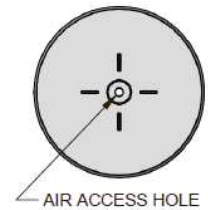
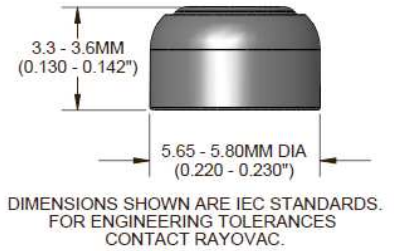
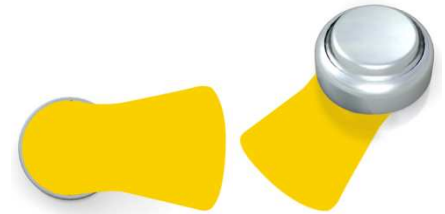
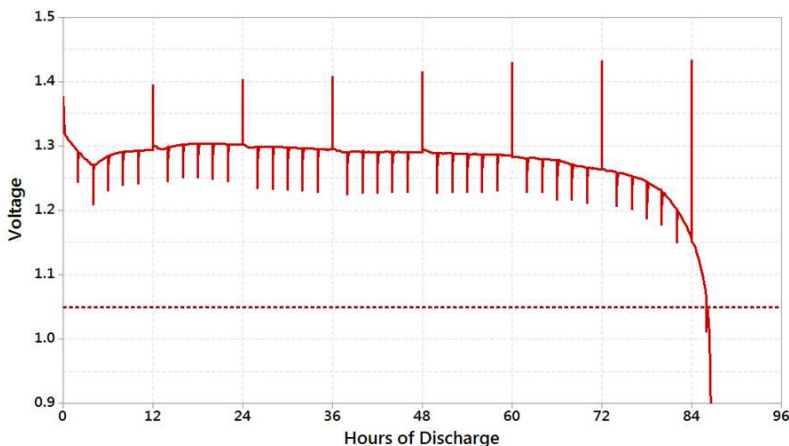


Name	Premium 10 0 Hg
Cell Chemistry	Zinc Air
Recommended Use	Hearing Aid Instruments
Nominal Voltage	1.45 volts
Designation	IEC : PR70 ANSI : 7005ZD Common : 10
Weight	0.30 grams (.011 oz)
Volume	.08 cc (.005 cu. in.)
Operating Temperature Range	-10° C to 50° C (14° F to 122° F)
Impedance	< 7.5 ohm @ AC 1000 Hz
Hearing Aid	131 hours – 0.7 mA background, 3 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
IEC/ANSI Standard	86 hours – 1 mA background, 5 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
IEC/ANSI High Drain	51 hours – 1.5 mA background, 5 mA 100 ms pulse, once every 2 h, 12 h/d to 1.1V at 21°C(70°F) and 50% R.H.
Storage Guarantee	Four years with tab applied when stored at 21°C (70°F) and 50% R.H.
Activation and use	Remove and discard the plastic tab covering air holes. Allow the battery to stand for one minute to insure proper activation.
Environmental	These cells have no added mercury. Refer to Rayovac Material Safety Data Sheets for more detailed information.



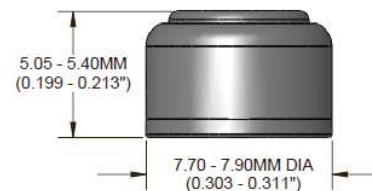
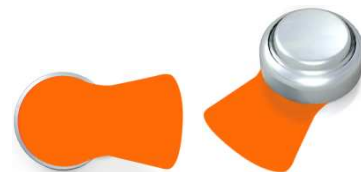
Typical IEC/ANSI Standard Discharge Performance



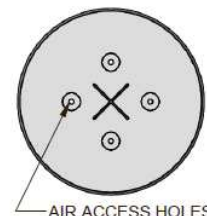
Zinc Air Cell



Name	Premium 13 0 Hg
Cell Chemistry	Zinc Air
Recommended Use	Hearing Aid Instruments
Nominal Voltage	1.45 volts
Designation	IEC : PR48 ANSI : 7000ZD Common : 13
Weight	0.79 grams (.028 oz)
Volume	.26 cc (.016 cu. in.)
Operating Temperature Range	-10° C to 50° C (14° F to 122° F)
Impedance	< 6.0 ohm @ AC 1000 Hz
Hearing Aid	139hours – 2 mA background, 6 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
IEC/ANSI Standard	84 hours – 3 mA background, 12 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
IEC/ANSI High Drain	62 hours – 3 mA background 45 min., 5 mA 15min. pulse, every h, 12 h/d to 1.1V at 21°C(70°F) and 50% R.H.
Storage Guarantee	Four years with tab applied when stored at 21°C (70°F) and 50% R.H.
Activation and use	Remove and discard the plastic tab covering air holes. Allow the battery to stand for one minute to insure proper activation.
Environmental	These cells have no added mercury. Refer to Rayovac Material Safety Data Sheets for more detailed information.



DIMENSIONS SHOWN ARE IEC STANDARDS.
 FOR ENGINEERING TOLERANCES
 CONTACT RAYOVAC.

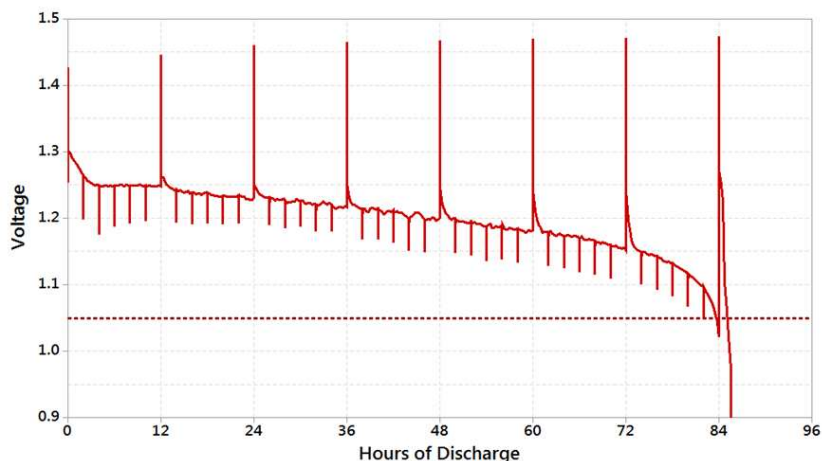


AIR ACCESS HOLES

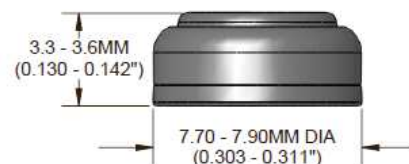
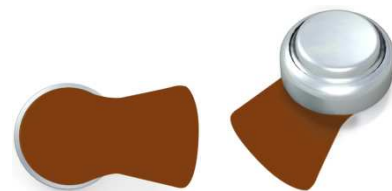
Zinc Air Cell



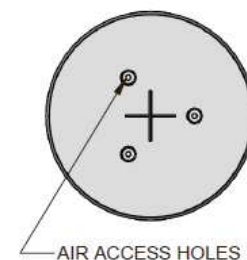
Typical IEC/ANSI Standard Discharge Performance



Name	Premium 312 0 Hg
Cell Chemistry	Zinc Air
Recommended Use	Hearing Aid Instruments
Nominal Voltage	1.45 volts
Designation	IEC : PR41 ANSI : 7002ZD Common : 312
Weight	0.50 grams (.018 oz)
Volume	.17 cc (.010 cu. in.)
Operating Temperature Range	-10° C to 50° C (14° F to 122° F)
Impedance	< 5.0 ohm @ AC 1000 Hz
Hearing Aid	137 hours – 1.2 mA background, 5 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
IEC/ANSI Standard	74 hours – 2 mA background, 10 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
IEC/ANSI High Drain	48 hours – 2 mA background 45 min., 5 mA 15min. pulse, every h, 12 h/d to 1.1V at 21°C(70°F) and 50% R.H.
Storage Guarantee	Four years with tab applied when stored at 21°C (70°F) and 50% R.H.
Activation and use	Remove and discard the plastic tab covering air holes. Allow the battery to stand for one minute to insure proper activation.
Environmental	These cells have no added mercury. Refer to Rayovac Material Safety Data Sheets for more detailed information.



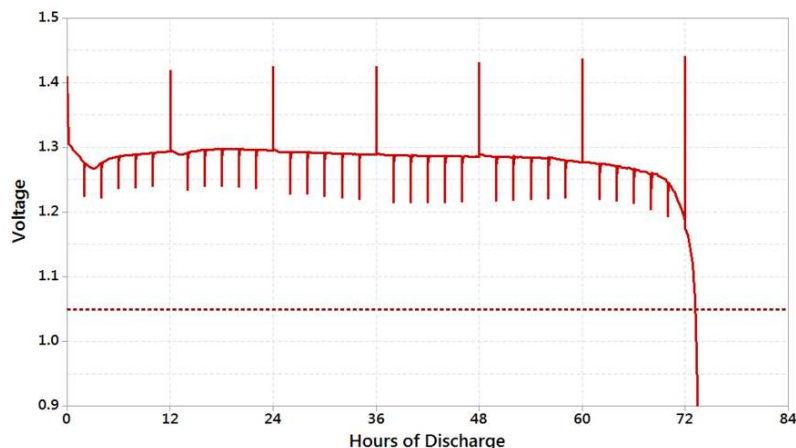
DIMENSIONS SHOWN ARE IEC STANDARDS. FOR ENGINEERING TOLERANCES CONTACT RAYOVAC.



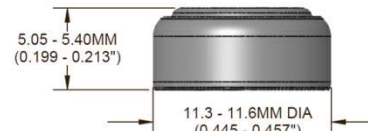
Zinc Air Cell



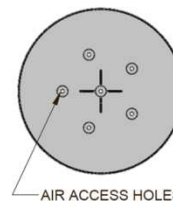
Typical IEC/ANSI Standard Discharge Performance



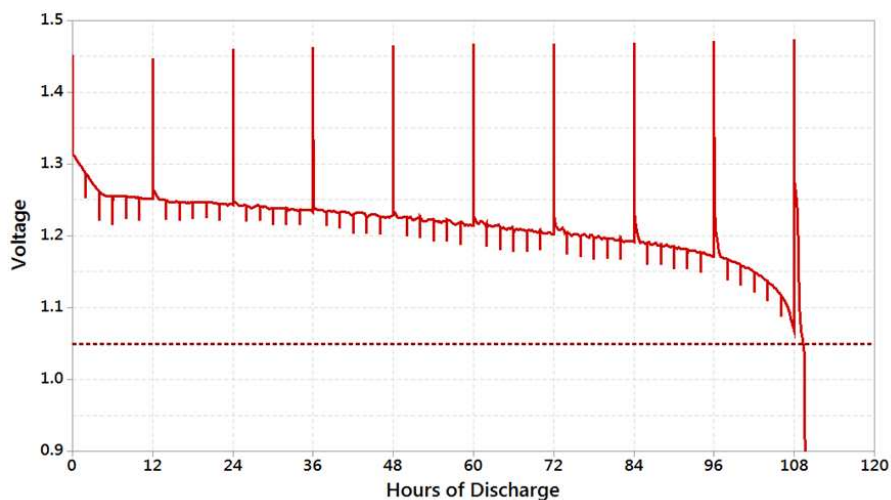
Name	Premium 675 0 Hg
Cell Chemistry	Zinc Air
Recommended Use	Hearing Aid Instruments
Nominal Voltage	1.45 volts
Designation	IEC : PR44 ANSI : 7003ZD Common : 675
Weight	1.79 grams (.063 oz)
Volume	.57 cc (.035cu. in.)
Operating Temperature Range	-10° C to 50° C (14° F to 122° F)
Impedance	< 3.0 ohm @ AC 1000 Hz
IEC/ANSI Standard	108 hours – 5 mA background, 15 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
IEC/ANSI High Drain	58 hours – 8 mA background, 24 mA 100 ms pulse, once every 2 h, 12 h/d to 1.05V at 21°C(70°F) and 50% R.H.
Storage Guarantee	Four years with tab applied when stored at 21°C (70°F) and 50% R.H.
Activation and use	Remove and discard the plastic tab covering air holes. Allow the battery to stand for one minute to insure proper activation.
Environmental	These cells have no added mercury. Refer to Rayovac Material Safety Data Sheets for more detailed information.



DIMENSIONS SHOWN ARE IEC STANDARDS.
 FOR ENGINEERING TOLERANCES
 CONTACT RAYOVAC.



Typical IEC/ANSI Standard Discharge Performance



Zinc Air Cell





Marketing Data Sheet - Batteries

S6600XXX

Issue A

Memo No:

Rayovac Stock Number: 824-HE

Name: AAA Alkaline "Advanced High Energy"

Engineering Parameters:

Cell Chemistry:

Alkaline Manganese Dioxide

Designation:

ANSI/NEDA – 24A (AA), IEC – LR03

Nominal Voltage:

1.5 volts

Approximate Weight:

0.4 Oz (12 grams)

Approximate Volume:

0.2 CU IN (3.3 cc)

Operating Temp. Range:

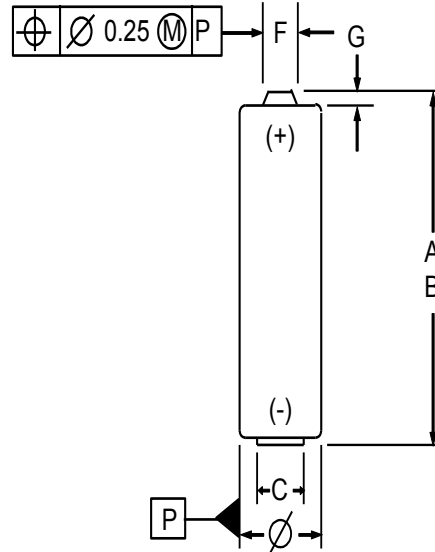
-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Plastic

Environmental:

Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
Rayovac Material Safety Sheets



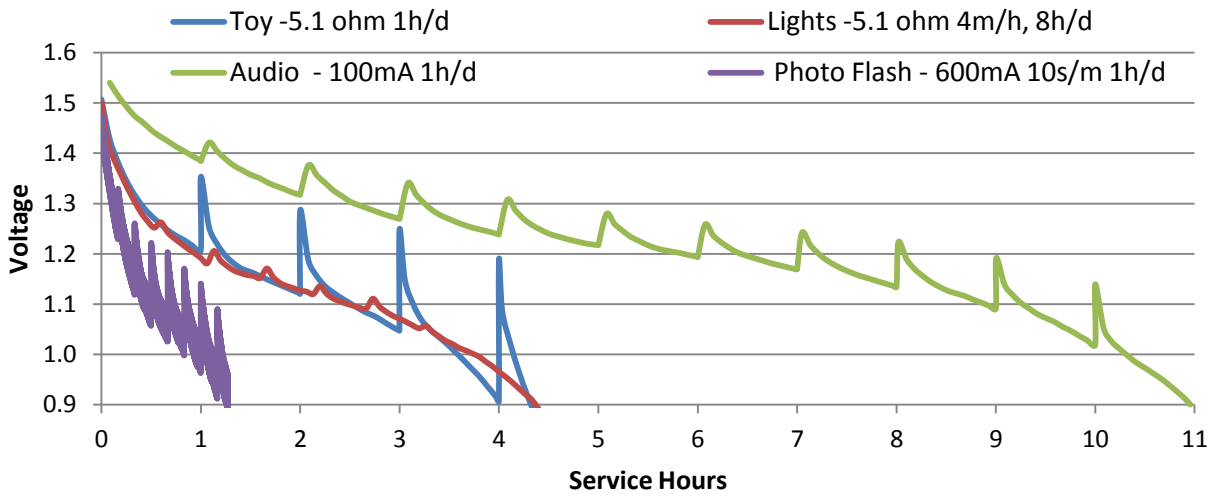
Dimensions	Millimeters	Inches
A (Max)	44.5	1.752
B (Min)	43.5	1.713
C (Min)	4.3	0.169
F (Max)	3.8	0.150
G (Min)	0.8	0.031
Ø (Max)	10.5	0.413
Ø (Min)	9.5	0.374

Service life guidelines and representative discharge curves are shown on the following page.

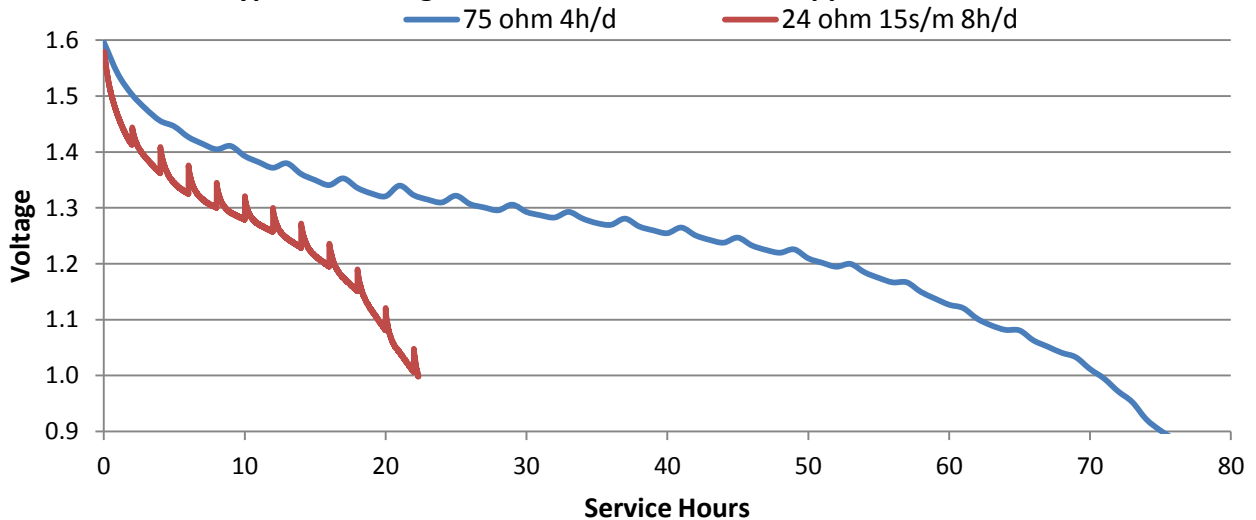
Typical Initial Service Life, ANSI and IEC Application Tests

Application and Duty Cycle	Discharge Load	Midpoint Current (mA @ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Photo Flash 10 sec/min 1 h/day	600 mA	600	0.9	440	pulses	800
Lighting 4 min/hr, 8hr/day	5.1 Ω	227	0.9	4.4	hours	1000
Toy 1 hr/day	5.1 Ω	223	0.8	4.3	hours	980
Tape / Audio 1 hr/day	100 mA	100	0.9	10.8	hours	1080
Remote 15 sec/min 8 hr/day	24 Ω	53	1.0	22.1	hours	1170
Radio 4 hrs/day	75 Ω	17	0.9	73.5	hours	1250

Typical Discharge Characteristics, ANSI/IEC Application Tests



Typical Discharge Characteristics, ANSI/IEC Application Tests





Marketing Data Sheet - Batteries

S6600XXX

Issue A

Memo No:

Rayovac Stock Number: 815-HE

Name: AA Alkaline "Advanced High Energy"

Engineering Parameters:

Cell Chemistry:

Alkaline Manganese Dioxide

Designation:

ANSI/NEDA – 15A (AA), IEC – LR6

Nominal Voltage:

1.5 volts

Approximate Weight:

0.8 Oz (24 grams)

Approximate Volume:

0.48 CU IN (7.87 CU CM)

Operating Temp. Range:

-30° C to 55° C (-20° F to 130° F)

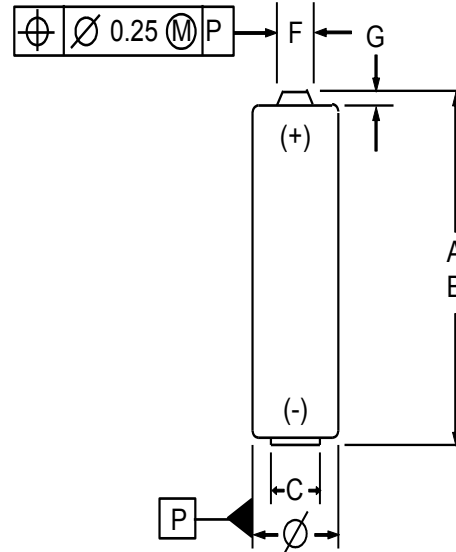
Terminals: Flashlight

Shell: Plastic

Environmental:

Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.

No Mercury Added Formulation
[Rayovac Material Safety Sheets](#)



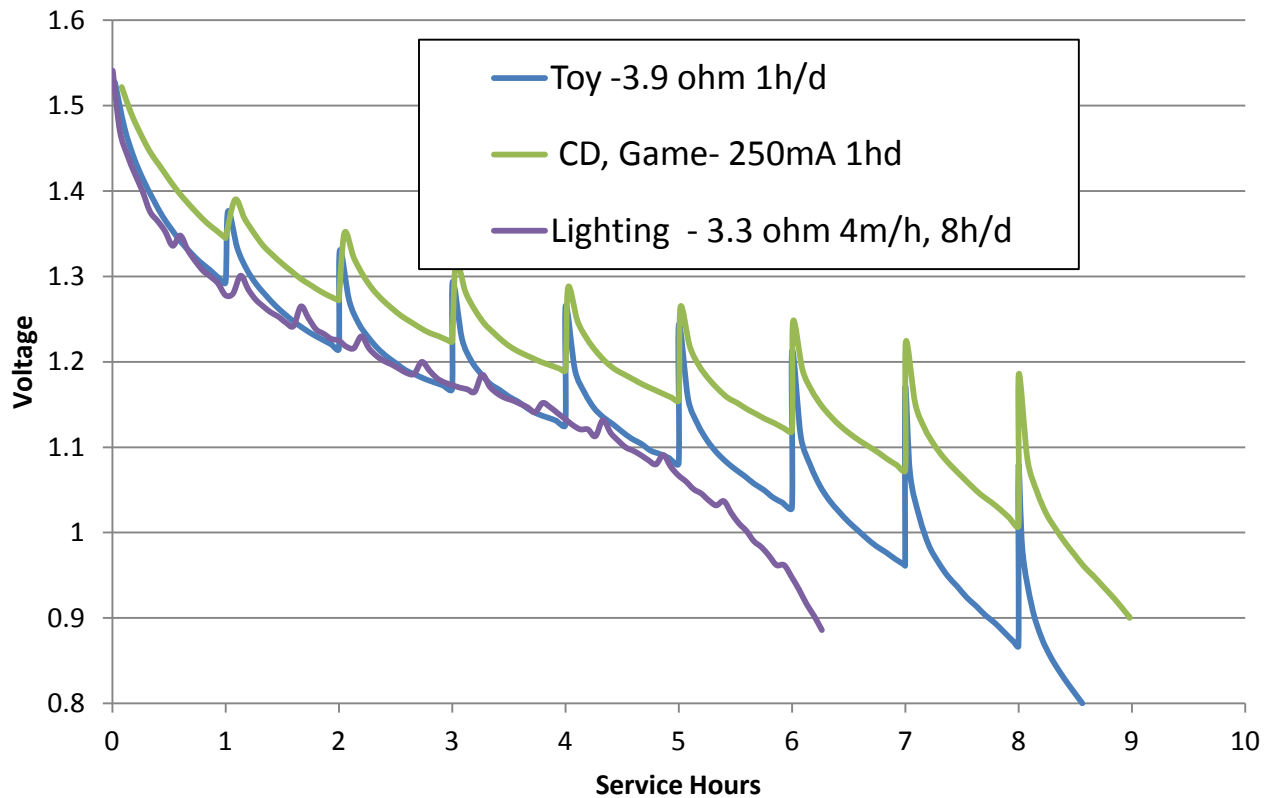
Dimensions	Millimeters	Inches
A (Max)	50.5	1.988
B (Min)	49.5	1.949
C (Min)	7.0	0.276
F (Max)	5.5	0.217
G (Min)	1.2	0.047
∅ (Max)	14.5	0.571
∅ (Min)	13.5	0.531

Service life guidelines and representative discharge curves are shown on the following page.

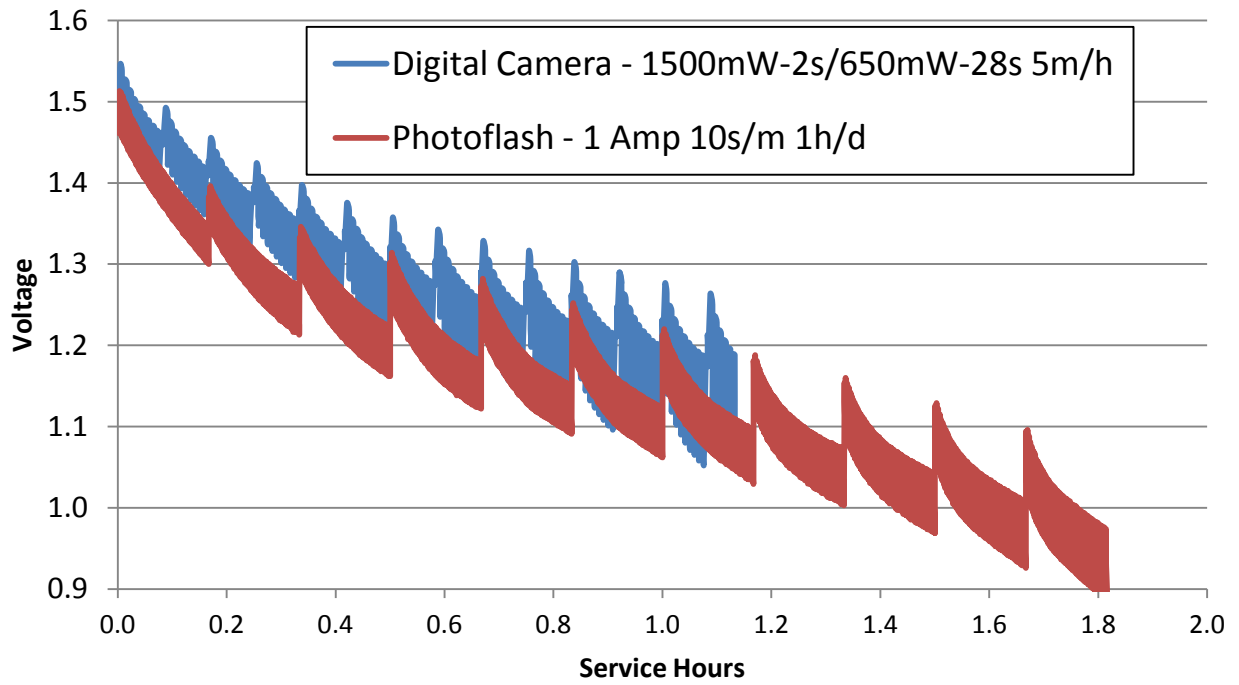
Typical Initial Service Life

Application and Duty Cycle	Discharge Load	Midpoint Current (mA)	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Digital Camera (2 sec Load 1, 28 sec Load 2) 5 min/hr	Load 1: 1.5W Load 2: 0.65W	Variable	1.05	106	pulses	1080
Photo Flash 10 sec/min 1 h/day	1000 mA	1000	0.9	636	pulses	1760
Toothbrush 2 min/15min	500 mA	500	0.8	4.2	hours	2100
Lighting 4 min/hr, 8hr/day	3.3 Ω	363	0.9	6.3	hours	2287
Toy 1 hr/day	3.9 Ω	290	0.8	8.5	hours	2465
CD / Games 1 hr/day	250 mA	250	0.9	9.4	hours	2350
Tape / Audio 1 hr/day	100 mA	100	0.9	25.0	hours	2500
Remote 15 sec/min 8 hr/day	24 Ω	50	1.0	49.5	hours	2660
Radio 4 hrs/day	43 Ω	28	0.9	95.3	hours	2820

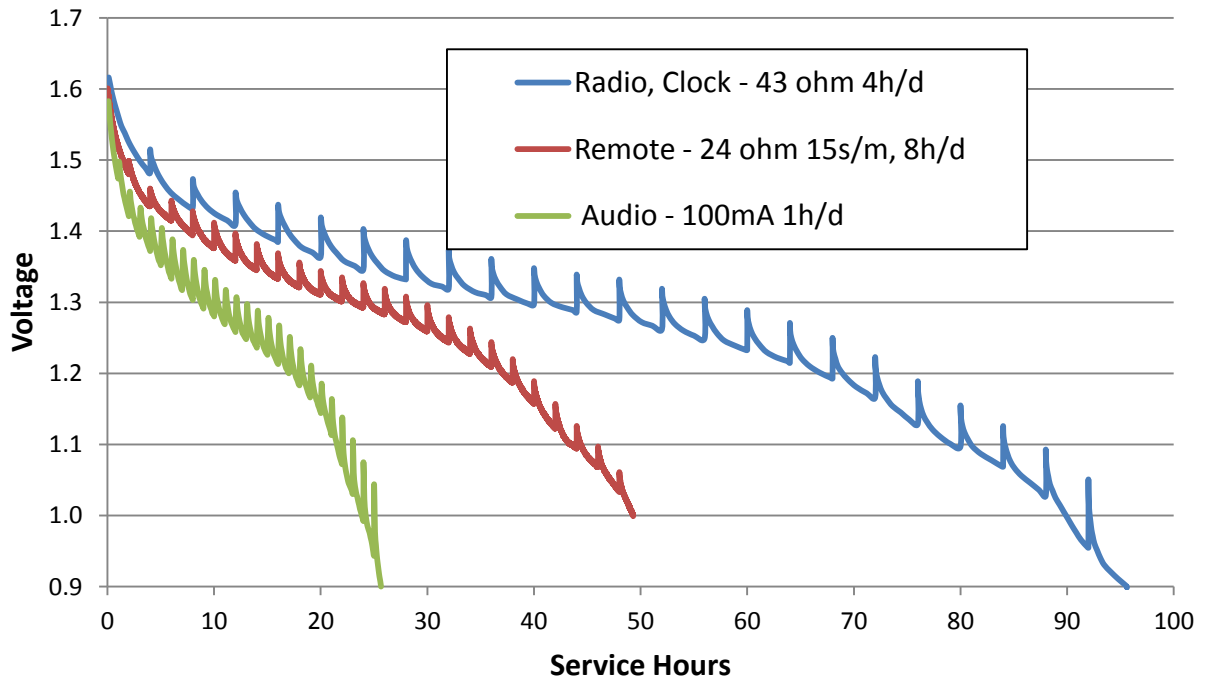
Typical Discharge Characteristics, ANSI Tests



Typical Discharge Characteristics - ANSI Photo Application Tests



Typical Discharge Characteristics, ANSI Tests





Rayovac Stock Number: **AL-9VA**

Name: **Industrial Alkaline 9 Volt**

ENGINEERING DATA:

Cell Chemistry: Alkaline

Designations: ANSI/NEDA – 1604AC
IEC – 6LR61

Nominal Voltage: 9 volts

Approximate Weight: 1.6 Oz (45.4 grams)

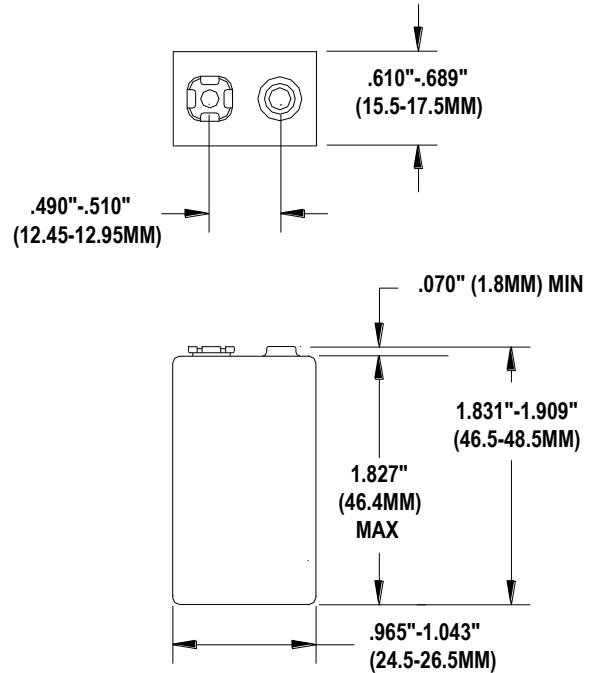
Approximate Volume: 1.2 CU IN (19.7 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Snap

Jacket: Steel

Environmental: Meets Environmental Protection Agency (EPA)
Requirements For Landfill Disposal.
No Mercury Added Formulation



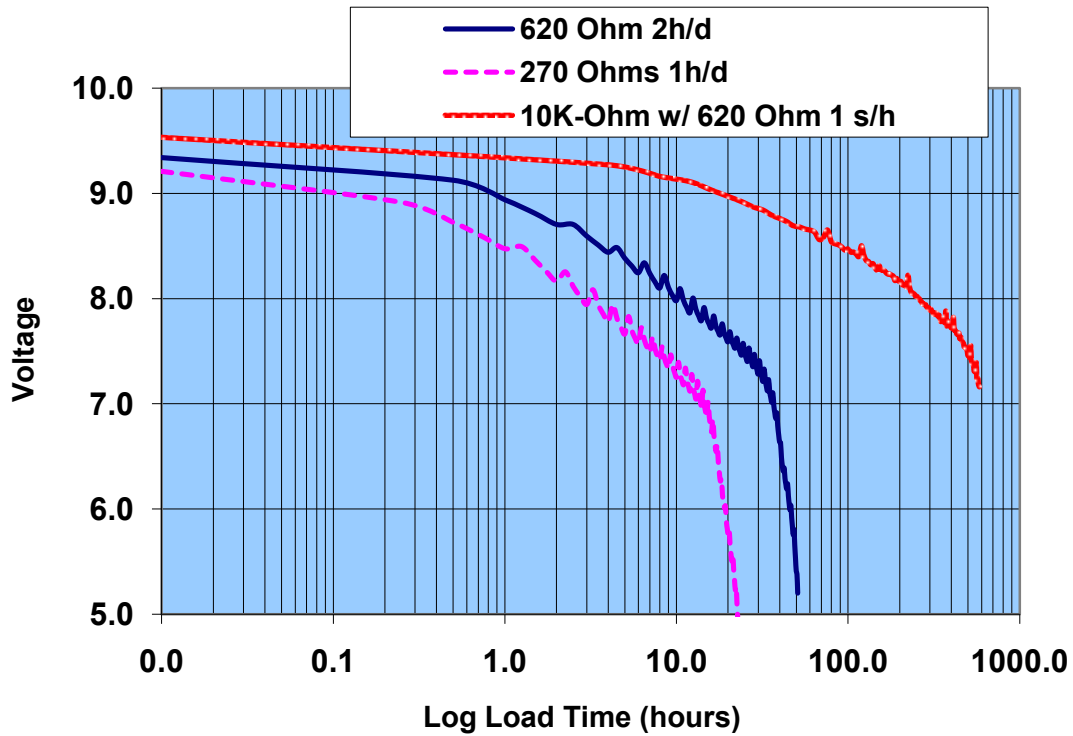
Dimensions shown are
ANSI / IEC standards

Expected service life and representative discharge curves are shown on the following page.

