GNB
INDUSTRIAL POWER
A Division of Exide Technologies

Stasyoner Sulu Tip Kurşun-Asit Akülerin Kullanımı “Classic”

GNB-Uygulama Mühendisliği







Powering a world in motion

Sulu Tip „Classic“ ürünler

GNB INDUSTRIAL POWER
A Division of Exide Technologies

Konular

Giriş ve Genel Bakış

Model Tasarımı “Classic”

5 GroE 500

8 OPzS 800 LA

O = Stasyoner Uygulamalar

6 OCSM 480 LA

10 OGi 530 LA 12V 3

OPzS 150 LA

Blok başına Nominal Gerilim

Pozitif plaka sayısı

Pozitif plaka tasarımı

LA = Düşük Antimon (Sb)

U_s = 1.80 Vpc 'de C_{10} Nominal Kapasitesi

Giriş ve Genel Bakış

“Classic” Akü Yelpazesi

“Classic”- serbest elektrolitli hücreler/bloklar

- GroE
- OPzS
- OCSM
- OGi
- Energy Bloc

Giriş ve Genel Bakış

Nominal Veri

Nominal voltaj	=	2.0 Vpc
Nominal sıcaklık	=	$C_{rt} = C_{10}$ I_{rt} ile deşarj edildiğinde 10 saat
Nominal deşarj akımı	=	$I_{rt} = I_{10}$ (C_{10}/10 h)
Son deşarj gerilimi	=	U_f = 1.80 Vpc
Nominal sıcaklık aralığı	=	20 °C
Çalışma sıcaklığı	=	-20 °C ila +55 °C arası
Güvenlik gereksinimleri	=	EN 50272- 2 / IEC 62485- 2
Test Yöntemleri	=	IEC 60896- 11

Giriş ve Genel Bakış

Karakteristik veriler

	Kendi kendine deşarj	Servis ömrü	Döngü [1])
	[%/ay]	[sene] [3])	
GroE	2.2	20 – 25	200
OPzS hücreler [2]), OCSM	3.3	15 – 20	1500
OPzS bloklar	3.3	15 – 20	1500
Energy Bloc	3.3	13 – 15	600
OGi hücreler	3.3	18	600

