



EN/ENL batteries

Technical manual 80 Ah to 500 Ah/10h

*Valve Regulated
Lead Acid batteries*



YUASA BATTERIES FRANCE



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EN/ENL battery range

YUASA offers an extensive range of gas recombination valve-regulated lead-acid batteries (VRLA). The EN (12 years) and ENL (15 years) ranges, with capacities from 80 to 500 Ah (C10) are specially designed for the most critical telecommunications, UPS and other high power applications.

General characteristics

- AGM (Absorbed Glass Mat) electrolyte immobilisation system
- Operates in all positions (except upside down)
- Over 99% gas recombination
- Low pressure safety valve
- Easy to maintain
- UL94 V0 (flame retardant) ABS container
- Series and parallel configuration
- High yield lead-tin-calcium plates
- Long service life
- Low auto-discharge / long storage life
- Wide operating temperature range
- Use in floating or cycling operation
- Good discharge and quick charge performance
- Good recovery after deep discharge



Floating or cycling charge applications

- Uninterruptable power supplies (UPS)
- Telecom and ISP data centres
- Emergency lighting
- Light electric vehicles
- Robotics, automatic control systems
- Medical equipment
- Maritime and railway equipment
- Solar or wind power systems
- etc.



Specifications

All applications

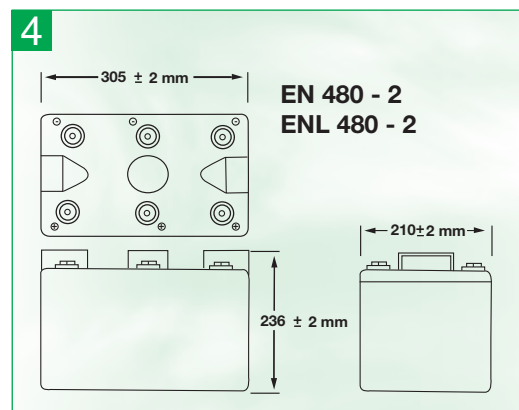
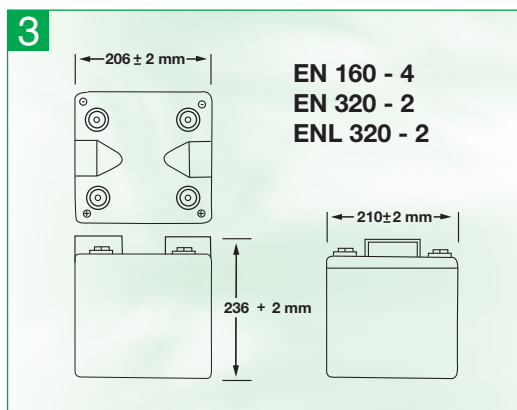
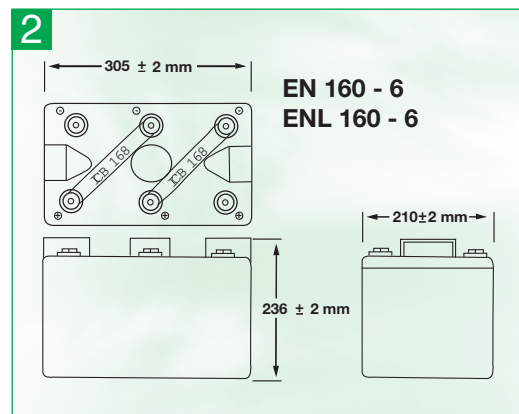
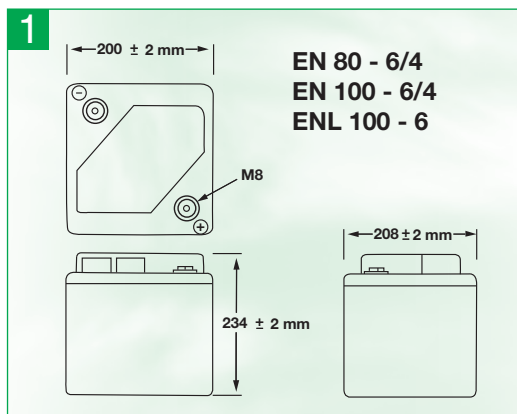
Type of Battery	Nominal voltage (V)	Capacity *		Length (mm)	Width (mm)	Height (mm)	Total height	Approx. weight (kg)	Diagram (below)	Terminals (Page 4)	Maximum current in 1 min (A)	Maximum current in 1 sec (A)	Internal impedance (mΩ)**
		(Ah/10h)	(Ah/20h)										
EN80-4	4	83	86	200	208	234	238	17	1	A	480	800	1.5
EN80-6	6	83	86	200	208	234	238	22	1	A	480	800	2.3
EN100-4	4	104	108	200	208	234	238	17,5	1	A	600	1000	1.2
EN100-6	6	104	108	200	208	234	238	23	1	A	600	1000	1.8
ENL100-6	6	104	108	200	208	234	238	23	1	B	600	950	2.0
EN160-4	4	166	173	206	210	236	240	24,5	3	B	960	1500	0.8
EN160-6	6	166	173	305	210	236	240	37	2	B	960	1500	1.2
ENL160-6	6	166	173	305	210	236	240	37	2	B	960	1500	1.5
EN320-2	2	333	346	206	210	236	240	24,5	3	B	1 920	3000	0.3
ENL320-2	2	333	346	206	210	236	240	24,5	3	B	1 920	3000	0.4
EN480-2	2	499	518	305	210	236	240	37	4	B	2 880	4500	0.2
ENL480-2	2	499	518	305	210	236	240	37	4	B	2 880	4500	0.2
ENL100-12FT	12	100	104	558	125	233	233	41	-	C	102	200	7.5

For telecommunications applications in 19" or 23" racks, with autonomy greater than 30 minutes, we recommend the ENL100-12FT Front Terminal battery (100 Ah, 12 V, 15 years).

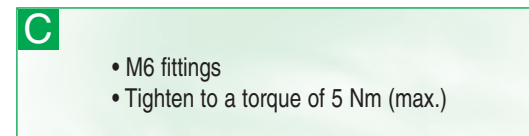
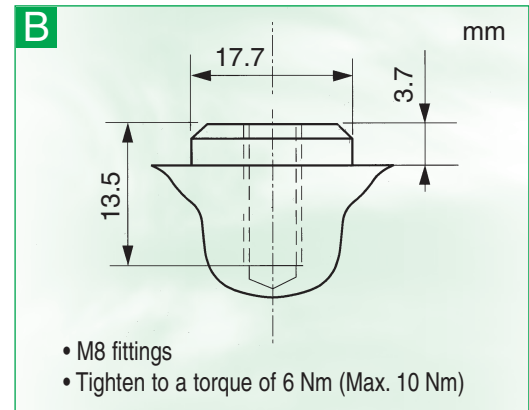
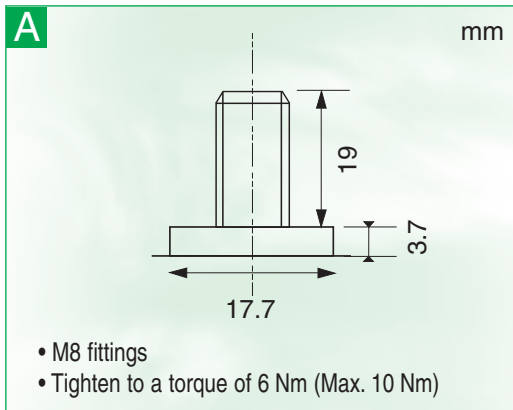
*: Temperature 20°C. Final voltage 1.75 V/cell.