ESTIMATED INITIAL SERVICE AT 70°F (HOURS)
CUTOFF VOLTAGE

APPLICATION DUTY CYCLE	LOAD (OHMS)	CURRENT (mA at 6V)	7.8V	7.2V	6.6V	6.0V	5.4V	4.8V	mAh CAPACITY To 4.8V
			2.2	5.9	10.2	11.9	12.7	12.9	
Transmitter, Continuous	180	33							510
RADIO (2 HR/DAY)	620	11.6	15	31	37	43	44	49	579
TOY/GAME (1 HR/DAY)	270	26.7	4.8	12	16	18	20.5	21.0	561
SMOKE DETECTOR (ACCELERATED)	10 K-Ohm BACKGROUND WITH 620 OHM PULSE 1 SEC/HR		500 HOURS (21.5 DAYS)						404
341461									TO 7.5V

Rayovac 9V Discharge Curves





Rayovac Stock Number: **A1604**

Name: **9 VOLT ALKALINE**

ENGINEERING DATA:

Cell Chemistry: Alkaline

Designation:

ANSI/NEDA – 1604A , IEC – 6LR61 or 6LF22

Nominal Voltage:

9 volts

Approximate Weight:

1.6 Oz (45.4 grams)

Approximate Volume:

1.2 CU IN (19.7 CU CM)

Operating Temp. Range:

-30° C to 55° C (-20° F to 130° F)

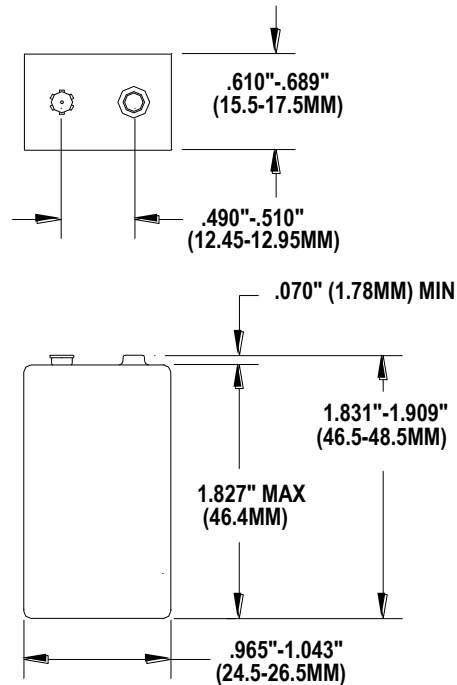
Terminals: Snap

Jacket: Steel

Environmental:

Meets Environmental Protection Agency (EPA)
Requirements For Landfill Disposal.
No Mercury Added Formulation

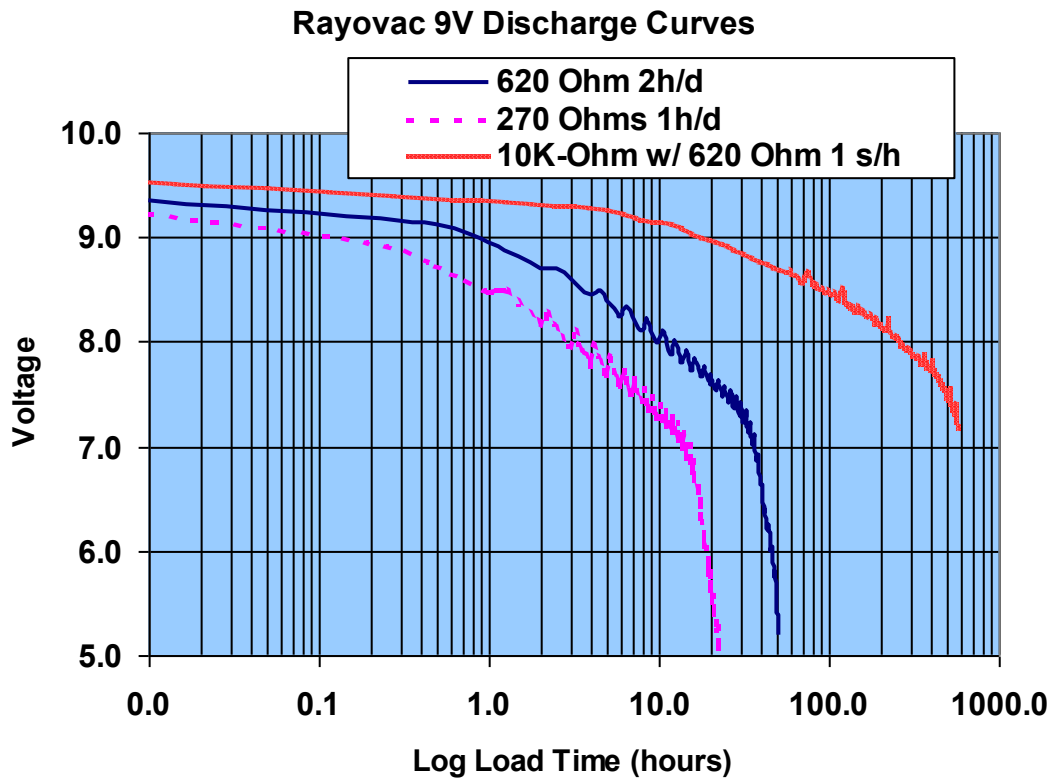
Expected service life and representative discharge curves are shown on the following page.



Dimensions shown are
ANSI/IEC standards

ESTIMATED INITIAL SERVICE AT 70°F (HOURS)

APPLICATION DUTY CYCLE	LOAD (OHMS)	CURRENT (mA at 7.2V)	CUTOFF VOLTAGE						mAh CAPACITY To 4.8V	
			7.8V	7.2V	6.6V	6.0V	5.4V	4.8V		
RADIO (2 HR/DAY)	620	11.6	13	32	39	45	49	52	614	
TOY/GAME (1 HR/DAY)	270	26.7	4	11	17	19	21	23	600	
SMOKE DETECTOR (ACCELERATED)	10K-Ohm BACKGROUND WITH 620 OHM PULSE 1 SEC/HR		500 HOURS TO 7.5V						424	TO 7.5V



This data sheet contains information specific to batteries manufactured at the time of its publication.
Contents herein do not constitute a warranty and are subject to change without notice.



Marketing Data Sheet - Batteries

S6600174

Issue W

Memo No:

Rayovac Stock Number: 815, 815 BULK, 815 OEM

Name: 815 (AA) Alkaline

Engineering Parameters:

Cell Chemistry:

Alkaline Manganese Dioxide

Designation:

ANSI/NEDA – 15A (AA), IEC – LR6

Nominal Voltage:

1.5 volts

Approximate Weight:

0.8 Oz (24 grams)

Approximate Volume:

0.48 CU IN (7.87 CU CM)

Operating Temp. Range:

-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

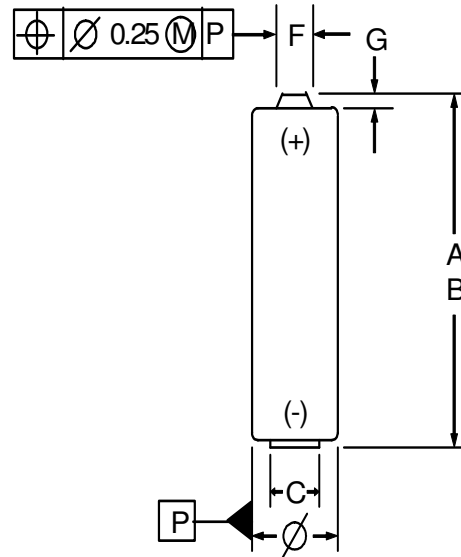
Shell: Plastic

Environmental:

Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.

No Mercury Added Formulation

Rayovac Material Safety Sheets



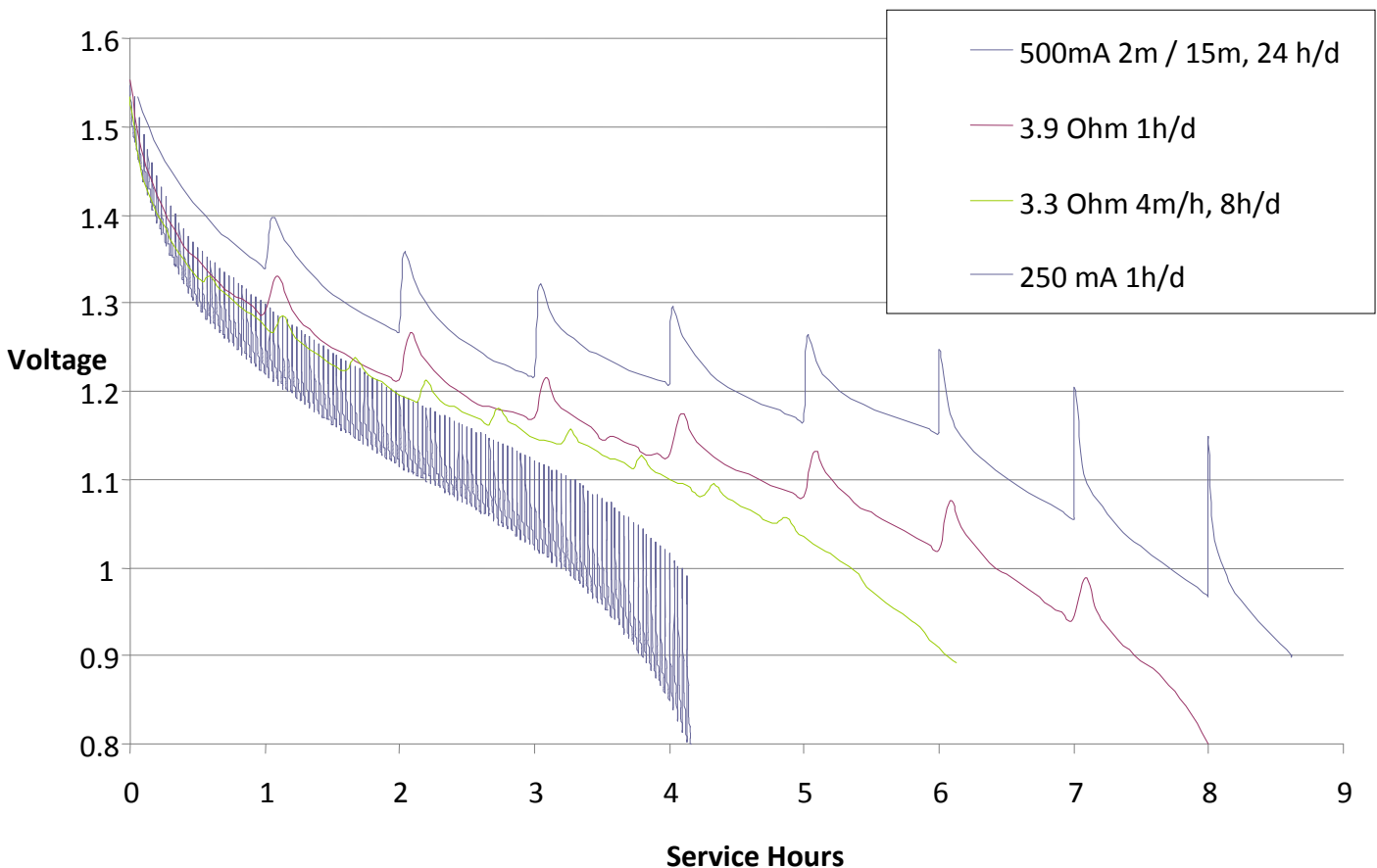
Dimensions	Millimeters	Inches
A (Max)	50.5	1.988
B (Min)	49.5	1.949
C (Min)	7.0	0.276
F (Max)	5.5	0.217
G (Min)	1.0	0.039
Ø (Max)	14.5	0.571
Ø (Min)	13.5	0.531

Service life guidelines and representative discharge curves are shown on the following page.

Typical Initial Service Life

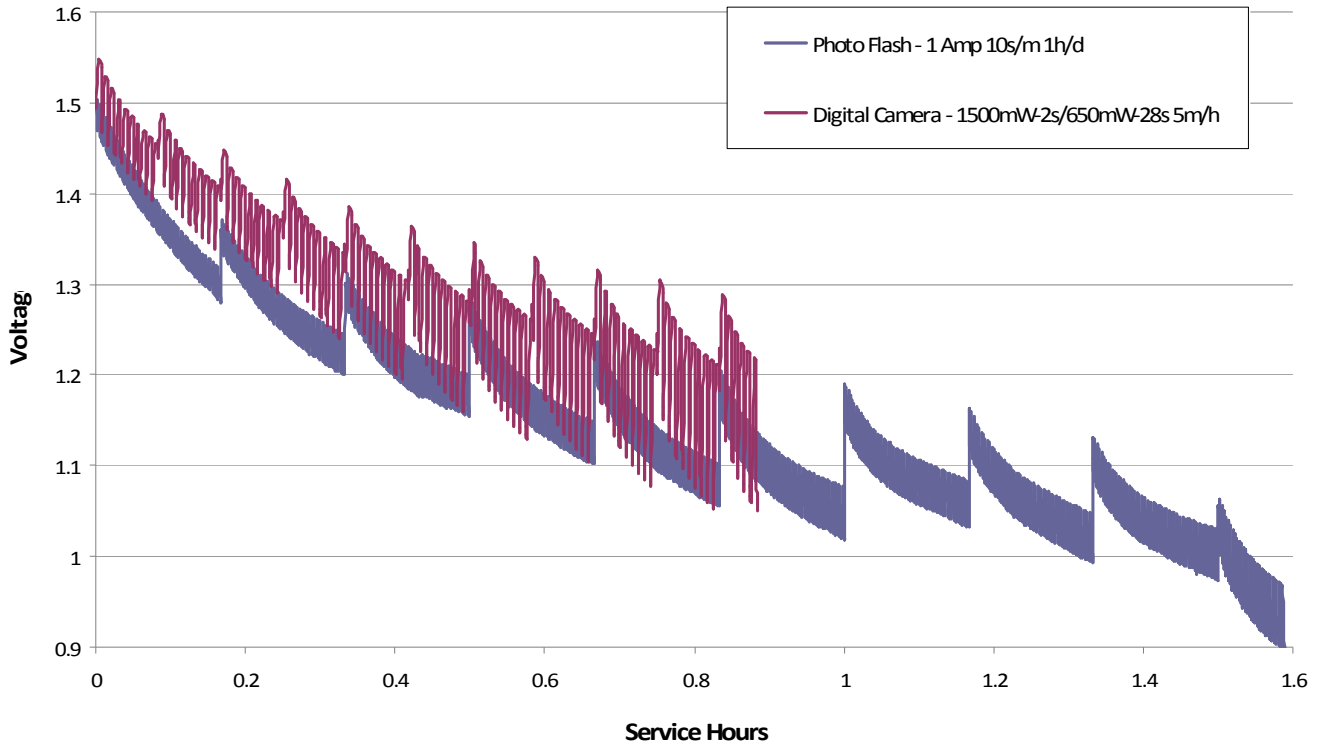
Application and Duty Cycle	Discharge Load	Midpoint Current (mA)	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Digital Camera (2 sec Load 1, 28 sec Load 2) 5 min/hr	Load 1: 1.5W Load 2: 0.65W	Variable	1.05	106	pulses	930
Photo Flash 10 sec/min 1 h/day	1000 mA	1000	0.9	510	pulses	1389
Toothbrush 2 min/15min	500 mA	510	0.8	4.1	hours	2050
Lighting 4 min/hr, 8hr/day	3.3 Ω	363	0.9	6.1	hours	2100
Toy 1 hr/day	3.9 Ω	290	0.8	8.0	hours	2317
CD / Games 1 hr/day	250 mA	250	0.9	8.6	hours	2150
Tape / Audio 1 hr/day	100 mA	100	0.9	25.0	hours	2500
Remote 15 sec/min 8 hr/day	24 Ω	50	1.0	49.5	hours	2660
Radio 4 hrs/day	43 Ω	28	0.9	93.5	hours	2790

Typical Discharge Characteristics at 21C (70F)

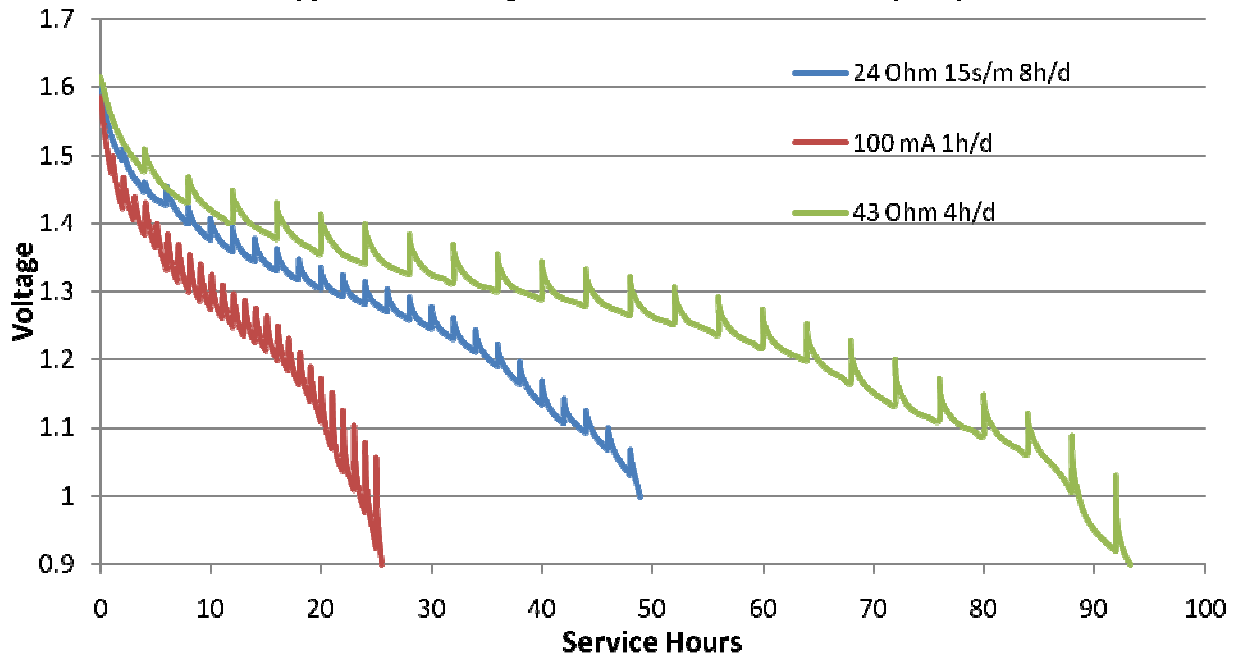


Contents are subject to change without notice and do not constitute a warranty.

Typical Discharge Characteristics at 21C (70F) - Camera Applications



Typical Discharge Characteristics at 21C (70F)



Contents are subject to change without notice and do not constitute a warranty.



Rayovac Stock Number: **824, 824 BULK, 824 OEM**

Name: **824 (AAA) Alkaline**

Engineering Parameters:

Cell Chemistry:

Alkaline Manganese Dioxide

Designation:

ANSI/NEDA – 24A (AA), IEC – LR03

Nominal Voltage:

1.5 volts

Approximate Weight:

0.4 Oz (12 grams)

Approximate Volume:

0.2 CU IN (3.3 cc)

Operating Temp. Range:

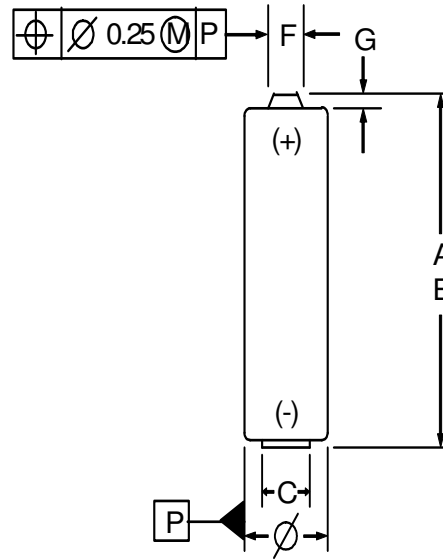
-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Plastic

Environmental:

Meets Environmental Protection Agency (EPA)
Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Sheets](#)



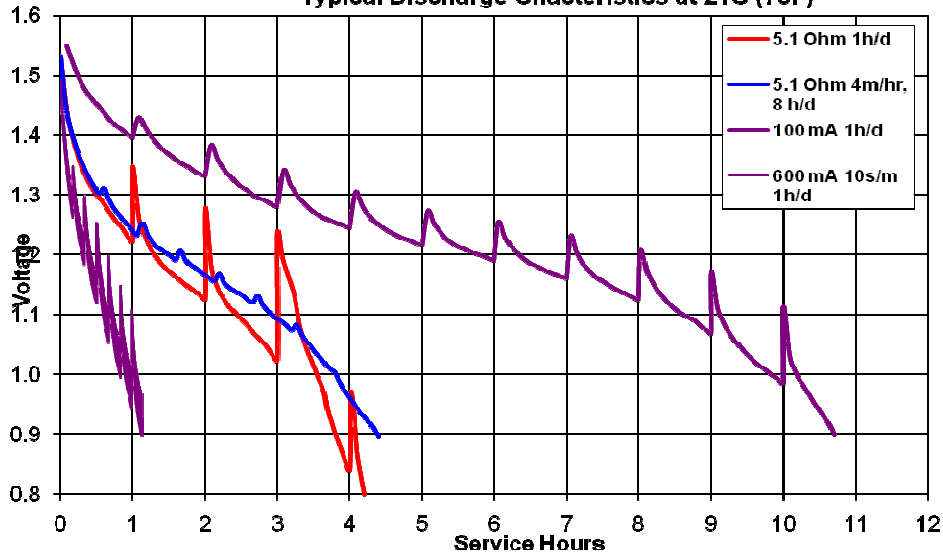
Dimensions	Millimeters	Inches
A (Max)	44.5	1.752
B (Min)	43.5	1.713
C (Min)	4.3	0.169
F (Max)	3.8	0.150
G (Min)	0.8	0.031
∅ (Max)	10.5	0.413
∅ (Min)	9.5	0.374

Service life guidelines and representative discharge curves are shown on the following page.

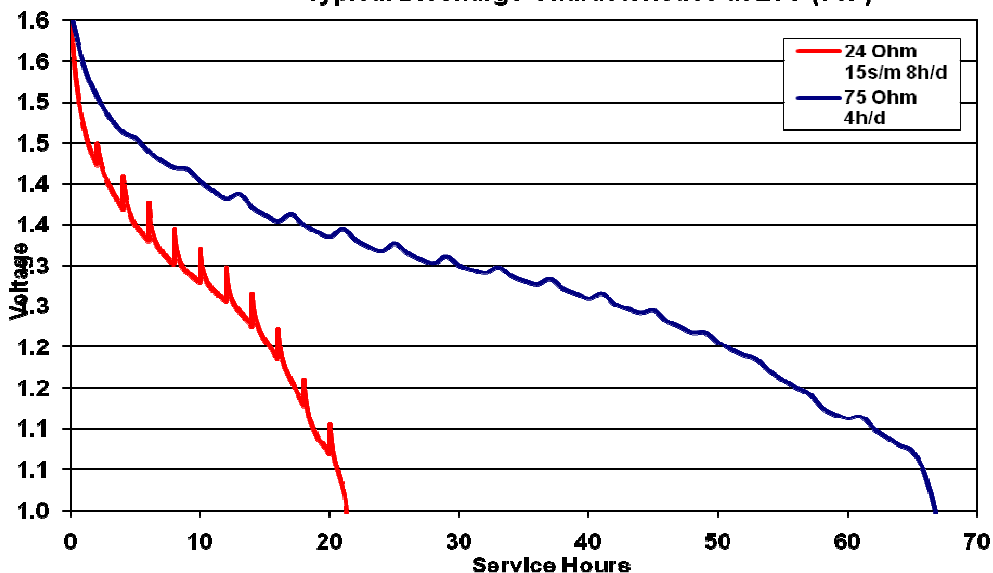
Typical Initial Service Life

Application and Duty Cycle	Discharge Load	Midpoint Current (mA @ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity
Photo Flash 10 sec/min 1 h/day	600 mA	600	0.9	410	pulses	683
Lighting 4 min/hr, 8hr/day	5.1 Ω	227	0.9	4.3	hours	976
Toy 1 hr/day	5.1 Ω	223	0.8	4.1	hours	914
Tape / Audio 1 hr/day	100 mA	100	0.9	10.5	hours	1050
Remote 15 sec/min 8 hr/day	24 Ω	53	1.0	21.5	hours	1141
Radio 4 hrs/day	75 Ω	17	0.9	70.2	hours	1200

Typical Discharge Characteristics at 21C (70F)



Typical Discharge Characteristics at 21C (70F)



Contents are subject to change without notice and do not constitute a warranty.



Marketing Data Sheet - Batteries

S6600173

Issue T

Memo No:

Rayovac Stock Number: **814, 814 BULK**

Name: **814 (C) Alkaline**

Engineering Parameters:

Cell Chemistry:

Alkaline Manganese Dioxide

Designation:

ANSI/NEDA – 14A (AA), IEC – LR14

Nominal Voltage:

1.5 volts

Approximate Weight:

2.5 Oz (70 grams)

Approximate Volume:

1.6 CU IN (26 cc)

Operating Temp. Range:

-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Plastic

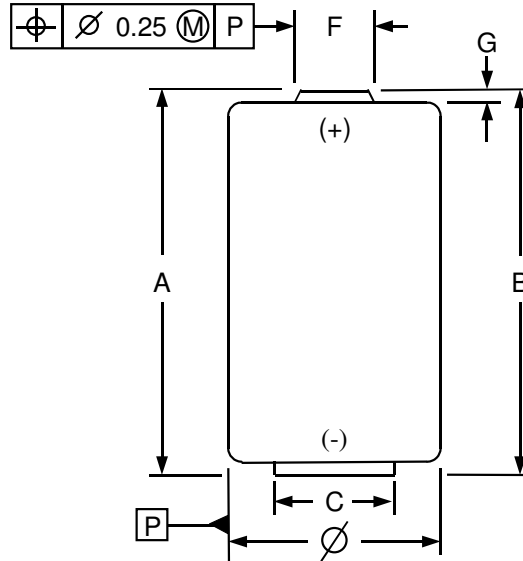
Environmental:

Meets Environmental Protection Agency (EPA)

Requirements For Landfill Disposal.

No Mercury Added Formulation

Rayovac Material Safety Sheets



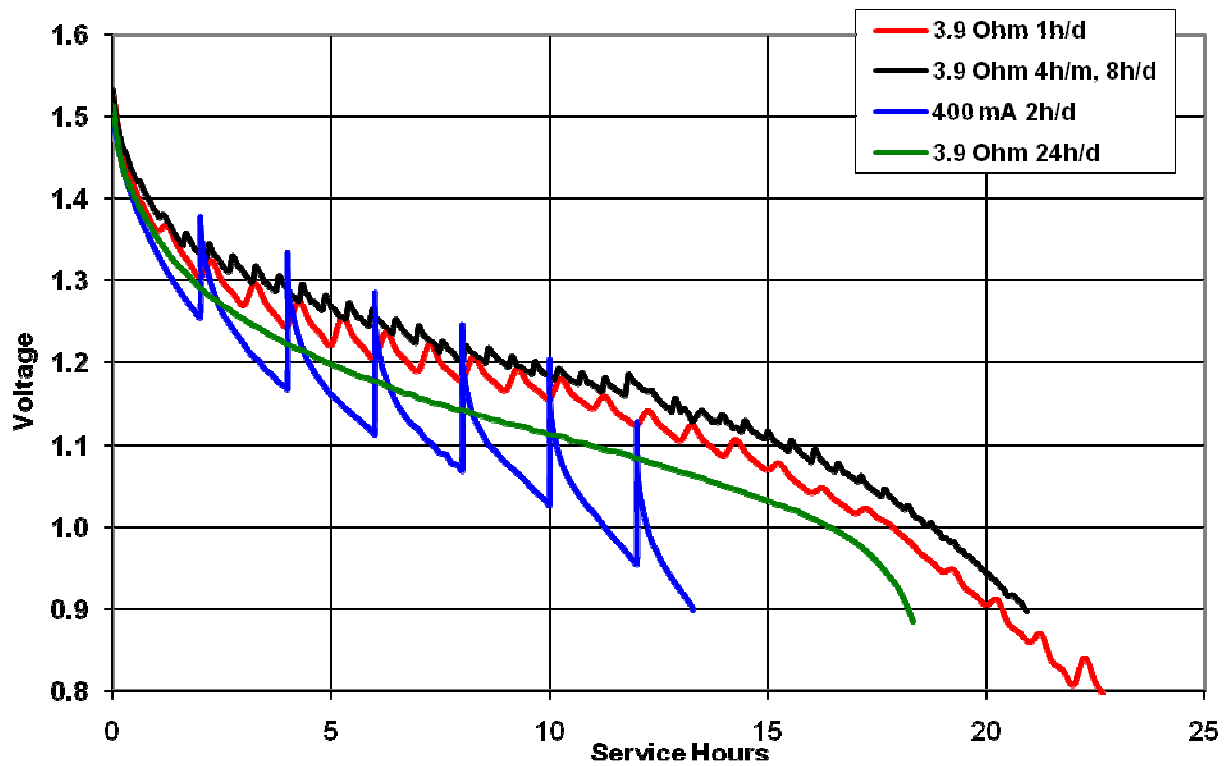
Dimensions	Millimeters	Inches
A (Max)	50.0	1.969
B (Min)	48.5	1.909
C (Min)	13.0	0.512
E (Max)	0.9	0.035
F (Max)	7.5	0.295
G (Min)	1.5	0.059
Ø (Max)	26.2	1.031
Ø (Min)	24.9	0.980

Service life guidelines and representative discharge curves are shown on the following page.

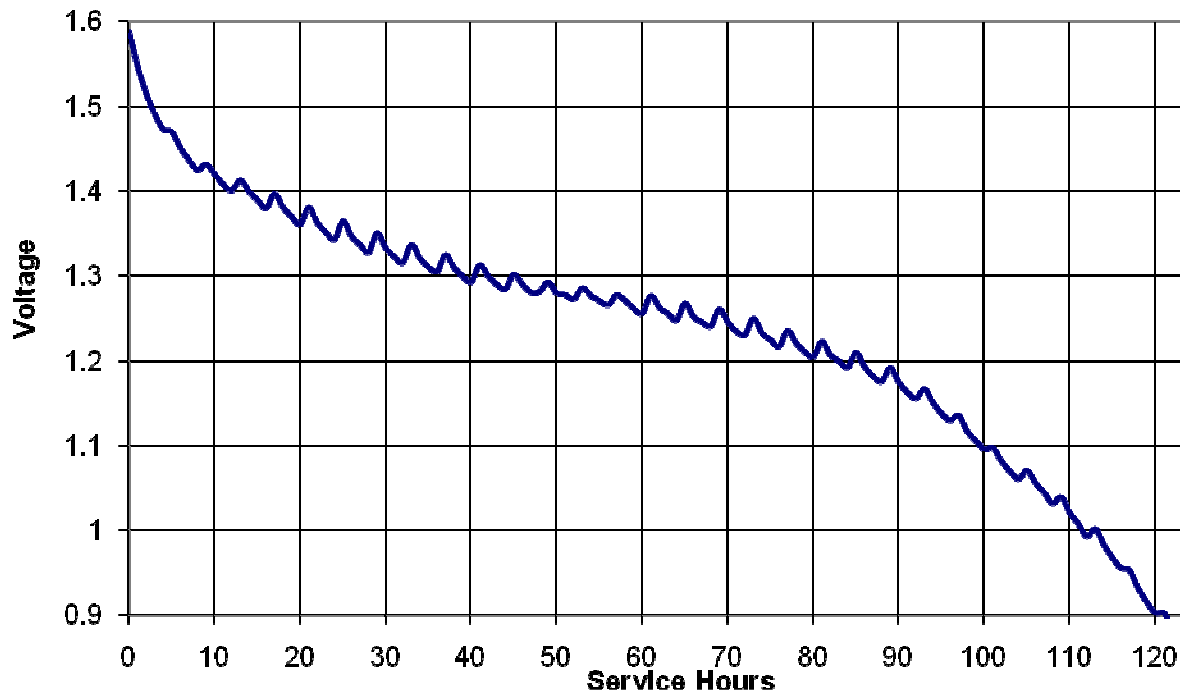
Typical Initial Service Life

Application and Duty Cycle	Discharge Load	Midpoint Current mA	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Lighting 4 min/hr, 8hr/day	3.9 Ω	300	0.9	20.7	hours	6210
Toy 1 hr/day	3.9 Ω	293	0.8	22.5	hours	6592
Portable Stereo 2 hrs/day	400 mA	400	0.9	13.2	hours	5280
Radio 4 hrs/day	20 Ω	125	0.9	118	hours	7316

Typical Discharge Characteristics at 21C (70F)



Typical Discharge Characteristics at 21C (70F) - Radio Application



Contents are subject to change without notice and do not constitute a warranty.



Rayovac Stock Number: **813, 813 BULK**

Name: **813 (D) Alkaline**

Engineering Parameters:

Cell Chemistry:

Alkaline Manganese Dioxide

Designation:

ANSI/NEDA – 13A (AA), IEC – LR20

Nominal Voltage:

1.5 volts

Approximate Weight:

5.0 Oz (144 grams)

Approximate Volume:

3.4 CU IN (56 cc)

Operating Temp. Range:

-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Plastic

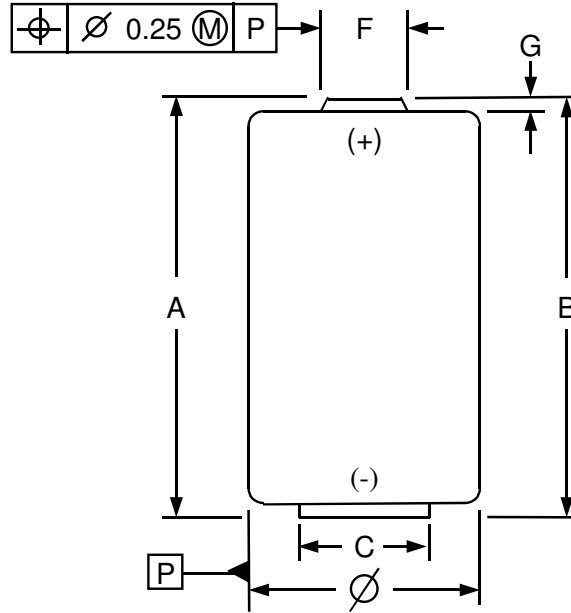
Environmental:

Meets Environmental Protection Agency (EPA)

Requirements For Landfill Disposal.