Referans sıcaklığı 20 °C

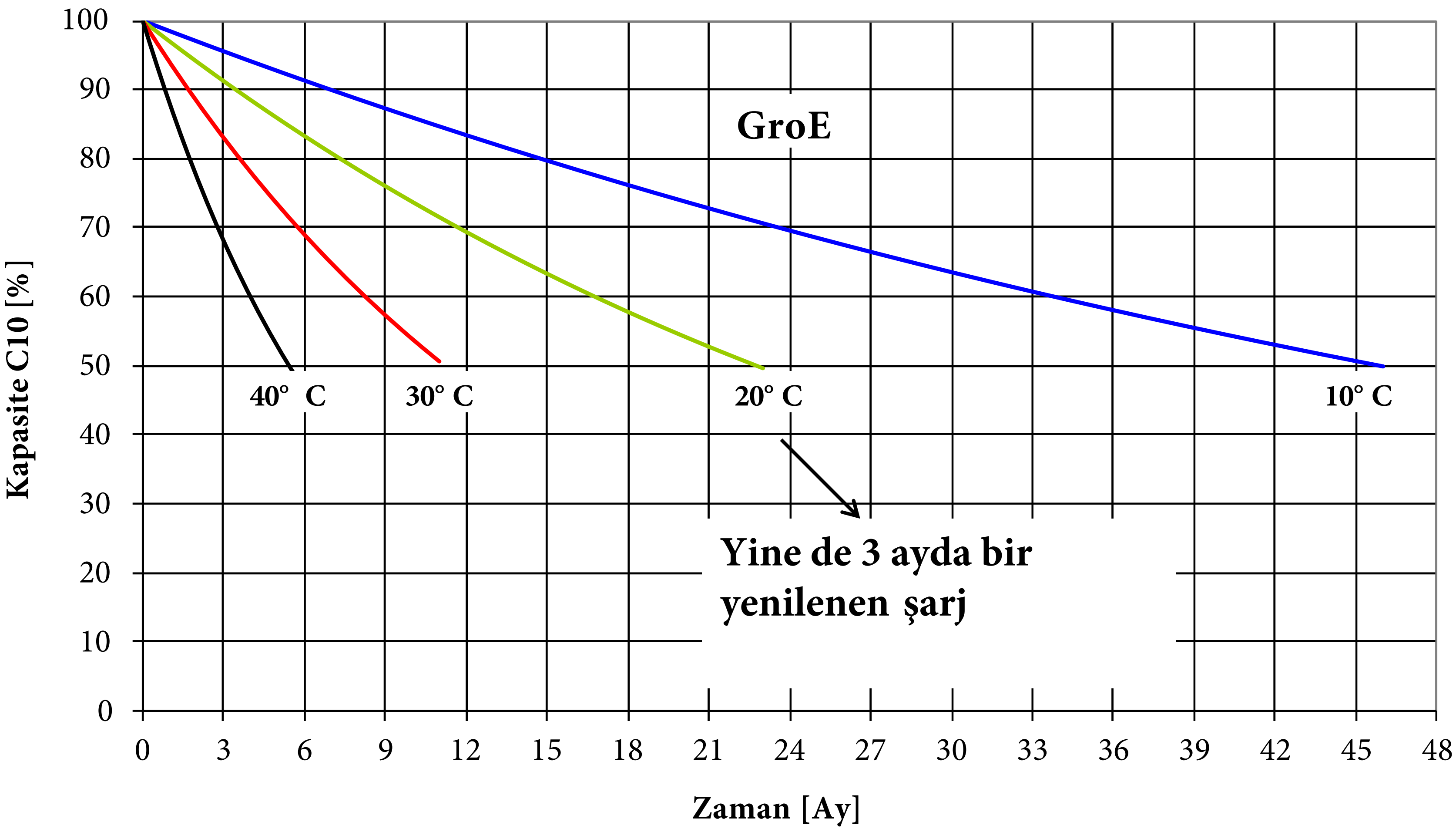
[1])IEC 60896-11'e göre döngü sayıları

[2]) 3000 Ah'a kadar

[3]) Referans: Nominal kapasite