** : Battery charged, measured at 1000 Hz.

Diagrams of terminal layout and overall dimensions



Terminals



Higher capacity

EN/ENL battery modules may be combined in parallel to adapt and increase their capacity.

As the battery plates are strictly identical, the self-contained units may be fitted together in parallel without causing balancing problems during charging or discharging.



Battery selection

Calculation methods

Examples for selecting **EN/ENL** (Endurance) batteries using the discharge performance tables (pages 6 to 9) for an application at constant current and an application at constant power.

Example A
DISCHARGE AT CONSTANT CURRENT
<p>A telecommunications PBX (48 V):</p> <ul style="list-style-type: none"> • uses a 24-cell battery • has a constant current consumption of 80 A • operates correctly down to a minimum voltage of 44.5 V. <p>Determine the ideal EN/ENL battery for 3 hours of autonomy at 20°C with a service life of 15 years.</p>
METHOD
<ul style="list-style-type: none"> • Voltage per cell at end of autonomy (final voltage): $\frac{44.5 \text{ V (minimum voltage)}}{24 \text{ (number of cells)}} = 1.85 \text{ V/cell}^*$ • In the constant current performance tables, for a final voltage of 1.85 V and an autonomy of 3 hours, the closest higher value is 86.4 A per cell for an ENL320-2 battery. <p>* Check that this final voltage is greater than the corresponding minimum (see fig. 3 p. 11) for an ENL320-2 battery with a discharge of:</p> $\frac{86.4 \text{ A (discharge current)}}{320 \text{ Ah (nominal capacity)}} = 0.27 \text{ C}$ <p>Figure 3 on page 11 shows that the minimum voltage is approximately 1.8 V.</p> <p>The calculated value (1.85 V/cell) is above this minimum value.</p> <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center; margin-top: 10px;"> Selected battery: 24 modules ENL320-2 </div>

Example B
DISCHARGE AT CONSTANT POWER
<p>A 100 kVA UPS consumes a constant power of 85 kW on its DC input. The voltage operating range varies between a maximum of 448 V and a minimum of 346 V.</p> <p>Determine the ideal EN/ENL battery for 20 minutes' autonomy and use at 20°C with a 15-year service life.</p>
METHOD
<ul style="list-style-type: none"> • Calculating the number of cells: The charge and floating voltage is set at 2.26 Volt per cell at 20°C. The battery will comprise: $\frac{448 \text{ V (maximum voltage)}}{2.26 \text{ V}} = 198 \text{ cells}$ • Voltage per cell at end of autonomy (final voltage): $\frac{346 \text{ V (minimum voltage)}}{198 \text{ (number of cells)}} = 1.75 \text{ V/cell}^*$ • Power per cell: $\frac{85,000 \text{ W (total power)}}{198 \text{ (number of cells)}} = 429 \text{ W/cell}$ • Determining the ideal battery: In the constant power performance tables, for a final voltage of 1.75 V and an autonomy of 20 minutes, the closest higher value is 464 W per cell for an ENLI60 battery. • Number of modules for an ENLI60-6 battery. $\frac{198 \text{ (number of cells)}}{3 \text{ (number of cells per module)}} = 66 \text{ modules}$ <p>* Check that this final voltage is greater than the corresponding minimum value (see fig. 3 p. 11)</p> <p>Discharge current (at nominal V):</p> $\frac{85,000 \text{ W (total power)}}{198 \text{ (number of cells)} \times 2 \text{ V}} = 215 \text{ A}$ <p>or for an ENLI60 battery, a discharge of:</p> $\frac{215 \text{ A (discharge current)}}{160 \text{ Ah (nominal capacity)}} = 1.3 \text{ C}$ <p>Figure 3 p. 11 shows that the minimum voltage is approximately 1.7 V/cell. The calculated value (1.75 V/cell) is above this minimum value.</p> <div style="background-color: #4CAF50; color: white; padding: 5px; text-align: center; margin-top: 10px;"> Selected battery: 66 modules ENLI60-6 </div>

➔ Contact our technical department for any additional information or if you have specific selection requirements.



Performance for constant current discharge

Discharge current (Amp) for a final voltage of 1.6 V per cell, at 20°C

Type of battery	Autonomy								Hours											
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	400	275	195	152	127	109	96.0	71.4	57.9	41.6	33.4	23.6	18.6	15.4	13.3	11.8	10.8	9.6	8.8	3.8
EN80-6	400	275	195	152	127	109	96.0	71.4	57.9	41.6	33.4	23.6	18.6	15.4	13.3	11.8	10.8	9.6	8.8	3.8
EN100-4	500	344	244	190	159	136	120	89.3	72.4	52.0	41.7	29.5	23.3	19.2	16.6	14.7	13.5	12.0	11.0	4.8
EN/ENL100-6	500	344	244	190	159	136	120	89.3	72.4	52.0	41.7	29.5	23.3	19.2	16.6	14.7	13.5	12.0	11.0	4.8
EN160-4	800	550	390	304	254	218	192	143	116	83.2	66.7	47.2	37.3	30.7	26.6	23.5	21.6	19.2	17.6	7.7
EN/ENL160-6	800	550	390	304	254	218	192	143	116	83.2	66.7	47.2	37.3	30.7	26.6	23.5	21.6	19.2	17.6	7.7
EN/ENL320-2	1600	1101	781	608	509	435	384	286	232	166.4	133.4	94.4	74.6	61.4	53.1	47.0	43.2	38.4	35.2	15.4
EN/ENL480-2	2400	1651	1171	912	763	653	576	429	348	249.6	200.2	141.6	111.8	92.2	79.7	70.6	64.8	57.6	52.8	23.0