No Mercury Added Formulation

Rayovac Material Safety Sheets



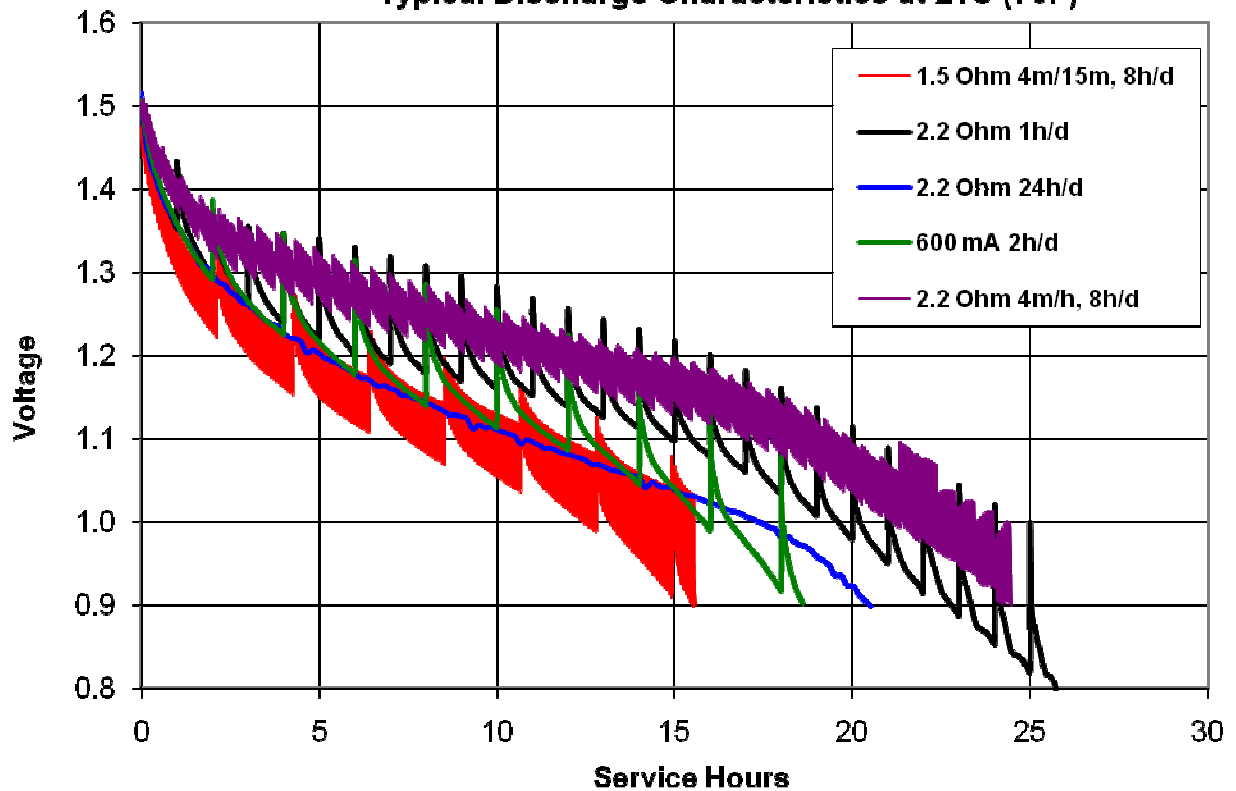
Dimensions	Millimeters	Inches
A (Max)	61.5	2.421
B (Min)	59.5	2.343
C (Min)	18.0	0.709
E (Max)	1.0	0.039
F (Max)	9.5	0.374
G (Min)	1.5	0.059
Ø (Max)	34.2	1.346
Ø (Min)	32.3	1.272

Service life guidelines and representative discharge curves are shown on the following page.

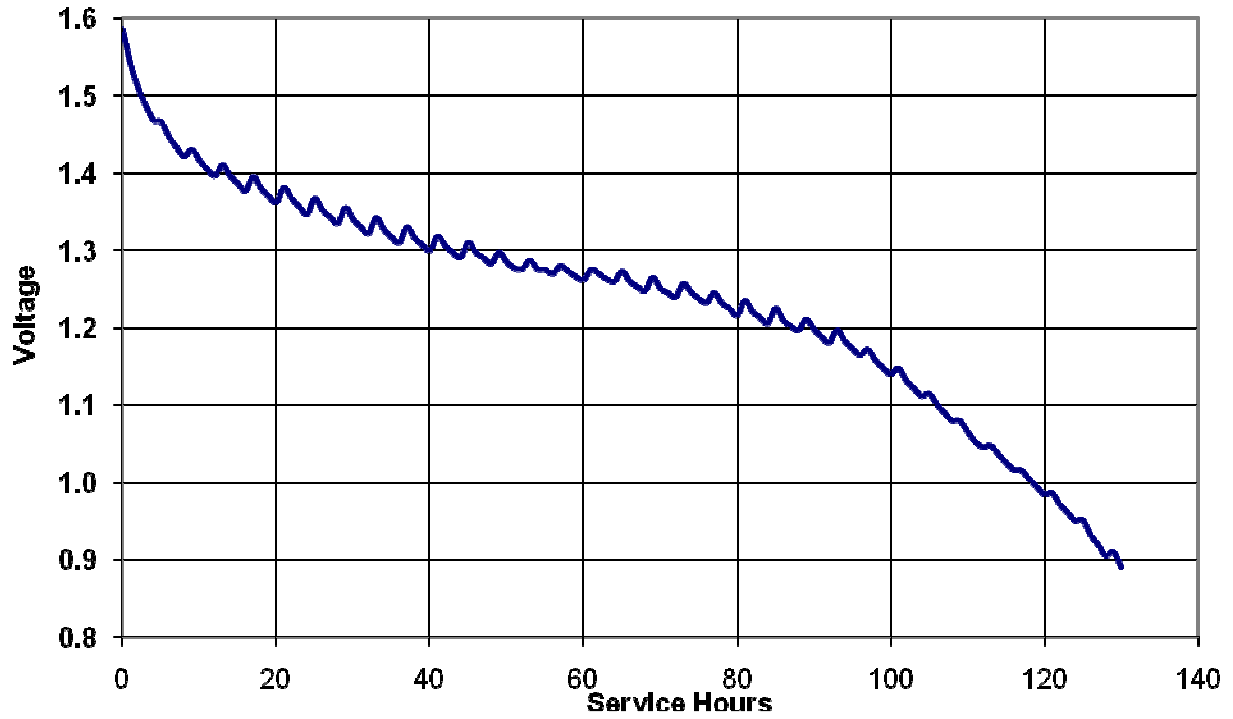
Typical Initial Service Life

Application and Duty Cycle	Discharge Load	Midpoint Current (mA @ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Lighting 4 min/15 min, 8hr/day	1.5 Ω	764	0.9	15.6	hours	11918
Lighting 4 min/hr, 8hr/day	2.2 Ω	545	0.9	24.6	hours	13407
Toy 1 hr/day	2.2 Ω	530	0.8	25.6	hours	13568
Portable Stereo 2 hrs/day	600 mA	600	0.9	18.4	hours	11040
Radio 4 hrs/day	10 Ω	126	0.9	129	hours	16254

Typical Discharge Characteristics at 21C (70F)



Typical Discharge Characteristics at 21C (70F) - Radio
Application: 10 Ohm 4 hrs/day



Contents are subject to change without notice and do not constitute a warranty.



Rayovac Stock Number: **813FT**

Name: **813 Flat Top, Alkaline**

ENGINEERING DATA:

Cell Chemistry: Alkaline

Designation:
ANSI/IEC: Not standardized.

Nominal Voltage:
1.5 volts

Approximate Weight:
5.0 Oz (144 grams)

Approximate Volume:
3.4 cu. in. (55.7 cc)

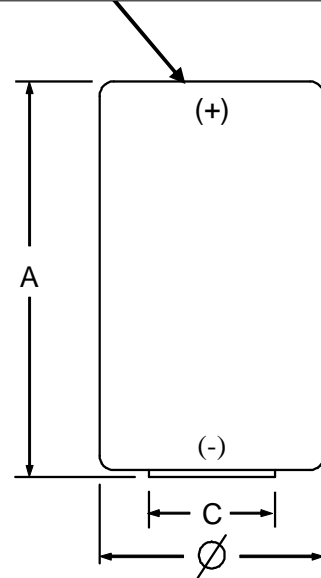
Operating Temp. Range:
-30° C to 55° C (-20° F to 130° F)

Terminals: Flat, nickel plated steel

Shell: Plastic Film

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal. No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)

Flat Positive terminal
24.2 – 27.9 mm diameter contact area



Dimension	Min (mm)	Max (mm)
A Overall Height	57.4	57.8
C Negative contact Diameter	23.8	24.3
Ø Outer Diameter	32.3	34.2

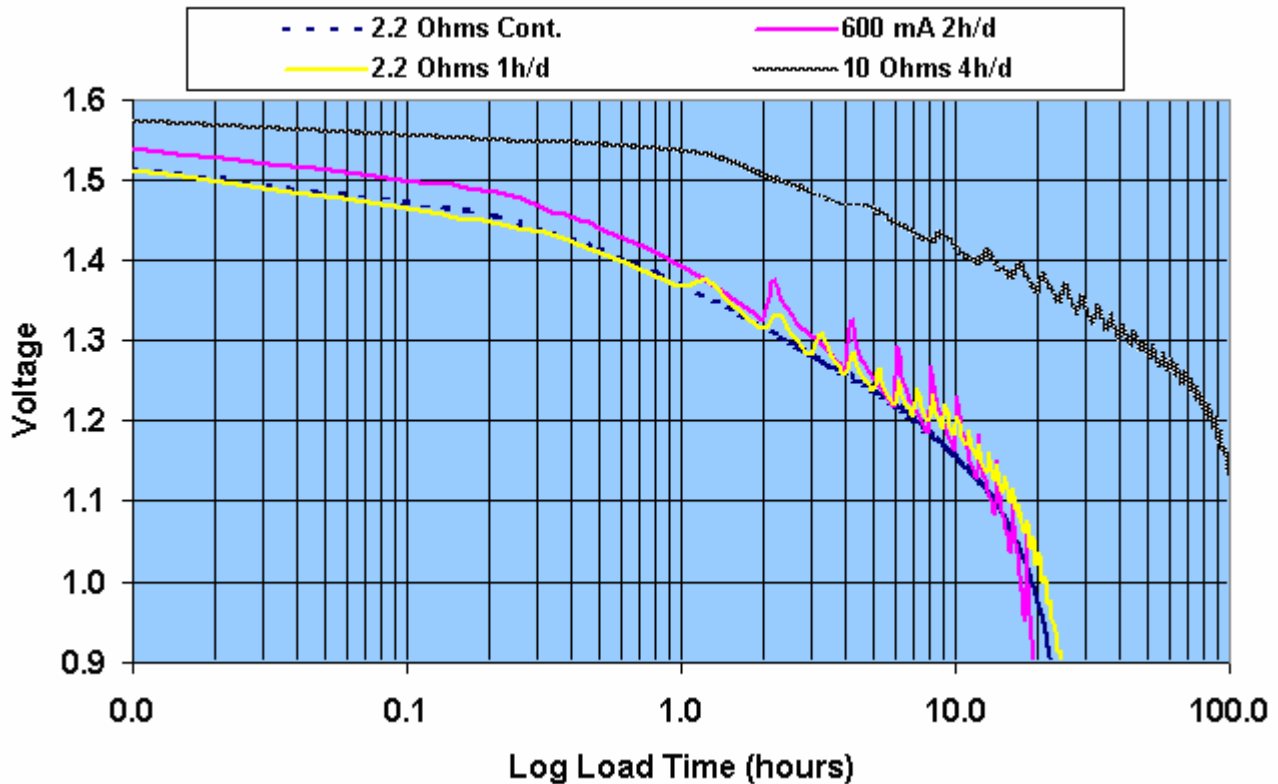
Service life guidelines and representative discharge curves are shown on the following page.

TYPICAL INITIAL SERVICE AT 70°F (HOURS)

APPLICATION <u>DUTY CYCLE</u>	<u>LOAD</u>	<u>CURRENT</u> (MA at 1.2V)	<u>CUTOFF VOLTAGE</u>					<u>mAh</u> <u>Capacity</u> <u>To 0.9V</u>
			<u>1.2V</u>	<u>1.1V</u>	<u>1.0V</u>	<u>0.9V</u>	<u>0.8V</u>	
RADIO (4 HRS/DAY)	10 Ω	120	81	102	116	130	-	15,989
CD STEREO (2 HRS/DAY)	600 mA	600				18.4	-	12,100
FLASHLIGHT (4 MIN/HR-8 HR/DAY)	2.2 Ω	545	11.0	18.3	22.9	25.2	-	13,501
TOY/GAME (1 HR/DAY)	2.2 Ω	545	8.0	15.7	20.8	23.8	26.6	12,614
FLASHLIGHT (CONTINUOUS)	2.2 Ω	545	6.7	13.5	18.6	22.3	-	12,469
FLASHLIGHT K2 KRYPTON BULB (4 MIN/15 MIN-8 HR/DAY)	1.5 Ω	800	3.7	8.5	12.9	15.8	-	11,813

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.

Rayovac D Discharge Curves





Rayovac Stock Number: **303**

Name: **303 Silver**

ENGINEERING DATA:

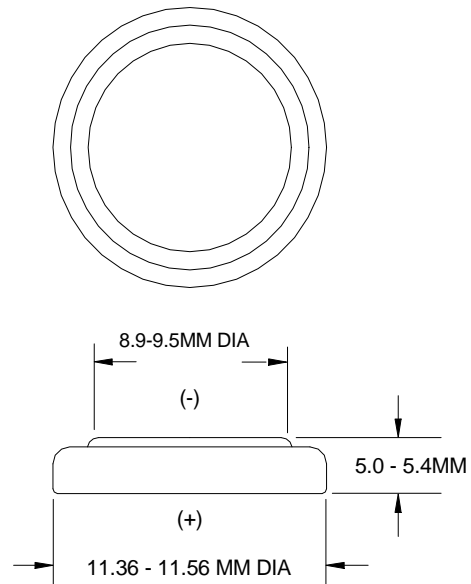
Cell Chemistry: Silver Oxide

Recommended Use: Watch

Nominal Voltage: 1.55 volts

Capacity: 165 mAh – 4.7k OHM 24 hour/day discharge
At 68°F (20°C) to 1.2 volts.

Storage Loss At 68°F (20°C): Less than 7% per year.



ITEM	INITIAL	AFTER 1 YEAR	AFTER 2 YEARS
Off-load voltage (Min. V.)	1.55V	1.55V	1.55V
Service life at 20°C Load: 4.7k ohm (End point 1.2 V)	409h	382h	364h

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **377**

Name: **377 Silver**

ENGINEERING DATA:

Cell Chemistry: Silver Oxide

Designation: ANSI/NEDA – 1176SO, IEC – SR66

Recommended Use: Watch

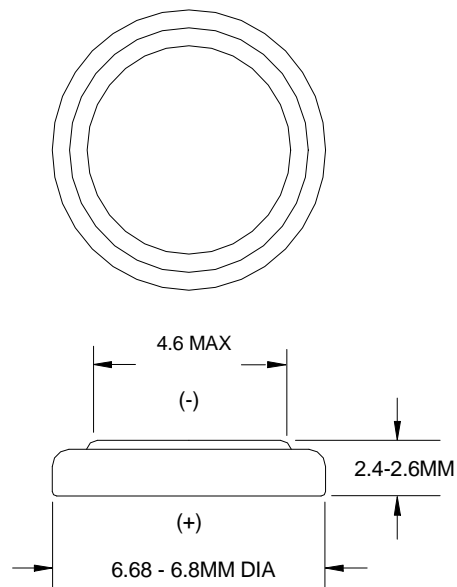
Nominal Voltage: 1.55 volts

Approximate Weight: 0.4 grams

Approximate Volume: 0.09 CU CM

Capacity: 28 mAh – 33k OHM 24 hour/day discharge
At 68°F (20°C) to 1.2 volts.

Storage Loss At 68°F (20°C): Less than 7% per year.



ITEM	INITIAL	AFTER 1 YEAR	AFTER 2 YEARS
Off-load voltage (Min. V.)	1.55V	1.55V	1.55V
Service life at 20°C Load: 33k ohm (End point 1.2 V)	X 525h MIN 473h	X 496h MIN 446h	X 480h MIN 432h

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **23A**

Name: **23A ALKALINE**

ENGINEERING DATA:

Cell Chemistry: Alkaline Manganese Dioxide

Designation: ANSI/NEDA – 1811A

Recommended Use: Remote controllers for keyless entry, garage door openers.

Nominal Voltage: 12 volts

Rated Capacity: 38 mAh at 20 K ohm load to 6.0 volts

Current Drain: Under 15mA pulse, 0.5 mA continuous

Approximate Weight: .26 Oz (7.3 gm)

Approximate Volume: .14 CU IN (2.3 CU CM)

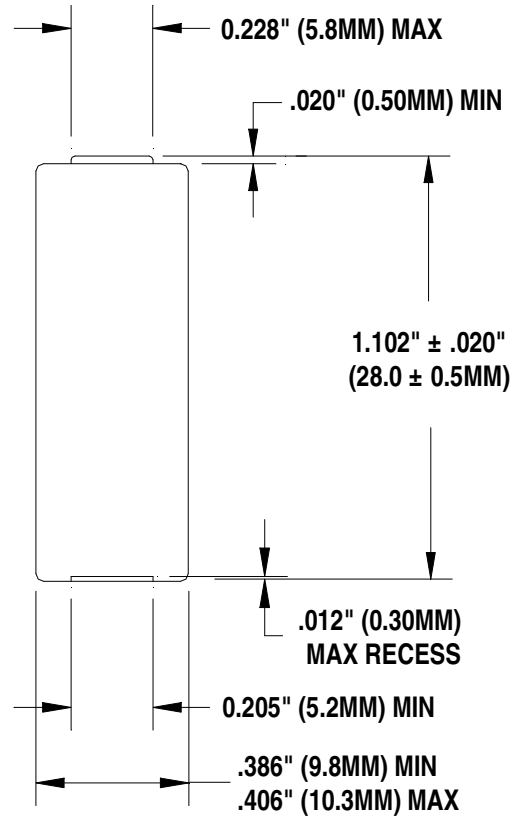
Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Shelf Life: 85% of original service life for 3 years storage at 70°F (21°C)

Terminals: Flashlight (Nickel Plated Flat)

Shell: Steel

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Sheets](#)



**TYPICAL INITIAL SERVICE AT 70°F (HOURS)
CUTOFF VOLTAGE**

APPLICATION DUTY CYCLE	LOAD	CURRENT (MA AT 9.6V)	6.0V	mAh Capacity To 6.0V
RATING TEST (24 HR/DAY)	20 KOHM	0.48	74	38

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **CR1616**

Name: **CR1616 LITHIUM**

ENGINEERING DATA:

Cell Chemistry: Lithium Manganese Dioxide (Li/MnO₂)

Designation: ANSI/NEDA – 5021LC, IEC-CR1616

Recommended Use: Watch and Calculators.

Nominal Voltage: 3 volts

Approximate Weight: 1.2 grams (.04 oz)

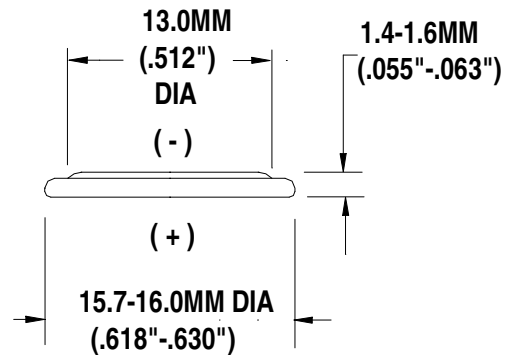
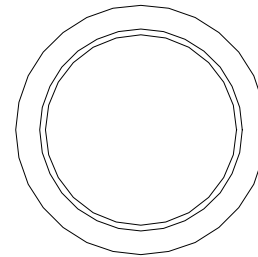
Approximate Volume: .33 CU CM (.02 CU IN)

Capacity: 55 mAh – 30k OHM 24 hour/day discharge
At 68°F (20°C) to 2.5 volts.

Internal Resistance: (Fresh) 1KHz 10mA PULSE: 50 ohm max

Storage Loss At 68°F (20°C): Less than 0.3% per year.

Environmental: [Rayovac Material Safety Data Sheets](#)



ITEM	INITIAL	AFTER 1 YEAR	AFTER 3 YEARS	60°C 100 DAYS
Off-load voltage (Min. V.)	3.1V	3.1V	3.1V	3.1V
Internal Resistance of the fresh battery 1kHz 10mA (Max Ohm)	50 ohm			
Service life at 20°C Load: 30k ohm (End point 2.5 V)	X 578h MIN 520h	X 566h MIN 509h	X 543h MIN 488h	X 520h MIN 468h

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **CR1620**

Name: **CR1620 LITHIUM**

ENGINEERING DATA:

Cell Chemistry: Lithium Manganese Dioxide (Li/MnO₂)

Designation: ANSI/NEDA – 5009LC, IEC-CR1620

Recommended Use: Watch and Calculators.

Nominal Voltage: 3 volts

Approximate Weight: 1.3 grams (.046 oz)

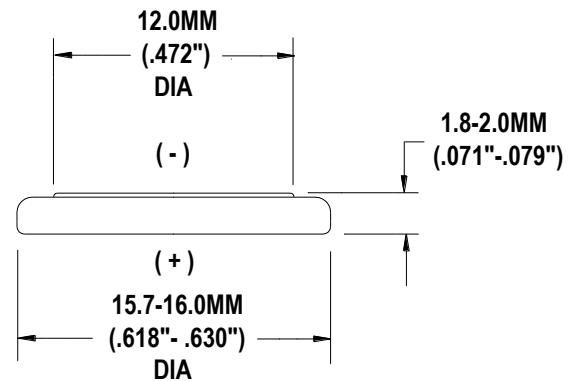
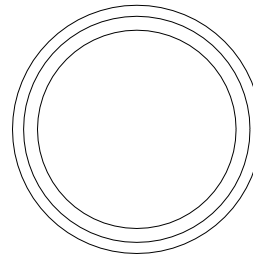
Approximate Volume: .41 CU CM (.025 CU IN)

Capacity: 75 mAh – 30k OHM 24 hour/day discharge
At 68°F (20°C) to 2.5 volts.

Internal Resistance: (Fresh) 1KHz 10mA PULSE: 50 ohm max

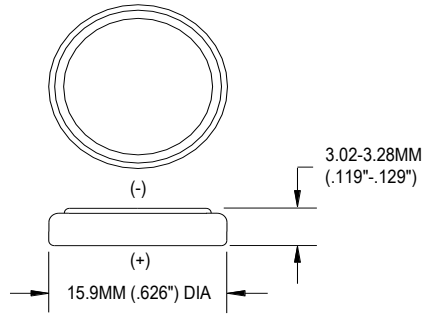
Storage Loss At 68°F (20°C): Less than 0.3% per year.

Environmental: [Rayovac Material Safety Data Sheets](#)



ITEM	INITIAL	AFTER 1 YEAR	AFTER 3 YEARS
Off-load voltage (Min. V.)	3.1V	3.1V	3.1V
Internal Resistance of the fresh battery 1kHz 10mA (Max Ohm)	50 ohm		
Service life at 20°C Load: 30k ohm (End point 2.5 V)	790 h	774 h	742 h

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.

Dimensions:
 (ANSI / IEC Standards)


DIMENSIONS	
MM	INCHES
3.0	0.119
3.3	0.129
15.9	0.626

Engineering Data:

Cell Chemistry:	Lithium/Manganese Dioxide (CR)
Designation:	IEC-CR1632
Nominal Voltage:	3.0 V
Maximum off-load voltage:	3.7 V
Approximate Weight:	1.6 g.
Approximate Volume:	.63 CU CM
Nominal Capacity:	75mAh (15k Ohm Cont. to 2.0V @ 20°C)
Operating Temp. Range:	-20°C to 60°C
Storage Temperature Range:	-20°C to 45°C

Typical Service (@ 20°C):

Application:	Load	Load Unit	Duty Cycle	Daily Cycle	EPV	ANSI Min. Ave. Duration	Actual
Rating:	15	kOhms		24 h	2.0	780 Hours	720 Hours



Rayovac Stock Number: **CR2016**

Name: **CR2016 Lithium**

ENGINEERING DATA:

Cell Chemistry: Lithium/manganese dioxide

Designation: ANSI/NEDA – 5000LC, IEC – CR2016

Recommended Use: Rating

Nominal Voltage: 3.0 volts

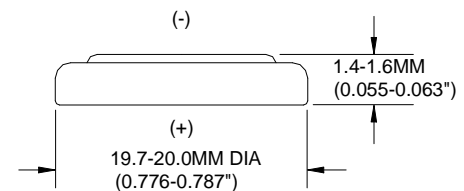
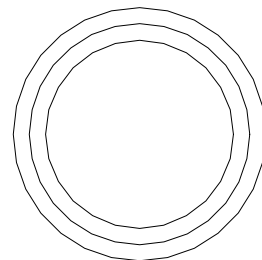
Approximate Weight: 1.7 grams

Internal Resistance of Fresh Battery: 1kHz 10mA (30 ohm Max.)

Capacity: 90 mAh – 15k OHM 24 hour/day discharge
At 68°F (20°C) to 2.5 volts.

Storage Loss At 68°F (20°C): Less than 3% per year.

Environmental: [Rayovac Material Safety Data Sheets](#)



ITEM	INITIAL	AFTER 1 YEAR	AFTER 3 YEARS
Off-load voltage (Min. V.)	3.1V	3.1V	3.1V
Service life at 20°C Load: 15k ohm (End point 2.5 V)	X 473h MIN 425h	X 463h MIN 416h	X 444h MIN 399h

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Marketing Data Sheet - Batteries

S6600071

Issue C

Memo No: [MDSR0104](#)

Rayovac Stock Number: **CR2025**

Name: **CR2025 LITHIUM**

ENGINEERING DATA:

Cell Chemistry: Lithium Manganese Dioxide (Li/MnO₂)

Designation: ANSI/NEDA – 5003LC, IEC-CR2025

Recommended Use: Watch and Calculators.

Nominal Voltage: 3 volts

Approximate Weight: 1.2 grams (.04 oz)

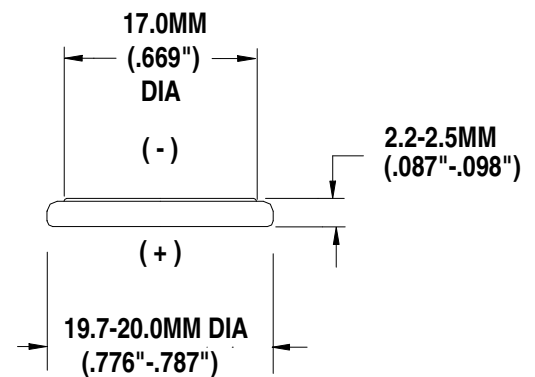
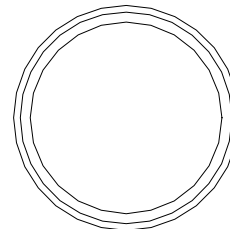
Approximate Volume: .33 CU CM (.02 CU IN)

Capacity: 165 mAh – 15k OHM 24 hour/day discharge
At 68°F (20°C) to 2.5 volts.

Internal Resistance: (Fresh) 1KHz 10mA PULSE: 15 ohm max

Storage Loss At 68°F (20°C): Less than 0.3% per year.

Environmental: [Rayovac Material Safety Data Sheets](#)



ITEM	INITIAL	AFTER 1 YEAR	AFTER 3 YEARS	60°C 100 DAYS
Off-load voltage (Min. V.)	3.1V	3.1V	3.1V	3.1V
Internal Resistance of the fresh battery 1kHz 10mA (Max Ohm)	15 ohm			
Service life at 20°C Load: 15k ohm (End point 2.5 V)	X 865h MIN 778h	X 847h MIN 762h	X 813h MIN 732h	X 778h MIN 700h

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **CR2032**

Name: **CR2032 LITHIUM**

ENGINEERING DATA:

Cell Chemistry: Lithium Manganese Dioxide (Li/MnO₂)

Designation: ANSI/NEDA – 5004LC, IEC-CR2032

Recommended Use: Watch and Calculators.

Nominal Voltage: 3 volts

Approximate Weight: 3.9 grams (.11 oz)

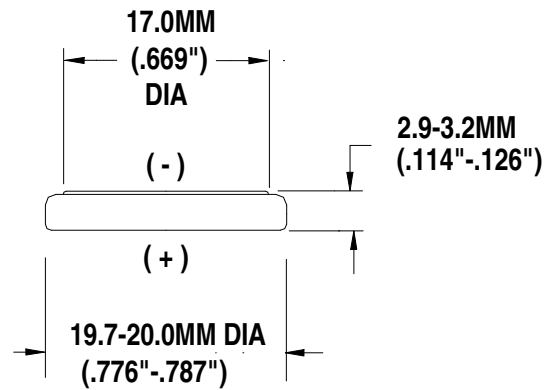
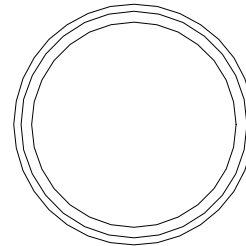
Approximate Volume: .98 CU CM (.06 CU IN)

Capacity: 220 mAh – 15k OHM 24 hour/day discharge
At 68°F (20°C) to 2.5 volts.

Internal Resistance: (Fresh) 1KHz 10mA PULSE: 20 ohm max

Storage Loss At 68°F (20°C): Less than 0.3% per year.

