

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 Industrial
Motor/toy <i>(hours, Avg/std)</i>		7,2 0,2
Radio/Clock <i>(hours, Avg/std)</i>		42,9 1,8
Types LR03/ Applications		Everactive Industrial
Toy <i>(minutes, Avg/std)</i>		262,9 1,7
Digital audio <i>(hours, Avg/std)</i>		19,8 0,6

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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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
	$0 < t_d \leq 2 \text{ s}$	$\pm 5\%$ 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%.

Application: Motor/toy											
Product: Everactive Industrial											
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	12625	NA	02-2027	NA	1,642	0,71	1,91	3,95	5,71	6,72	7,30
2	12625	NA	02-2027	NA	1,638	0,69	1,91	4,40	5,74	6,72	7,28
3	12625	NA	02-2027	NA	1,425	0,68	1,90	4,00	5,76	6,78	7,33
4	12625	NA	02-2027	NA	1,639	0,68	1,90	4,41	5,73	6,69	7,00
5	12625	NA	02-2027	NA	1,640	0,70	1,93	4,41	5,76	6,79	7,32
6	12625	NA	02-2027	NA	1,642	0,71	1,93	4,40	5,75	6,74	7,31
7	12625	NA	02-2027	NA	1,642	0,69	1,92	4,43	5,80	6,79	7,33
8	12625	NA	02-2027	NA	1,642	0,69	1,89	3,99	5,72	6,69	6,97
Average (hours)						0,7	1,9	4,2	5,7	6,7	7,2
<i>Std. Dev.</i>						0,0	0,0	0,2	0,0	0,0	0,2
<i>NA = Not Available</i>						Max (hours)					
						0,7	1,9	4,4	5,8	6,8	7,3
<i>IEC 60086-2 End voltage (Bold font)</i>						Min (hours)					
						0,7	1,9	4,0	5,7	6,7	7,0

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

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	12626	NA	02-2027	NA	1,641	19,52	31,92	38,43	40,78	42,84	43,94
10	12626	NA	02-2027	NA	1,6418	19,62	33,78	41,63	44,85	47,42	48,43
11	12626	NA	02-2027	NA	1,6426	19,57	31,63	37,61	40,42	42,31	43,30
12	12626	NA	02-2027	NA	1,6415	18,99	32,76	39,61	42,54	44,53	45,55
13	12626	NA	02-2027	NA	1,6416	19,54	32,87	39,78	42,67	44,79	45,92
14	12626	NA	02-2027	NA	1,6382	18,93	32,81	39,82	42,77	44,94	46,30
15	12626	NA	02-2027	NA	1,6388	18,94	32,77	39,91	43,64	45,68	46,78
16	12626	NA	02-2027	NA	1,6419	19,58	33,79	41,92	45,84	48,33	49,29
Average (hours)						19,3	32,8	39,8	42,9	45,1	46,2
<i>Std. Dev.</i>						0,3	0,8	1,4	1,8	2,1	2,0
<i>NA = Not Available</i>						Max (hours)					
						19,6	33,8	41,9	45,8	48,3	49,3
<i>IEC 60086-2 End voltage (Bold font)</i>						Min (hours)					
						18,9	31,6	37,6	40,4	42,3	43,3

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Application: Toy											
Product: Everactive Industrial											
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	12629	NA	02-2027	NA	1,640	21,57	47,29	113,82	200,33	224,96	262,13
2	12629	NA	02-2027	NA	1,640	21,93	48,56	114,78	200,98	226,73	263,77
3	12629	NA	02-2027	NA	1,639	22,29	49,48	115,43	201,12	226,81	262,63
4	12629	NA	02-2027	NA	1,641	23,75	51,80	117,90	202,88	229,63	265,28
5	12629	NA	02-2027	NA	1,641	21,89	48,52	116,93	202,80	229,80	265,21
6	12629	NA	02-2027	NA	1,640	22,29	49,04	113,18	199,30	223,30	260,63
7	12629	NA	02-2027	NA	1,640	22,25	49,44	113,27	179,80	222,53	261,15
8	12629	NA	02-2027	NA	1,640	21,95	48,35	112,64	200,33	224,83	262,47
Average (minutes)						22,2	49,1	114,7	198,4	226,1	262,9
<i>Std. Dev.</i>						0,7	1,3	1,9	7,6	2,7	1,7
<i>NA = Not Available</i>						Max (minutes)					
						23,8	51,8	117,9	202,9	229,8	265,3
<i>IEC 60086-2 End voltage (Bold font)</i>						Min (minutes)					
						21,6	47,3	112,6	179,8	222,5	260,6

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Application: Digital audio
Product: Everactive Industrial

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	12630	NA	02-2027	NA	1,640	6,67	12,72	15,92	17,60	18,41	18,66
10	12630	NA	02-2027	NA	1,640	6,62	12,83	16,88	18,80	19,78	20,34
11	12630	NA	02-2027	NA	1,639	6,64	12,85	16,90	18,86	19,93	20,47
12	12630	NA	02-2027	NA	1,640	6,69	12,96	17,48	19,31	20,38	20,71
13	12630	NA	02-2027	NA	1,640	6,67	12,90	16,99	18,95	19,98	20,56
19	12630	NA	02-2027	NA	1,641	6,68	13,42	17,56	19,43	20,51	20,86
15	12630	NA	02-2027	NA	1,639	5,97	12,80	16,84	18,76	19,76	20,28
16	12630	NA	02-2027	NA	1,641	5,90	12,85	16,88	18,78	19,78	20,33
Average (hours)						6,5	12,9	16,9	18,8	19,8	20,3
<i>Std. Dev.</i>						0,3	0,2	0,5	0,6	0,6	0,7
<i>NA = Not Available</i>						Max (hours)					
						6,7	13,4	17,6	19,4	20,5	20,9
<i>IEC 60086-2 End voltage (Bold font)</i>						Min (hours)					
						5,9	12,7	15,9	17,6	18,4	18,7

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