Discharge current (A) for a final voltage of 1.63 V per cell, at 20°C

Type of battery	Autonomy								Hours											
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	380	266	192	151	126	108	95.2	71.1	57.6	41.5	33.2	23.5	18.4	15.2	13.2	11.8	10.6	9.4	8.6	3.8
EN80-6	380	266	192	151	126	108	95.2	71.1	57.6	41.5	33.2	23.5	18.4	15.2	13.2	11.8	10.6	9.4	8.6	3.8
EN100-4	475	333	240	189	158	135	119	88.9	72.0	51.9	41.5	29.4	23.0	19.0	16.5	14.7	13.2	11.8	10.8	4.8
EN/ENL100-6	475	333	240	189	158	135	119	88.9	72.0	51.9	41.5	29.4	23.0	19.0	16.5	14.7	13.2	11.8	10.8	4.8
EN160-4	760	533	384	302	253	216	190	142	115	83.0	66.4	47.0	36.8	30.4	26.4	23.5	21.1	18.9	17.3	7.7
EN/ENL160-6	760	533	384	302	253	216	190	142	115	83.0	66.4	47.0	36.8	30.4	26.4	23.5	21.1	18.9	17.3	7.7
EN/ENL320-2	1520	1066	768	605	506	432	381	284	230	166	133	94.1	73.6	60.8	52.8	47.0	42.2	37.8	34.6	15.4
EN/ENL480-2	2280	1598	1152	907	758	648	571	427	346	249	199	141	110	91.2	79.2	70.6	63.4	56.6	51.8	23.0

Discharge current (A) for a final voltage of 1.65 V per cell, at 20°C

Type of battery	Autonomy								Hours											
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	364	258	188	150	125	107	94.4	70.8	57.4	41.4	33.0	23.4	18.4	15.2	13.2	11.6	10.6	9.4	8.6	3.8
EN80-6	364	258	188	150	125	107	94.4	70.8	57.4	41.4	33.0	23.4	18.4	15.2	13.2	11.6	10.6	9.4	8.6	3.8
EN100-4	455	323	235	187	156	134	118	88.5	71.7	51.8	41.3	29.3	23.0	19.0	16.5	14.5	13.2	11.8	10.8	4.8
EN/ENL100-6	455	323	235	187	156	134	118	88.5	71.7	51.8	41.3	29.3	23.0	19.0	16.5	14.5	13.2	11.8	10.8	4.8
EN160-4	728	517	376	299	250	214	189	142	115	82.9	66.1	46.9	36.8	30.4	26.4	23.2	21.1	18.9	17.3	7.7
EN/ENL160-6	728	517	376	299	250	214	189	142	115	82.9	66.1	46.9	36.8	30.4	26.4	23.2	21.1	18.9	17.3	7.7
EN/ENL320-2	1456	1034	752	598	499	429	378	283	229	166	132	93.8	73.6	60.8	52.8	46.4	42.2	37.8	34.6	15.4
EN/ENL480-2	2184	1550	1128	898	749	643	566	425	344	249	198	141	110	91.2	79.2	69.6	63.4	56.6	51.8	23.0

Discharge current (A) for a final voltage of 1.67 V per cell, at 20°C

Type of battery	Autonomy								Hours											
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	348	254	186	148	123	106	93.6	70.2	56.9	41.3	32.6	23.4	18.4	15.2	12.9	11.6	10.4	9.3	8.6	3.8
EN80-6	348	254	186	148	123	106	93.6	70.2	56.9	41.3	32.6	23.4	18.4	15.2	12.9	11.6	10.4	9.3	8.6	3.8
EN100-4	435	317	232	185	154	133	117	87.8	71.1	51.6	40.8	29.2	23.0	19.0	16.1	14.5	13.0	11.6	10.8	4.8
EN/ENL100-6	435	317	232	185	154	133	117	87.8	71.1	51.6	40.8	29.2	23.0	19.0	16.1	14.5	13.0	11.6	10.8	4.8
EN160-4	696	507	371	296	246	213	187	140	114	82.6	65.3	46.7	36.8	30.4	25.8	23.2	20.8	18.6	17.3	7.7
EN/ENL160-6	696	507	371	296	246	213	187	140	114	82.6	65.3	46.7	36.8	30.4	25.8	23.2	20.8	18.6	17.3	7.7
EN/ENL320-2	1392	1014	742	592	493	426	374	281	228	165	131	93.4	73.6	60.8	51.5	46.4	41.6	37.1	34.6	15.4
EN/ENL480-2	2088	1522	1114	888	739	638	562	421	341	248	196	140	110	91.2	77.3	69.6	62.4	55.7	51.8	23.0

Discharge current (A) for a final voltage of 1.70 V per cell, at 20°C

Type of battery	Autonomy								Minutes											Hours												
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	340	248	182	146	122	106	92.8	69.6	56.3	41.0	32.2	23.2	18.2	15.1	12.9	11.6	10.4	9.3	8.5	3.8	56.3	41.0	32.2	23.2	18.2	15.1	12.9	11.6	10.4	9.3	8.5	3.8
EN80-6	340	248	182	146	122	106	92.8	69.6	56.3	41.0	32.2	23.2	18.2	15.1	12.9	11.6	10.4	9.3	8.5	3.8	56.3	41.0	32.2	23.2	18.2	15.1	12.9	11.6	10.4	9.3	8.5	3.8
EN100-4	425	310	227	183	152	132	116	87.0	70.4	51.3	40.3	29.0	22.7	18.9	16.1	14.5	13.0	11.6	10.6	4.7	70.4	51.3	40.3	29.0	22.7	18.9	16.1	14.5	13.0	11.6	10.6	4.7
EN/ENL100-6	425	310	227	183	152	132	116	87.0	70.4	51.3	40.3	29.0	22.7	18.9	16.1	14.5	13.0	11.6	10.6	4.7	70.4	51.3	40.3	29.0	22.7	18.9	16.1	14.5	13.0	11.6	10.6	4.7
EN160-4	680	496	363	293	243	211	186	139	113	82.1	64.5	46.4	36.3	30.2	25.8	23.2	20.8	18.6	17.0	7.5	113	82.1	64.5	46.4	36.3	30.2	25.8	23.2	20.8	18.6	17.0	7.5
EN/ENL160-6	680	496	363	293	243	211	186	139	113	82.1	64.5	46.4	36.3	30.2	25.8	23.2	20.8	18.6	17.0	7.5	113	82.1	64.5	46.4	36.3	30.2	25.8	23.2	20.8	18.6	17.0	7.5
EN/ENL320-2	1360	992	726	586	486	422	371	278	225	164	129	92.8	72.6	60.5	51.5	46.4	41.6	37.1	33.9	15.0	225	164	129	92.8	72.6	60.5	51.5	46.4	41.6	37.1	33.9	15.0
EN/ENL480-2	2040	1488	1090	878	730	634	557	418	338	246	193	139	109	90.7	77.3	69.6	62.4	55.7	50.9	22.6	338	246	193	139	109	90.7	77.3	69.6	62.4	55.7	50.9	22.6