Environmental: [Rayovac Material Safety Data Sheets](#)



ITEM	INITIAL	AFTER 1 YEAR	AFTER 3 YEARS	60°C 100 DAYS
Off-load voltage (Min. V.)	3.1V	3.1V	3.1V	3.1V
Internal Resistance of the fresh battery 1kHz 10mA (Max Ohm)	20 ohm			
Service life at 20°C Load: 15k ohm (End point 2.5 V)	\bar{X} 1157h MIN 778h	\bar{X} 1133h MIN 762h	\bar{X} 1087h MIN 732h	\bar{X} 1041h MIN 700h

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Marketing Data Sheet - Batteries

S6600188

Issue M

Memo No: MDSR0104

Rayovac Stock Number: **641**

Name: **641 GENERAL PURPOSE CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 907

Nominal Voltage: 6 volts

Approximate Weight: 5 Lb 12 Oz (2.62 Kg)

Approximate Volume: .125 CU FT (.004 CU M)

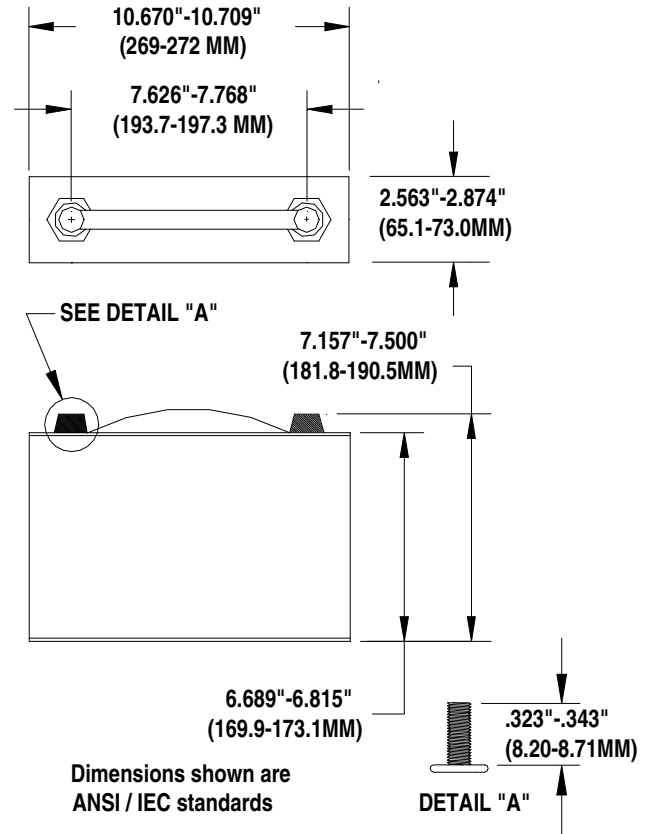
Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Screw

Shell: Plastic

Number Of Cells: 16

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



TYPICAL INITIAL SERVICE AT 70°F (HOURS) CUTOFF VOLTAGE

APPLICATION DUTY CYCLE	LOAD (OHMS)	CURRENT (MA AT 4.8V)	CUTOFF VOLTAGE			mAh Capacity To 3.6V
			4.4V	4.0V	3.6V	
ELECTRONIC (24 HR/DAY)	200	24	1,565	1,650	1,725	43,850
HIGH RATE RATING (24 HR/DAY)	2.7	1,777	7.8	11.1	14.5	23,750

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Marketing Data Sheet - Batteries

S6600182

Issue F

Memo No: [MDSR0104](#)

Rayovac Stock Number: **803**

Name: **803 ALKALINE**

ENGINEERING DATA:

Cell Chemistry: Alkaline

Designation: ANSI/NEDA – 903A

Nominal Voltage: 7.5 volts

Approximate Weight: 5.6 Lb (2.55 Kg)

Approximate Volume: 108 CU IN (1770 CU CM)

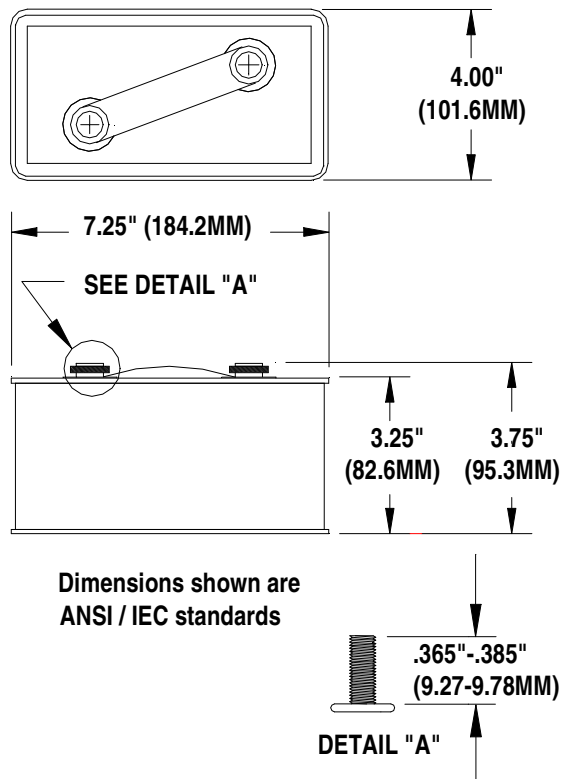
Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Screw

Shell: Steel

Number Of Cells: 15

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal. No Mercury Added Formulation
[Rayovac Material Safety Sheets](#)



**TYPICAL INITIAL SERVICE AT 70°F (HOURS)
CUTOFF VOLTAGE**

<u>DUTY CYCLE</u>	<u>LOAD (OHMS)</u>	<u>CURRENT (AMPS AT 6V)</u>	<u>CUTOFF VOLTAGE</u>				<u>mAh CAPACITY To 4.5V</u>
			<u>6.0V</u>	<u>5.5V</u>	<u>5.0V</u>	<u>4.5V</u>	
30 MIN/HR (8 HRS/DAY)	10	.75	32	54	62	69	40,000
30 MIN/HR (8 HR/DAY)	2.7	2.22	2.1	6.0	11.2	15.9	31,700
24 HR/DAY	2.46	2.44	1.5	4.8	10.7	13.1	29,000

950728

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: 903

Name: 903 HEAVY DUTY CARBON ZINC

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 903

Nominal Voltage: 7.5 volts

Approximate Weight: 7.0 Lb (3.18 Kg)

Approximate Volume: 186 CU IN (3048 CU CM)

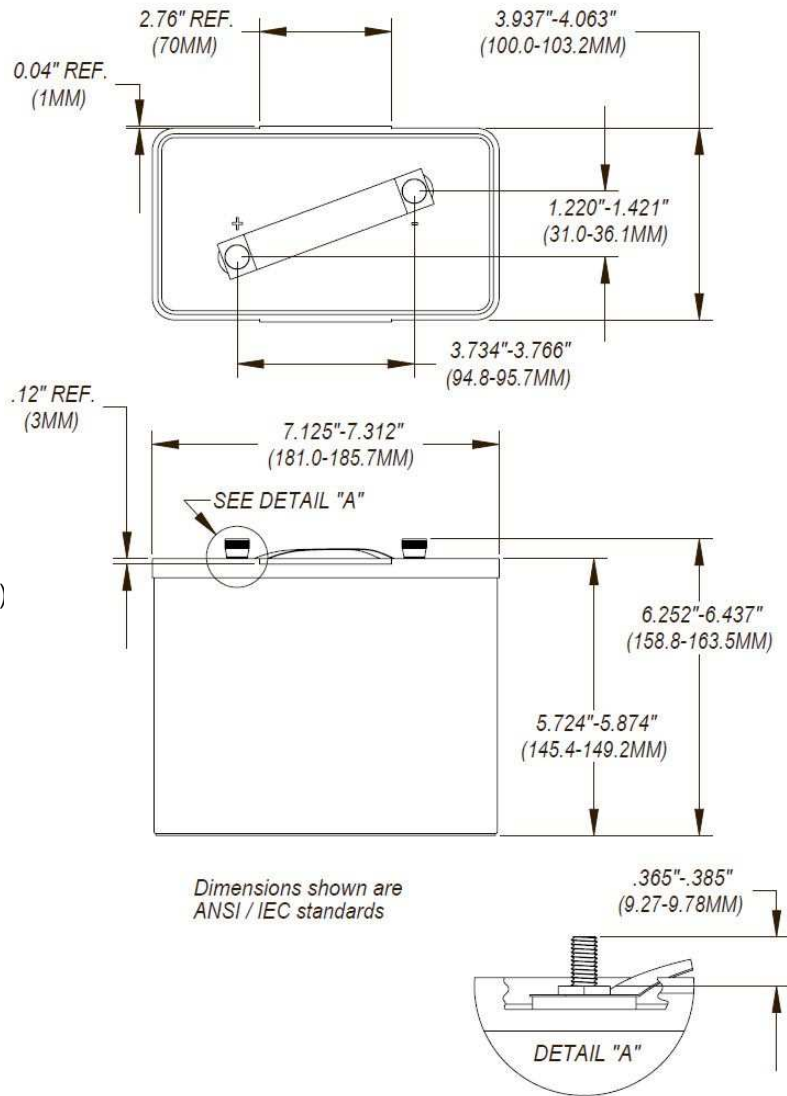
Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Screw

Shell: Plastic

Number Of Cells: 20

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal. No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



**TYPICAL INITIAL SERVICE AT 70°F (HOURS)
CUTOFF VOLTAGE**

APPLICATION DUTY CYCLE	LOAD (OHMS)	CURRENT (AMPS AT 6V)	CUTOFF VOLTAGE				mAh CAPACITY To 4.5V
			6.0V	5.5V	5.0V	4.5V	
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	2.7	2.22	1.5	5.0	8.5	11.3	23,000
HIGH RATE RATING (24 HR/DAY)	2.7	2.22	1.4	4.5	7.0	10.0	20,000

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Marketing Data Sheet



Rayovac Stock Number: **813FUS**

Name: **813 D Fusion Alkaline Battery**

Engineering Parameters

Cell Chemistry

Alkaline Manganese Dioxide

Designation

ANSI/NEDA – 13A (AA), IEC – LR20

Nominal Voltage

1.5 volts

Approximate Weight

5.0 Oz (144 grams)

Approximate Volume

3.4 CU IN (56 cc)

Operating Temp. Range

-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Plastic Film

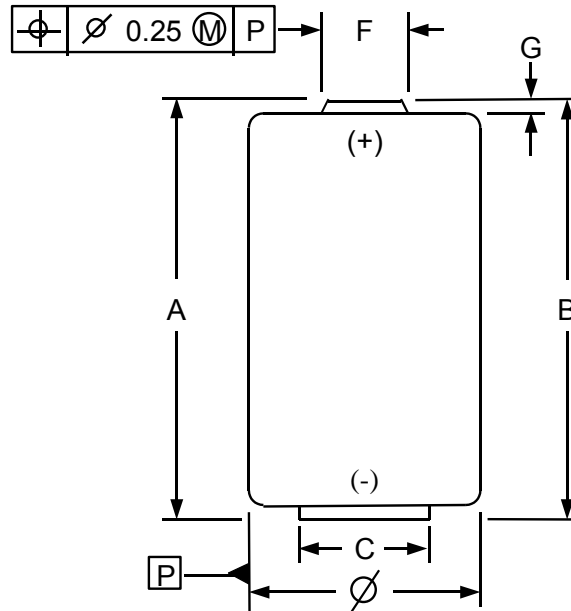
Environmental:

Meets Environmental Protection Agency (EPA)

Requirements For Landfill Disposal.

No Mercury Added Formulation

Meets EU Battery Directive 2006/66/EC



Dimensions	Millimeters	Inches
A (Max)	61.5	2.421
B (Min)	59.5	2.343
C (Min)	18.0	0.709
E (Max)	1.0	0.039
F (Max)	9.5	0.374
G (Min)	1.5	0.059
Ø (Max)	34.2	1.346
Ø (Min)	32.3	1.272

Service life guidelines and are shown on the following page.

Typical Initial Service Life

Application and Duty Cycle	Discharge Load	Midpoint Current (mA @ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Lighting 4 min/15 min, 8hr/day	1.5 Ω	764	0.9	16	hours	12220
Lighting 4 min/hr, 8hr/day	2.2 Ω	545	0.9	26	hours	14170
Toy 1 hr/day	2.2 Ω	530	0.8	25	hours	13250
Portable Stereo 2 hrs/day	600 mA	600	0.9	19	hours	11400
Radio 4 hrs/day	10 Ω	126	0.9	128	hours	16130



Rayovac Stock Number: 814FUS

Name: 814 Fusion Alkaline Battery

Engineering Parameters

Cell Chemistry

Alkaline Manganese Dioxide

Designation

ANSI/NEDA – 14A (AA), IEC – LR14

Nominal Voltage

1.5 volts

Approximate Weight

2.5 Oz (70 grams)

Approximate Volume

1.6 CU IN (26 cc)

Operating Temp. Range

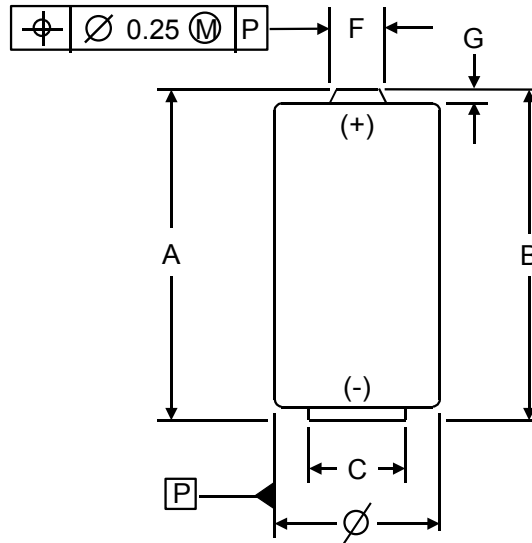
-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell Plastic Film

Environmental

Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
Meets EU Battery Directive 2006/66/EC



Dimensions	Millimeters	Inches
A (Max)	50.0	1.969
B (Min)	48.6	1.913
C (Min)	13.0	0.512
E (Max)	0.9	0.035
F (Max)	7.5	0.295
G (Min)	1.5	0.059
Ø (Max)	26.2	1.031
Ø (Min)	24.9	0.980

Typical Initial Service Life

Application and Duty Cycle	Discharge Load	Midpoint Current mA	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Lighting 4 min/hr, 8hr/day	3.9 Ω	300	0.9	22	hours	6600
Toy 1 hr/day	3.9 Ω	293	0.8	23	hours	6740
Portable Stereo 2 hrs/day	400 mA	400	0.9	14	hours	5600
Radio 4 hrs/day	20 Ω	63	0.9	121	hours	7623

Contents are subject to change without notice and do not constitute a warranty.



Marketing Data Sheet
Fusion AA Battery



Rayovac Stock Number: **815FUS,**
815OEMFUS AA Bulk

Name: **815 AA Fusion Alkaline Battery**

Engineering Parameters:

Cell Chemistry:

Alkaline Zinc / Manganese Dioxide

Designation

ANSI/NEDA – 15A (AA), IEC – LR6

Nominal Voltage

1.5 volts

Approximate Weight

0.9 Oz (25 grams)

Approximate Volume

0.50 CU IN (8.2 cm³)

Operating Temp. Range

-30° C to 55° C (-20° F to 130° F)

Shelf Life

10 years from date of manufacture.

Terminals: Flashlight

Shell: Plastic

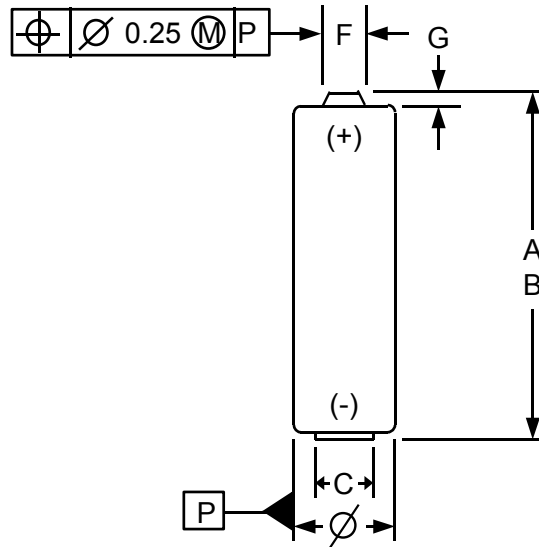
Environmental:

Meets Environmental Protection Agency (EPA)

Requirements For Landfill Disposal.

No Mercury Added Formulation

Meets EU Battery Directive 2006/66/EC



Dimensions	Millimeters	Inches
A (Max)	50.5	1.988
B (Min)	49.5	1.949
C (Min)	7.0	0.276
F (Max)	5.5	0.217
G (Min)	1.0	0.039
Ø (Max)	14.5	0.571
Ø (Min)	13.7	0.539

Service life guidelines are shown on the following page.

Typical Initial Service Life

ANSI C18.1 Standard Application Tests

Application and Duty Cycle	Discharge Load	Midpoint Current (mA)	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Digital Camera (2 sec Load 1, 28 sec Load 2) 5 min/hr	Load 1: 1.5W Load 2: 0.65W	Variable	1.05	130	pulses	1080
Photo Flash 10 sec/min 1 h/day	1000 mA	1000	0.9	584	pulses	1622
Toothbrush 2 min/15min	500 mA	500	0.8	4.6	hours	2300
Lighting 4 min/hr, 8 hrs/day	3.3 Ω	363	0.9	6.7	hours	2190
Toy 1 hr/day	3.9 Ω	308	0.8	8.8	hours	2421
CD / Games 1 hr/day	250 mA	250	0.9	9.6	hours	2400
Tape / Audio 1 hr/day	100 mA	100	0.9	26.5	hours	2650
Remote 15 sec/min 8 hrs/day	24 Ω	50	1.0	49.9	hours	2680
Radio 4 hrs/day	43 Ω	28	0.9	95.5	hours	2850



Rayovac Stock Number: 824FUS, 824 OEMFUS AAA Bulk

Name: 824 AAA Fusion Alkaline Battery

Engineering Parameters

Cell Chemistry

Alkaline (Zinc-Manganese Dioxide)

Designation

ANSI/NEDA – 24A (AA), IEC – LR03

Nominal Voltage

1.5 volts

Approximate Weight

0.4 Oz (11 grams)

Approximate Volume

0.2 CU IN (3.5 cc)

Operating Temp. Range

-30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Case material Plastic Film

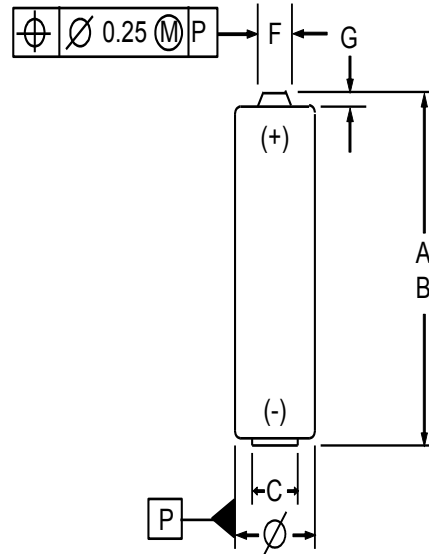
Environmental:

Meets Environmental Protection Agency (EPA)

Requirements For Landfill Disposal.

No Mercury Added Formulation

[Rayovac Material Safety Sheets](#)



Dimensions	Millimeters	Inches
A (Max)	44.5	1.752
B (Min)	43.5	1.713
C (Min)	4.3	0.169
F (Max)	3.8	0.150
G (Min)	0.8	0.031
∅ (Max)	10.5	0.413
∅ (Min)	9.5	0.374

Typical Service Life – ANSI Application Tests

Application and Duty Cycle	Discharge Load	Midpoint Current (mA @ 1.2V)	Cut-off Voltage (V)	Service	Units	Discharge Capacity (mAh)
Photo Flash 10 sec/min 1 h/day	600 mA	600	0.9	440	pulses	733
Lighting 4 min/hr, 8hr/day	5.1 Ω	227	0.9	4.6	hours	1040
Toy 1 hr/day	5.1 Ω	223	0.8	4.5	hours	1004
Audio 1 hr/day	100 mA	100	0.9	10.8	hours	1080
Remote 15 sec/min, 8 hr/day	24 Ω	53	1.0	21.5	hours	1141



Marketing Data Sheet- Fusion 9-Volt



Rayovac Stock Number: A1604FUS

Name: 9-Volt Fusion Alkaline battery

Engineering Parameters

Cell Chemistry Alkaline

Designation

ANSI/NEDA – 1604A , IEC – 6LR61

Nominal Voltage

9 Volts

Approximate Weight

1.6 Oz (45.4 grams)

Approximate Volume

1.2 CU IN (19.7 CU CM)

Operating Temp. Range

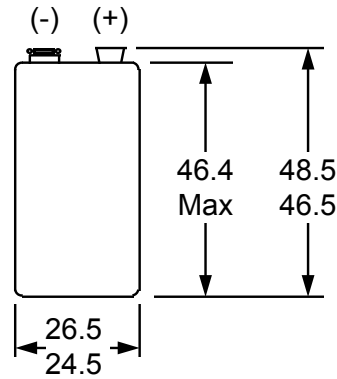
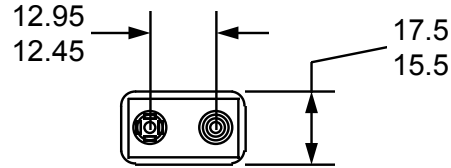
-30° C to 55° C (-20° F to 130° F)

Terminals: Snap

Jacket: Steel

Environmental:

Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
 No Mercury Added Formulation
 Meets EU Battery Directive 2006/66/EC



Typical Initial Service Life (ANSI C18.1 Tests)

Application and Duty Cycle	Discharge Load	Midpoint Current (mA @ 7.2V)	Cut-off Voltage	Service	Units	Discharge Capacity (mAh)
Radio, Light drain 4 min/15 min, 8hr/day	620 Ω	12	5.4	54	hours	650
Toy/Game 4 min/hr, 8hr/day	270 Ω	27	5.4	24	hours	650
Smoke Detector 1 sec/hr	620 Ω 10kΩ background	12 (pulse)	7.5	550	hours	450



Rayovac Stock Number: **D1604**

Name: **9 VOLT HEAVY DUTY CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 1604D , IEC – 6F22

Nominal Voltage: 9.0 Volts

Approximate Weight: 1.5 Oz (42.5 grams)

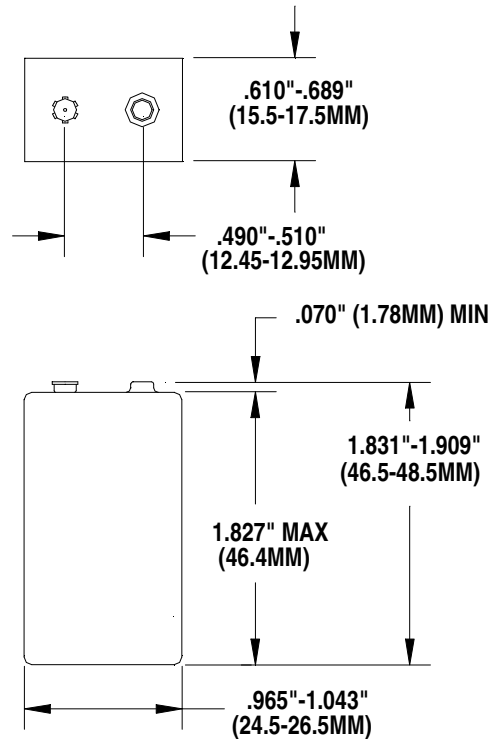
Approximate Volume: 1.2 CU IN (19.7 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Snap

Jacket: Steel

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



TYPICAL INITIAL SERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA @ 7.2V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Radio	620 Ω	2 hr/day	11.6	5.4	31.56	hours	374
Toy/Game	270 Ω	1 hr/day	27	5.4	12.49	hours	326
Smoke Detector (Accelerated)	43K Background with 620 Ohm Pulse 1 /hr		11.6	7.5	9.7	days	205
Tape Recorder	180 Ω	1 hr/day	40	5.4	7.56	hours	284
Release	180 Ω	24 hr/day	40	4.8	3.84	hours	148

540849, 540880, 540914



Rayovac Stock Number: **HD-AA**

Name: **HD-AA (AA) HEAVY DUTY INDUSTRIAL CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 15D (AA), IEC – R6

Nominal Voltage: 1.5 volts

Approximate Weight: .65 Oz (18.4 grams)

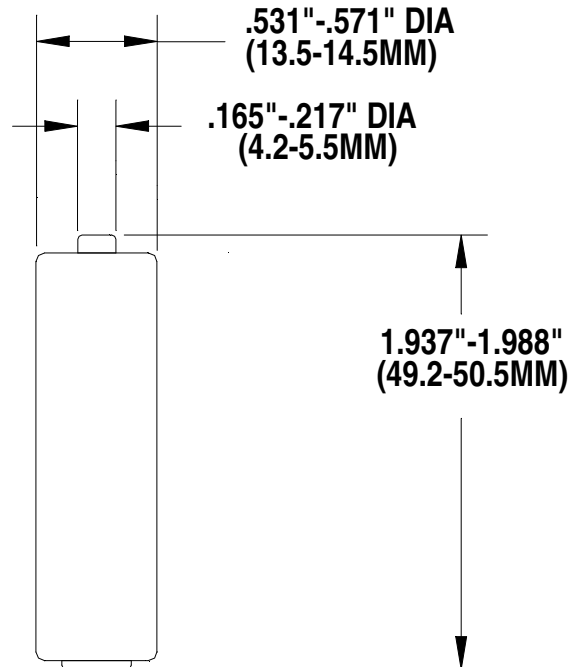
Approximate Volume: .48 CU IN (7.87 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Steel or Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



TYPICAL INITIAL SERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA @ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Photoflash	1.8 Ω	15 sec/min, 24 hr/day	667	0.9	186	pulses	467
Lighting	3.3 Ω	4 min/hr, 8hr/day	364	0.9	2.18	hours	720
Toy	3.9 Ω	1 hr/day	308	0.8	2.58	hours	708
Release	3.9 Ω	24 hr/day	308	0.9	1.77	hours	507
CD / Games	250 mA	1 hr/day	187	0.9	2.48	hours	621
Tape / Audio	10 Ω	1 hr/day	120	0.9	7.23	hours	860
Tape / Audio	100 mA	1 hr/day	75	0.9	8.70	hours	870
Remote	24 Ω	15 sec/min 8 hr/day	50	1.0	17.40	hours	928
Radio	43 Ω	4 hrs/day	28	0.9	33.60	hours	980

540572, 540642, 540827

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **3AAA**

Name: **3AAA (AAA) HEAVY DUTY CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 24D (AAA), IEC – R03

Nominal Voltage: 1.5 volts

Approximate Weight: .3 Oz (9 grams)

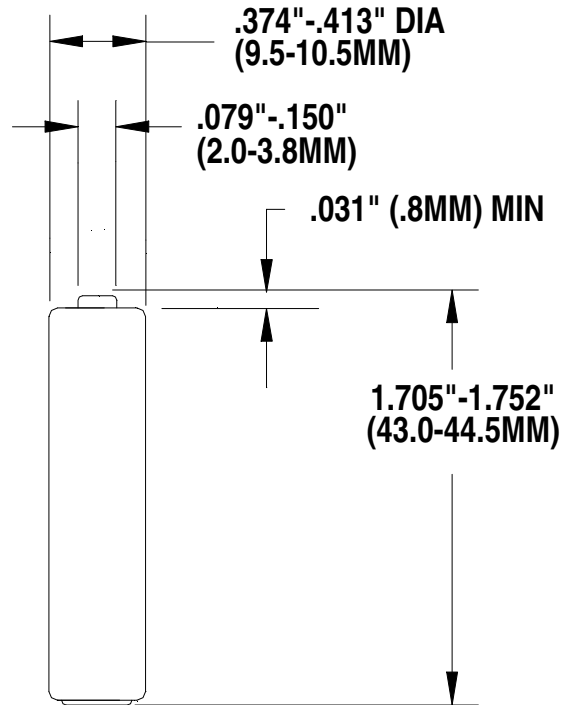
Approximate Volume: .2 CU IN (3.3 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



TYPICAL INITIAL SERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA@ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Photoflash	3.6 Ω	15 sec/min, 24 hr/day	333	0.9	215	pulses	248
Tape/Audio	10 Ω	1 hr/day	120	0.9	3.27	hours	376
Radio	75 Ω	4 hr/day	16	0.9	28.45	hours	454
Lighting	5.1 Ω	4 min/hr, 8 hr/day	235	0.9	1.63	hours	349
Release	5.1 Ω	24 hr/day	235	0.9	1.07	hours	234
Remote	24 Ω	15 sec/min, 8 hr/day	50	1.0	8.60	hours	452
Audio	100 mA	1 hr/day	75	0.9	3.64	hours	364

540242, 540571, 540826

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **HD-C**

Name: **HD-C HEAVY DUTY INDUSTRIAL CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 14D (C), IEC – R14

Nominal Voltage: 1.5 volts

Approximate Weight: 1.5 Oz (42.5 grams)

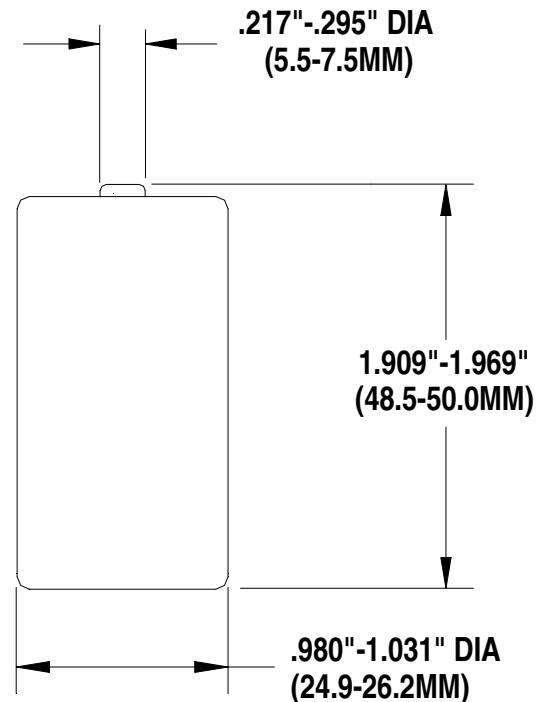
Approximate Volume: 1.6 CU IN (26.2 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Steel

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



TYPICAL INITIAL SERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA@ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Radio	20 Ω	4 hr/day	60	0.9	37.4	hours	2274
Lighting	3.9 Ω	4 min/hr, 8 hr/day	308	0.9	6.03	hours	1715
Toy/Game	3.9 Ω	1 hr/day	308	0.8	5.94	hours	1603
Release	3.9 Ω	24 hr/day	308	0.9	3.45	hours	983
Portable Stereo	400 mA	2 hr/day	300	0.9	1.66	hours	664

540320, 540582, 540742, 540857

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **HD-D**

Name: **HD-D (D) HEAVY DUTY INDUSTRIAL CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 13D (D), IEC – R20

Nominal Voltage: 1.5 volts

Approximate Weight: 3.3 Oz (93 grams)

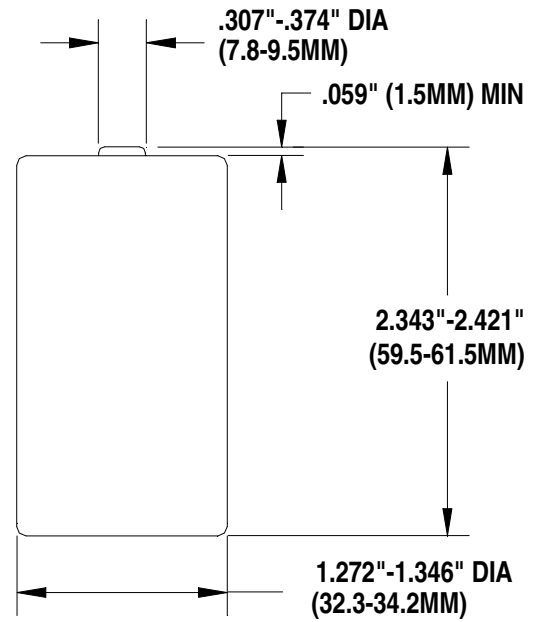
Approximate Volume: 3.4 CU IN (55.7 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Flashlight

Shell: Steel

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



TYPICAL INITIAL SERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA@ 1.2V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Toy/Game	2.2 Ω	1 hr/day	545	0.8	8.85	hours	4029
Portable Stereo	600 mA	2 hr/day	62	0.9	3.67	hours	2194
Radio	10 Ω	4 hr/day	120	0.9	43.5	hours	5186
Lighting	2.2 Ω	4 min/hr, 8 hr/day	545	0.9	5.65	hours	2857
Release	2.2 Ω	24 hr/day	545	0.9	5.52	hours	2705
Lighting	1.5 Ω	4 min/15 min, 8 hr/day	800	0.9	3.62	hours	2626

540318, 540319, 540645, 540850

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **6V-HDM**

Name: **6V-HDM PREMIUM INDUSTRIAL CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 908CD, IEC – 4R25X

Nominal Voltage: 6 volts

Approximate Weight: 1 Lb 5 Oz (.58 Kg)

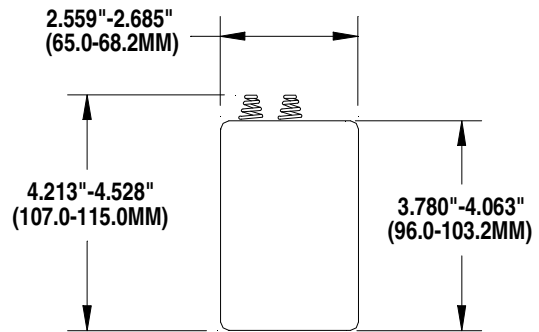
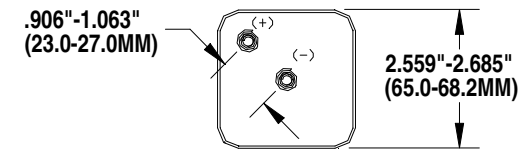
Approximate Volume: 32 CU IN (524.4 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Spring

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



Dimensions shown are ANSI / IEC standards

TYPICAL INITIALSERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA @ 4.8V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Portable Light	9.1 Ω	30 min/hr, 8 hr/day	527	3.6	15.85	hours	7818
Portable Light	33 Ω	30 min/hr, 8 hr/day	145	3.6	59.8	hours	8936
Steady Burn Barricade	110 Ω	12 hr/day	44	3.6	208.6	hours	9686
Release	9.1 Ω	24 hr/day	527	3.6	13.6	hours	6690

540708, 540833

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **806**

Name: **806 ALKALINE**

ENGINEERING DATA:

Cell Chemistry: Alkaline

Designation: ANSI/NEDA – 908A

Nominal Voltage: 6 volts

Approximate Weight: 1 Lb 6 Oz (.62 Kg)

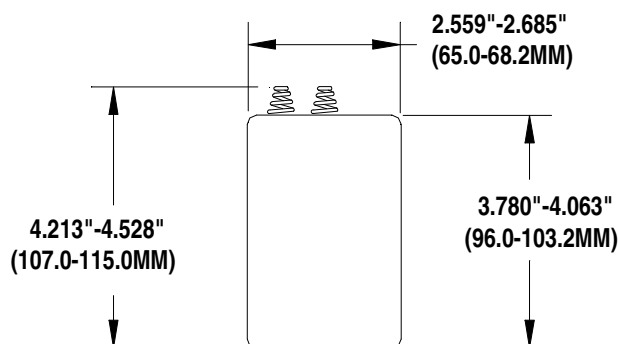
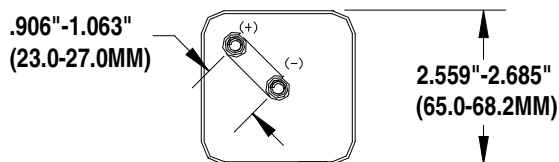
Approximate Volume: 32 CU IN (524.4 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Spring

Shell: Steel

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Sheets](#)



Dimensions shown are ANSI / IEC standards

**TYPICAL INITIAL SERVICE AT 70°F (HOURS)
CUTOFF VOLTAGE**

APPLICATION <u>DUTY CYCLE</u>	LOAD <u>(OHMS)</u>	CURRENT <u>(MA at 4.8V)</u>	<u>CUTOFF VOLTAGE</u>					<u>MAh</u> <u>CAPACITY</u> <u>To 3.6V</u>
			<u>4.4V</u>	<u>4.0V</u>	<u>3.6V</u>	<u>3.0V</u>	<u>2.6V</u>	
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	6.8	705	8.4	13.9	17.2	20.6	21.3	11,148
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	9.1	527	16.0	20.8	24.4	28.7	29.5	12,249
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	33	145	83.1	92.6	104.7	-	-	15,379
STEADY BURN BARRICADE (12 HR/DAY)	110	44	295	336	380	442	-	17,109

952277

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: 808

Name: 808 ALKALINE

ENGINEERING DATA:

Cell Chemistry: Alkaline

Designation: ANSI/NEDA – 908A

Nominal Voltage: 6 volts

Approximate Weight: 2 Lb 4 Oz (1.0 Kg)

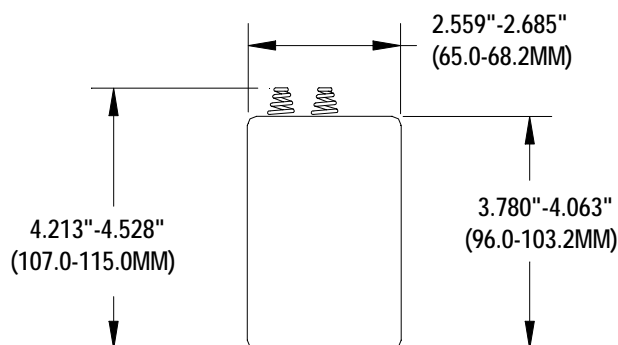
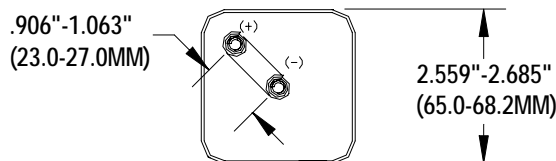
Approximate Volume: 32 CU IN (524.4 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Spring

Shell: Plastic, Ultrasonically sealed.

