	4000	4300	400		6000	2.8	32.3 <sup>+0.6</sup> <sub>-0.6</sub>	59.5 <sup>+0.6</sup> <sub>-0.6</sub>	32.3±0.3	58.4±0.4	160		


Operating temperature range; Charge: 0 ~ 45 (standard), 10 ~ 45 (quick), 5 ~ 40 (1-hour), discharge: - 20 ~ 60, storage: - 30 ~ 50 (- 30 ~ 35 for long periods)  
 Note: Quick charge: Sanyo can provide model N-1700SCR or higher model batteries to meet specific conditions of use.  
 1-hour rate charge: Contact Sanyo regarding 30-minutes rate charge.  
 When using assembled batteries consisting of N-4000DRL, consideration must be given to the problem of cell temperature increase.  
 Sanyo can provide assembled batteries that meet your specific conditions of use.

## High Temperature CADNICA batteries (H Series)

Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Trickle charge		Standard charge		Internal resistance (mΩ)	External dimensions				Weight (approx.g)
			Minimum <sup>1</sup>	Typical <sup>2</sup>	Current (mA)	Time (hr.)	Current (mA)	Time (hr.)		Including tube		Bare cell		
										Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	KR-AAH	1.2	600	650	20	48 ~	60	14 ~ 16	15	14.3 <sup>0</sup> <sub>-0.5</sub>	48.9 <sup>0</sup> <sub>-1.2</sub>	13.8 $\pm 0.2$	48.2 $\pm 0.3$	23
	KR-SCH (1.2)	1.2	1200	1300	40		120		8.5	22.9 <sup>0</sup> <sub>-1.2</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	22.0 $\pm 0.3$	42.0 $\pm 0.3$	47
	KR-SCH (1.5)	1.2	1500	1600	50		150		12	22.9 <sup>0</sup> <sub>-1.2</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	22.0 $\pm 0.3$	42.0 $\pm 0.3$	47
	KR-SCH (1.6)	1.2	1600	1650	53		160		6.8	22.9 <sup>0</sup> <sub>-1.2</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	22.0 $\pm 0.3$	42.0 $\pm 0.3$	49
	KR-SCH (1.7)	1.2	1700	1800	57		170		6.8	22.9 <sup>0</sup> <sub>-1.2</sub>	43.0 <sup>0</sup> <sub>-1.2</sub>	22.0 $\pm 0.3$	42.0 $\pm 0.3$	49
	KR-CH (2.0)	1.2	2000	2100	67		200		6.5	26.0 <sup>0</sup> <sub>-0.8</sub>	50.0 <sup>0</sup> <sub>-1.3</sub>	25.2 $\pm 0.3$	49.0 $\pm 0.3$	72
	KR-CH (2.5)	1.2	2500	2600	83		250		6.5	26.0 <sup>0</sup> <sub>-0.8</sub>	50.0 <sup>0</sup> <sub>-1.3</sub>	25.2 $\pm 0.3$	49.0 $\pm 0.3$	75
	KR-CH (3.0)	1.2	2900	3050	100		300		5.9	26.0 <sup>0</sup> <sub>-0.8</sub>	50.5 <sup>0</sup> <sub>-1.2</sub>	25.2 $\pm 0.3$	49.0 $\pm 0.3$	78
	KR-DHL	1.2	4000	4500	133	400	4.2	33.2 <sup>0</sup> <sub>-0.9</sub>	59.5 <sup>0</sup> <sub>-1.5</sub>	32.3 $\pm 0.3$	58.4 $\pm 0.4$	146		
	KR-FH	1.2	7000	7700	233	700	3.5	33.2 <sup>0</sup> <sub>-0.9</sub>	91.0 <sup>0</sup> <sub>-1.4</sub>	32.3 $\pm 0.3$	90.0 $\pm 0.4$	224		
	KR-MH	1.2	10000	12000	200	1000	2.6	43.1 <sup>0</sup> <sub>-1.1</sub>	91.0 <sup>0</sup> <sub>-1.4</sub>	42.1 $\pm 0.3$	90.0 $\pm 0.4$	395		
	KR-5/3MH	1.2	20000	22000	400	2000	2.6	43.1 <sup>0</sup> <sub>-1.1</sub>	146.1 <sup>0</sup> <sub>-1.5</sub>	42.1 $\pm 0.3$	145.0 $\pm 0.4$	648		



Operating temperature range; Charge: 0 ~ 70 (standard), discharge: - 20 ~ 70, storage: - 30 ~ 70 (- 30 ~ 45 for long periods)  
 Note: H Series can meet specific conditions of IEC 61951-1 MT grade.  
 When using assembled batteries consisting of KR-DHL or higher model batteries, consideration must be given to the problem of cell temperature increase.  
 Sanyo can provide assembled batteries that meet your specific conditions of use.