Discharge current (A) for a final voltage of 1.75 V per cell, at 20°C

Type of battery	Autonomy								Minutes											Hours												
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	296	222	170	139	118	102	91.2	68.4	54.7	40.0	31.4	22.6	17.8	14.8	12.9	11.4	10.2	9.1	8.3	3.8	54.7	40.0	31.4	22.6	17.8	14.8	12.9	11.4	10.2	9.1	8.3	3.8
EN80-6	296	222	170	139	118	102	91.2	68.4	54.7	40.0	31.4	22.6	17.8	14.8	12.9	11.4	10.2	9.1	8.3	3.8	54.7	40.0	31.4	22.6	17.8	14.8	12.9	11.4	10.2	9.1	8.3	3.8
EN100-4	370	278	212	174	147	128	114	85.5	68.4	50.0	39.2	28.2	22.2	18.5	16.1	14.3	12.8	11.4	10.4	4.7	68.4	50.0	39.2	28.2	22.2	18.5	16.1	14.3	12.8	11.4	10.4	4.7
EN/ENL100-6	370	278	212	174	147	128	114	85.5	68.4	50.0	39.2	28.2	22.2	18.5	16.1	14.3	12.8	11.4	10.4	4.7	68.4	50.0	39.2	28.2	22.2	18.5	16.1	14.3	12.8	11.4	10.4	4.7
EN160-4	592	445	339	278	235	205	182	137	109	80.0	62.7	45.1	35.5	29.6	25.8	22.6	20.5	18.2	16.6	7.5	109	80.0	62.7	45.1	35.5	29.6	25.8	22.6	20.5	18.2	16.6	7.5
EN/ENL160-6	592	445	339	278	235	205	182	137	109	80.0	62.7	45.1	35.5	29.6	25.8	22.6	20.5	18.2	16.6	7.5	109	80.0	62.7	45.1	35.5	29.6	25.8	22.6	20.5	18.2	16.6	7.5
EN/ENL320-2	1184	890	678	557	470	410	365	274	219	160	125	90.2	71.0	59.2	51.5	45.8	41.0	36.5	33.3	15.0	219	160	125	90.2	71.0	59.2	51.5	45.8	41.0	36.5	33.3	15.0
EN/ENL480-2	1776	1334	1018	835	706	614	747	410	328	240	188	135	107	88.8	77.3	68.6	61.4	54.7	49.9	22.6	328	240	188	135	107	88.8	77.3	68.6	61.4	54.7	49.9	22.6

Discharge current (A) for a final voltage of 1.80 V per cell, at 20°C

Type of battery	Autonomy								Minutes											Hours												
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	242	192	154	126	108	95.2	85.6	65.0	53.4	38.8	30.8	22.2	17.4	14.6	12.7	11.0	10.0	8.8	8.2	3.6	53.4	38.8	30.8	22.2	17.4	14.6	12.7	11.0	10.0	8.8	8.2	3.6
EN80-6	242	192	154	126	108	95.2	85.6	65.0	53.4	38.8	30.8	22.2	17.4	14.6	12.7	11.0	10.0	8.8	8.2	3.6	53.4	38.8	30.8	22.2	17.4	14.6	12.7	11.0	10.0	8.8	8.2	3.6
EN100-4	303	240	192	158	135	119	107	81.3	66.7	48.5	38.5	27.7	21.7	18.2	15.9	13.7	12.5	11.0	10.2	4.5	66.7	48.5	38.5	27.7	21.7	18.2	15.9	13.7	12.5	11.0	10.2	4.5
EN/ENL100-6	303	240	192	158	135	119	107	81.3	66.7	48.5	38.5	27.7	21.7	18.2	15.9	13.7	12.5	11.0	10.2	4.5	66.7	48.5	38.5	27.7	21.7	18.2	15.9	13.7	12.5	11.0	10.2	4.5
EN160-4	485	384	307	253	216	190	171	130	107	77.6	61.6	44.3	34.7	29.1	25.4	21.9	20.0	17.6	16.3	7.2	107	77.6	61.6	44.3	34.7	29.1	25.4	21.9	20.0	17.6	16.3	7.2
EN/ENL160-6	485	384	307	253	216	190	171	130	107	77.6	61.6	44.3	34.7	29.1	25.4	21.9	20.0	17.6	16.3	7.2	107	77.6	61.6	44.3	34.7	29.1	25.4	21.9	20.0	17.6	16.3	7.2
EN/ENL320-2	970	768	614	506	432	381	342	260	213	155	123	88.6	69.4	58.2	50.9	43.8	40.0	35.2	32.6	14.4	213	155	123	88.6	69.4	58.2	50.9	43.8	40.0	35.2	32.6	14.4
EN/ENL480-2	1454	1152	922	758	648	571	514	390	320	233	185	133	104	87.4	76.3	65.8	60.0	52.8	49.0	21.6	320	233	185	133	104	87.4	76.3	65.8	60.0	52.8	49.0	21.6

Discharge current (A) for a final voltage of 1.85 V per cell, at 20°C

Type of battery	Autonomy								Minutes											Hours												
	1	5	10	15	20	25	30	45	1	1.5	2	3	4	5	6	7	8	9	10	24	1	1.5	2	3	4	5	6	7	8	9	10	24
EN80-4	***	160	129	110	97.6	85.6	78.4	61.4	50.3	37.2	29.6	21.6	16.8	14.2	12.5	10.8	9.8	8.6	8.0	3.5	50.3	37.2	29.6	21.6	16.8	14.2	12.5	10.8	9.8	8.6	8.0	3.5
EN80-6	***	160	129	110	97.6	85.6	78.4	61.4	50.3	37.2	29.6	21.6	16.8	14.2	12.5	10.8	9.8	8.6	8.0	3.5	50.3	37.2	29.6	21.6	16.8	14.2	12.5	10.8	9.8	8.6	8.0	3.5
EN100-4	***	200	161	138	122	107	98.0	76.8	62.9	46.5	37.0	27.0	21.0	17.8	15.6	13.5	12.2	10.8	10.0	4.4	62.9	46.5	37.0	27.0	21.0	17.8	15.6	13.5	12.2	10.8	10.0	4.4
EN/ENL100-6	***	200	161	138	122	107	98.0	76.8	62.9	46.5	37.0	27.0	21.0	17.8	15.6	13.5	12.2	10.8	10.0	4.4	62.9	46.5	37.0	27.0	21.0	17.8	15.6	13.5	12.2	10.8	10.0	4.4
EN160-4	***	320	258	221	195	171	157	123	101	74.4	59.2	43.2	33.6	28.5	25.0	21.6	19.5	17.3	16.0	7.0	101	74.4	59.2	43.2	33.6	28.5	25.0	21.6	19.5	17.3	16.0	7.0
EN/ENL160-6	***	320	258	221	195	171	157	123	101	74.4	59.2	43.2	33.6	28.5	25.0	21.6	19.5	17.3	16.0	7.0	101	74.4	59.2	43.2	33.6	28.5	25.0	21.6	19.5	17.3	16.0	7.0
EN/ENL320-2	***	640	515	442	390	342	314	246	201	149	118	86.4	67.2	57.0	49.9	43.2	39.0	34.6	32.0	14.1	201	149	118	86.4	67.2	57.0	49.9	43.2	39.0	34.6	32.0	14.1
EN/ENL480-2	***	960	773	662	586	514	470	369	302	223	178	130	101	85.4	74.9	64.8	58.6	51.8	48.0	21.1	302	223	178	130	101	85.4	74.9	64.8	58.6	51.8	48.0	21.1