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal. No Mercury Added Formulation Rayovac Material Safety Sheets



Dimensions shown are ANSI / IEC standards

TYPICAL INITIAL SERVICE AT 70°F (HOURS)

APPLICATION DUTY CYCLE	Load (Ohms)	Current (mA at 4.8V)	Service to 3.6V	mAh Capacity To 3.6V
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	9.1	527	31	15800
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	33	145	135	19575
STEADY BURN BARRICADE (12 HR/DAY)	110	44	456	20060

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Marketing Data Sheet - Batteries

S6600192
Issue Q
Memo No: [MDSR1103](#)

Rayovac Stock Number: **918**

Name: **918 GENERAL PURPOSE CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 918, IEC 4R25-2

Nominal Voltage: 6 volts

Approximate Weight: 2 Lb 10 Oz (1.18 Kg)

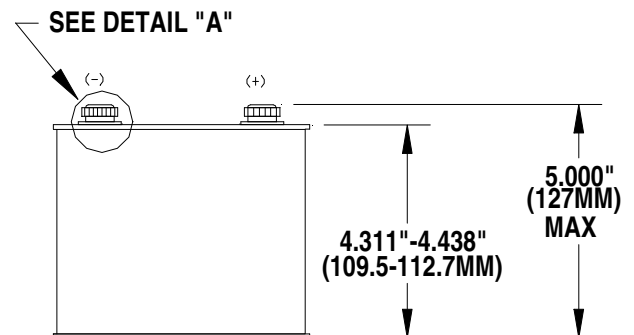
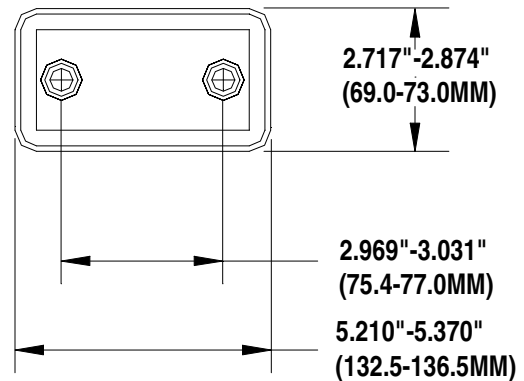
Approximate Volume: 76 CU IN (1245 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Screw

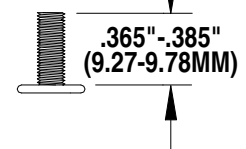
Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



Dimensions shown are ANSI / IEC standards

DETAIL "A"



TYPICAL INITIAL SERVICE AT 70°F (HOURS) CUTOFF VOLTAGE

APPLICATION DUTY CYCLE	LOAD (OHMS)	CURRENT (MA at 4.8V)	CUTOFF VOLTAGE				MAh CAPACITY To 3.6V
			4.4V	4.0V	3.6V	2.6V	
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	9.1	527	14.7	19.0	25.0	32.1	12,400
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	6.8	705	9.5	13.2	17.2	23.5	11,300
PORTABLE LIGHT (CONTINUOUS-24 HR/DAY)	9.1	527	13.6	18.0	23.8	31.9	11,700

538377

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **926**

Name: **926 GENERAL PURPOSE CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 926

Nominal Voltage: 12 volts

Approximate Weight: 2 Lb 11 Oz (1.22 Kg)

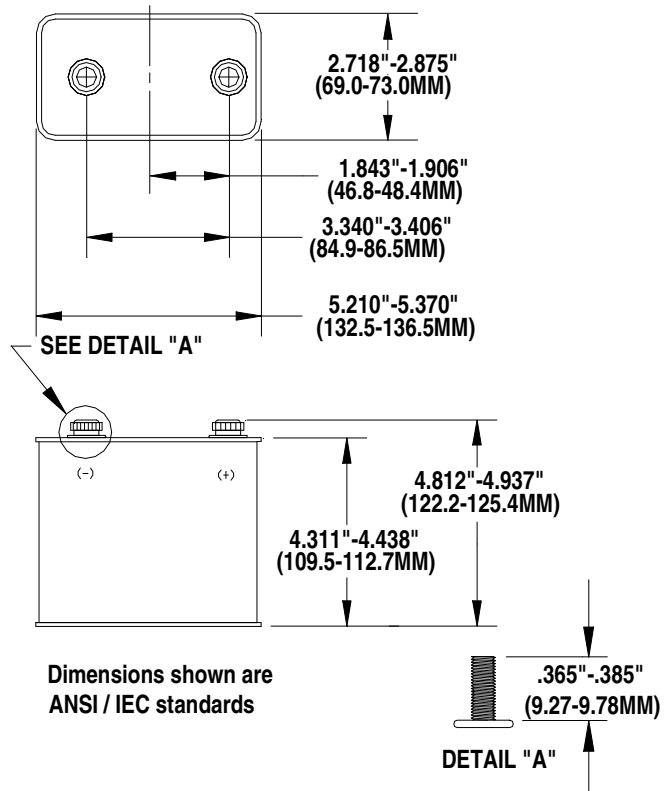
Approximate Volume: 74 CU IN (1213 CU CM)

Operating Temp. Range: -30° C to 55° C
(-20° F to 130° F)

Terminals: Screw

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



**TYPICAL INITIAL SERVICE AT 70°F (HOURS)
CUTOFF VOLTAGE**

APPLICATION <u>DUTY CYCLE</u>	LOAD <u>(OHMS)</u>	CURRENT <u>(MA AT 9.6V)</u>	<u>CUTOFF VOLTAGE</u>					<u>MAh CAPACITY To 5.2V</u>
			<u>8.8V</u>	<u>8.0V</u>	<u>7.2V</u>	<u>6.0V</u>	<u>5.2V</u>	
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	18	533	6.2	9.3	11.7	15.3	17.7	7,900
PORTABLE LIGHT (CONTINUOUS-24 HR/DAY)	18	533	5.4	7.9	10.4	14.3	16.5	7,200

538376

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **941**

Name: **941 GENERAL PURPOSE CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 908, IEC – 4R25X

Nominal Voltage: 6 volts

Approximate Weight: 1 Lb 4 Oz (.57 Kg)

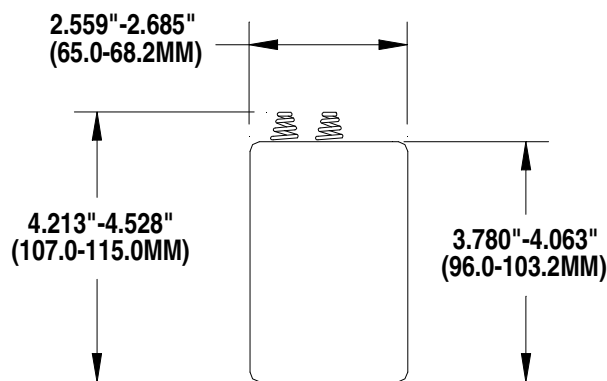
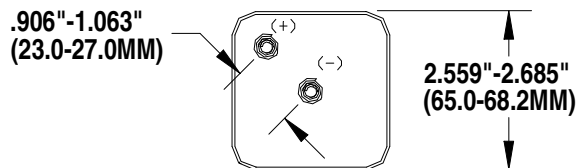
Approximate Volume: 32 CU IN (524.4 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Spring

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



Dimensions shown are
ANSI / IEC standards

TYPICAL INITIALSERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA @ 4.8V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Portable Light	9.1 Ω	30 min/hr, 8 hr/day	527	3.6	9.13	hours	4323
Portable Light	33 Ω	30 min/hr, 8 hr/day	145	3.6	50.9	hours	7075
Steady Burn Barricade	110 Ω	12 hr/day	44	3.6	195.3	hours	8400
Release	9.1 Ω	24 hr/day	527	3.6	7.9	hours	3724

540706, 540831

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **944**

Name: **944 HEAVY DUTY CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 908D, IEC – 4R25X

Nominal Voltage: 6 volts

Approximate Weight: 1 Lb 5 Oz (.58 Kg)

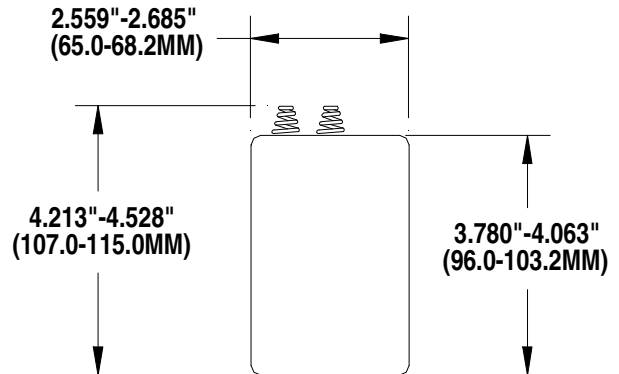
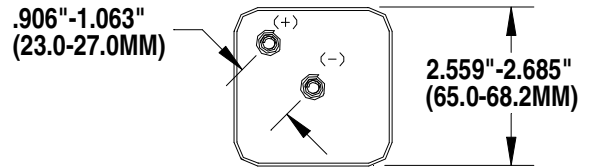
Approximate Volume: 32 CU IN (524.4 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Spring

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



Dimensions shown are ANSI / IEC standards

TYPICAL INITIALSERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA @ 4.8V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Portable Light	9.1 Ω	30 min/hr, 8 hr/day	527	3.6	11.7	hours	5660
Portable Light	33 Ω	30 min/hr, 8 hr/day	145	3.6	50.4	hours	7336
Steady Burn Barricade	110 Ω	12 hr/day	44	3.6	193	hours	8601
Release	9.1 Ω	24 hr/day	527	3.6	10.1	hours	4828

540707, 540832

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **945**

Name: **945 HEAVY DUTY CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 915D, IEC 4R25Y

Nominal Voltage: 6 volts

Approximate Weight: 1 Lb 5 Oz (.59 Kg)

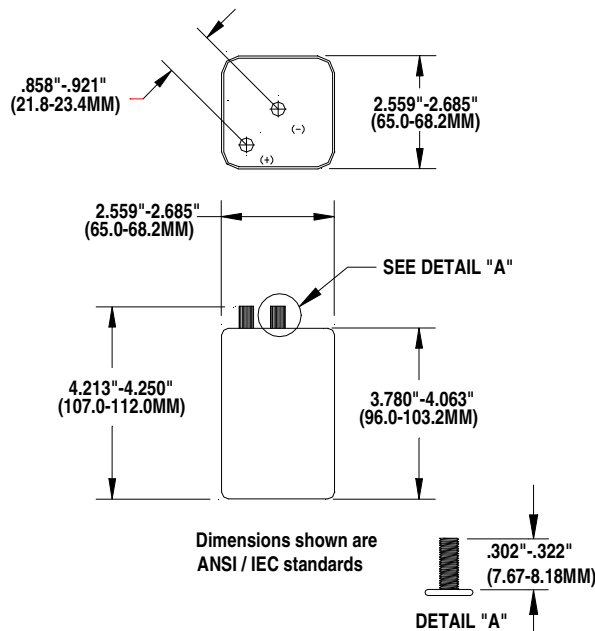
Approximate Volume: 29 CU IN (475 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Screw

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements For Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



**TYPICAL INITIAL SERVICE AT 70°F (HOURS)
CUTOFF VOLTAGE**

APPLICATION DUTY CYCLE	LOAD (OHMS)	CURRENT (MA at 4.8V)	CUTOFF VOLTAGE					AMP HOURS To 3.6V
			4.4V	4.0V	3.6V	3.0V	2.6V	
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	9.1	527	6.3	9.5	12.7	16.2	17.9	6.1
PORTABLE LIGHT (30 MIN/HR-8 HR/DAY)	33	145	42.8	52.2	60.6	-	-	8.7
STEADY BURN BARRICADE (12 HR/DAY)	110	44	172	201	216	233	-	9.7
PORTABLE LIGHT (30 MIN/DAY)	6.8	706	3.3	5.9	8.3	11.0	12.9	5.2
PORTABLE LIGHT (CONTINUOUS-24 HR/DAY)	9.1	527	6.0	8.5	10.9	14.7	16.8	5.3

538387

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **6V-GP**

Name: **6V-GP INDUSTRIAL CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 908C, IEC – 4R25X

Nominal Voltage: 6 volts

Approximate Weight: 1 Lb 4 Oz (.57 Kg)

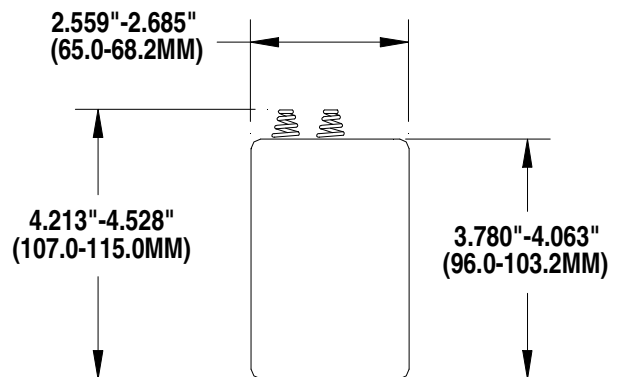
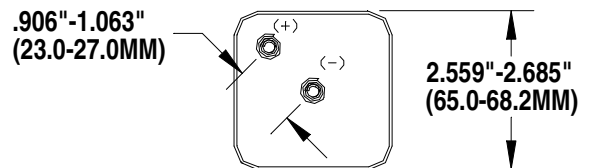
Approximate Volume: 32 CU IN (524.4 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Spring

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



Dimensions shown are ANSI / IEC standards

TYPICAL INITIALSERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA @ 4.8V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Portable Light	9.1 Ω	30 min/hr, 8 hr/day	527	3.6	9.13	hours	4323
Portable Light	33 Ω	30 min/hr, 8 hr/day	145	3.6	50.9	hours	7075
Steady Burn Barricade	110 Ω	12 hr/day	44	3.6	195.3	hours	8400
Release	9.1 Ω	24 hr/day	527	3.6	7.9	hours	3724

540706, 540831

This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: **6V-HD**

Name: **6V-HD HEAVY DUTY INDUSTRIAL CARBON ZINC**

ENGINEERING DATA:

Cell Chemistry: Carbon Zinc

Designation: ANSI/NEDA – 908CD, IEC – 4R25X

Nominal Voltage: 6 volts

Approximate Weight: 1 Lb 5 Oz (.58 Kg)

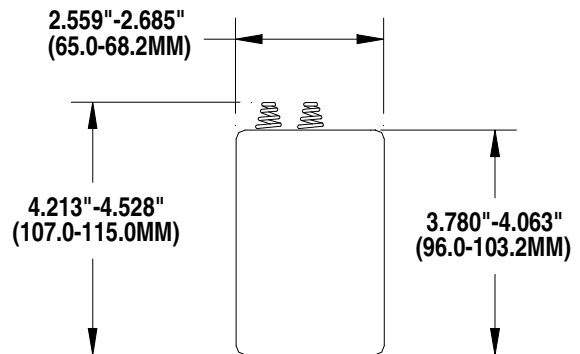
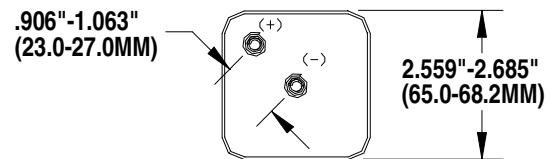
Approximate Volume: 32 CU IN (524.4 CU CM)

Operating Temp. Range: -30° C to 55° C (-20° F to 130° F)

Terminals: Spring

Shell: Plastic

Environmental: Meets Environmental Protection Agency (EPA) Requirements for Landfill Disposal.
No Mercury Added Formulation
[Rayovac Material Safety Data Sheets](#)



Dimensions shown are ANSI / IEC standards

TYPICAL INITIALSERVICE AT 70°F (HOURS)

Application	Discharge Load	Duty Cycle	Midpoint Current (mA @ 4.8V)	Cut-off Voltage	Service	Units	Discharge Capacity @ Cut-off Voltage (mAh)
Portable Light	9.1 Ω	30 min/hr, 8 hr/day	527	3.6	11.7	hours	5660
Portable Light	33 Ω	30 min/hr, 8 hr/day	145	3.6	50.4	hours	7336
Steady Burn Barricade	110 Ω	12 hr/day	44	3.6	193	hours	8601
Release	9.1 Ω	24 hr/day	527	3.6	10.1	hours	4828

540706, 540831

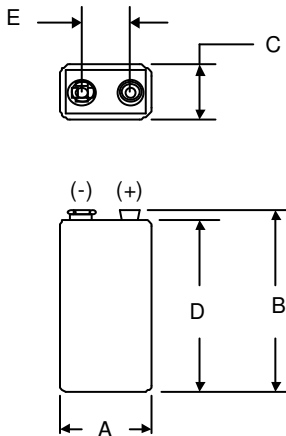
This data is subject to change. Performance information is typical. Contents herein do not constitute a warranty.



Rayovac Stock Number: U9VL-J

Name: 9V Lithium Battery

Dimensions:

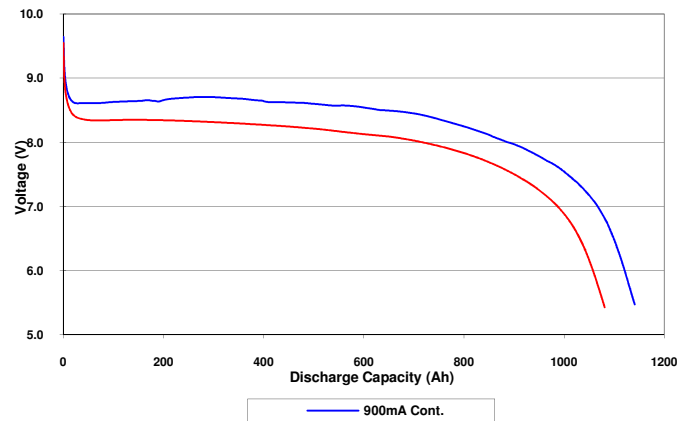


A	24.5 – 26.5 mm (0.965" - 0.1.043")
B	46.5 – 49.0 mm (1.831 – 1.909")
C	1.5.5 – 17.5 mm (0.610 – 0.689")
D	46.4 mm MAX (1.827")
E	12.45 – 12.95 mm (0.490 – 0.510")

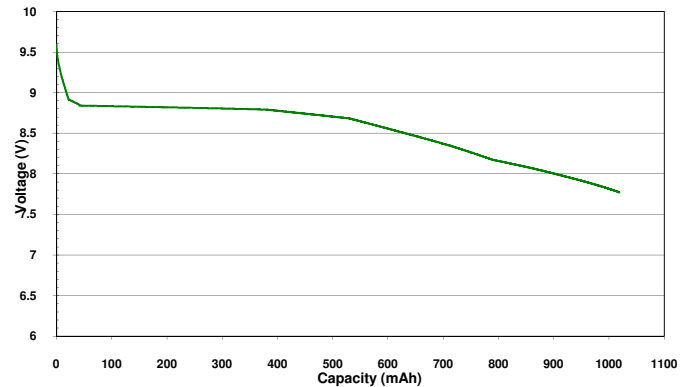


Discharge Capacity Profile

Continuous Testing



Smoke Alarm Test



Cell Type: Lithium Manganese Dioxide		Size: 9V
Size Designation	ANSI C18.3	1604LC
Rated Capacity	9mA to 5.4 V	1200mAh
Physical Attributes	Weight	37.5 g
	Size	17.3 (W) x 26.3 (L) x 44.8 (H) mm
	Volume	20.37 cc
External Insulating Cell Jacket		Mylar
Nominal Voltage for 40mA (0.2I_A) load		9.0 V
Energy Content	Energy Density	530 Wh/l
	Specific Energy	288 Wh/kg
Discharge Temperature Range		-20° to 60°C
Storage Temperature Range	<3-20 Months	-40° to 60°C
Meets EPA requirements for landfill, no mercury added formulation		
Smoke Detector - Life Tests		
Type	Typical Use	
Ionization	~10 Years*	
Photoelectric	~7 Years*	
*Dependant on pulse duration and background discharge current		

Photo:



Charger Specifications

Cell Chemistry: Rechargeable NiMH & NiCd
Cell Size and Quantity: 2 AAA/AA
Approximate Dimensions: 98L x 34.5W x 21H (mm)
Housing: Black ABS V-0
Approximate Weight: 30 g
Ave. Main Charge Current: AA: 200mA (±10%)
(Pulsating DC) AAA: 90mA (±10%)
Operating Temp. Range: 10°C to 40°C
Input: 5 VDC, 500mA, 2.5 Watts

Charge Times:

Size	Battery Capacity	Charging Times
AA	1400mAh	9 Hours
	1900mAh	11.5 Hours
	2100mAh	12.5 Hours
	2500mAh	14.5 Hours
	2700mAh	15.5 Hours
	2800mAh	16 Hours
AAA	800mAH	9 Hours
	900mAh	10 Hours
	1000mAh	11 Hours
	1100mAh	12 Hours

LED Functions: Two Green LED's indicate charging status

LED Status: **ON:** Charge cycle in progress
OFF: Contact problem at power source (USB port) or with battery alignment (contact)

Notes:

* It is to be noted that the power to the USB port of a computer is not energized when the computer is in the OFF mode.

Photo:



Charger Specifications

Cell Chemistry: Rechargeable NiMH and NiCd
Cell Size and Quantity: 2 to 4 AAA/AA
Approximate Dimensions: 111L x 68W x 47H (mm)
Housing: PS13-4BE: Black, PS131E: Gray
Approximate Weight: 140 g
Ave. Main Charge Current: (Pulsating DC) AA: 160mA (±20%)
 AAA: 70mA (±20%)
Operating Temp. Range: 0°C to 40°C
Input: 120VAC, 60Hz Swinging Retractable Blade

Charge Times:

Size	Battery Capacity	Charging Times
AAA	800mAh	13 Hours
AAA	1000mAh	16 Hours
AA	1400mAh	10 Hours
AA	1900mAh	13 Hours
AA	2100mAh	14.5 Hours

LED Functions:

Two Red LED's indicate charging status

LED Status:

ON: Charge cycle in progress
OFF: No cell inserted, or no AC power present

Cell Alignment:



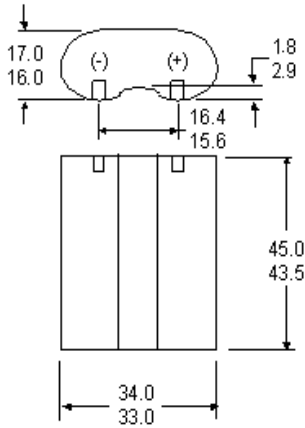
Fig. 1



Fig. 2

Dimensions:

(ANSI / IEC Standards)



DIMENSIONS	
Millimeters	Inches
1.8	0.071
2.9	0.114
15.6	0.614
16.0	0.630
16.4	0.646
17.0	0.669
33.0	1.300
34.0	1.339
43.5	1.713
45.0	1.772

Engineering Data:

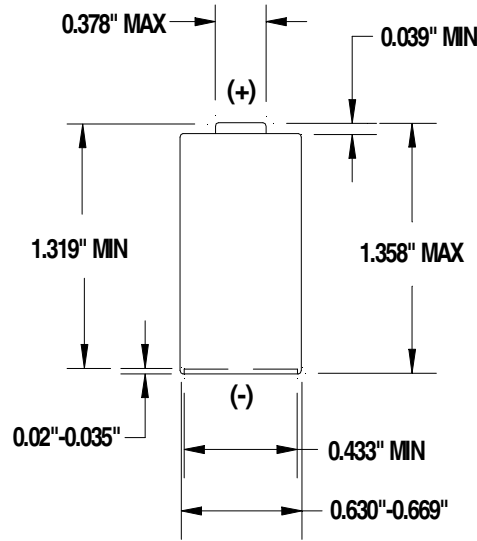
Cell Chemistry:	Lithium/Manganese Dioxide (CR)
Designation:	ANSI/NEDA-5032LC
Nominal Voltage:	6.0 V
Maximum off-load voltage:	7.4 V
Approximate Weight:	38 g.
Approximate Volume:	21.7 CU CM
Nominal Capacity:	1400mAh (200 Ohm Cont. to 4.0V @ 20°C)
Operating Temp. Range:	-20°C to 60°C
Storage Temperature Range:	-20°C to 45°C
Terminals:	Cap and Recessed base
Shell:	Plastic

Typical Service (@ 20°C):

Application:	Load	Load Unit	Duty Cycle	Daily Cycle	EPV	ANSI Min. Ave. Duration	Actual
Rating:	200	Ohms		24 h	4.0	40 Hours	55 Hours
Photo (1):	1800	mA	3s ON/7s OFF	24 h	3.6	675 Pulses	826 Pulses
Photo (2):	1200	mA	3s ON/7s OFF	24 h	3.6	1050 Pulses	1134 Pulses

Dimensions:

(ANSI / IEC Standards)



DIMENSIONS	
MM	INCHES
0.5	0.020
0.9	0.035
1.0	0.039
9.6	0.378
11.0	0.433
16.0	0.630
17.0	0.669
33.5	1.319
34.5	1.358

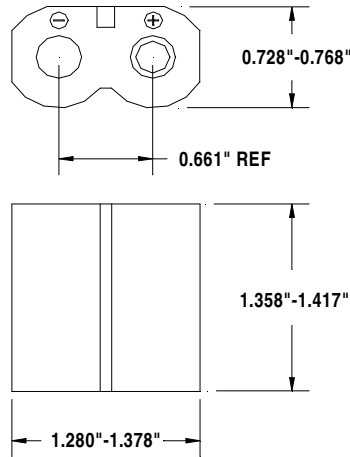
Engineering Data:

Cell Chemistry:	Lithium/Manganese Dioxide (CR)
Designation:	ANSI/NEDA-5018LC, IEC-CR17345
Nominal Voltage:	3.0 V
Maximum off-load voltage:	3.7 V
Approximate Weight:	16 g.
Approximate Volume:	7.18 CU CM
Nominal Capacity:	1400mAh (100 Ohm Cont. to 2.0V @ 20°C)
Operating Temp. Range:	-20°C to 60°C
Storage Temperature Range:	-20°C to 45°C
Terminals:	Cap and Recessed Base
Shell:	Plastic

Typical Service (@ 20°C):

Application:	Load	Load Unit	Duty Cycle	Daily Cycle	EPV	ANSI Min. Ave. Duration	Actual
Rating:	100	Ohms		24 h	2.0	45 Hours	56.0 Hours
Photo (1)	1800	mA	3s ON/7s OFF	24 h	1.8	525 Pulses	854 Pulses
Photo (2)	1200	mA	3s ON/7s OFF	24 h	1.8	950 Pulses	1346 Pulses

Dimensions:
(ANSI / IEC Standards)



DIMENSIONS	
MM	INCHES
16.8	0.661
18.5	0.728
19.5	0.768
32.5	1.280
34.5	1.358
35.0	1.378
36.0	1.417

Engineering Data:

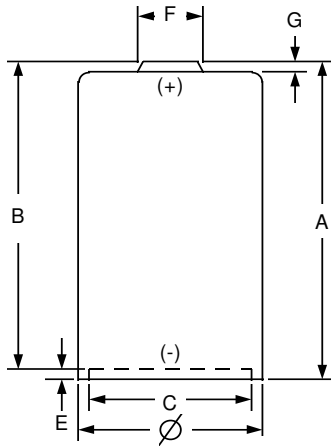
Cell Chemistry:	Lithium/Manganese Dioxide (CR)
Designation:	ANSI/NEDA-5024LC, IEC-CR-P2
Nominal Voltage:	6.0 V
Maximum off-load voltage:	7.4 V
Approximate Weight:	38 g.
Approximate Volume:	20.1 CU CM
Nominal Capacity:	1400mAh (200 Ohm Cont. to 4.0V @ 20°C)
Operating Temp. Range:	-20°C to 60°C
Storage Temperature Range:	-20°C to 45°C
Terminals:	Cap and Recessed Base
Shell:	Plastic

Typical Service (@ 20°C):

Application:	Load	Load Unit	Duty Cycle	Daily Cycle	EPV	ANSI Min. Ave. Duration	Actual
Rating:	200	Ohms		24 h	4.0	40 Hours	46 Hours
Photo (1)	1800	mA	3s ON/7s OFF	24 h	3.6	650 Pulses	876 Pulses
Photo (2)	1200	mA	3s ON/7s OFF	24 h	3.6	1050 Pulses	1193 Pulses

Dimensions:

(ANSI / IEC Standards)



Dimension	Millimeters	Inches
A (Max)	27	1.063
B (Min)	25.8	1.015
C (Min)	8.5	0.335
E (Max)	0.5	0.02
E (Min)	0.05	0.002
F (Max)	6.5	0.256
G (Min)	0.7	0.027
∅ (Max)	15.6	0.614
∅ (Min)	15.1	0.594

Engineering Data:

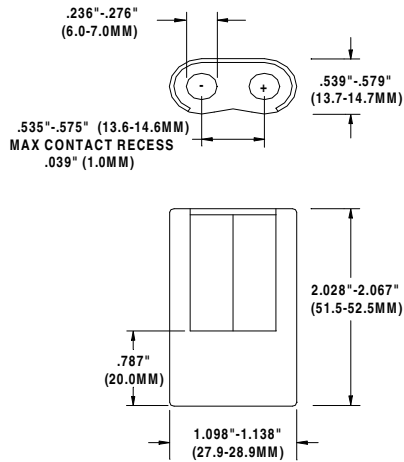
Cell Chemistry:	Lithium/Manganese Dioxide
Designation:	ANSI/NEDA-5046LC, IEC-CR2
Nominal Voltage:	3.0 V
Maximum off-load voltage:	3.7 V
Approximate Weight:	11 g.
Approximate Volume:	5.16 CU CM
Nominal Capacity:	1400mAh (200 Ohm Cont. to 2.0V @ 20°C)
Operating Temp. Range:	-20°C to 85°C
Storage Temperature Range:	-20°C to 45°C

Typical Service (@ 20°C):

Application:	Load	Load Unit	Duty Cycle	Daily Cycle	EPV	ANSI Min. Ave. Duration	Actual
Rating:	100	Ohms		24 h	2.0	25 Hours	32 Hours
Photoflash (1)	1200	mA	3s ON/7s OFF	24 h	1.8	525 Pulses	776 Pulses
Photoflash (2)	900	mA	3s ON/7s OFF	24 h	1.8	900 Pulses	1105 Pulses

Dimensions:

(ANSI / IEC Standards)



DIMENSIONS	
MM	INCHES
6.0	0.236
7.0	0.276
13.7	0.539
14.7	0.579
13.6	0.535
14.6	0.575
20	0.787
27.9	1.098
28.9	1.138
51.5	2.028
52.5	2.067

Engineering Data:

Cell Chemistry:	Lithium/Manganese Dioxide (CR)
Designation:	ANSI/NEDA-5047LC
Nominal Voltage:	3.0 V
Maximum off-load voltage:	3.7 V
Approximate Weight:	39 g.
Approximate Volume:	22.3 CU CM
Nominal Capacity:	3700mAh (200 Ohm Cont. to 2.0V @ 20°C)
Operating Temp. Range:	-20°C to 60°C
Storage Temperature Range:	-20°C to 45°C
Terminals:	Flat Contact
Shell:	Plastic

Typical Service (@ 20°C):

Application:	Load	Load Unit	Duty Cycle	Daily Cycle	EPV	ANSI Min. Ave. Duration	Actual
Rating:	100	Ohms		24 h	2.0	100 Hours	128 Hours
Photo	3000/1300	mW	2s/28s:5min55min	24 h	2.1	400 Pulses	726 Pulses

Photo:



Charger Specifications

Cell Chemistry:	Rechargeable NiMH and NiCd
Cell Size and Quantity:	2 to 4 AAA/AA/C/D and/or 1 9V
Approximate Dimensions:	166L x 95W x 56H (mm)
Housing:	ABS Black
Approximate Weight:	249 ±3 g
Ave. Main Charge Current: (Pulsating DC)	AA/C/D: 380mA (±20%) AAA: 150mA (±20%) 9 Volt: 34mA (±20%)
Operating Temp. Range:	10°C to 40°C
Input:	12VDC 600mA
Charge Termination:	Back-up Timer: 8 Hrs. ±40Min.