## Heat-resistant CADNICA batteries (K Series)

Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Standard charge		Quick charge		Internal resistance (mΩ)	External dimensions				Weight (approx.g)
			Minimum	Typical	Current (mA)	Time (hr.)	Current (mA)	Time (hr.)		Including tube		Bare cell		
										Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
	N-270AAK	1.2	270	300	27	14 ~ 16	81	4 ~ 6	15	14.5 <sup>+0/-0.5</sup>	30.3 <sup>+0/-0.5</sup>	14.0±0.2	29.5±0.3	13
	N-600AAK	1.2	600	650	60		180		12	14.3 <sup>+0/-0.5</sup>	50.2 <sup>+0/-1</sup>	13.8±0.2	49.5±0.3	22
	N-1200SCK	1.2	1200	1350	120		360		4.2	22.9 <sup>+0/-1</sup>	43.0 <sup>+0/-1.2</sup>	22.0±0.3	42.0±0.3	52
	N-1700SCK	1.2	1700	1800	170		4.1		22.9 <sup>+0/-1.2</sup>	42.9 <sup>+0/-1.2</sup>	22.0±0.3	42.0±0.4	57	
	N-2000CK	1.2	2000	2200	200		4.1		26.0 <sup>+0/-0.8</sup>	50.0 <sup>+0/-0.3</sup>	25.2±0.3	49.0±0.3	81	

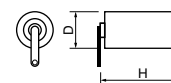
Operating temperature range; Charge: 0 ~ 70 (standard), 10 ~ 70 (quick), discharge: - 20 ~ 70, storage: - 30 ~ 70 (- 30 ~ 45 for long periods)  
 Note: Sanyo can provide model N-1700SCK and N-2000CK with quick - charge capability depending on your specific conditions of use.

## Memory-backup CADNICA batteries (S Series)

Type	Model	Nominal Voltage (V)	Capacity (mAh) at 0.2It rate.		Trickle charge		External dimensions				Weight (approx.)
			Minimum	Typical	Current (mA)	Time (hr.)	Including tube		Bare cell		
							Diameter (D) (mm)	Height (H) (mm)	Diameter (D) (mm)	Height (H) (mm)	
 	N-50AAS	1.2	45	50	1.5	48 ~	10.5 <sup>+0.5</sup> <sub>-0.5</sub>	15.8 <sup>+0</sup> <sub>-0</sub>	10.0 <sub>±0.2</sub>	15.0 <sub>±0.3</sub>	4
	N-100AAS *	1.2	90	100	3.0		14.5 <sup>+0.5</sup> <sub>-0.5</sub>	17.5 <sup>+0</sup> <sub>-0</sub>	14.0 <sub>±0.2</sub>	16.7 <sub>±0.3</sub>	8
	N-270AAS *	1.2	250	270	8.3		14.5 <sup>+0.5</sup> <sub>-0.5</sub>	30.3 <sup>+0</sup> <sub>-0</sub>	14.0 <sub>±0.2</sub>	29.5 <sub>±0.3</sub>	13
	N-550AAS *	1.2	500	550	17.0		14.3 <sup>+0.5</sup> <sub>-0.5</sub>	50.2 <sup>+0</sup> <sub>-0</sub>	13.8 <sub>±0.2</sub>	49.5 <sub>±0.3</sub>	22

Operating temperature range; Charge: 0 ~ 70 (trickle), discharge: - 20 ~ 70, storage: - 30 ~ 70 (- 30 ~ 45 for long periods), Charge: 0 ~ 80 (trickle), discharge: - 20 ~ 80, storage: - 30 ~ 80 (- 30 ~ 45 for long periods) (\* Mark)  
 For more details, contact a Sanyo office.

## External Shape



Sanyo also manufactures assembled batteries in accordance with your specifications.

- 1 : Minimum capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16 hours.
- 2 : Typical capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16 hours.
- 3 : Minimum capacity when a single cell is discharged at 0.2It after being charged at 1/30It for 48 hours.
- 4 : Typical capacity when a single cell is discharged at 0.2It after being charged at 1/30It for 48 hours.

## (Standard Assembled CADNICA Batteries)

In the device design stage, battery model selection requires consideration of ratings, conditions of use and operating temperature range, while the determination of assembled battery configuration must take into account the equipment space and battery mounting method. For reference, Sanyo's standard configurations of assembled batteries are shown below.

Contact Sanyo if the standard configurations are inappropriate, or a special battery case is needed.

### Precautions for Incorporating Assembled Batteries

When batteries are used at high temperatures, their charge efficiency decreases and degradation of their performance and material properties is accelerated. To prevent this, keep the battery away from heat generating parts such as in transformers, and attempt to improve the heat radiation of equipment and battery.

Reversed charging of a battery may cause leakage of electrolyte (strong alkaline), thus calling for alkaline-resistant material in the periphery of the battery.

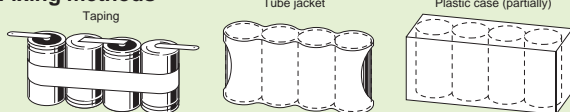
Together with the electrolyte, oxygen or hydrogen gas may leak. During design, measures must be incorporated to prevent combustion which may be caused by sparks from motors or switches. Avoid contact-type connections such as those employing a spring, as an oxidized coating will form on the contact surface after prolonged periods of use, leading to possible improper contact. If a contact-type connection is used, remove the battery and wipe the contact with a cloth every few months to improve conductivity.