Performance for constant power discharge

Discharge power (W) per cell for a final voltage of 1.60 V, at 20°C

Type of battery	Autonomy							Hours												
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24
EN80-4	670	520	384	304	248	184	136	110	79	63.2	53	44.8	32.8	26.4	23.2	20.8	19.2	17.6	16.0	6.66
EN80-6	670	520	384	304	248	184	136	110	79	63.2	53	44.8	32.8	26.4	23.2	20.8	19.2	17.6	16.0	6.66
EN100-4	838	650	480	380	310	230	170	138	99	79	66	56	41	33	29	26	24	22	20	8.33
EN/ENL100-6	838	650	480	380	310	230	170	138	99	79	66	56	41	33	29	26	24	22	20	8.33
EN160-4	1341	1040	768	608	496	368	272	221	158	126	106	89.6	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL160-6	1341	1040	768	608	496	368	272	221	158	126	106	89.6	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL320-2	2682	2080	1536	1216	992	736	544	442	317	253	211	179	131	106	92.8	83.2	76.8	70.4	64	26.7
EN/ENL480-2	4022	3120	2304	1824	1488	1104	816	662	475	379	317	269	197	158	139	125	115	106	96	40

Discharge power (W) per cell for a final voltage of 1.63 V, at 20°C

Type of battery	Autonomy							Hours												
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24
EN80-4	653	520	384	304	248	184	136	110	79	62.4	53	44.8	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67
EN80-6	653	520	384	304	248	184	136	110	79	62.4	53	44.8	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67
EN100-4	816	650	480	380	310	230	170	137	99	78	66	56	41	33	29	26	24	22	20	8.33
EN/ENL100-6	816	650	480	380	310	230	170	137	99	78	66	56	41	33	29	26	24	22	20	8.33
EN160-4	1306	1040	768	608	496	368	272	219	158	125	106	89.6	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL160-6	1306	1040	768	608	496	368	272	219	158	125	106	89.6	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL320-2	2611	2080	1536	1216	992	736	544	438	317	250	211	179	131	106	92.8	83.2	76.8	70.4	64	26.7
EN/ENL480-2	3917	3120	2304	1824	1488	1104	816	658	475	375	317	269	197	159	139	125	115	106	96	40

Discharge power (W) per cell for a final voltage of 1.65 V, at 20°C

Type of battery	Autonomy							Hours												
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24
EN80-4	636	504	376	304	248	184	136	110	79	62.4	53	44.8	32.8	26.4	23.2	20.8	19.2	17.6	16	6.66
EN80-6	636	504	376	304	248	184	136	110	79	62.4	53	44.8	32.8	26.4	23.2	20.8	19.2	17.6	16	6.66
EN100-4	795	630	470	380	310	230	170	137	99	78	66	56	41	33	29	26	24	22	20	8.33
EN/ENL100-6	795	630	470	380	310	230	170	137	99	78	66	56	41	33	29	26	24	22	20	8.33
EN160-4	1272	1008	752	608	496	368	272	219	158	125	106	89.6	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL160-6	1272	1008	752	608	496	368	272	219	158	125	106	89.6	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL320-2	2544	2016	1504	1216	992	736	544	438	317	250	211	179	131	106	92.8	83.2	76.8	70.4	64	26.7
EN/ENL480-2	3816	3024	2256	1824	1488	1104	816	658	475	374	317	269	197	159	139.2	125	115	106	96	40

Discharge power (W) per cell for a final voltage of 1.67 V, at 20°C

Type of battery	Autonomy							Hours												
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24
EN80-4	620	488	368	296	240	184	134	109	78	61.6	51	44	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67
EN80-6	620	488	368	296	240	184	134	109	78	61.6	51	44	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67
EN100-4	775	610	460	370	300	230	167	136	98	77	64	55	41	33	29	26	24	22	20	8.33
EN/ENL100-6	775	610	460	370	300	230	167	136	98	77	64	55	41	33	29	26	24	22	20	8.33
EN160-4	1240	976	736	592	480	368	267	218	157	123	102	88	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL160-6	1240	976	736	592	480	368	267	218	157	123	102	88	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3
EN/ENL320-2	2480	1952	1472	1184	960	736	534	435	314	246	205	176	131	106	92.8	83.2	76.8	70.4	64	26.7
EN/ENL480-2	3720	2928	2208	1776	1440	1104	802	653	470	370	307	264	197	158	139	125	115	106	96	40

Discharge power (W) per cell for a final voltage of 1.70 V, at 20°C

Type of battery	Autonomy							Minutes							Hours						
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24	
EN80-4	584	464	352	280	240	184	132	108	78	61.6	51	44	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN80-6	584	464	352	280	240	184	132	108	78	61.6	51	44	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN100-4	730	580	440	350	300	230	165	135	98	77	64	55	41	33	29	26	24	22	20	8.33	
EN/ENL100-6	730	580	440	350	300	230	165	135	98	77	64	55	41	33	29	26	24	22	20	8.33	
EN160-4	1168	928	704	560	480	368	264	216	157	123	102	88	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL160-6	1168	928	704	560	480	368	264	216	157	123	102	88	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL320-2	2336	1856	1408	1120	960	736	528	432	314	246	205	176	131	106	92.8	83.2	76.8	70.4	64	26.7	
EN/ENL480-2	3504	2784	2112	1680	1440	1104	792	648	470	370	307	264	197	158	139	125	115	106	96	40	

Discharge power (W) per cell for a final voltage of 1.75 V, at 20°C

Type of battery	Autonomy							Minutes							Hours						
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24	
EN80-4	522	432	336	272	232	176	130	105	77	60	51	43.2	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN80-6	522	432	336	272	232	176	130	105	77	60	51	43.2	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN100-4	652	540	420	340	290	220	163	131	96	75	64	54	41	33	29	26	24	22	20	8.33	
EN/ENL100-6	652	540	420	340	290	220	163	131	96	75	64	54	41	33	29	26	24	22	20	8.33	
EN160-4	1043	864	672	544	464	352	261	210	154	120	102	86.4	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL160-6	1043	864	672	544	464	352	261	210	154	120	102	86.4	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL320-2	2086	1728	1344	1088	928	704	522	419	307	240	205	173	131	106	92.8	83.2	76.8	70.4	64	26.7	
EN/ENL480-2	3130	2592	2016	1632	1392	1056	782	629	461	360	307	259	197	158	139.2	125	115	106	96	40	

Discharge power (W) per cell for a final voltage of 1.80 V, at 20°C

Type of battery	Autonomy							Minutes							Hours						
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24	
EN80-4	438	376	296	248	208	162	128	102	74	59.2	50	42.4	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN80-6	438	376	296	248	208	162	128	102	74	59.2	50	42.4	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN100-4	547	470	370	310	260	203	160	128	93	74	62	53	41	33	29	26	24	22	20	8.33	
EN/ENL100-6	547	470	370	310	260	203	160	128	93	74	62	53	41	33	29	26	24	22	20	8.33	
EN160-4	875	752	592	496	416	325	256	205	149	118	99	84.8	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL160-6	875	752	592	496	416	325	256	205	149	118	99	84.8	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL320-2	1750	1504	1184	992	832	650	512	410	298	237	198	170	131	106	92.8	83.2	76.8	70.4	64	26.7	
EN/ENL480-2	2626	2256	1776	1488	1248	974	768	614	446	355	298	254	197	158	139	125	115	106	96	40	