Adaptor Specifications

Classification:	Class 2 Power Switching
Voltage:	Converts 100-240 VAC to 12 VDC
Power Supply:	SMPS (Switch Mode Power Supply)
Housing:	PC - Black
Fuse:	3N T1A 250V
Weight:	76 ±5 g
Input Operating V:	100-240±10% VAC 50/60 Hz
Output Power:	12VDC X .6A = 7.2 Watt
Output Current:	.6A ±5%
No Load Output V	12.6 VDC ±5%

Charge Times:

Size	Battery Capacity	Charging Times
AA	1400-2000mAh	4-6 Hours
AA	2000-2700mAh	6-8 Hours
C/D	3000mAh	8 Hours
AAA	650-1000mAh	5-6 Hours
9V	200mAh	7 Hours
ROV-AA	LD715	4 Hours
ROV-AA	PL715	6 Hours
ROV-AAA	LD724	5 Hours
ROV-AAA	PL724	6 Hours

LED Functions:

Three Green LED's indicate charging status of each cell or pair of cells

LED Status:

- ON:** Charge cycle in progress
- OFF:** Charge complete (Termination Timer - 8 Hours met)

Cell Alignment:

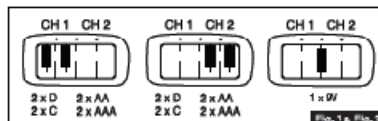


Photo:



Charger Specifications:

Cell Chemistry: Rechargeable NiMH and NiCd
Cell Size and Quantity: 2 to 4 AAA/AA
Approximate Dimensions: 105L x 65W x 29H (mm)
Housing: Upper: Silver Lower: Gray
Approximate Weight: 90 g
Ave. Main Charge Current: AA: 450mA (±20%)
(Pulsating DC) AAA: 200mA (±20%)
Operating Temp. Range: 0°C to 40°C
Input: 100-240VAC, 50-60Hz, 6W
Charge Termination: Back-up Timer: 6.5 Hrs.
Maximum Voltage: 1.73V/Cell

Charge Times:

Size	Battery Capacity	Charging Times
LD715-4OP	1400mAh	3.5 Hours
PL715-4	2100mAh	5 Hours
LD724-4OP	650mAh	3.5 Hours
PL724-4	800mAh	4.5 Hours

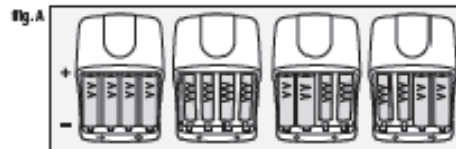
LED Functions:

Two Red LED's indicate charging status of each pair of cells

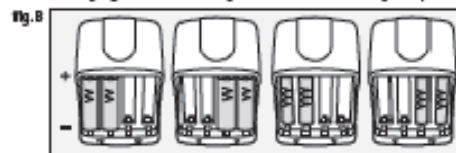
LED Status:

- ON:** Charge cycle in progress
- OFF:** Charge complete or no battery
- Flashing:** Wrong or defective cell

Cell Alignment:



Charging 4 Batteries/Cargor 4 Pilas/Como cargar 4 pilas



Charging 2 Batteries/Cargor 2 Pilas/Como cargar 2 pilas

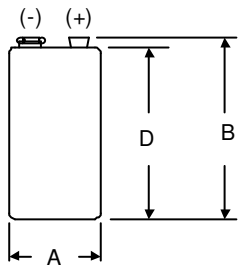
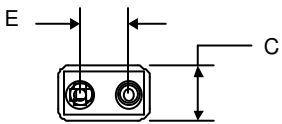


Rayovac Stock Number: PL1604

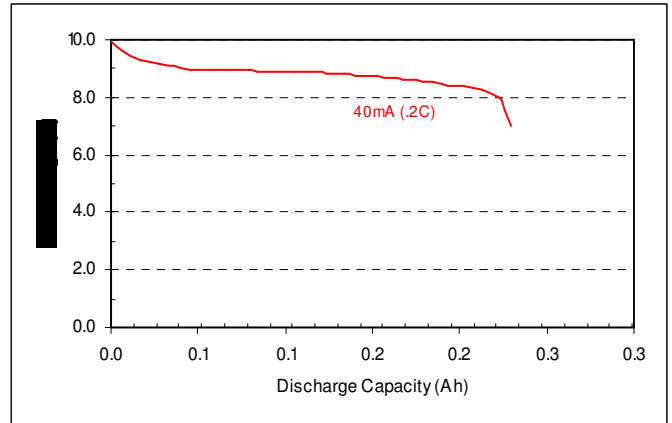
Name: PL1604 9V Platinum NiMH, R2U Grade (200mAh)

Dimensions:

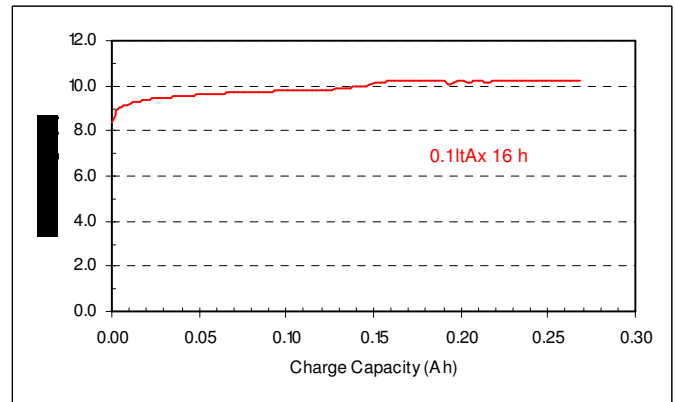
A	24.5 – 26.5 mm (0.965" - 0.1.043")
B	46.5 - 48.5 mm (1.831 – 1.909")
C	15.5 – 17.5 mm (0.610 – 0.689")
D	46.4 mm MAX (1.827")
E	12.45 – 12.95 mm (0.490 – 0.510")



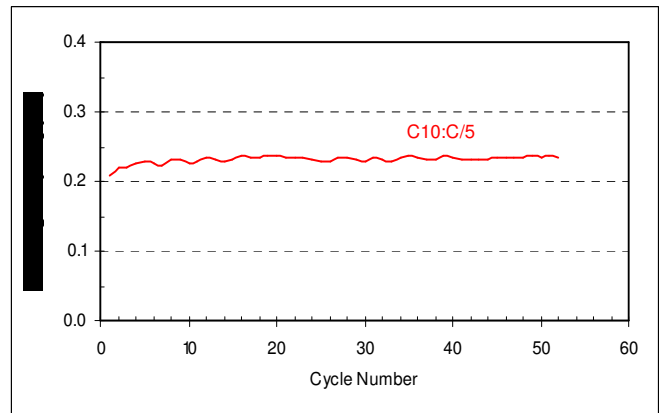
Discharge Curve Profiles:



Charge Capacity Profile:



Discharge Capacity Profile (Crg:Dis):



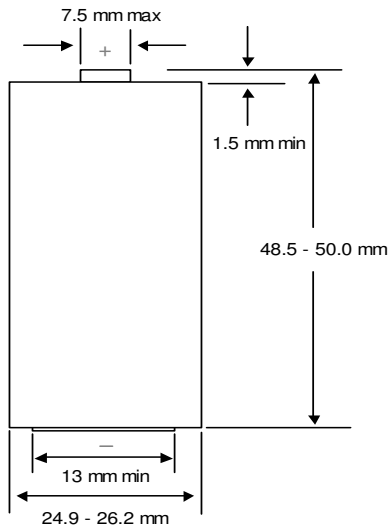
Cell Type: Nickel Metal Hydride		Size: 9V-PL1604
Size Designation	ANSI C18.2	8.4H5
	IEC 61951-2	
Physical Attributes	Weight	40.2 g
	Size	15.8 (W) x 26.2 (L) x 45.4 (H) mm
	Volume	18.68 cc
External Insulating Cell Jacket		Polyvinylchloride (PVC)
Nominal Voltage for 40mA (0.2ItA) load		8.4 V
Energy Content	Energy Density	96 Wh/l
	Specific Energy	45 Wh/kg
Charge Temperature Range	Standard	0° to 45°C
	Rapid	0° to 45°C
	Maintenance	0° to 45°C
Discharge Temperature Range		-10° to 45°C
Storage Temperature Range	<3 Months	-20° to 50°C
	3-9 Months	-20° to 40°C
	3-12 Months	-20° to 30°C
Cycle Life Expectancy		More than 200 Cycles
Meets EPA requirements for landfill, no mercury added formulation		



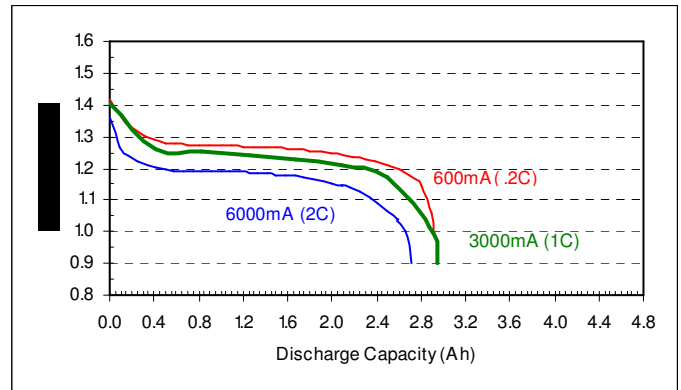
Rayovac Stock Number: PL714

Name: PL714 C Platinum NiMH, R2U Grade (3000)

Dimensions:



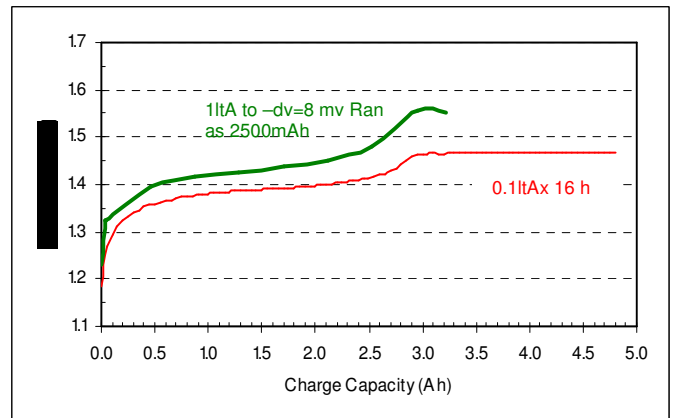
Discharge Curve Profiles:



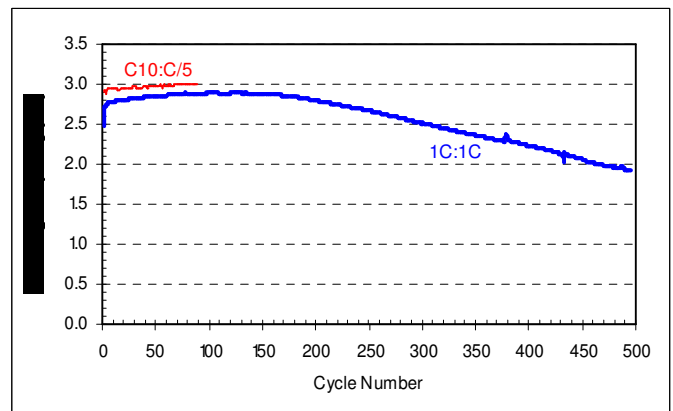
Specifications:

Cell Type: Nickel Metal Hydride		Size: C - PL714
Size Designation	ANSI C18.2	1.2H3
	IEC 61951-2	HR 14
Physical Attributes	Weight	62 g
	Size	7.5 (D) x 50 (H) mm
	Volume	24.53 cc
External Insulating Cell Jacket		Polyvinylchloride (PVC)
Nominal Voltage for 600mA (0.2I _A) load		1.24 V
Energy Content	Energy Density	147 Wh/l
	Specific Energy	59 Wh/kg
Charge Temperature Range	Standard	0° to 45°C
	Rapid	0° to 45°C
	Maintenance	0° to 45°C
Discharge Temperature Range		-10° to 60°C
Storage Temperature Range	<3 Months	-20° to 50°C
	3-9 Months	-20° to 40°C
	3-12 Months	-20° to 30°C
Cycle Life Expectancy		More than 200 Cycles
Meets EPA requirements for landfill, no mercury added formulation		

Charge Curve Profiles:



Discharge Capacity Profile (Crg:Dis)

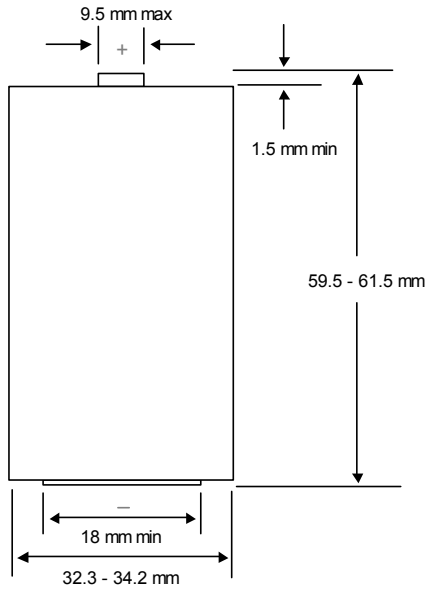




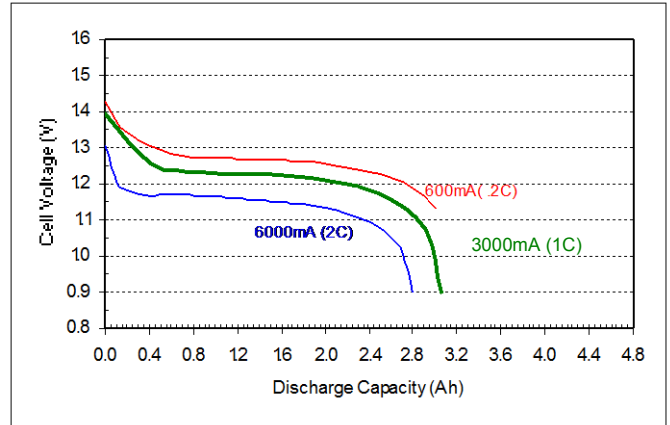
Rayovac Stock Number: PL713

Name: PL713 D Platinum NiMH, R2U Grade (3000)

Dimensions:



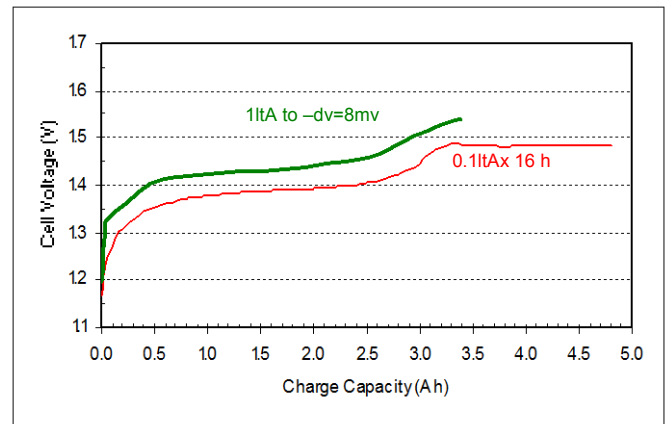
Discharge Curve Profiles:



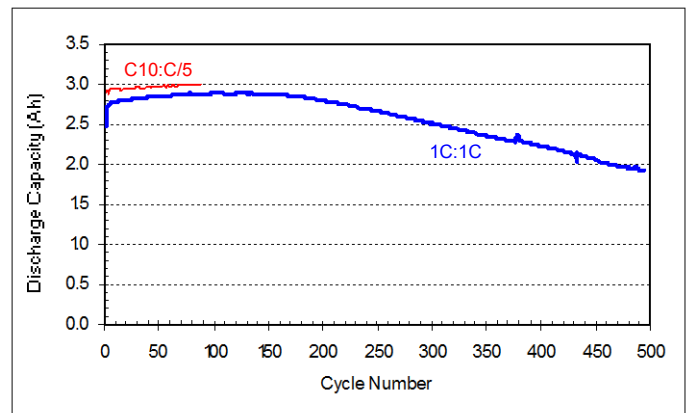
Specifications:

Cell Type: Nickel Metal Hydride		Size: D - PL713
Size Designation	ANSI C18.2	1.2H4
	IEC 61951-2	HR20
Physical Attributes	Weight	73 g
	Size	32.3 (D) x 60.7 (H) mm
	Volume	50.47 cc
Discharge Capacity	Typical	3000 mAh
	Minimum	2790 mAh
External Insulating Cell Jacket		Polyvinylchloride (PVC)
Nominal Voltage for 400mA (0.2I _r) load		1.24 V
Energy Content	Energy Density	71 Wh/l
	Specific Energy	50 Wh/kg
Charge Temperature Range	Standard	0° to 45°C
	Rapid	0° to 45°C
	Maintenance	0° to 45°C
Discharge Temperature Range		-10° to 60°C
Storage Temperature Range	<3 Months	-20° to 50°C
	3-9 Months	-20° to 40°C
	3-12 Months	-20° to 30°C
Cycle Life Expectancy		More than 200 Cycles
Meets EPA requirements for landfill, no mercury added formulation		

Charge Curve Profiles:



Discharge Capacity Profile (Crg:Dis)





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Policy

It is the policy of Rayovac to establish and publish performance standards on all products we ship to customers. It is the responsibility of each manufacturing location to establish documented programs that assure compliance to these standards are achieved and maintained.

Scope

This specification defines the performance requirements for the AA nickel-metal hydride ready to use rechargeable battery providing a rated capacity of 1350 mAh.

Purpose

To specify performance requirements to insure that nickel-metal hydride batteries procured under this specification meet or exceed Rayovac's marketability claims and our customers' expectations.

Reference Documents

<u>Number</u>	<u>Title</u>
ANSI C18.2M, Part 1	Portable Rechargeable Cells and Batteries – General and Specifications
UL 2054, August 2008	Standard for Safety for Household and Commercial Batteries
CEI / IEC 61951-2: 2003	International Standard Secondary Cells and Batteries – Nickel Metal Hydride
JIS C 8708: 2004	Sealed Nickel-Metal Hydride Rechargeable Single Cells
S1000231	Date Coding (HUM)
S1002120	Manufacturer Code
S4000977	Quality Requirements For Duplex PVC/PET Labels
MSDS	Material Safety Data Sheet
	Test Methods for Evaluation of Solid Wastes, SW 846 3 rd Edition

1 Ratings

1.1 Ratings After Charge

1.1.1	Nominal Operating Voltage	1.2 volt (discharged at 0.2I _t A to 1.0 V at 20 ± 5°C)
1.1.2	Nominal (C ₅) Capacity	1350 mAh
1.1.3	Minimum Individual (C ₅) Capacity	1256 mAh
1.1.4	Constant Current Charge Methods	Standard: at 0.1I _t A for 16 hrs, (1.2) Rapid: at 1I _t A to -dv = 3 - 8 mv, (1.3)
1.1.5	Max. Continuous Discharge Current	2I _t A at 21 ± 2°C
1.1.6	Temperature Range of Operation	Charge: 0°C to 45°C at a max RH of 85% Discharge: -10°C to 45°C at a max RH of 85%
1.1.7	Nominal Weight	24 g

1.2 Standard charge

Standard charge is defined as charging at a constant current of 0.1I_tA for a 16 hour period followed by a 60-minute rest period. The environmental conditions during charge and rest include a temperature range of 20 ± 5°C and a relative humidity range of 50 ± 15%. The I_tA nomenclature used in the document is based on IEC guidelines. The reference I_tA value is defined as I_tA = C_nAh / 1h where:

I_t is the reference test current in amperes

C_n is the rated capacity in ampere-hours

n is the time, based in hours, for which the rated capacity is based, which is 5.

1.3 Rapid Charge

Rapid charge is defined as charging at a constant current of 1I_tA to a -dv = 3 - 8 mv cutoff followed by a 30-minute rest period. The environmental conditions for charge and rest are listed in section 1.2.

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1.4 Shipping Condition

- 1.4.1 All batteries shall be shipped (except Latin America) at a state of charge of 75-90% from the factory
- 1.4.2 All batteries shipped to Latin America are to be shipped at a state of charge of 55-65% from the factory
- 1.4.3 All batteries shall contain a top external insulator and a full protective label that covers both the insulator and sides of the battery prior to shipment.
- 1.4.4 All batteries shall be shipped by a method that prevents the battery terminals from shorting against each other, against the shipping container and against other materials that they may reasonably encounter during shipment.
- 1.4.5 All packaged batteries shall be shipped in a refrigerated container where the temperature inside the container is 20 - 23°C and does not exceed 27°C.

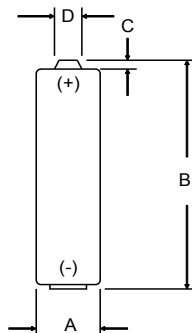
2 Physical Requirements

2.1 Dimensions

The battery shall meet the dimensions in Figure 1.

Figure 1: Dimensions

A	13.5 – 14.5 mm DIA (0.531" - 0.571")
B	49.5 – 50.5 mm (1.949 – 1.988")
C	1.0 mm (0.039") MIN
D	5.5 mm (0.217") MAX DIA



2.2 Date Coding

Identify manufacture date of battery using Rayovac date coding per Specification S1000231. Preferred location of date code is on jacket of battery although negative terminal is also acceptable. Date code must be printed clearly and legibly on each battery. Other methods of age traceable coding may be acceptable but must be pre-approved by Rayovac Corporate Quality.

2.3 Manufacturer Coding

Identify the manufacturer of the battery using the Rayovac manufacturer coding method per Rayovac Specification S1002120. The preferred location of the manufacturer code is adjacent to the date code on the jacket of the battery although negative terminal is also acceptable. Manufacturer code must be permanent, clear and legible on each battery. Other methods of manufacturer code may be acceptable but must be pre-approved by Rayovac Corporate Quality.



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2.4 Visual Inspection

Visual inspection shall be performed to insure that defects are not shipped. Examples of defects include but are not limited to:

- Surface scratches, wrinkles, holes or improper wrap of label
- Smudged or non-registered printing on labels
- Wrong hues (colors) or distorted artwork on label graphics
- Illegible, or missing date code
- Missing external top insulator
- Misshapen cans
- Broken, bent or loose terminals
- External leakage

3 Electrical Requirements

The cells used to determine electrical and battery service life requirements. Charge each cell at 0.1I_rA for 16 hours, (section 1.2). Unless otherwise specified, all testing is conducted at a standard temperature of 20 ± 5°C and a standard relative humidity of 50 ± 15%. The measurements are to be taken within 48 hours of the completion of the charge step.

3.1 Open Circuit Voltage (OCV)

Charge at 0.1I_rA for 16 hours, (section 1.2), then measure with a voltmeter having a minimum internal resistance of 1MΩ/volt.

Lot Criteria Minimum Average of 1.365 V
Individual Criteria Average ± 25 mV

3.2 AC Internal Impedance

Charge at 0.1I_rA for 16 hours, (section 1.2), then measure impedance using the 1KHz AC method.

Lot Criteria Maximum Average of 40 mΩ
Individual Criteria Average ± 5 mΩ

3.3 Closed Circuit Voltage (CCV)

Apply standard charge, (section 1.2), then measure the CCV after 500 milli-seconds on a load of 3.9 Ω.

Lot Criteria Minimum Average of 1.34 V
Individual Criteria Average ± 25 mV

4 Battery Service Life

Perform all testing at 20 ± 5°C unless otherwise specified

4.1 Capacity Testing

4.1.1 Rated (C₅) Capacity

Charge at 0.1I_rA for 16 hours, (section 1.2), then discharge at 0.2I_rA to a 1.0 end point voltage.

Average Capacity (cycles 3-5): 1350 mAh
Minimum individual capacity (93% of Average Capacity): 1256 mAh

4.1.2 Constant Current (1C/1C) Capacity

Charge at 1I_rA to a -dv = 3 - 8 mv cutoff, (section 1.3) then discharge at 1I_rA to a 0.9 end point voltage.

Average Capacity (cycles 3-5): 1256 mAh
Minimum individual capacity (cycles 3-5): 1168 mAh



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4.1.3 Digital Camera Application Test

Charge at 0.1I_A for 16 hours, (section 1.2), store according to the durations specified below, then discharge per the following test regime:

Test Regime Step	Duration	EPV
1) Discharge 1500mW	2 Seconds	1.05V
2) Discharge 650mW	28 Seconds	1.05V
3) Run load steps 1 and 2 a total of 10 Times (5 Minutes Total)		
4) Rest	55 Minutes (each hour)	1.05V
5) Repeat steps 1-4 until EPV (1.05V) is reached		

One pulse is defined to be one complete load period (Steps 1 and 2)
Reference: ANSI 18.3 Part 1M-2005, Spec. Sheet 15LF

Storage Conditions and Capacity Requirements:

Storage Time:	Temp.	Minimum Average	Minimum Individual
No Delay	20°C	270 Pulses	251 Pulses

4.2 Cycle Life Testing: 20°C

Discharge unit initially to establish State of Charge as received. Continue testing following charge, discharge and rest steps as executed, at 20 ± 5°C.

4.2.1 Rated (C₅) Capacity Cycle Life

Discharge: 0.2I_A to a 1.0 end point voltage (Initial State of Charge) then cycle as follows:
Charge: 0.1I_A for 16 Hours, (section 1.2)
Rest: 30 minutes between *each* charge and discharge half cycle
Discharge: 0.2I_A to a 1.0 end point voltage

Minimum average capacity as received:	75% of initial average capacity
Minimum average capacity at cycle 50:	98% of initial average capacity
Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	75% of initial average capacity
Minimum average capacity at cycle 500:	60% of initial average capacity

4.2.2 Consumer Cycle Life

Charge: 1I_A to a -dv = 3 - 8 mv cutoff, (section 1.3)
Rest: 30 minutes between each charge and discharge half cycle
Discharge: 1I_A to a 0.90 end point voltage

Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	80% of initial average capacity
Minimum average capacity at cycle 500:	60% of initial average capacity

4.3 Maximum Charge Temperature Using Constant Current Charge Regime

The outer case temperature of the cell measured at 25°C should not exceed 45°C during constant current charge regimes listed in sections 4.1 and 4.2.

4.4 Charge Capacity Retention

Charge: 0.1I_A for 16 Hours, (section 1.2)
Store: As indicated in table
Discharge: 0.2I_A to 1.0V end point voltage to determine average

4.5 Requirements:



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Storage Temp	Storage Time	Minimum Ave. % Retained vs. Rated Capacity (1.1.2)
20°C	28 days	85%
20°C	91 days	82.5%
20°C	182 days	80%
20°C	365 days	60%
45°C	28 days	60%
45°C	14 days	80%
60°C	7 days	75%

4.6 Discharge Capacity Recovery

Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Store: As indicated in table
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Repeat for 3 cycles and report maximum retained average.

Storage Temp	Storage Time	Recovered vs Rated Capacity (1.1.2)
20°C	28 days	100%
20°C	90 days	98%
45°C	14 days	95%
60°C	7 days	95%

4.7 Standard 0.1I_rA Overcharge at 20°C ± 5°C

Confirm that the cells will withstand overcharge at the 0.1I_rA rate, (section 1.2).
 Rest: Between 1 and 4 hr
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (section 1.1.3)

4.8 Over-discharge at 20°C ± 5°C

Confirm that the cells will withstand constant current over-discharge at the 0.2I_rA rate.
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Discharge: 0.2I_rA for minimum of 10 hrs
 Rest: between 1 and 4 hr
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes before discharge
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (1.1.3)

5 Battery Leakage

All samples must be fully charged using standard charge (section 1.2) prior to leakage testing.

5.1 Thermal Cycle Storage – Leakage

Subject battery to the repeating thermal cycle described. Battery shall not show visible leakage after 4 weeks.

The thermal cycles are as follows:

-30°C ± 2°C (-20°F ± 4°F) 8 hrs ± 0.5 hr.



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71°C ± 2°C (160°F ± 4°F)	16 hrs ± 0.5 hr.
Transition Times	allow up to 1 hr.
Duration	1 cycle every 24 hr. for 4 weeks

5.2 Room Temperature Storage – Leakage

Store battery at ambient conditions. Battery shall not show visible leakage and must meet requirements of Section 2 after 6 months of storage.

Environment	21°C ± 5°C (70°F ± 9°F)
Duration	6 months

5.3 High Temperature Dry Storage – Leakage

Store battery in a high temperature environment. Battery shall not show visible leakage after 8 weeks.

Environment	71°C ± 2°C (160°F ± 4°F)
Duration	8 weeks

5.4 High Temperature/Humidity Storage – Leakage

Store battery in a high temperature/high humidity environment. Battery shall not show visible leakage after 4 weeks.

Environment	45°C ± 2°C (113°F ± 4°F) 90% ± 4.5% RH
Duration	4 weeks

6 Foreseeable Misuse

Tests described with “UL” listed are based on procedures outlined in UL 2054 Standard for Safety. All testing in section 6 requires that samples be fully charged via standard charge method, (1.2) prior to test. For tests with a “no venting” failure criteria, the cells are to be weighed before and after the testing and the following criteria shall apply:

<u>Mass of cell or battery</u>	<u>Maximum Mass % Loss</u>
Not more than 1 gram	0.5
More than 1.0g but less than 5.0g	0.2
More than 5.0g	0.1

6.1 UL Short Circuit at 20°C (UL-9)

Individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.2 UL Short Circuit at 55°C (UL-9)

After the units have reached equilibrium at 55 ± 2°C as applicable, individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.3 UL Projectile Test (UL-22)

Each test sample cell or battery is to be placed on a platform table having a 4-inch (102 mm) diameter hole in the center covered by a screen. The screen is to be constructed of steel wire mesh having 20 openings per inch (25.4 mm) and a wire diameter of 0.017 inch (0.43 mm). An eight-sided covered wire cage, 2 feet (610



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mm) across and 1 foot (305 mm) high, made from metal screening is to be placed over the test sample. See Figure 23.1 in the UL2054 procedure document. The metal screening is to be constructed from 0.010 inch (0.25 mm) diameter metal wire with 16-18 wires per inch (25.4 mm) in each direction. The sample is to be placed on the screen covering the hole in the center of the table and is to be heated with a direct flame until it explodes, or until it is destroyed.

Failure Criteria: When subjected to the test described, no part of an exploding cell or battery shall penetrate the wire screen such that some or all of the cell or battery protrudes through the screen.

6.4 UL Shock Test (UL-16)

The cell is to be secured to the testing machine by means of a rigid mount, which supports all mounting surfaces of the cell. Each cell shall be subjected to a total of three shocks of equal magnitude. The shocks are to be applied in each of three mutually perpendicular directions unless it has only two axes normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 75 g, (where g is the local acceleration due to gravity). The peak acceleration shall be between 125 and 175 g. Cells shall be tested at a temperature of $20 \pm 2^{\circ}\text{C}$

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.5 UL Vibration Test (UL-17)

A battery is subjected to simple harmonic motion with an amplitude of 0.03 inch, (0.8 mm) with a total maximum excursion of 0.06 inch, (1.6 mm). The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz and return in not less than 90 or more than 100 minutes. The battery is to be tested in three mutually perpendicular directions. For each battery that has only two axes of symmetry, the battery is to be tested perpendicular to each axis.

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.6 UL Heating Test (UL-23)

A charged cell is to be heated in a gravity convection or circulating oven. The temperature of the oven is to be raised at a rate of $5 \pm 2^{\circ}\text{C}$ per minute to a temperature of $150 \pm 2^{\circ}\text{C}$. The oven is to remain for 10 minutes at $150 \pm 2^{\circ}\text{C}$ before test is discontinued.

Failure Criteria: The samples shall not explode or catch fire.

6.7 UL Abnormal Charge(UL Sect 10)

6.6.1 The battery is to be subjected to a charging current of three times the current I_c , specified by the manufacturer by connecting it in opposition to a dc-power supply. The minimum charging time is to be the time required to reach the manufacturers specified end-of-charge condition plus 7 hours.

The test charging time is to be calculated using the formula:

$$T_c = 2.5C / 3(I_c)$$

In which:

t_c is the charging time in hours,

C is the capacity of the cell/battery in ampere-hours, and

I_c is the maximum charging current, in amperes, specified by the manufacturer

6.6.2 The maximum temperature reached on the exterior of the cell, T_{max} , shall be recorded.

6.6.3 Failure Criteria: The samples shall not explode or catch fire.

6.8 Temperature Cycling Test (UL Sect. 24)

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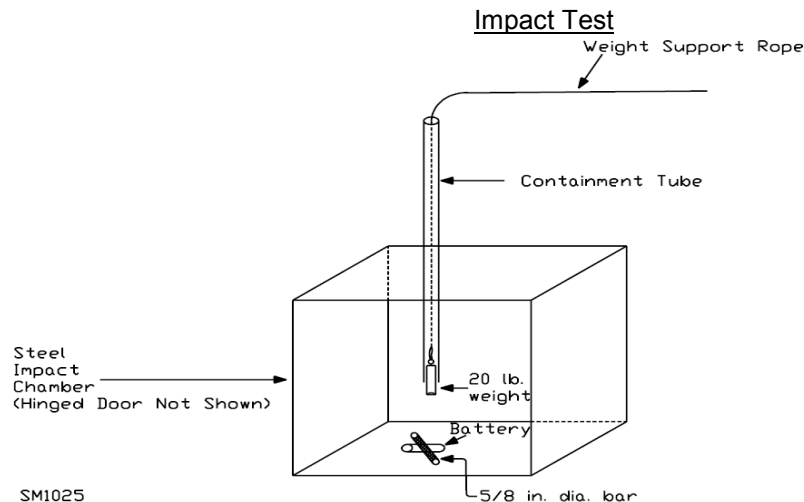
6.8.1 The batteries are to be placed in a test chamber and subjected to the following cycles:

- a) Raising the chamber-temperature to $70 \pm 3^{\circ}\text{C}$ ($158 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- b) Reducing the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 2 hours.
- c) Reducing the chamber temperature to minus $40 \pm 3^{\circ}\text{C}$ (minus $40 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- d) Raising the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes.
- e) Repeating the sequence for a further 9 cycles.
- f) After the 10th cycle, storing the batteries for a minimum of 24 hours, at a temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) prior to examination.

6.8.2 Failure Criteria: The samples shall not explode, catch fire, vent or leak. In addition, Any mass loss exceeding 0.1% after is considered a failure.

6.9 Impact Test (UL Sect. 15)

- 6.9.1. Perform x-ray imaging of each pre-conditioned group to determine initial void volume of the batteries inner windings
- 6.9.2. The battery is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 5/8 inch (15.8 mm) diameter curved surface lying across the center of the test sample.
- 6.9.3. The testing sequence is to be performed as follows:
 - 6.2.3.1. The test sample battery is to be placed on a flat surface.
 - 6.2.3.2. A 15.8 mm (5/8 inch) diameter bar is placed across the center of the sample.
 - 6.2.3.3. A 9.1 ± 0.46 kg (20 ± 1 pound) weight is to be dropped from a height of 610 \square 25 mm (24 ± 1 inch) onto the sample.
 - 6.2.3.4. Each sample battery is to be subjected to only a single impact.



6.9.4. Failure Criteria: The sample shall not explode or catch fire.



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7 Packaging and Labeling Requirements Labels shall be duplex type per Rayovac Specification S4000977.

7.1 Shrinkage Test

Place a drop of whiteout on the label overlap 1 cm from (+) end of battery. Subject battery to 68°C ± 2°C (154°F ± 3.5°F) for 7 days. Measure the distance between the two halves of the drop of whiteout.

Failure Criteria: Battery may not have any can metal exposed due to label shrinkage. Nominal shrinkage = 1.75 mm (0.070")

7.2 High Temperature/High Humidity Label Test

Subject batteries to 45°C ± 2°C (113°F ± 4°F), 90% relative humidity for one week.

Failure Criteria: No discoloration of printing or distortion of label artwork is allowed.

7.3 Packaging Requirement

Packaging for shipment or sales shall conform to a mutually agreed upon packaging specification.

8 Environmental Requirements

8.1 A Material Safety Data Sheet (MSDS) must be provided. (for US and Canada sale only)

8.2 Heavy Metal Limits

The heavy metal contents of the battery shall conform to all applicable regulations (local, national and international) where batteries are to be sold. For US consumption, these additional requirements apply (ppm limits per weight of battery):

Mercury:	Max 1 ppm
Cadmium:	Max 3 ppm
Lead:	Max 250 ppm
Arsenic:	Max 1 ppm
Barium:	Max 100 ppm
Chromium:	Max 50 ppm
Selenium:	Max 10 ppm

8.3 The supplier shall maintain records of analytical data insuring that contents of batteries produced for Rayovac meet the requirements specified in 8.2 and 8.3.

9 Program Requirements

9.1 Lot Definition

A production lot shall consist of one shipment quantity.

9.2 Sample

Samples for performance testing (and any additional audit testing) shall be collected in a way to equally represent the whole production lot in terms of time of manufacture across all cell assembly lines used to create the production lot.

9.3 Conflicts

If there are conflicts between this document and referenced specifications, statements in this specification shall have precedence.

9.4 Product and Process Changes



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- 9.4.1 If any substantial changes are made that will affect the "fit", "form", or "function" of the battery in a device, the supplier must have Rayovac approval in advance of such changes.
- 9.4.2 Any product or process changes that could affect conformance to the requirements of this specification will necessitate a retest and certification in advance of shipment to Rayovac U.S.A.
- 9.4.3 The supplier shall keep records of all substantial changes for at least four years in order to enable tracing of problems throughout the expected lifetime of the product.

9.5 Lot Acceptance

- 9.5.1 Inspection and testing of each lot including initial qualification testing of batteries is the responsibility of the supplier. Spectrum Brands reserves the right to resample and perform any test listed in this specification. Spectrum Brands results will be the determining factor on all issues of lot acceptance.
- 9.5.2 Any area of non-conformance will be reviewed with Spectrum Brands Purchasing, Corporate Quality and the supplier. Spectrum Brands will decide final disposition.

9.6 Certificate of Compliance

Each lot shipped to Varta or Rayovac will be supported by a Certificate of Compliance containing the information shown in Attachment 1. Certificate of Compliance submission frequency will be agreed between the supplier and Spectrum Brands Corporate Quality.

