

PRIMARY BATTERY TESTING

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PRIMARY BATTERY TESTING

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EXECUTIVE SUMMARY

Discharge testing have been performed on alkaline batteries in accordance with IEC 60086-2. Discharge time to specified voltage levels have been determined.

Types LR6/ Applications	Everactive
	Pro
Motor/toy <i>(hours, Avg/std)</i>	8,6 0,0
Radio/Clock <i>(hours, Avg/std)</i>	50,6 0,3
Types LR03/ Applications	Everactive
	Pro
Toy <i>(minutes, Avg/std)</i>	280,4 0,9
Digital audio <i>(hours, Avg/std)</i>	22,1 0,3

The test results apply only to the tested samples.



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References:

IEC 60086-1, Ed. 13.0, 2021

IEC 60086-2, Ed. 14.0, 2021



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1 COMMISSION

The commission was conducted in accordance with our proposal No. SO2205347

Alkaline primary batteries have been tested in accordance with IEC 60086-2. Test conditions are according to IEC 60086-1. Discharge time to specified voltage levels has been determined.

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2 TEST SAMPLES

Table 2.1

Brand	IEC Designation	Date Code	Delivery Date	ES Number
Everactive Pro	LR6	02-2032	2022-06-22	ES22-045
Everactive Pro	LR03	02-2032	2022-06-22	ES22-045

note: ES number is Intertek Semko AB identification for each sample. Test samples were delivered from the client to Intertek Semko AB for testing.

Photograph of tested products:



Figure 2.1 Everactive Pro LR6



Figure 2.2 Everactive Pro LR03



3 TEST PROGRAM

Test methods in Table 3.1 are according to IEC 60086-2. These methods are accredited by SWEDAC.

Table 3.1: Test program including IEC 60086-2 requirements for minimum average duration (MAD)

Type LR6 applications	Load	Load interval	End voltage	MAD (IEC)
Motor/toy	3.9 Ω	1h/d	0,8 V	5 h
Radio/Clock	50 mA	1h/8h	1,0 V	30 h
Type LR03 applications	Load	Load interval	End voltage	MAD (IEC)
Toy	5,1 Ω	1h/d	0,8 V	120 min
Digital audio	50 mA	1 h/12 h, 24 h/d	0,9 V	12 h



4 TEST CONDITIONS

Test conditions are according to IEC 60086-1.

IEC 60086-1 testing was performed on a PEC test system BDT1012 for primary batteries. The batteries were connected to the discharge circuits by pressure contacts.

OCV measurements: Tektronix DMM830, Intertek ID: 31671

Temperature and Humidity measurements: Rotronic Hygrolog, Intertek ID No. 13957

Ambient temperature during test: $21 \pm 1^\circ\text{C}$
Humidity: 45 – 65 % RH

The time to voltage levels / cut-off voltage was determined by scanning every 10 ms and registration with ΔV and Δt .

4.1 Uncertainty of load resistance, voltage measurement and load current

The uncertainty of load resistance is calculated to be less than $\pm 0,5$ % based on calibrations.

The uncertainty of voltage measurement is calculated to be $\leq 0,25$ % based on calibrations.

The uncertainty of load current is calculated to be less than $\pm 0,5$ % based on calibrations.

The uncertainty of time is calculated to be less than tolerances given in Table 4.1.

Table 4.1

Time "accuracy"	Discharge time t_d	Tolerance
	$0 < t_d \leq 2 \text{ s}$	± 5 % of t_d
	$2 \text{ s} < t_d \leq 100 \text{ s}$	$\pm 0,1 \text{ s}$
	$t_d > 100 \text{ s}$	$\pm 0,1$ % of t_d

Measurement uncertainty is reported in accordance with the EA publication EA-4/16 "EA guidelines on the expression of uncertainty in quantitative testing", December 2003 and is indicated by the coverage factor $k = 2$ which for normal distribution corresponds to a coverage probability of about 95%.



5 TEST RESULTS

Test results are summarized in Tables 5.1 - 5.2 below.

Test start: 2022-06-28

Test end: 2022-07-20

Result: Discharge time to end voltage

Tables showing life of individual batteries, discharged to specified end voltages are compiled in Appendix A.

The test results apply only to the tested samples.

Table 5.1 Summary of test results for LR6

Types LR6/ Applications	Everactive Pro
Motor/toy <i>(hours, Avg/std)</i>	8,6 0,0
Radio/Clock <i>(hours, Avg/std)</i>	50,6 0,3

Table 5.2 Summary of test results for LR03

Types LR03/ Applications	Everactive Pro
Toy <i>(minutes, Avg/std)</i>	280,4 0,9
Digital audio <i>(hours, Avg/std)</i>	22,1 0,3

Application: Motor/toy
Product: Everactive Pro

Type: LR6
Load: 3,9 ohm, 1h/d
Test date: 2022-06-28

Cell#:	Test Id	Mfg Date:	Date code	Made In	OCV	1,3 V	1,2 V	1,1 V	1,0 V	0,9 V	0,8 V
1	12623	NA	02-2032	NA	1,649	0,71	2,51	4,84	6,71	7,67	8,54
2	12623	NA	02-2032	NA	1,649	0,79	2,57	4,83	6,69	7,70	8,58
3	12623	NA	02-2032	NA	1,649	0,73	2,53	4,85	6,73	7,68	8,55
4	12623	NA	02-2032	NA	1,649	0,78	2,58	4,85	6,70	7,71	8,59
5	12623	NA	02-2032	NA	1,649	0,71	2,53	4,83	6,69	7,66	8,55
6	12623	NA	02-2032	NA	1,650	0,73	2,51	4,87	6,74	7,70	8,58
7	12623	NA	02-2032	NA	1,649	0,75	2,54	4,82	6,63	7,65	8,52
8	12623	NA	02-2032	NA	1,649	0,78	2,54	4,83	6,70	7,68	8,56
Average (hours)						0,7	2,5	4,8	6,7	7,7	8,6
<i>Std. Dev.</i>						0,0	0,0	0,0	0,0	0,0	0,0
<i>NA = Not Available</i>											
Max (hours)						0,8	2,6	4,9	6,7	7,7	8,6
<i>IEC 60086-2 End voltage (Bold font)</i>											
Min (hours)						0,7	2,5	4,8	6,6	7,6	8,5