Discharge power (W) per cell for a final voltage of 1.85 V, at 20°C

Type of battery	Autonomy							Minutes							Hours						
	1	5	10	15	20	30	45	1	1.5	2	2.5	3	4	5	6	7	8	9	10	24	
EN80-4	***	320	272	232	200	152	120	96	71	57.6	48	41.6	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN80-6	***	320	272	232	200	152	120	96	71	57.6	48	41.6	32.8	26.4	23.2	20.8	19.2	17.6	16	6.67	
EN100-4	***	400	340	290	250	190	150	120	89	72	60	52	41	33	29	26	24	22	20	8.33	
EN/ENL100-6	***	400	340	290	250	190	150	120	89	72	60	52	41	33	29	26	24	22	20	8.33	
EN160-4	***	640	544	464	400	304	240	192	142	115	96	83.2	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL160-6	***	640	544	464	400	304	240	192	142	115	96	83.2	65.6	52.8	46.4	41.6	38.4	35.2	32	13.3	
EN/ENL320-2	***	1280	1088	928	800	608	480	384	285	230	192	166	131	106	92.8	83.2	76.8	70.4	64	26.7	
EN/ENL480-2	***	1920	1632	1392	1200	912	720	576	427	346	288	250	197	158	139	125	115	105.6	96	40	

Charging

The performance and service life of the batteries depend directly on the efficiency of charging.

Floating charge

To recharge and correctly maintain the charge of these batteries, we recommended charging at a constant voltage of 2.26 V +/- 1% per cell (at 20°C).

At this voltage there is no need to limit the charge current. The batteries will limit the current peak ($< 3 \times C_{10}^{*max}$) at the start of charging).

The ripple current must be no more than $0.05 C_{10}^{*}$.

Note that for batteries connected in series, the floating voltages for each self-contained battery may vary due to gas recombination.

A dispersion of +6% / -3% may be observed at the start of the batteries' life, dropping to +/- 2% after 6 months of use.

Fast charge, floating application

To recharge the batteries more quickly, charge at a constant voltage of 2.35 V to 2.45 V +/- 1% per cell (subject to special precautions below).

Cycling charge

To recharge the batteries more effectively in a cycling charge application, charge at a constant voltage of 2.45 V +/- 1% per cell (subject to special precautions below).

Precautions to avoid over-charging:

- At this voltage level the charge current must be limited to $0.25 C_{10}^{*}$.
- The fast charge should not last more than 20 hours or should be stopped to resume floating charge once the charge current drops to below $0.07 C_{10}^{*}$.

Charging time

For a charge limited to $0.1 C_{10}^{**}$ or $0.25 C_{10}^{*}$, fully discharged batteries (100% deep discharge) will take approximately 72 hours to recharge with a floating charge.



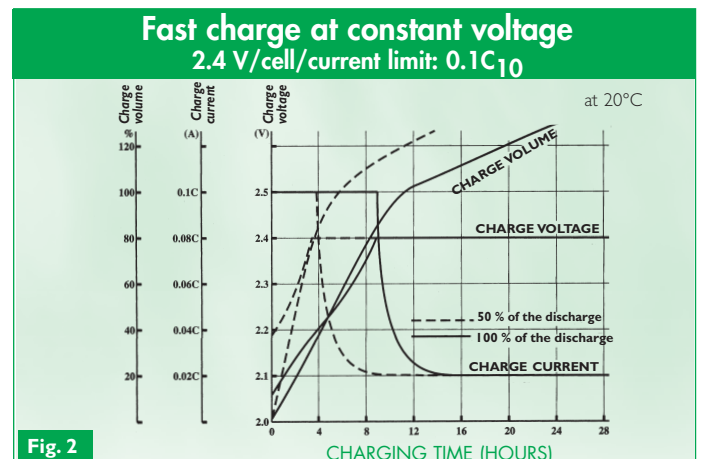
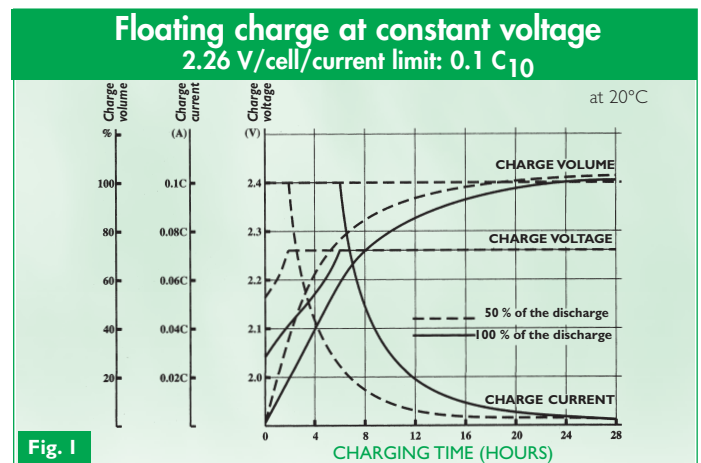
With a quick charge, fully discharged batteries cannot be recharged in less than 4 hours.

Figures 1 and 2 show the voltage, current and charge volume of the batteries as a function of time, for different charge methods.

Note that the charge volume:

- must reach 110 to 115% charge to obtain 100% available capacity.
- will be greater, for a given time, at high temperatures and less at low temperatures.

*: C_{10} represents the battery capacity in 10 hours (final voltage = 1.8 V/cell).





Temperature compensation

In order to optimise the service life of batteries, it is important to avoid over-charging at high temperatures (risk of thermal runaway) or under-charging at low temperatures. **For floating applications**, the floating discharge voltage should be compensated by $-3\text{ mV}/^\circ\text{C}$ for temperatures above 25°C and $+3\text{ mV}/^\circ\text{C}$ for temperatures below 15°C (central point $2.26\text{ V}/\text{cell}$ at 20°C). It is preferable to stop charging if the temperature exceeds 45°C .

If the batteries are at constant temperature (for example in indoor use) and the charger is not compensated, adjust the floating voltage as a function of the battery temperature.

For cycling applications, the charge voltage should be compensated by $-4\text{ mV}/^\circ\text{C}$ for temperatures above 25°C and $+4\text{ mV}/^\circ\text{C}$ for temperatures below 15°C (central point $2.45\text{ V}/\text{cell}$ at 20°C).

Discharge

Battery selection from discharge tables

To determine the batteries required as a function of discharge current or power (at 20°C) and expected autonomy, use the calculation method on page 5 and the tables on pages 6, 7, 8 and 9.