Revision History			
A	Initial Release		
Material Group:	SAAA	MSDS Required:	<input type="checkbox"/> Yes <input type="checkbox"/> No



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Certificate of Compliance

Date of Shipment		Shipping Order		QA Manager Signature:					
Battery Type		Battery Date Code		Date:					
Part Num./Spec.		Production Plant		Review the Performance Specification for additional information					
Test Description			Supplier – Actual Results						
		Sample Size	Average	Minimum Individual	Maximum Individual	Standard Deviation	Cpk	Histogram	Line Graph
Dimensional:			Dimensional:						
A-Diameter		10						Include	
B-Overall Height		10						Include	
C- + Protrusion Height		10						Include	
D- + Protrusion Diameter		10						include	
Visual:									
-Date / Manufacturer Code		200							
-Number of Defects Identified									
Initial Target:			Initial Target:						
-Open Circuit Voltage (OCV)		100%							
-Closed Circuit Voltage (CCV)		65							
-Impedance		100%							
Capacity:			Capacity:						
	Section 4.1.1	15							Include
	Section 4.1.2	15							Include
	Section 4.1.3	15							Include
	Section 4.1.4	15							Include
Leakage:			Leakage:						
-Section 5	As specified	20							
Safety:			Safety:						
-Section 6	As specified	10							
Environmental:			Environmental:						
-Section 8	As specified								



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Policy

It is the policy of Rayovac to establish and publish performance standards on all products we ship to customers. It is the responsibility of each manufacturing location to establish documented programs that assure compliance to these standards are achieved and maintained.

Scope

This specification defines the performance requirements for the AA nickel-metal hydride ready to use rechargeable battery providing a rated capacity of 2000 mAh.

Purpose

To specify performance requirements to insure that nickel-metal hydride batteries procured under this specification meet or exceed Rayovac's marketability claims and our customers' expectations.

Reference Documents

<u>Number</u>	<u>Title</u>
ANSI C18.2M, Part 1	Portable Rechargeable Cells and Batteries – General and Specifications
UL 2054, August 2008	Standard for Safety for Household and Commercial Batteries
CEI / IEC 61951-2: 2003	International Standard Secondary Cells and Batteries – Nickel Metal Hydride
JIS C 8708: 2004	Sealed Nickel-Metal Hydride Rechargeable Single Cells
S1000231	Date Coding (HUM)
S1002120	Manufacturer Code
S4000977	Quality Requirements For Duplex PVC/PET Labels
MSDS	Material Safety Data Sheet
	Test Methods for Evaluation of Solid Wastes, SW 846 3 rd Edition

1 Ratings

1.1 Ratings After Charge

1.1.1	Nominal Operating Voltage	1.2 volt (discharged at 0.2I _t A to 1.0 V at 20 ± 5°C)
1.1.2	Nominal (C ₅) Capacity	600 mAh
1.1.3	Minimum Individual (C ₅) Capacity	558 mAh
1.1.4	Constant Current Charge Methods	Standard: at 0.1I _t A for 16 hrs, (1.2) Rapid: at 1I _t A to -dv = 3 - 8 mv, (1.3)
1.1.5	Max. Continuous Discharge Current	2I _t A at 21 ± 2°C
1.1.6	Temperature Range of Operation	Charge: 0°C to 45°C at a max RH of 85% Discharge: -10°C to 45°C at a max RH of 85%
1.1.7	Nominal Weight	12 g

1.2 Standard charge

Standard charge is defined as charging at a constant current of 0.1I_tA for a 16 hour period followed by a 60-minute rest period. The environmental conditions during charge and rest include a temperature range of 20 ± 5°C and a relative humidity range of 50 ± 15%. The I_tA nomenclature used in the document is based on IEC guidelines. The reference I_tA value is defined as I_tA = C_nAh / 1h where:

I_t is the reference test current in amperes

C_n is the rated capacity in ampere-hours

n is the time, based in hours, for which the rated capacity is based, which is 5.

1.3 Rapid Charge

Rapid charge is defined as charging at a constant current of 1I_tA to a -dv = 3 - 8 mv cutoff followed by a 30-minute rest period. The environmental conditions for charge and rest are listed in section 1.2.

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1.4 Shipping Condition

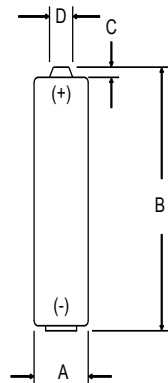
- 1.4.1 All batteries shall be shipped (except Latin America) at a state of charge of 75-90% from the factory
- 1.4.2 All batteries shipped to Latin America are to be shipped at a state of charge of 55-65% from the factory
- 1.4.3 All batteries shall contain a top external insulator and a full protective label that covers both the insulator and sides of the battery prior to shipment.
- 1.4.4 All batteries shall be shipped by a method that prevents the battery terminals from shorting against each other, against the shipping container and against other materials that they may reasonably encounter during shipment.
- 1.4.5 All packaged batteries shall be shipped in a refrigerated container where the temperature inside the container is 20 - 23°C and does not exceed 27°C.

2 Physical Requirements

2.1 Dimensions

The battery shall meet the dimensions in Figure 1.

Figure 1: Dimensions



A	9.5 – 10.5 mm DIA (0.374" - 0.413")
B	43.3 – 44.5 mm (1.705 – 1.752")
C	0.8 mm (0.0315") MIN
D	3.8 mm (0.150") MAX DIA

2.2 Date Coding

Identify manufacture date of battery using Rayovac date coding per Specification S1000231. Preferred location of date code is on jacket of battery although negative terminal is also acceptable. Date code must be printed clearly and legibly on each battery. Other methods of age traceable coding may be acceptable but must be pre-approved by Rayovac Corporate Quality.

2.3 Manufacturer Coding

Identify the manufacturer of the battery using the Rayovac manufacturer coding method per Rayovac Specification S1002120. The preferred location of the manufacturer code is adjacent to the date code on the jacket of the battery although negative terminal is also acceptable. Manufacturer code must be permanent, clear and legible on each battery. Other methods of manufacturer code may be acceptable but must be pre-approved by Rayovac Corporate Quality.

2.4 Visual Inspection

Visual inspection shall be performed to insure that defects are not shipped. Examples of defects include but are not limited to:

- Surface scratches, wrinkles, holes or improper wrap of label



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- Smudged or non-registered printing on labels
- Wrong hues (colors) or distorted artwork on label graphics
- Illegible, or missing date code
- Missing external top insulator
- Misshapen cans
- Broken, bent or loose terminals
- External leakage

3 Electrical Requirements

The cells used to determine electrical and battery service life requirements. Charge each cell at 0.1I_rA for 16 hours, (section 1.2). Unless otherwise specified, all testing is conducted at a standard temperature of 20 ± 5°C and a standard relative humidity of 50 ± 15%. The measurements are to be taken within 48 hours of the completion of the charge step.

3.1 Open Circuit Voltage (OCV)

Charge at 0.1I_rA for 16 hours, (section 1.2), then measure with a voltmeter having a minimum internal resistance of 1MΩ/volt.

Lot Criteria Minimum Average of 1.365 V
Individual Criteria Average ± 25 mV

3.2 AC Internal Impedance

Charge at 0.1I_rA for 16 hours, (section 1.2), then measure impedance using the 1KHz AC method.

Lot Criteria Maximum Average of 40 mΩ
Individual Criteria Average ± 5 mΩ

3.3 Closed Circuit Voltage (CCV)

Apply standard charge, (section 1.2), then measure the CCV after 500 milli-seconds on a load of 3.9 Ω.

Lot Criteria Minimum Average of 1.34 V
Individual Criteria Average ± 25 mV

4 Battery Service Life

Perform all testing at 20 ± 5°C unless otherwise specified

4.1 Capacity Testing

4.1.1 Rated (C₅) Capacity

Charge at 0.1I_rA for 16 hours, (section 1.2), then discharge at 0.2I_rA to a 1.0 end point voltage.

Average Capacity (cycles 3-5): 600 mAh
Minimum individual capacity (93% of Average Capacity): 558 mAh

4.1.2 Constant Current (1C/1C) Capacity

Charge at 1I_rA to a -dv = 3 - 8 mv cutoff, (section 1.3) then discharge at 1I_rA to a 0.9 end point voltage.

Average Capacity (cycles 3-5): 558 mAh
Minimum individual capacity (cycles 3-5): 519 mAh

4.1.3 Digital Camera Application Test

Charge at 0.1I_rA for 16 hours, (section 1.2), store according to the durations specified below, then discharge per the following test regime:



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Test Regime Step	Duration	EPV
1) Discharge 1200mW	2 Seconds	1.05V
2) Discharge 650mW	28 Seconds	1.05V
3) Run load steps 1 and 2 a total of 10 Times (5 Minutes Total)		
4) Rest	55 Minutes (each hour)	1.05V
5) Repeat steps 1-4 until EPV (1.05V) is reached		

One pulse is defined to be one complete load period (Steps 1 and 2)
Reference: ANSI 18.3 Part 1M-2005, Spec. Sheet 15LF

Storage Conditions and Capacity Requirements:

Storage Time:	Temp.	Minimum Average	Minimum Individual
No Delay	20°C	120 Pulses	112 Pulses

4.2 Cycle Life Testing: 20°C

Discharge unit initially to establish State of Charge as received. Continue testing following charge, discharge and rest steps as executed, at $20 \pm 5^\circ\text{C}$.

4.2.1 Rated (C_5) Capacity Cycle Life

Discharge: 0.2I_rA to a 1.0 end point voltage (Initial State of Charge) then cycle as follows:
Charge: 0.1I_rA for 16 Hours, (section 1.2)
Rest: 30 minutes between *each* charge and discharge half cycle
Discharge: 0.2I_rA to a 1.0 end point voltage

Minimum average capacity as received:	75% of initial average capacity
Minimum average capacity at cycle 50:	98% of initial average capacity
Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	75% of initial average capacity
Minimum average capacity at cycle 500:	60% of initial average capacity

4.2.2 Consumer Cycle Life

Charge: 1I_rA to a $-dv = 3 - 8$ mv cutoff, (section 1.3)
Rest: 30 minutes between each charge and discharge half cycle
Discharge: 1I_rA to a 0.90 end point voltage

Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	80% of initial average capacity
Minimum average capacity at cycle 500:	60% of initial average capacity

4.3 Maximum Charge Temperature Using Constant Current Charge Regime

The outer case temperature of the cell measured at 25°C should not exceed 45°C during constant current charge regimes listed in sections 4.1 and 4.2.

4.4 Charge Capacity Retention

Charge: 0.1I_rA for 16 Hours, (section 1.2)
Store: As indicated in table
Discharge: 0.2I_rA to 1.0V end point voltage to determine average

Requirements:

Minimum Ave. % Retained



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Storage Temp	Storage Time	vs. Rated Capacity (1.1.2)
20°C	28 days	85%
20°C	91 days	82.5%
20°C	182 days	80%
20°C	365 days	60%
45°C	28 days	60%
45°C	14 days	80%
60°C	7 days	75%

4.5 Discharge Capacity Recovery

Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Store: As indicated in table
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Repeat for 3 cycles and report maximum retained average.

Storage Temp	Storage Time	Recovered vs Rated Capacity (1.1.2)
20°C	28 days	100%
20°C	90 days	98%
45°C	14 days	95%
60°C	7 days	95%

4.6 Standard 0.1I_rA Overcharge at 20°C ± 5°C

Confirm that the cells will withstand overcharge at the 0.1I_rA rate, (section 1.2).
 Rest: Between 1 and 4 hr
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (section 1.1.3)

4.7 Over-discharge at 20°C ± 5°C

Confirm that the cells will withstand constant current over-discharge at the 0.2I_rA rate.
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Discharge: 0.2I_rA for minimum of 10 hrs
 Rest: between 1 and 4 hr
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes before discharge
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (1.1.3)

5 Battery Leakage

All samples must be fully charged using standard charge (section 1.2) prior to leakage testing.

5.1 Thermal Cycle Storage – Leakage

Subject battery to the repeating thermal cycle described. Battery shall not show visible leakage after 4 weeks. The thermal cycles are as follows:

-30°C ± 2°C (-20°F ± 4°F)	8 hrs ± 0.5 hr.
71°C ± 2°C (160°F ± 4°F)	16 hrs ± 0.5 hr.



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Transition Times allow up to 1 hr.
 Duration 1 cycle every 24 hr. for 4 weeks

5.2 Room Temperature Storage – Leakage

Store battery at ambient conditions. Battery shall not show visible leakage and must meet requirements of Section 2 after 6 months of storage.

Environment 21°C ± 5°C (70°F ± 9°F)
 Duration 6 months

5.3 High Temperature Dry Storage – Leakage

Store battery in a high temperature environment. Battery shall not show visible leakage after 8 weeks.

Environment 71°C ± 2°C (160°F ± 4°F)
 Duration 8 weeks

5.4 High Temperature/Humidity Storage – Leakage

Store battery in a high temperature/high humidity environment. Battery shall not show visible leakage after 4 weeks.

Environment 45°C ± 2°C (113°F ± 4°F) 90% ± 4.5% RH
 Duration 4 weeks

6 Foreseeable Misuse

Tests described with “UL” listed are based on procedures outlined in UL 2054 Standard for Safety. All testing in section 6 requires that samples be fully charged via standard charge method, (1.2) prior to test. For tests with a “no venting” failure criteria, the cells are to be weighed before and after the testing and the following criteria shall apply:

Mass of cell or battery	Maximum Mass % Loss
Not more than 1 gram	0.5
More than 1.0g but less than 5.0g	0.2
More than 5.0g	0.1

6.1 UL Short Circuit at 20°C (UL-9)

Individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.2 UL Short Circuit at 55°C (UL-9)

After the units have reached equilibrium at 55 ± 2°C as applicable, individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.3 UL Projectile Test (UL-22)

Each test sample cell or battery is to be placed on a platform table having a 4-inch (102 mm) diameter hole in the center covered by a screen. The screen is to be constructed of steel wire mesh having 20 openings per inch (25.4 mm) and a wire diameter of 0.017 inch (0.43 mm). An eight-sided covered wire cage, 2 feet (610 mm) across and 1 foot (305 mm) high, made from metal screening is to be placed over the test sample. See Figure 23.1 in the UL2054 procedure document. The metal screening is to be constructed from 0.010 inch



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(0.25 mm) diameter metal wire with 16-18 wires per inch (25.4 mm) in each direction. The sample is to be placed on the screen covering the hole in the center of the table and is to be heated with a direct flame until it explodes, or until it is destroyed.

Failure Criteria: When subjected to the test described, no part of an exploding cell or battery shall penetrate the wire screen such that some or all of the cell or battery protrudes through the screen.

6.4 UL Shock Test (UL-16)

The cell is to be secured to the testing machine by means of a rigid mount, which supports all mounting surfaces of the cell. Each cell shall be subjected to a total of three shocks of equal magnitude. The shocks are to be applied in each of three mutually perpendicular directions unless it has only two axes normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 75 g, (where g is the local acceleration due to gravity). The peak acceleration shall be between 125 and 175 g. Cells shall be tested at a temperature of $20 \pm 2^{\circ}\text{C}$

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.5 UL Vibration Test (UL-17)

A battery is subjected to simple harmonic motion with an amplitude of 0.03 inch, (0.8 mm) with a total maximum excursion of 0.06 inch, (1.6 mm). The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz and return in not less than 90 or more than 100 minutes. The battery is to be tested in three mutually perpendicular directions. For each battery that has only two axes of symmetry, the battery is to be tested perpendicular to each axis.

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.6 UL Heating Test (UL-23)

A charged cell is to be heated in a gravity convection or circulating oven. The temperature of the oven is to be raised at a rate of $5 \pm 2^{\circ}\text{C}$ per minute to a temperature of $150 \pm 2^{\circ}\text{C}$. The oven is to remain for 10 minutes at $150 \pm 2^{\circ}\text{C}$ before test is discontinued.

Failure Criteria: The samples shall not explode or catch fire.

6.7 UL Abnormal Charge (UL Sect 10)

6.6.1 The battery is to be subjected to a charging current of three times the current I_c , specified by the manufacturer by connecting it in opposition to a dc-power supply. The minimum charging time is to be the time required to reach the manufacturers specified end-of-charge condition plus 7 hours.

The test charging time is to be calculated using the formula:

$$T_c = 2.5C / 3(I_c)$$

In which:

t_c is the charging time in hours,

C is the capacity of the cell/battery in ampere-hours, and

I_c is the maximum charging current, in amperes, specified by the manufacturer

6.6.2 The maximum temperature reached on the exterior of the cell, T_{max} , shall be recorded.

6.6.3 Failure Criteria: The samples shall not explode or catch fire.

6.8 Temperature Cycling Test (UL Sect. 24)

6.8.1 The batteries are to be placed in a test chamber and subjected to the following cycles:

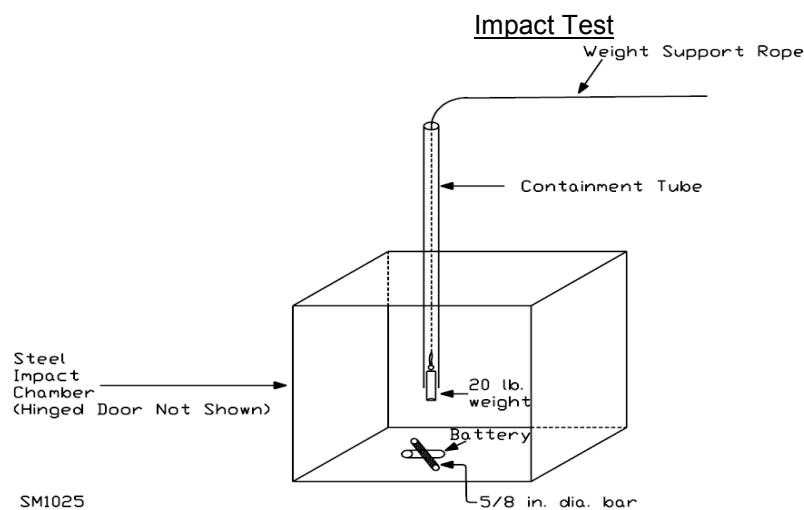
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- a) Raising the chamber-temperature to $70 \pm 3^{\circ}\text{C}$ ($158 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- b) Reducing the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 2 hours.
- c) Reducing the chamber temperature to minus $40 \pm 3^{\circ}\text{C}$ (minus $40 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- d) Raising the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes.
- e) Repeating the sequence for a further 9 cycles.
- f) After the 10th cycle, storing the batteries for a minimum of 24 hours, at a temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) prior to examination.

6.8.2 Failure Criteria: The samples shall not explode, catch fire, vent or leak. In addition, Any mass loss exceeding 0.1% after is considered a failure.

6.9 Impact Test (UL Sect. 15)

- 6.9.1. Perform x-ray imaging of each pre-conditioned group to determine initial void volume of the batteries inner windings
- 6.9.2. The battery is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 5/8 inch (15.8 mm) diameter curved surface lying across the center of the test sample.
- 6.9.3. The testing sequence is to be performed as follows:
 - 6.2.3.1. The test sample battery is to be placed on a flat surface.
 - 6.2.3.2. A 15.8 mm (5/8 inch) diameter bar is placed across the center of the sample.
 - 6.2.3.3. A 9.1 ± 0.46 kg (20 ± 1 pound) weight is to be dropped from a height of 610 \square 25 mm (24 ± 1 inch) onto the sample.
 - 6.2.3.4. Each sample battery is to be subjected to only a single impact.



6.9.4. Failure Criteria: The sample shall not explode or catch fire.

7 Packaging and Labeling Requirements Labels shall be duplex type per Rayovac Specification S4000977.



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7.1 Shrinkage Test

Place a drop of whiteout on the label overlap 1 cm from (+) end of battery. Subject battery to 68°C ± 2°C (154°F ± 3.5°F) for 7 days. Measure the distance between the two halves of the drop of whiteout.

Failure Criteria: Battery may not have any can metal exposed due to label shrinkage. Nominal shrinkage = 1.75 mm (0.070")

7.2 High Temperature/High Humidity Label Test

Subject batteries to 45°C ± 2°C (113°F ± 4°F), 90% relative humidity for one week.

Failure Criteria: No discoloration of printing or distortion of label artwork is allowed.

7.3 Packaging Requirement

Packaging for shipment or sales shall conform to a mutually agreed upon packaging specification.

8 Environmental Requirements

8.1 A Material Safety Data Sheet (MSDS) must be provided. (for US and Canada sale only)

8.2 Heavy Metal Limits

The heavy metal contents of the battery shall conform to all applicable regulations (local, national and international) where batteries are to be sold. For US consumption, these additional requirements apply (ppm limits per weight of battery):

Mercury:	Max 1 ppm
Cadmium:	Max 3 ppm
Lead:	Max 250 ppm
Arsenic:	Max 1 ppm
Barium:	Max 100 ppm
Chromium:	Max 50 ppm
Selenium:	Max 10 ppm

8.3 The supplier shall maintain records of analytical data insuring that contents of batteries produced for Rayovac meet the requirements specified in 8.2 and 8.3.

9 Program Requirements

9.1 Lot Definition

A production lot shall consist of one shipment quantity.

9.2 Sample

Samples for performance testing (and any additional audit testing) shall be collected in a way to equally represent the whole production lot in terms of time of manufacture across all cell assembly lines used to create the production lot.

9.3 Conflicts

If there are conflicts between this document and referenced specifications, statements in this specification shall have precedence.

9.4 Product and Process Changes

9.4.1 If any substantial changes are made that will affect the "fit", "form", or "function" of the battery in a device, the supplier must have Rayovac approval in advance of such changes.



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- 9.4.2 Any product or process changes that could affect conformance to the requirements of this specification will necessitate a retest and certification in advance of shipment to Rayovac U.S.A.
- 9.4.3 The supplier shall keep records of all substantial changes for at least four years in order to enable tracing of problems throughout the expected lifetime of the product.

9.5 Lot Acceptance

- 9.5.1 Inspection and testing of each lot including initial qualification testing of batteries is the responsibility of the supplier. Spectrum Brands reserves the right to resample and perform any test listed in this specification. Spectrum Brands results will be the determining factor on all issues of lot acceptance.
- 9.5.2 Any area of non-conformance will be reviewed with Spectrum Brands Purchasing, Corporate Quality and the supplier. Spectrum Brands will decide final disposition.

9.6 Certificate of Compliance

Each lot shipped to Varta or Rayovac will be supported by a Certificate of Compliance containing the information shown in Attachment 1. Certificate of Compliance submission frequency will be agreed between the supplier and Spectrum Brands Corporate Quality.

Revision History			
A	Initial Release		
Material Group:	SAAA	MSDS Required:	<input type="checkbox"/> Yes <input type="checkbox"/> No



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Certificate of Compliance

Date of Shipment		Shipping Order		QA Manager Signature:					
Battery Type		Battery Date Code		Date:					
Part Num./Spec.		Production Plant		Review the Performance Specification for additional information					
Test Description			Supplier – Actual Results						
		Sample Size	Average	Minimum Individual	Maximum Individual	Standard Deviation	Cpk	Histogram	Line Graph
Dimensional:			Dimensional:						
A-Diameter		10						Include	
B-Overall Height		10						Include	
C- + Protrusion Height		10						Include	
D- + Protrusion Diameter		10						include	
Visual:									
-Date / Manufacturer Code		200							
-Number of Defects Identified									
Initial Target:			Initial Target:						
-Open Circuit Voltage (OCV)		100%							
-Closed Circuit Voltage (CCV)		65							
-Impedance		100%							
Capacity:			Capacity:						
	Section 4.1.1	15							Include
	Section 4.1.2	15							Include
	Section 4.1.3	15							Include
	Section 4.1.4	15							Include
Leakage:			Leakage:						
-Section 5	As specified	20							
Safety:			Safety:						
-Section 6	As specified	10							
Environmental:			Environmental:						
-Section 8	As specified								



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Policy

It is the policy of Rayovac to establish and publish performance standards on all products we ship to customers. It is the responsibility of each manufacturing location to establish documented programs that assure compliance to these standards are achieved and maintained.

Scope

This specification defines the performance requirements for the AA nickel-metal hydride ready to use rechargeable battery providing a rated capacity of 2000 mAh.

Purpose

To specify performance requirements to insure that nickel-metal hydride batteries procured under this specification meet or exceed Rayovac's marketability claims and our customers' expectations.

Reference Documents

<u>Number</u>	<u>Title</u>
ANSI C18.2M, Part 1	Portable Rechargeable Cells and Batteries – General and Specifications
UL 2054, August 2008	Standard for Safety for Household and Commercial Batteries
CEI / IEC 61951-2: 2003	International Standard Secondary Cells and Batteries – Nickel Metal Hydride
JIS C 8708: 2004	Sealed Nickel-Metal Hydride Rechargeable Single Cells
S1000231	Date Coding (HUM)
S1002120	Manufacturer Code
S4000977	Quality Requirements For Duplex PVC/PET Labels
MSDS	Material Safety Data Sheet
	Test Methods for Evaluation of Solid Wastes, SW 846 3 rd Edition

1 Ratings

1.1 Ratings After Charge

1.1.1	Nominal Operating Voltage	1.2 volt (discharged at 0.2I _t A to 1.0 V at 20 ± 5°C)
1.1.2	Nominal (C ₅) Capacity	2000 mAh
1.1.3	Minimum Individual (C ₅) Capacity	1860 mAh
1.1.4	Constant Current Charge Methods	Standard: at 0.1I _t A for 16 hrs, (1.2) Rapid: at 1I _t A to -dv = 3 - 8 mv, (1.3)
1.1.5	Max. Continuous Discharge Current	2I _t A at 21 ± 2°C
1.1.6	Temperature Range of Operation	Charge: 0°C to 45°C at a max RH of 85% Discharge: -10°C to 45°C at a max RH of 85%
1.1.7	Nominal Weight	28 g

1.2 Standard charge

Standard charge is defined as charging at a constant current of 0.1I_tA for a 16 hour period followed by a 60-minute rest period. The environmental conditions during charge and rest include a temperature range of 20 ± 5°C and a relative humidity range of 50 ± 15%. The I_tA nomenclature used in the document is based on IEC guidelines. The reference I_tA value is defined as I_tA = C_nAh / 1h where:

I_t is the reference test current in amperes

C_n is the rated capacity in ampere-hours

n is the time, based in hours, for which the rated capacity is based, which is 5.

1.3 Rapid Charge

Rapid charge is defined as charging at a constant current of 1I_tA to a -dv = 3 - 8 mv cutoff followed by a 30-minute rest period. The environmental conditions for charge and rest are listed in section 1.2.

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1.4 Shipping Condition

- 1.4.1 All batteries shall be shipped (except Latin America) at a state of charge of 75-90% from the factory
- 1.4.2 All batteries shipped to Latin America are to be shipped at a state of charge of 55-65% from the factory
- 1.4.3 All batteries shall contain a top external insulator and a full protective label that covers both the insulator and sides of the battery prior to shipment.
- 1.4.4 All batteries shall be shipped by a method that prevents the battery terminals from shorting against each other, against the shipping container and against other materials that they may reasonably encounter during shipment.
- 1.4.5 All packaged batteries shall be shipped in a refrigerated container where the temperature inside the container is 20 - 23°C and does not exceed 27°C.

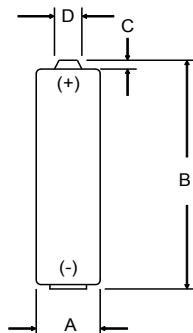
2 Physical Requirements

2.1 Dimensions

The battery shall meet the dimensions in Figure 1.

Figure 1: Dimensions

A	13.5 – 14.5 mm DIA (0.531" - 0.571")
B	49.5 – 50.5 mm (1.949 – 1.988")
C	1.0 mm (0.039") MIN
D	5.5 mm (0.217") MAX DIA



2.2 Date Coding

Identify manufacture date of battery using Rayovac date coding per Specification S1000231. Preferred location of date code is on jacket of battery although negative terminal is also acceptable. Date code must be printed clearly and legibly on each battery. Other methods of age traceable coding may be acceptable but must be pre-approved by Rayovac Corporate Quality.

2.3 Manufacturer Coding

Identify the manufacturer of the battery using the Rayovac manufacturer coding method per Rayovac Specification S1002120. The preferred location of the manufacturer code is adjacent to the date code on the jacket of the battery although negative terminal is also acceptable. Manufacturer code must be permanent, clear and legible on each battery. Other methods of manufacturer code may be acceptable but must be pre-approved by Rayovac Corporate Quality.



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2.4 Visual Inspection

Visual inspection shall be performed to insure that defects are not shipped. Examples of defects include but are not limited to:

- Surface scratches, wrinkles, holes or improper wrap of label
- Smudged or non-registered printing on labels
- Wrong hues (colors) or distorted artwork on label graphics
- Illegible, or missing date code
- Missing external top insulator
- Misshapen cans
- Broken, bent or loose terminals
- External leakage

3 Electrical Requirements

The cells used to determine electrical and battery service life requirements. Charge each cell at $0.1I_rA$ for 16 hours, (section 1.2). Unless otherwise specified, all testing is conducted at a standard temperature of $20 \pm 5^\circ C$ and a standard relative humidity of $50 \pm 15\%$. The measurements are to be taken within 48 hours of the completion of the charge step.

3.1 Open Circuit Voltage (OCV)

Charge at $0.1I_rA$ for 16 hours, (section 1.2), then measure with a voltmeter having a minimum internal resistance of $1M\Omega/volt$.

Lot Criteria Minimum Average of 1.365 V
Individual Criteria Average ± 25 mV

3.2 AC Internal Impedance

Charge at $0.1I_rA$ for 16 hours, (section 1.2), then measure impedance using the 1KHz AC method.

Lot Criteria Maximum Average of 40 $m\Omega$
Individual Criteria Average ± 5 $m\Omega$

3.3 Closed Circuit Voltage (CCV)

Apply standard charge, (section 1.2), then measure the CCV after 500 milli-seconds on a load of 3.9 Ω .

Lot Criteria Minimum Average of 1.34 V
Individual Criteria Average ± 25 mV

4 Battery Service Life

Perform all testing at $20 \pm 5^\circ C$ unless otherwise specified

4.1 Capacity Testing

4.1.1 Rated (C_5) Capacity

Charge at $0.1I_rA$ for 16 hours, (section 1.2), then discharge at $0.2I_rA$ to a 1.0 end point voltage.

Average Capacity (cycles 3-5): 2000 mAh
Minimum individual capacity (93% of Average Capacity): 1860 mAh

4.1.2 Constant Current (1C/1C) Capacity

Charge at $1I_rA$ to a $-dv = 3 - 8$ mv cutoff, (section 1.3) then discharge at $1I_rA$ to a 0.9 end point voltage.

Average Capacity (cycles 3-5): 1860 mAh
Minimum individual capacity (cycles 3-5): 1730 mAh



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4.1.3 Digital Camera Application Test

Charge at 0.1I_rA for 16 hours, (section 1.2), store according to the durations specified below, then discharge per the following test regime:

Test Regime Step	Duration	EPV
1) Discharge 1500mW	2 Seconds	1.05V
2) Discharge 650mW	28 Seconds	1.05V
3) Run load steps 1 and 2 a total of 10 Times (5 Minutes Total)		
4) Rest	55 Minutes (each hour)	1.05V
5) Repeat steps 1-4 until EPV (1.05V) is reached		

One pulse is defined to be one complete load period (Steps 1 and 2)
Reference: ANSI 18.3 Part 1M-2005, Spec. Sheet 15LF

Storage Conditions and Capacity Requirements:

Storage Time:	Temp.	Minimum Average	Minimum Individual
No Delay	20°C	400 Pulses	353 Pulses

4.2 Cycle Life Testing: 20°C

Discharge unit initially to establish State of Charge as received. Continue testing following charge, discharge and rest steps as executed, at 20 ± 5°C.

4.2.1 Rated (C₅) Capacity Cycle Life

Discharge: 0.2I_rA to a 1.0 end point voltage (Initial State of Charge) then cycle as follows:
Charge: 0.1I_rA for 16 Hours, (section 1.2)
Rest: 30 minutes between each charge and discharge half cycle
Discharge: 0.2I_rA to a 1.0 end point voltage

Minimum average capacity as received:	75% of initial average capacity
Minimum average capacity at cycle 50:	98% of initial average capacity
Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	75% of initial average capacity
Minimum average capacity at cycle 300:	60% of initial average capacity

4.2.2 Consumer Cycle Life

Charge: 1I_rA to a -dv = 3 - 8 mv cutoff, (section 1.3)
Rest: 30 minutes between each charge and discharge half cycle
Discharge: 1I_rA to a 0.90 end point voltage

Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	80% of initial average capacity
Minimum average capacity at cycle 300:	60% of initial average capacity

4.3 Maximum Charge Temperature Using Constant Current Charge Regime

The outer case temperature of the cell measured at 25°C should not exceed 45°C during constant current charge regimes listed in sections 4.1 and 4.2.

4.4 Charge Capacity Retention

Charge: 0.1I_rA for 16 Hours, (section 1.2)
Store: As indicated in table
Discharge: 0.2I_rA to 1.0V end point voltage to determine average



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Requirements:

Storage Temp	Storage Time	Minimum Ave. % Retained vs. Rated Capacity (1.1.2)
20°C	28 days	85%
20°C	91 days	82.5%
20°C	182 days	80%
20°C	365 days	60%
45°C	28 days	60%
45°C	14 days	80%
60°C	7 days	75%

4.5 Discharge Capacity Recovery

Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Store: As indicated in table
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Repeat for 3 cycles and report maximum retained average.

Storage Temp	Storage Time	Recovered vs Rated Capacity (1.1.2)
20°C	28 days	100%
20°C	90 days	98%
45°C	14 days	95%
60°C	7 days	95%

4.6 Standard 0.1I_rA Overcharge at 20°C ± 5°C

Confirm that the cells will withstand overcharge at the 0.1I_rA rate, (section 1.2).
 Rest: Between 1 and 4 hr
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (section 1.1.3)

4.7 Over-discharge at 20°C ± 5°C

Confirm that the cells will withstand constant current over-discharge at the 0.2I_rA rate.
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Discharge: 0.2I_rA for minimum of 10 hrs
 Rest: between 1 and 4 hr
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes before discharge
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (1.1.3)

5 Battery Leakage

All samples must be fully charged using standard charge (section 1.2) prior to leakage testing.

5.1 Thermal Cycle Storage – Leakage

Subject battery to the repeating thermal cycle described. Battery shall not show visible leakage after 4 weeks. The thermal cycles are as follows:



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-30°C ± 2°C (-20°F ± 4°F)	8 hrs ± 0.5 hr.
71°C ± 2°C (160°F ± 4°F)	16 hrs ± 0.5 hr.
Transition Times	allow up to 1 hr.
Duration	1 cycle every 24 hr. for 4 weeks

5.2 Room Temperature Storage – Leakage

Store battery at ambient conditions. Battery shall not show visible leakage and must meet requirements of Section 2 after 6 months of storage.

Environment	21°C ± 5°C (70°F ± 9°F)
Duration	6 months

5.3 High Temperature Dry Storage – Leakage

Store battery in a high temperature environment. Battery shall not show visible leakage after 8 weeks.