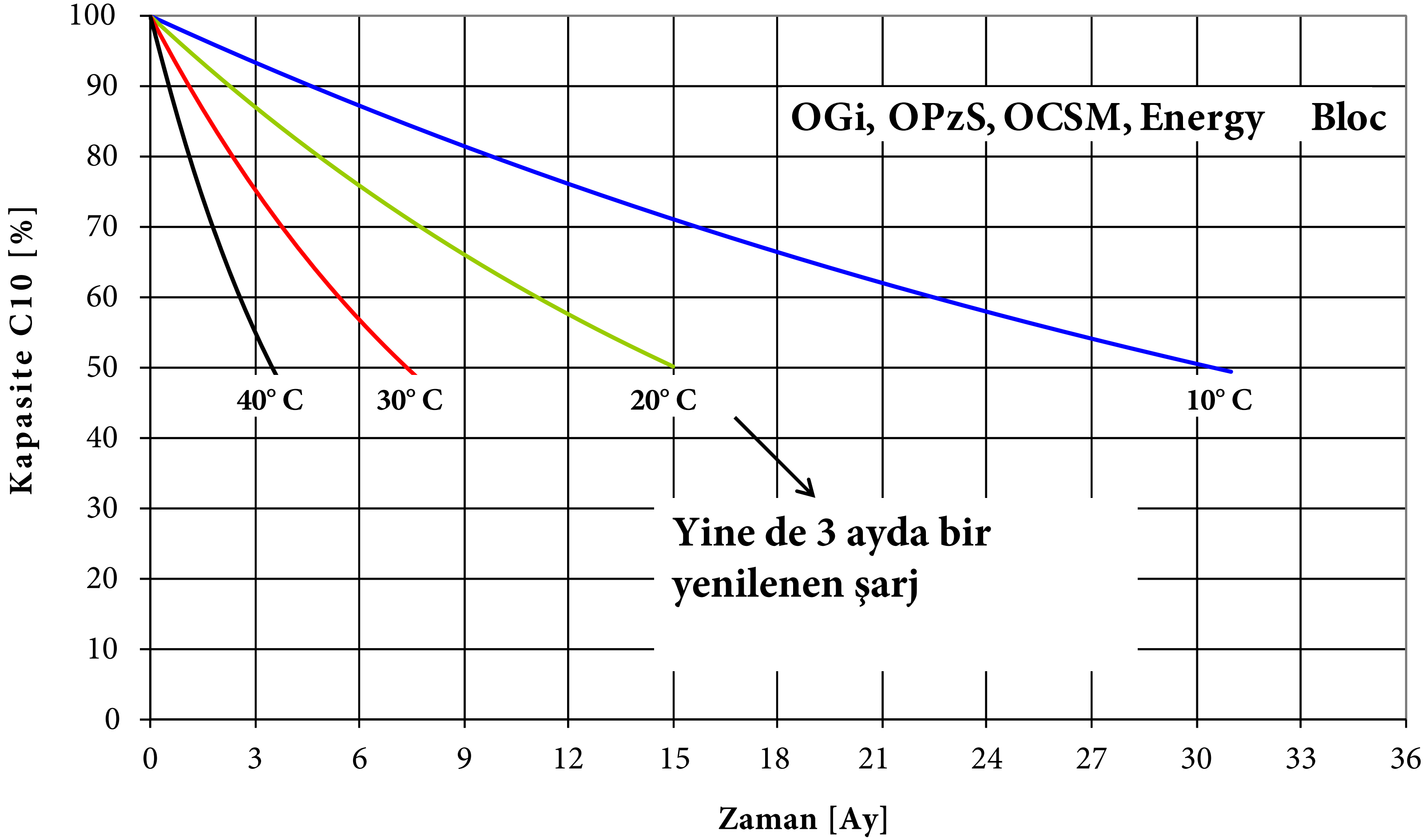
Giriş ve Genel Bakış

Zaman ve Sıcaklığa karşı Kendi kendine Deşarj



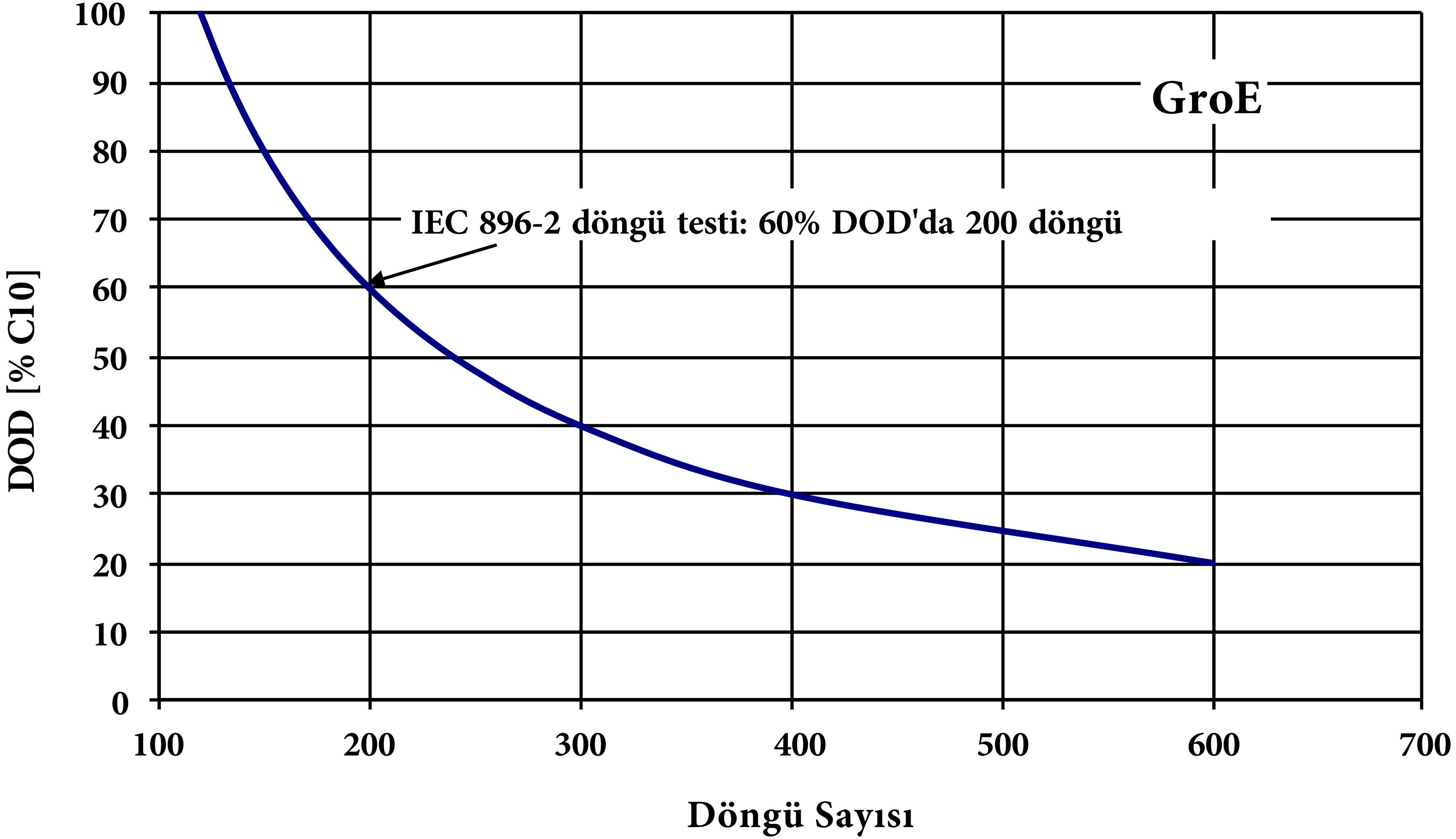
Giriş ve Genel Bakış