Recharge batteries as soon as possible after any discharge.

Final voltage / deep discharge

Figure 3 shows how battery voltage varies depending on discharge rates and times (autonomy).

The dotted line shows the minimum recommended discharge voltage. To avoid deep discharge and deterioration of the batteries by sulphatation of the plates, do not go below this final voltage.

If batteries are accidentally discharged below this limit, recharge them as soon as possible.

Capacity and temperature

Battery capacity varies as a function of temperature. The table below shows the capacity correction coefficient (at 20°C) as a function of temperature and discharge autonomy. This should be taken into account in selecting a battery based on power or current.

For example, the capacity at 5°C for 38 minutes' autonomy = capacity at 20°C x 0.83 (likewise for current and power).

Autonomy (min)	-20	-15	-10	-5	0	+5	+10	+15	+20	+25	+30	+35	+40	+45	+50
600	0.70	0.76	0.81	0.85	0.89	0.93	0.96	0.98	1.00	1.02	1.03	1.05	1.06	1.08	1.09
150	0.63	0.70	0.76	0.82	0.87	0.91	0.94	0.97	1.00	1.02	1.04	1.06	1.08	1.10	1.12
65	0.50	0.60	0.69	0.76	0.83	0.87	0.91	0.96	1.00	1.03	1.06	1.09	1.11	1.14	1.17
38	0.40	0.52	0.63	0.71	0.78	0.83	0.89	0.95	1.00	1.04	1.08	1.12	1.16	1.20	1.24
14	0.04	0.29	0.51	0.62	0.72	0.80	0.87	0.94	1.00	1.06	1.11	1.17	1.22	1.28	1.34
6	0.00	0.15	0.29	0.47	0.63	0.73	0.83	0.91	1.00	1.09	1.17	1.26	1.34	1.43	1.51

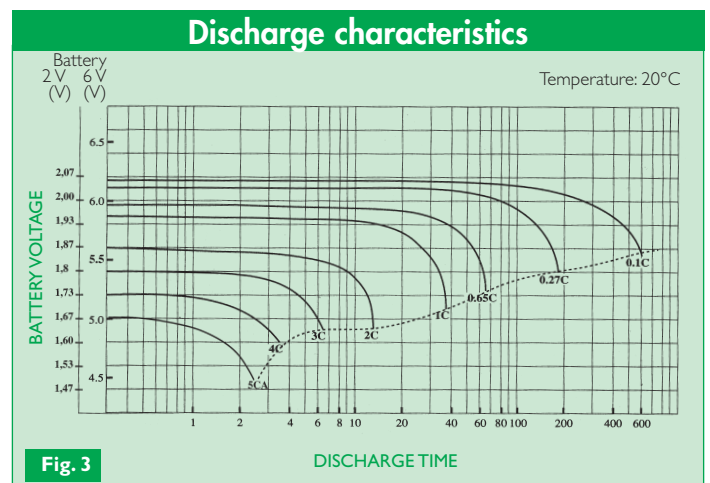


Fig. 3

Self-discharge

The self-discharge rate for EN/ENL batteries is approximately 3% per month when stored at 20°C. The self-discharge rate increases with temperature (see fig. 4).

Batteries should be stored in a cool, dry place.

Storage times should be limited to avoid any deterioration of the battery or difficulty in recharging.

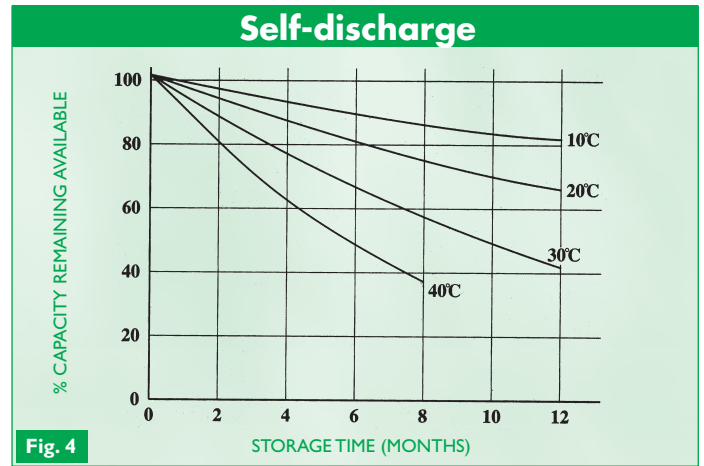


Fig. 4

The table below shows the maximum storage time as a function of temperature.

STORAGE TEMPERATURE	MAXIMUM STORAGE TIME
0°C to 25°C	12 months
25°C to 30°C	9 months
31°C to 40°C	5 months
41°C to 50°C	2.5 months

If the storage limits are reached, batteries must be recharged at 2.4 V/cell (current limited to $0.25 C_{10}$) for 24 hours in order to compensate for the loss of capacity due to self-discharge.

Open circuit voltage and capacity

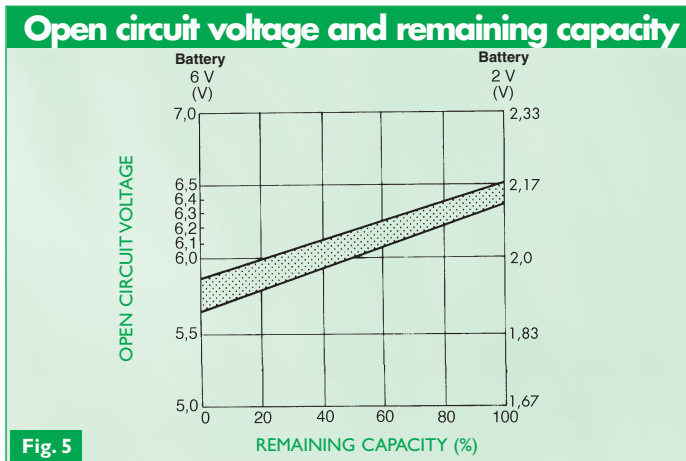


Fig. 5

The remaining battery capacity can be determined empirically by measuring the open circuit voltage after at least 24 hours' rest (see fig. 5).



Date code

The manufacturing date and the date the batteries were charged in the factory are given by a barcode label affixed to each battery. The last six digits correspond to the day, month and year of manufacture.

Service life with floating charge

EN batteries are designed to operate for 12 years in floating charge and 15 years for ENL.

The following conditions must be met:

Floating voltage: 2.26 V/cell (at 20°C).

Temperature less than or equal to 20°C.

Use for backup (on average the battery is fully discharged once every three months).

Figure 6 shows how capacity varies over time.