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Application: Radio/Clock/Remote Control
Product: Everactive Pro

Type: LR6
Load: 50 mA, 1h/8h 24h/d
Test date: 2022-06-28

Cell#:	Test Id	Mfg Date:	Date code	Made In	OCV	1,3 V	1,2 V	1,1 V	1,0 V	0,9 V	0,8 V
9	12624	NA	02-2032	NA	1,650	20,95	37,85	45,85	50,67	52,37	53,75
10	12624	NA	02-2032	NA	1,650	20,83	37,73	45,75	50,55	51,83	53,43
11	12624	NA	02-2032	NA	1,648	20,98	37,85	45,93	50,80	52,48	53,94
12	12624	NA	02-2032	NA	1,649	20,80	37,70	45,68	50,49	51,75	53,36
13	12624	NA	02-2032	NA	1,649	20,85	37,73	45,80	50,65	52,31	53,66
14	12624	NA	02-2032	NA	1,649	20,80	36,95	45,63	49,95	51,53	52,99
15	12624	NA	02-2032	NA	1,650	20,85	37,80	45,88	50,73	52,40	53,74
16	12624	NA	02-2032	NA	1,649	20,95	37,78	45,93	50,79	52,43	53,86
Average (hours)						20,9	37,7	45,8	50,6	52,1	53,6
<i>Std. Dev.</i>						0,1	0,3	0,1	0,3	0,4	0,3
<i>NA = Not Available</i>						Max (hours)					
						21,0	37,9	45,9	50,8	52,5	53,9
<i>IEC 60086-2 End voltage (Bold font)</i>						Min (hours)					
						20,8	37,0	45,6	50,0	51,5	53,0

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Application: Toy											
Product: Everactive Pro											
Type:	LR03										
Load:	5,1 ohm, 1h/day										
Test date:	2022-06-28										
Cell#:	Test Id	Mfg Date:	Date code	Made In	OCV	1,3 V	1,2 V	1,1 V	1,0 V	0,9 V	0,8 V
1	12627	NA	02-2032	NA	1,642	23,98	80,08	146,94	211,10	263,77	281,55
2	12627	NA	02-2032	NA	1,644	23,50	79,10	146,35	210,58	263,47	280,48
3	12627	NA	02-2032	NA	1,643	22,87	58,87	145,44	208,77	261,13	280,12
4	12627	NA	02-2032	NA	1,644	20,32	50,57	141,23	206,28	239,53	279,05
5	12627	NA	02-2032	NA	1,644	23,26	79,04	145,87	209,43	262,51	280,48
6	12627	NA	02-2032	NA	1,643	23,68	59,57	144,98	208,66	261,67	281,74
7	12627	NA	02-2032	NA	1,644	22,95	58,77	144,88	207,88	262,53	279,52
8	12627	NA	02-2032	NA	1,644	24,10	79,58	145,32	208,00	261,50	280,23
Average (minutes)						23,1	68,2	145,1	208,8	259,5	280,4
<i>Std. Dev.</i>						1,2	12,4	1,7	1,5	8,1	0,9
<i>NA = Not Available</i>						Max (minutes)					
						24,1	80,1	146,9	211,1	263,8	281,7
<i>IEC 60086-2 End voltage (Bold font)</i>						Min (minutes)					
						20,3	50,6	141,2	206,3	239,5	279,1

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Application: Digital audio
Product: Everactive Pro

Type: LR03
Load: 50 mA, 1h/12h 24h/d
Test date: 2022-06-28

Cell#:	Test Id	Mfg Date:	Date code	Made In	OCV	1,3 V	1,2 V	1,1 V	1,0 V	0,9 V	0,8 V
9	12628	NA	02-2032	NA	1,643	4,00	6,58	17,88	21,40	22,16	22,32
10	12628	NA	02-2032	NA	1,643	7,75	14,88	19,55	21,57	22,27	22,44
11	12628	NA	02-2032	NA	1,643	7,63	14,60	18,83	20,95	21,85	22,12
12	12628	NA	02-2032	NA	1,644	7,80	14,93	19,60	21,71	22,49	22,69
13	12628	NA	02-2032	NA	1,645	7,77	14,87	19,53	21,52	22,15	22,30
14	12628	NA	02-2032	NA	1,644	7,75	14,77	19,47	21,47	22,17	22,33
15	12628	NA	02-2032	NA	1,643	7,70	10,28	15,53	19,89	21,68	22,30
16	12628	NA	02-2032	NA	1,644	7,70	14,70	19,44	21,52	22,28	22,46
Average (hours)						7,3	13,2	18,7	21,3	22,1	22,4
<i>Std. Dev.</i>						1,3	3,1	1,4	0,6	0,3	0,2
<i>NA = Not Available</i>						Max (hours)					
						7,8	14,9	19,6	21,7	22,5	22,7
<i>IEC 60086-2 End voltage (Bold font)</i>						Min (hours)					
						4,0	6,6	15,5	19,9	21,7	22,1

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