Environment	71°C ± 2°C (160°F ± 4°F)
Duration	8 weeks

5.4 High Temperature/Humidity Storage – Leakage

Store battery in a high temperature/high humidity environment. Battery shall not show visible leakage after 4 weeks.

Environment	45°C ± 2°C (113°F ± 4°F) 90% ± 4.5% RH
Duration	4 weeks

6 Foreseeable Misuse

Tests described with “UL” listed are based on procedures outlined in UL 2054 Standard for Safety. All testing in section 6 requires that samples be fully charged via standard charge method, (1.2) prior to test. For tests with a “no venting” failure criteria, the cells are to be weighed before and after the testing and the following criteria shall apply:

<u>Mass of cell or battery</u>	<u>Maximum Mass % Loss</u>
Not more than 1 gram	0.5
More than 1.0g but less than 5.0g	0.2
More than 5.0g	0.1

6.1 UL Short Circuit at 20°C (UL-9)

Individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.2 UL Short Circuit at 55°C (UL-9)

After the units have reached equilibrium at 55 ± 2°C as applicable, individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.3 UL Projectile Test (UL-22)

Each test sample cell or battery is to be placed on a platform table having a 4-inch (102 mm) diameter hole in the center covered by a screen. The screen is to be constructed of steel wire mesh having 20 openings per inch (25.4 mm) and a wire diameter of 0.017 inch (0.43 mm). An eight-sided covered wire cage, 2 feet (610



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mm) across and 1 foot (305 mm) high, made from metal screening is to be placed over the test sample. See Figure 23.1 in the UL2054 procedure document. The metal screening is to be constructed from 0.010 inch (0.25 mm) diameter metal wire with 16-18 wires per inch (25.4 mm) in each direction. The sample is to be placed on the screen covering the hole in the center of the table and is to be heated with a direct flame until it explodes, or until it is destroyed.

Failure Criteria: When subjected to the test described, no part of an exploding cell or battery shall penetrate the wire screen such that some or all of the cell or battery protrudes through the screen.

6.4 UL Shock Test (UL-16)

The cell is to be secured to the testing machine by means of a rigid mount, which supports all mounting surfaces of the cell. Each cell shall be subjected to a total of three shocks of equal magnitude. The shocks are to be applied in each of three mutually perpendicular directions unless it has only two axes normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 75 g, (where g is the local acceleration due to gravity). The peak acceleration shall be between 125 and 175 g. Cells shall be tested at a temperature of $20 \pm 2^{\circ}\text{C}$

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.5 UL Vibration Test (UL-17)

A battery is subjected to simple harmonic motion with an amplitude of 0.03 inch, (0.8 mm) with a total maximum excursion of 0.06 inch, (1.6 mm). The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz and return in not less than 90 or more than 100 minutes. The battery is to be tested in three mutually perpendicular directions. For each battery that has only two axes of symmetry, the battery is to be tested perpendicular to each axis.

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.6 UL Heating Test (UL-23)

A charged cell is to be heated in a gravity convection or circulating oven. The temperature of the oven is to be raised at a rate of $5 \pm 2^{\circ}\text{C}$ per minute to a temperature of $150 \pm 2^{\circ}\text{C}$. The oven is to remain for 10 minutes at $150 \pm 2^{\circ}\text{C}$ before test is discontinued.

Failure Criteria: The samples shall not explode or catch fire.

6.7 UL Abnormal Charge(UL Sect 10)

6.6.1 The battery is to be subjected to a charging current of three times the current I_c , specified by the manufacturer by connecting it in opposition to a dc-power supply. The minimum charging time is to be the time required to reach the manufacturers specified end-of-charge condition plus 7 hours.

The test charging time is to be calculated using the formula:

$$T_c = 2.5C / 3(I_c)$$

In which:

t_c is the charging time in hours,

C is the capacity of the cell/battery in ampere-hours, and

I_c is the maximum charging current, in amperes, specified by the manufacturer

6.6.2 The maximum temperature reached on the exterior of the cell, T_{max} , shall be recorded.

6.6.3 Failure Criteria: The samples shall not explode or catch fire.

6.8 Temperature Cycling Test (UL Sect. 24)

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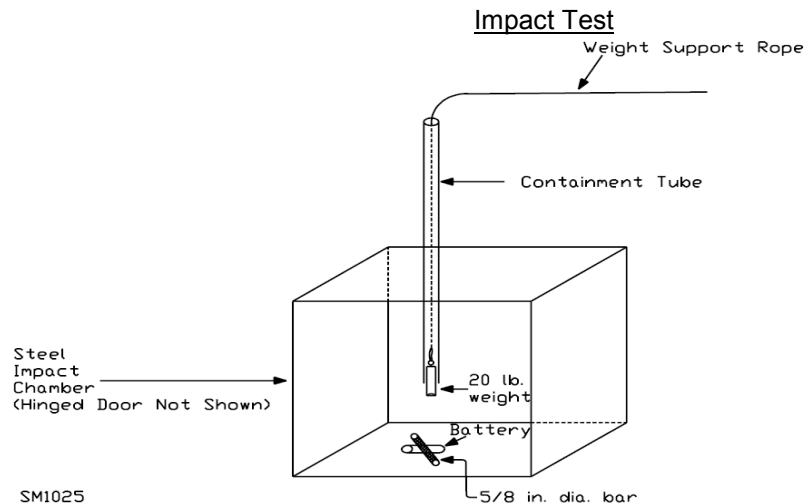
6.8.1 The batteries are to be placed in a test chamber and subjected to the following cycles:

- a) Raising the chamber-temperature to $70 \pm 3^{\circ}\text{C}$ ($158 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- b) Reducing the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 2 hours.
- c) Reducing the chamber temperature to minus $40 \pm 3^{\circ}\text{C}$ (minus $40 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- d) Raising the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes.
- e) Repeating the sequence for a further 9 cycles.
- f) After the 10th cycle, storing the batteries for a minimum of 24 hours, at a temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) prior to examination.

6.8.2 Failure Criteria: The samples shall not explode, catch fire, vent or leak. In addition, Any mass loss exceeding 0.1% after is considered a failure.

6.9 Impact Test (UL Sect. 15)

- 6.9.1. Perform x-ray imaging of each pre-conditioned group to determine initial void volume of the batteries inner windings
- 6.9.2. The battery is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 5/8 inch (15.8 mm) diameter curved surface lying across the center of the test sample.
- 6.9.3. The testing sequence is to be performed as follows:
 - 6.2.3.1. The test sample battery is to be placed on a flat surface.
 - 6.2.3.2. A 15.8 mm (5/8 inch) diameter bar is placed across the center of the sample.
 - 6.2.3.3. A 9.1 ± 0.46 kg (20 ± 1 pound) weight is to be dropped from a height of 610 ± 25 mm (24 ± 1 inch) onto the sample.
 - 6.2.3.4. Each sample battery is to be subjected to only a single impact.



6.9.4. Failure Criteria: The sample shall not explode or catch fire.



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7 Packaging and Labeling Requirements Labels shall be duplex type per Rayovac Specification S4000977.

7.1 Shrinkage Test

Place a drop of whiteout on the label overlap 1 cm from (+) end of battery. Subject battery to 68°C ± 2°C (154°F ± 3.5°F) for 7 days. Measure the distance between the two halves of the drop of whiteout.

Failure Criteria: Battery may not have any can metal exposed due to label shrinkage. Nominal shrinkage = 1.75 mm (0.070")

7.2 High Temperature/High Humidity Label Test

Subject batteries to 45°C ± 2°C (113°F ± 4°F), 90% relative humidity for one week.

Failure Criteria: No discoloration of printing or distortion of label artwork is allowed.

7.3 Packaging Requirement

Packaging for shipment or sales shall conform to a mutually agreed upon packaging specification.

8 Environmental Requirements

8.1 A Material Safety Data Sheet (MSDS) must be provided. (for US and Canada sale only)

8.2 Heavy Metal Limits

The heavy metal contents of the battery shall conform to all applicable regulations (local, national and international) where batteries are to be sold. For US consumption, these additional requirements apply (ppm limits per weight of battery):

Mercury:	Max 1 ppm
Cadmium:	Max 3 ppm
Lead:	Max 250 ppm
Arsenic:	Max 1 ppm
Barium:	Max 100 ppm
Chromium:	Max 50 ppm
Selenium:	Max 10 ppm

8.3 The supplier shall maintain records of analytical data insuring that contents of batteries produced for Rayovac meet the requirements specified in 8.2 and 8.3.

9 Program Requirements

9.1 Lot Definition

A production lot shall consist of one shipment quantity.

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Samples for performance testing (and any additional audit testing) shall be collected in a way to equally represent the whole production lot in terms of time of manufacture across all cell assembly lines used to create the production lot.

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9.4 Product and Process Changes



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- 9.4.1 If any substantial changes are made that will affect the "fit", "form", or "function" of the battery in a device, the supplier must have Rayovac approval in advance of such changes.
- 9.4.2 Any product or process changes that could affect conformance to the requirements of this specification will necessitate a retest and certification in advance of shipment to Rayovac U.S.A.
- 9.4.3 The supplier shall keep records of all substantial changes for at least four years in order to enable tracing of problems throughout the expected lifetime of the product.

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- 9.5.1 Inspection and testing of each lot including initial qualification testing of batteries is the responsibility of the supplier. Spectrum Brands reserves the right to resample and perform any test listed in this specification. Spectrum Brands results will be the determining factor on all issues of lot acceptance.
- 9.5.2 Any area of non-conformance will be reviewed with Spectrum Brands Purchasing, Corporate Quality and the supplier. Spectrum Brands will decide final disposition.

9.6 Certificate of Compliance

Each lot shipped to Varta or Rayovac will be supported by a Certificate of Compliance containing the information shown in Attachment 1. Certificate of Compliance submission frequency will be agreed between the supplier and Spectrum Brands Corporate Quality.

Revision History			
A	Initial Release		
Material Group:	SAAA	MSDS Required:	<input type="checkbox"/> Yes <input type="checkbox"/> No



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Title	AA 2000mAh Platinum NiMH Performance Specification		

Certificate of Compliance

Date of Shipment		Shipping Order		QA Manager Signature:					
Battery Type		Battery Date Code		Date:					
Part Num./Spec.		Production Plant		Review the Performance Specification for additional information					
Test Description			Supplier – Actual Results						
		Sample Size	Average	Minimum Individual	Maximum Individual	Standard Deviation	Cpk	Histogram	Line Graph
Dimensional:			Dimensional:						
A-Diameter		10						Include	
B-Overall Height		10						Include	
C- + Protrusion Height		10						Include	
D- + Protrusion Diameter		10						include	
Visual:									
-Date / Manufacturer Code		200							
-Number of Defects Identified									
Initial Target:			Initial Target:						
-Open Circuit Voltage (OCV)		100%							
-Closed Circuit Voltage (CCV)		65							
-Impedance		100%							
Capacity:			Capacity:						
	Section 4.1.1	15							Include
	Section 4.1.2	15							Include
	Section 4.1.3	15							Include
	Section 4.1.4	15							Include
Leakage:			Leakage:						
-Section 5	As specified	20							
Safety:			Safety:						
-Section 6	As specified	10							
Environmental:			Environmental:						
-Section 8	As specified								



Performance Specification	Memo	22651	Number
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Title	AAA 750mAh Platinum NiMH Performance Specification		

Policy

It is the policy of Rayovac to establish and publish performance standards on all products we ship to customers. It is the responsibility of each manufacturing location to establish documented programs that assure compliance to these standards are achieved and maintained.

Scope

This specification defines the performance requirements for the AA nickel-metal hydride ready to use rechargeable battery providing a rated capacity of 2000 mAh.

Purpose

To specify performance requirements to insure that nickel-metal hydride batteries procured under this specification meet or exceed Rayovac's marketability claims and our customers' expectations.

Reference Documents

<u>Number</u>	<u>Title</u>
ANSI C18.2M, Part 1	Portable Rechargeable Cells and Batteries – General and Specifications
UL 2054, August 2008	Standard for Safety for Household and Commercial Batteries
CEI / IEC 61951-2: 2003	International Standard Secondary Cells and Batteries – Nickel Metal Hydride
JIS C 8708: 2004	Sealed Nickel-Metal Hydride Rechargeable Single Cells
S1000231	Date Coding (HUM)
S1002120	Manufacturer Code
S4000977	Quality Requirements For Duplex PVC/PET Labels
MSDS	Material Safety Data Sheet
	Test Methods for Evaluation of Solid Wastes, SW 846 3 rd Edition

1 Ratings

1.1 Ratings After Charge

1.1.1	Nominal Operating Voltage	1.2 volt (discharged at 0.2I _t A to 1.0 V at 20 ± 5°C)
1.1.2	Nominal (C ₅) Capacity	750 mAh
1.1.3	Minimum Individual (C ₅) Capacity	698 mAh
1.1.4	Constant Current Charge Methods	Standard: at 0.1I _t A for 16 hrs, (1.2) Rapid: at 1I _t A to -dv = 3 - 8 mv, (1.3)
1.1.5	Max. Continuous Discharge Current	2I _t A at 21 ± 2°C
1.1.6	Temperature Range of Operation	Charge: 0°C to 45°C at a max RH of 85% Discharge: -10°C to 45°C at a max RH of 85%
1.1.7	Nominal Weight	13 g

1.2 Standard charge

Standard charge is defined as charging at a constant current of 0.1I_tA for a 16 hour period followed by a 60-minute rest period. The environmental conditions during charge and rest include a temperature range of 20 ± 5°C and a relative humidity range of 50 ± 15%. The I_tA nomenclature used in the document is based on IEC guidelines. The reference I_tA value is defined as I_tA = C_nAh / 1h where:

I_t is the reference test current in amperes

C_n is the rated capacity in ampere-hours

n is the time, based in hours, for which the rated capacity is based, which is 5.

1.3 Rapid Charge

Rapid charge is defined as charging at a constant current of 1I_tA to a -dv = 3 - 8 mv cutoff followed by a 30-minute rest period. The environmental conditions for charge and rest are listed in section 1.2.

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1.4 Shipping Condition

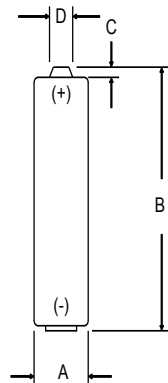
- 1.4.1 All batteries shall be shipped (except Latin America) at a state of charge of 75-90% from the factory
- 1.4.2 All batteries shipped to Latin America are to be shipped at a state of charge of 55-65% from the factory
- 1.4.3 All batteries shall contain a top external insulator and a full protective label that covers both the insulator and sides of the battery prior to shipment.
- 1.4.4 All batteries shall be shipped by a method that prevents the battery terminals from shorting against each other, against the shipping container and against other materials that they may reasonably encounter during shipment.
- 1.4.5 All packaged batteries shall be shipped in a refrigerated container where the temperature inside the container is 20 - 23°C and does not exceed 27°C.

2 Physical Requirements

2.1 Dimensions

The battery shall meet the dimensions in Figure 1.

Figure 1: Dimensions



A	9.5 – 10.5 mm DIA (0.374" - 0.413")
B	43.3 – 44.5 mm (1.705 – 1.752")
C	0.8 mm (0.0315") MIN
D	3.8 mm (0.150") MAX DIA

2.2 Date Coding

Identify manufacture date of battery using Rayovac date coding per Specification S1000231. Preferred location of date code is on jacket of battery although negative terminal is also acceptable. Date code must be printed clearly and legibly on each battery. Other methods of age traceable coding may be acceptable but must be pre-approved by Rayovac Corporate Quality.

2.3 Manufacturer Coding

Identify the manufacturer of the battery using the Rayovac manufacturer coding method per Rayovac Specification S1002120. The preferred location of the manufacturer code is adjacent to the date code on the jacket of the battery although negative terminal is also acceptable. Manufacturer code must be permanent, clear and legible on each battery. Other methods of manufacturer code may be acceptable but must be pre-approved by Rayovac Corporate Quality.

2.4 Visual Inspection

Visual inspection shall be performed to insure that defects are not shipped. Examples of defects include but are not limited to:

- Surface scratches, wrinkles, holes or improper wrap of label



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- Smudged or non-registered printing on labels
- Wrong hues (colors) or distorted artwork on label graphics
- Illegible, or missing date code
- Missing external top insulator
- Misshapen cans
- Broken, bent or loose terminals
- External leakage

3 Electrical Requirements

The cells used to determine electrical and battery service life requirements. Charge each cell at 0.1I_rA for 16 hours, (section 1.2). Unless otherwise specified, all testing is conducted at a standard temperature of 20 ± 5°C and a standard relative humidity of 50 ± 15%. The measurements are to be taken within 48 hours of the completion of the charge step.

3.1 Open Circuit Voltage (OCV)

Charge at 0.1I_rA for 16 hours, (section 1.2), then measure with a voltmeter having a minimum internal resistance of 1MΩ/volt.

Lot Criteria Minimum Average of 1.365 V
Individual Criteria Average ± 25 mV

3.2 AC Internal Impedance

Charge at 0.1I_rA for 16 hours, (section 1.2), then measure impedance using the 1KHz AC method.

Lot Criteria Maximum Average of 40 mΩ
Individual Criteria Average ± 5 mΩ

3.3 Closed Circuit Voltage (CCV)

Apply standard charge, (section 1.2), then measure the CCV after 500 milli-seconds on a load of 3.9 Ω.

Lot Criteria Minimum Average of 1.34 V
Individual Criteria Average ± 25 mV

4 Battery Service Life

Perform all testing at 20 ± 5°C unless otherwise specified

4.1 Capacity Testing

4.1.1 Rated (C₅) Capacity

Charge at 0.1I_rA for 16 hours, (section 1.2), then discharge at 0.2I_rA to a 1.0 end point voltage.

Average Capacity (cycles 3-5): 750 mAh
Minimum individual capacity (93% of Average Capacity): 698 mAh

4.1.2 Constant Current (1C/1C) Capacity

Charge at 1I_rA to a -dv = 3 - 8 mv cutoff, (section 1.3) then discharge at 1I_rA to a 0.9 end point voltage.

Average Capacity (cycles 3-5): 698 mAh
Minimum individual capacity (cycles 3-5): 649 mAh

4.1.3 Digital Camera Application Test

Charge at 0.1I_rA for 16 hours, (section 1.2), store according to the durations specified below, then discharge per the following test regime:



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Test Regime Step	Duration	EPV
1) Discharge 1200mW	2 Seconds	1.05V
2) Discharge 650mW	28 Seconds	1.05V
3) Run load steps 1 and 2 a total of 10 Times (5 Minutes Total)		
4) Rest	55 Minutes (each hour)	1.05V
5) Repeat steps 1-4 until EPV (1.05V) is reached		

One pulse is defined to be one complete load period (Steps 1 and 2)
Reference: ANSI 18.3 Part 1M-2005, Spec. Sheet 15LF

Storage Conditions and Capacity Requirements:

Storage Time:	Temp.	Minimum Average	Minimum Individual
No Delay	20°C	140 Pulses	130 Pulses

4.2 Cycle Life Testing: 20°C

Discharge unit initially to establish State of Charge as received. Continue testing following charge, discharge and rest steps as executed, at $20 \pm 5^\circ\text{C}$.

4.2.1 Rated (C_5) Capacity Cycle Life

Discharge: 0.2I_rA to a 1.0 end point voltage (Initial State of Charge) then cycle as follows:
Charge: 0.1I_rA for 16 Hours, (section 1.2)
Rest: 30 minutes between *each* charge and discharge half cycle
Discharge: 0.2I_rA to a 1.0 end point voltage

Minimum average capacity as received:	75% of initial average capacity
Minimum average capacity at cycle 50:	98% of initial average capacity
Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	75% of initial average capacity
Minimum average capacity at cycle 300:	60% of initial average capacity

4.2.2 Consumer Cycle Life

Charge: 1I_rA to a $-dv = 3 - 8$ mv cutoff, (section 1.3)
Rest: 30 minutes between each charge and discharge half cycle
Discharge: 1I_rA to a 0.90 end point voltage

Minimum average capacity at cycle 100:	90% of initial average capacity
Minimum average capacity at cycle 200:	80% of initial average capacity
Minimum average capacity at cycle 300:	60% of initial average capacity

4.3 Maximum Charge Temperature Using Constant Current Charge Regime

The outer case temperature of the cell measured at 25°C should not exceed 45°C during constant current charge regimes listed in sections 4.1 and 4.2.

4.4 Charge Capacity Retention

Charge: 0.1I_rA for 16 Hours, (section 1.2)
Store: As indicated in table
Discharge: 0.2I_rA to 1.0V end point voltage to determine average

Requirements:

Minimum Ave. % Retained



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Storage Temp	Storage Time	vs. Rated Capacity (1.1.2)
20°C	28 days	85%
20°C	91 days	82.5%
20°C	182 days	80%
20°C	365 days	60%
45°C	28 days	60%
45°C	14 days	80%
60°C	7 days	75%

4.5 Discharge Capacity Recovery

Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Store: As indicated in table
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes between charge and discharge half cycles
 Discharge: 0.2I_rA to 1.0V end point voltage
 Repeat for 3 cycles and report maximum retained average.

Storage Temp	Storage Time	Recovered vs Rated Capacity (1.1.2)
20°C	28 days	100%
20°C	90 days	98%
45°C	14 days	95%
60°C	7 days	95%

4.6 Standard 0.1I_rA Overcharge at 20°C ± 5°C

Confirm that the cells will withstand overcharge at the 0.1I_rA rate, (section 1.2).
 Rest: Between 1 and 4 hr
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (section 1.1.3)

4.7 Over-discharge at 20°C ± 5°C

Confirm that the cells will withstand constant current over-discharge at the 0.2I_rA rate.
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Discharge: 0.2I_rA for minimum of 10 hrs
 Rest: between 1 and 4 hr
 Charge: 0.1I_rA for 16 Hours, (section 1.2)
 Rest: 60 minutes before discharge
 Discharge: 0.2I_rA to end point voltage of 1.0V

Minimum individual cell capacity: 95% of minimum C₅ capacity, (1.1.3)

5 Battery Leakage

All samples must be fully charged using standard charge (section 1.2) prior to leakage testing.

5.1 Thermal Cycle Storage – Leakage

Subject battery to the repeating thermal cycle described. Battery shall not show visible leakage after 4 weeks. The thermal cycles are as follows:

-30°C ± 2°C (-20°F ± 4°F)	8 hrs ± 0.5 hr.
71°C ± 2°C (160°F ± 4°F)	16 hrs ± 0.5 hr.



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Transition Times allow up to 1 hr.
 Duration 1 cycle every 24 hr. for 4 weeks

5.2 Room Temperature Storage – Leakage

Store battery at ambient conditions. Battery shall not show visible leakage and must meet requirements of Section 2 after 6 months of storage.

Environment 21°C ± 5°C (70°F ± 9°F)
 Duration 6 months

5.3 High Temperature Dry Storage – Leakage

Store battery in a high temperature environment. Battery shall not show visible leakage after 8 weeks.

Environment 71°C ± 2°C (160°F ± 4°F)
 Duration 8 weeks

5.4 High Temperature/Humidity Storage – Leakage

Store battery in a high temperature/high humidity environment. Battery shall not show visible leakage after 4 weeks.

Environment 45°C ± 2°C (113°F ± 4°F) 90% ± 4.5% RH
 Duration 4 weeks

6 Foreseeable Misuse

Tests described with “UL” listed are based on procedures outlined in UL 2054 Standard for Safety. All testing in section 6 requires that samples be fully charged via standard charge method, (1.2) prior to test. For tests with a “no venting” failure criteria, the cells are to be weighed before and after the testing and the following criteria shall apply:

Mass of cell or battery	Maximum Mass % Loss
Not more than 1 gram	0.5
More than 1.0g but less than 5.0g	0.2
More than 5.0g	0.1

6.1 UL Short Circuit at 20°C (UL-9)

Individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.2 UL Short Circuit at 55°C (UL-9)

After the units have reached equilibrium at 55 ± 2°C as applicable, individually connect the (+) and (-) terminals of each battery through a copper wire having a maximum resistance of 0.1Ω. The sample shall remain on test until the cell case temperature has returned to near ambient temperature.

Failure Criteria: Battery may not explode or catch fire. The external cell case temperature shall not exceed 150°C.

6.3 UL Projectile Test (UL-22)

Each test sample cell or battery is to be placed on a platform table having a 4-inch (102 mm) diameter hole in the center covered by a screen. The screen is to be constructed of steel wire mesh having 20 openings per inch (25.4 mm) and a wire diameter of 0.017 inch (0.43 mm). An eight-sided covered wire cage, 2 feet (610 mm) across and 1 foot (305 mm) high, made from metal screening is to be placed over the test sample. See Figure 23.1 in the UL2054 procedure document. The metal screening is to be constructed from 0.010 inch



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(0.25 mm) diameter metal wire with 16-18 wires per inch (25.4 mm) in each direction. The sample is to be placed on the screen covering the hole in the center of the table and is to be heated with a direct flame until it explodes, or until it is destroyed.

Failure Criteria: When subjected to the test described, no part of an exploding cell or battery shall penetrate the wire screen such that some or all of the cell or battery protrudes through the screen.

6.4 UL Shock Test (UL-16)

The cell is to be secured to the testing machine by means of a rigid mount, which supports all mounting surfaces of the cell. Each cell shall be subjected to a total of three shocks of equal magnitude. The shocks are to be applied in each of three mutually perpendicular directions unless it has only two axes normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 75 g, (where g is the local acceleration due to gravity). The peak acceleration shall be between 125 and 175 g. Cells shall be tested at a temperature of $20 \pm 2^{\circ}\text{C}$

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.5 UL Vibration Test (UL-17)

A battery is subjected to simple harmonic motion with an amplitude of 0.03 inch, (0.8 mm) with a total maximum excursion of 0.06 inch, (1.6 mm). The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz and return in not less than 90 or more than 100 minutes. The battery is to be tested in three mutually perpendicular directions. For each battery that has only two axes of symmetry, the battery is to be tested perpendicular to each axis.

Failure Criteria: The samples shall not explode or catch fire. In addition, the samples shall not vent or leak.

6.6 UL Heating Test (UL-23)

A charged cell is to be heated in a gravity convection or circulating oven. The temperature of the oven is to be raised at a rate of $5 \pm 2^{\circ}\text{C}$ per minute to a temperature of $150 \pm 2^{\circ}\text{C}$. The oven is to remain for 10 minutes at $150 \pm 2^{\circ}\text{C}$ before test is discontinued.

Failure Criteria: The samples shall not explode or catch fire.

6.7 UL Abnormal Charge (UL Sect 10)

6.6.1 The battery is to be subjected to a charging current of three times the current I_c , specified by the manufacturer by connecting it in opposition to a dc-power supply. The minimum charging time is to be the time required to reach the manufacturers specified end-of-charge condition plus 7 hours.

The test charging time is to be calculated using the formula:

$$T_c = 2.5C / 3(I_c)$$

In which:

t_c is the charging time in hours,

C is the capacity of the cell/battery in ampere-hours, and

I_c is the maximum charging current, in amperes, specified by the manufacturer

6.6.2 The maximum temperature reached on the exterior of the cell, T_{max} , shall be recorded.

6.6.3 Failure Criteria: The samples shall not explode or catch fire.

6.8 Temperature Cycling Test (UL Sect. 24)

6.8.1 The batteries are to be placed in a test chamber and subjected to the following cycles:

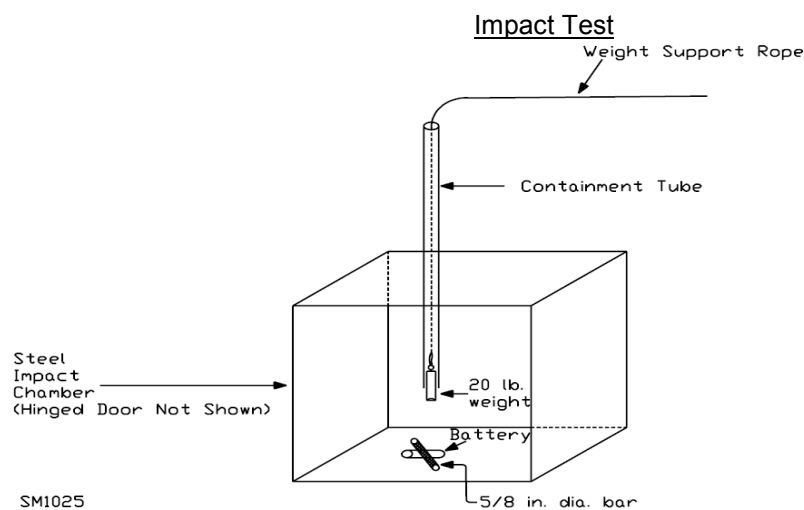
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- a) Raising the chamber-temperature to $70 \pm 3^{\circ}\text{C}$ ($158 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- b) Reducing the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 2 hours.
- c) Reducing the chamber temperature to minus $40 \pm 3^{\circ}\text{C}$ (minus $40 \pm 5^{\circ}\text{F}$) within 30 minutes and maintaining this temperature for 4 hours.
- d) Raising the chamber temperature to $20 \pm 3^{\circ}\text{C}$ ($68 \pm 5^{\circ}\text{F}$) within 30 minutes.
- e) Repeating the sequence for a further 9 cycles.
- f) After the 10th cycle, storing the batteries for a minimum of 24 hours, at a temperature of $20 \pm 5^{\circ}\text{C}$ ($68 \pm 9^{\circ}\text{F}$) prior to examination.

6.8.2 Failure Criteria: The samples shall not explode, catch fire, vent or leak. In addition, Any mass loss exceeding 0.1% after is considered a failure.

6.9 Impact Test (UL Sect. 15)

- 6.9.1. Perform x-ray imaging of each pre-conditioned group to determine initial void volume of the batteries inner windings
- 6.9.2. The battery is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 5/8 inch (15.8 mm) diameter curved surface lying across the center of the test sample.
- 6.9.3. The testing sequence is to be performed as follows:
 - 6.2.3.1. The test sample battery is to be placed on a flat surface.
 - 6.2.3.2. A 15.8 mm (5/8 inch) diameter bar is placed across the center of the sample.
 - 6.2.3.3. A 9.1 ± 0.46 kg (20 ± 1 pound) weight is to be dropped from a height of 610 \square 25 mm (24 ± 1 inch) onto the sample.
 - 6.2.3.4. Each sample battery is to be subjected to only a single impact.



6.9.4. Failure Criteria: The sample shall not explode or catch fire.

7 Packaging and Labeling Requirements Labels shall be duplex type per Rayovac Specification S4000977.



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7.1 Shrinkage Test

Place a drop of whiteout on the label overlap 1 cm from (+) end of battery. Subject battery to 68°C ± 2°C (154°F ± 3.5°F) for 7 days. Measure the distance between the two halves of the drop of whiteout.

Failure Criteria: Battery may not have any can metal exposed due to label shrinkage. Nominal shrinkage = 1.75 mm (0.070")

7.2 High Temperature/High Humidity Label Test

Subject batteries to 45°C ± 2°C (113°F ± 4°F), 90% relative humidity for one week.

Failure Criteria: No discoloration of printing or distortion of label artwork is allowed.

7.3 Packaging Requirement

Packaging for shipment or sales shall conform to a mutually agreed upon packaging specification.

8 Environmental Requirements

8.1 A Material Safety Data Sheet (MSDS) must be provided. (for US and Canada sale only)

8.2 Heavy Metal Limits

The heavy metal contents of the battery shall conform to all applicable regulations (local, national and international) where batteries are to be sold. For US consumption, these additional requirements apply (ppm limits per weight of battery):

Mercury:	Max 1 ppm
Cadmium:	Max 3 ppm
Lead:	Max 250 ppm
Arsenic:	Max 1 ppm
Barium:	Max 100 ppm
Chromium:	Max 50 ppm
Selenium:	Max 10 ppm

8.3 The supplier shall maintain records of analytical data insuring that contents of batteries produced for Rayovac meet the requirements specified in 8.2 and 8.3.

9 Program Requirements

9.1 Lot Definition

A production lot shall consist of one shipment quantity.

9.2 Sample

Samples for performance testing (and any additional audit testing) shall be collected in a way to equally represent the whole production lot in terms of time of manufacture across all cell assembly lines used to create the production lot.

9.3 Conflicts

If there are conflicts between this document and referenced specifications, statements in this specification shall have precedence.

9.4 Product and Process Changes

9.4.1 If any substantial changes are made that will affect the "fit", "form", or "function" of the battery in a device, the supplier must have Rayovac approval in advance of such changes.



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- 9.4.2 Any product or process changes that could affect conformance to the requirements of this specification will necessitate a retest and certification in advance of shipment to Rayovac U.S.A.
- 9.4.3 The supplier shall keep records of all substantial changes for at least four years in order to enable tracing of problems throughout the expected lifetime of the product.

9.5 Lot Acceptance

- 9.5.1 Inspection and testing of each lot including initial qualification testing of batteries is the responsibility of the supplier. Spectrum Brands reserves the right to resample and perform any test listed in this specification. Spectrum Brands results will be the determining factor on all issues of lot acceptance.
- 9.5.2 Any area of non-conformance will be reviewed with Spectrum Brands Purchasing, Corporate Quality and the supplier. Spectrum Brands will decide final disposition.

9.6 Certificate of Compliance

Each lot shipped to Varta or Rayovac will be supported by a Certificate of Compliance containing the information shown in Attachment 1. Certificate of Compliance submission frequency will be agreed between the supplier and Spectrum Brands Corporate Quality.

Revision History			
A	Initial Release		
Material Group:	SAAA	MSDS Required:	<input type="checkbox"/> Yes <input type="checkbox"/> No



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Certificate of Compliance

Date of Shipment		Shipping Order		QA Manager Signature:					
Battery Type		Battery Date Code		Date:					
Part Num./Spec.		Production Plant		Review the Performance Specification for additional information					
Test Description			Supplier – Actual Results						
		Sample Size	Average	Minimum Individual	Maximum Individual	Standard Deviation	Cpk	Histogram	Line Graph
Dimensional:			Dimensional:						
A-Diameter		10						Include	
B-Overall Height		10						Include	
C- + Protrusion Height		10						Include	
D- + Protrusion Diameter		10						include	
Visual:									
-Date / Manufacturer Code		200							
-Number of Defects Identified									
Initial Target:			Initial Target:						
-Open Circuit Voltage (OCV)		100%							
-Closed Circuit Voltage (CCV)		65							
-Impedance		100%							
Capacity:			Capacity:						
	Section 4.1.1	15							Include
	Section 4.1.2	15							Include
	Section 4.1.3	15							Include
	Section 4.1.4	15							Include
Leakage:			Leakage:						
-Section 5	As specified	20							
Safety:			Safety:						
-Section 6	As specified	10							
Environmental:			Environmental:						
-Section 8	As specified								