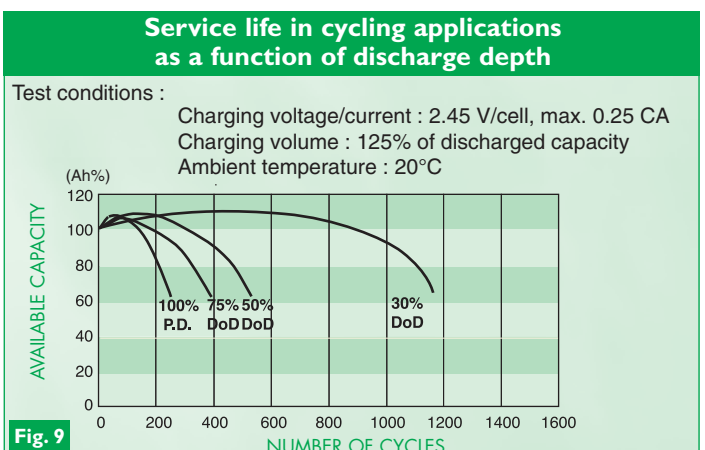
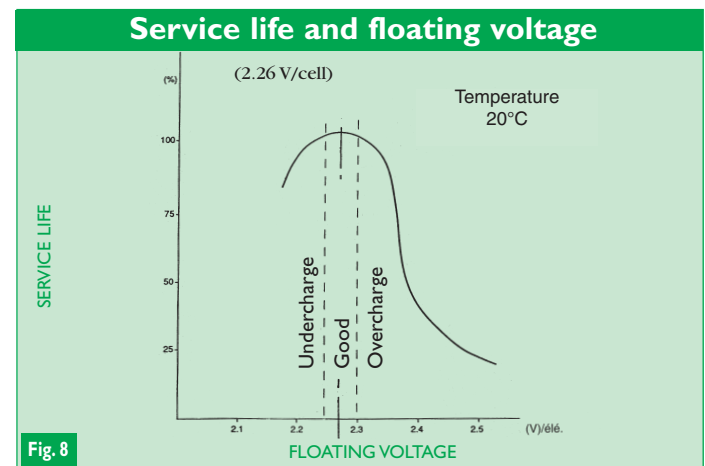
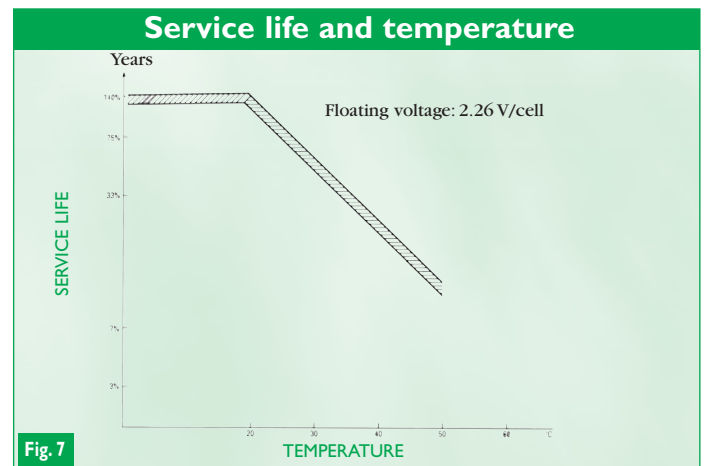
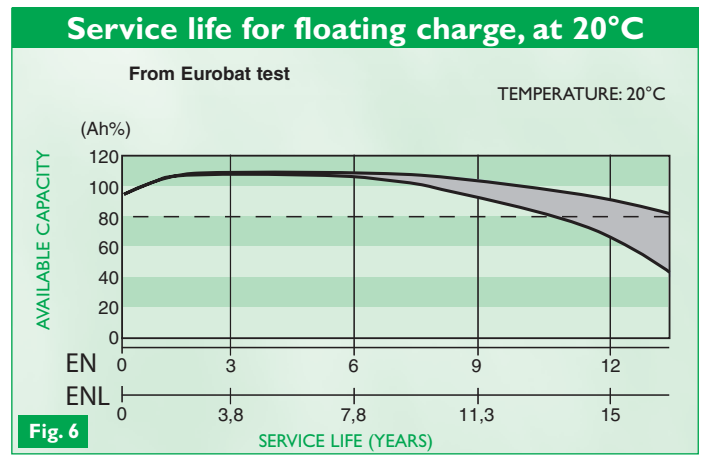
It should be noted that the service life of the batteries is directly affected by:

- Ambient temperature (see fig. 7). The service life is halved for every 10°C above 20°C. Note that the loss of service life can be reduced by 20% by compensating the floating voltage as a function of temperature.
- Floating voltage (see fig. 8).
- Number of discharges.
- Discharge depth and failure to stop at the specified final voltage.
- Poor charge current quality.

Service life with cycling charge

Unlike floating charge applications, the service life for cycling applications is expressed as a number of cycles*. The number of cycles depends directly on the battery discharge depth (see fig. 9).

* One cycle consists of a discharge followed by a recharge.



Standards

EN/ENL batteries:

Comply with or are compatible with the following standards:
IEC 60896-21 and 22, BS6290-4, UL94V0.

UL reference MH28018.

Manufactured in accordance with an ISO 9001:2000 quality system and ISO 14001 environmental management system.

Eurobat: 12 years and longer - long life.

WEEE/ROHS: directives 2002/96/EC and 2002/95/EC, batteries excluded and subject to 91/157/EC.

Temperature

For charging:

20°C recommended, limit -15°C to +50°C.

For discharging:

20°C recommended, limit -20°C to +60°C.

For storage:

0 to 20°C recommended, limit -20°C to +50°C.

Transport

IATA classification: class 8, group 3, UN2800 **A67**
(nohazardous goods).

Environment

Used batteries must be recovered and recycled in accordance with applicable directives.

The WEEE directive and batteries directive are applicable within EC countries.

Usage recommendations

Persons handling the batteries must be qualified to work with live electrical equipment (in accordance with UTE C 18-510 in France, or equivalent standards).

Terminals must never be short-circuited. Insulated tools which meet applicable standards must be used.

Batteries must not be used in an enclosed space. Natural ventilation is required, in compliance with standard EN 50272-2 or NFC 15-100.

Leave a gap of 5 to 10 mm between batteries for ventilation if possible.

Safety cabling must be used if several monoblocs are to be connected together; avoiding any close potential difference and any risk of electric shock.

The cross-section and length of the connectors must be appropriate.

Tighten terminals to the specified torque (see page 4).

Batteries are supplied charged but it is recommended that they should be recharged with a floating charge for 72 hours before any discharge.

Do not suspend batteries by their handles.

Servicing

Ensure that batteries and connectors are kept clean.

Clean batteries with a damp cloth. Do not use solvents.

Every three months, check that the total battery voltage is equal to $2.26 \text{ V} \times N$ cells in series for a temperature of 20°C .

Every year, check the individual voltages of each self-contained battery. Dispersion of + or -2% due to gas recombination may be observed.

An annual autonomy test may be performed, either by discharging or by measuring the impedance.

Installation

Our commercial and technical services are at your disposal for any further information and quotations for:

Supply of batteries in cabinets or on wooden or metal stands, with appropriate connection equipment, accessories and wiring diagrams.

On-site installation and wiring by qualified and authorised installers.