### Standard Configurations

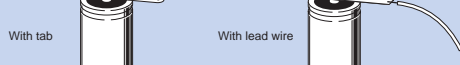
#### Connection types



#### Fixing methods

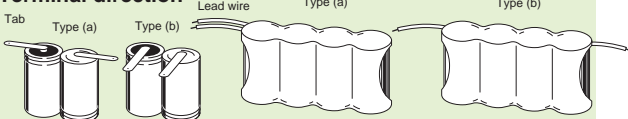


#### Terminal



Battery size	TA, AAA	AA, A	SC, C	D	F	10000M	20000M
Connection tab (W x L x T) (mm)	3 x 11 x 0.15	3 x 15 x 0.15	5 x 22 x 0.15	7 x 32 x 0.15	7 x 32 x 0.15	11 x 40 x 0.15	11 x 40 x 0.15
Lead wire (approx. 200mm long)	UL1007 AWG22	UL1007 AWG22	UL1007 AWG20	UL1007 AWG16	UL1007 AWG16	UL1007 AWG16	0.26/37

#### Terminal direction

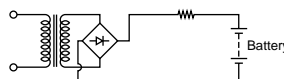


## (Charging Circuit for CADNICA Batteries)

### Standard Charging

#### Quasi-constant current charging

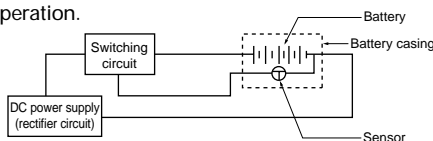
With this method, nearly constant current is produced by inserting resistance between the DC power supply and the cell in series, which in turn increases the impedance of the charging circuit. The value of the resistance should be adjusted so that the charge current at the end of charging does not exceed the specified current value. Quasi-constant current is widely used in charging CADNICA batteries because the circuit configuration is simple and therefore relatively inexpensive. In devices using CADNICA batteries, the DC component of AC/DC current is sufficient as a charging circuit, eliminating the need for a special charger.



### Fast Charge

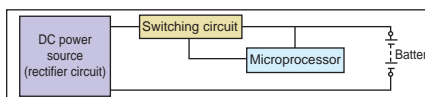
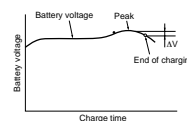
#### Temperature sensor fast-charge circuit

By combining with a simple charger as shown in the figure below, temperature sensor-controlled fast-charge CADNICA batteries can be charged in approx. one hour. In this system, the sensor attached to the cell detects the cell temperature increase at full charging, activates the switching circuit and terminates the quick charge operation.



#### - ΔV Sensor fast-charging circuit

When CADNICA batteries are being quick charged, the charge voltage increases up to the peak level at the end of charging, then starts to decrease. At the point where the voltage drops by ΔV charging is terminated automatically, with this system approximately 100% charge capacity (nominal) is secured in a wide temperature range (0 ~ 45 °C). This allows safe and accurate charging.



## (Types and Applications of CADNICA Batteries)

Application		Type								
		Consumer	General-use (Standard Series)	High- capacity (E·U Series)	Fast- charge (R Series)	High- power (B Series)	Fast- charge (CP Series)	High- temperature (H Series)	Heat- resistant (K Series)	Extended service life CADNICA bat- teries (C Series)
For cycle use										
For power tools/For high rate discharge										
Power tools	Drills, screwdrivers, grinders, circular saws, jig saws shears, lawn mower etc.									
	Cordless cleaners									
	Electric bicycles, Electric assisted bicycles									
	Electric wheelchairs									
	Engine starters									
	Robots (for business use)									
	Electric transporters (for business use)									
	For photovoltaic use									
Guide lights										
Lighting systems, Safety lights										
Road tacked sign										
Illuminated traffic signs, Illuminated signboards										
Stand-alone systems (with Solar)										
Others										
Cordless telephones, pagers										
Cellular mobile phones										
2way radios										
Portable VTR										
CD, MD Players										
Search lights, photographic illumination										
Disital steel cameras										
Printers, word processors										Memory- backup
Electrical shavers, toothbrushes										
Electrical can openers, mixers										
Medical equipment										
Measuring instruments										Memory- backup
Mini car										
Radio control units, toys										
Dry cell-applied products										
For back-up use										
Uninterrupted power supplies (small/large size) UPS										
Back up for base stations										
Security products										
Telephone branch exchange										
Computers, copy machines										
Emergency lights, guide lights										
Microwave ovens, refrigerators										
Car security alarms										
Electronic control circuits, semiconductor memory retention power supplies										

\*Typical applications are shown in the table above. For other purposes, consult Sanyo.



Certified by  
ISO 9000S



SANYO Electric Co., Ltd. Mobile Energy Company, as a part of the SANYO Electric Group, has received Environmental Management System ISO14001 certification.

Approval Certificate NO : EC00J0303  
Registration Date : 19/Mar/2001



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