Zaman ve Sıcaklığa karşı Kendi kendine Deşarj



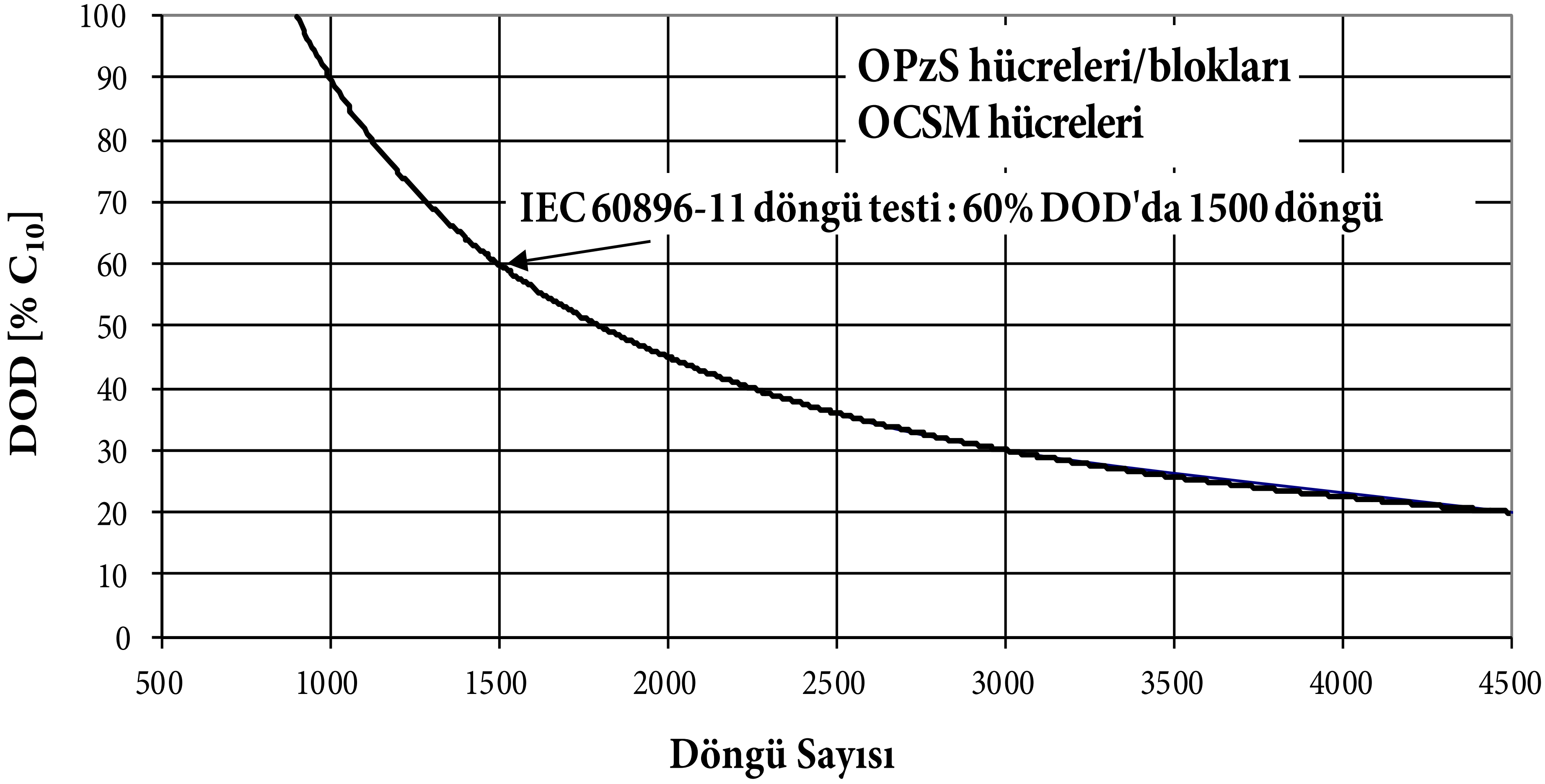
Giriş ve Genel bakış

Deşarj Derinliğine(DOD) karşı Döngü Sayısı



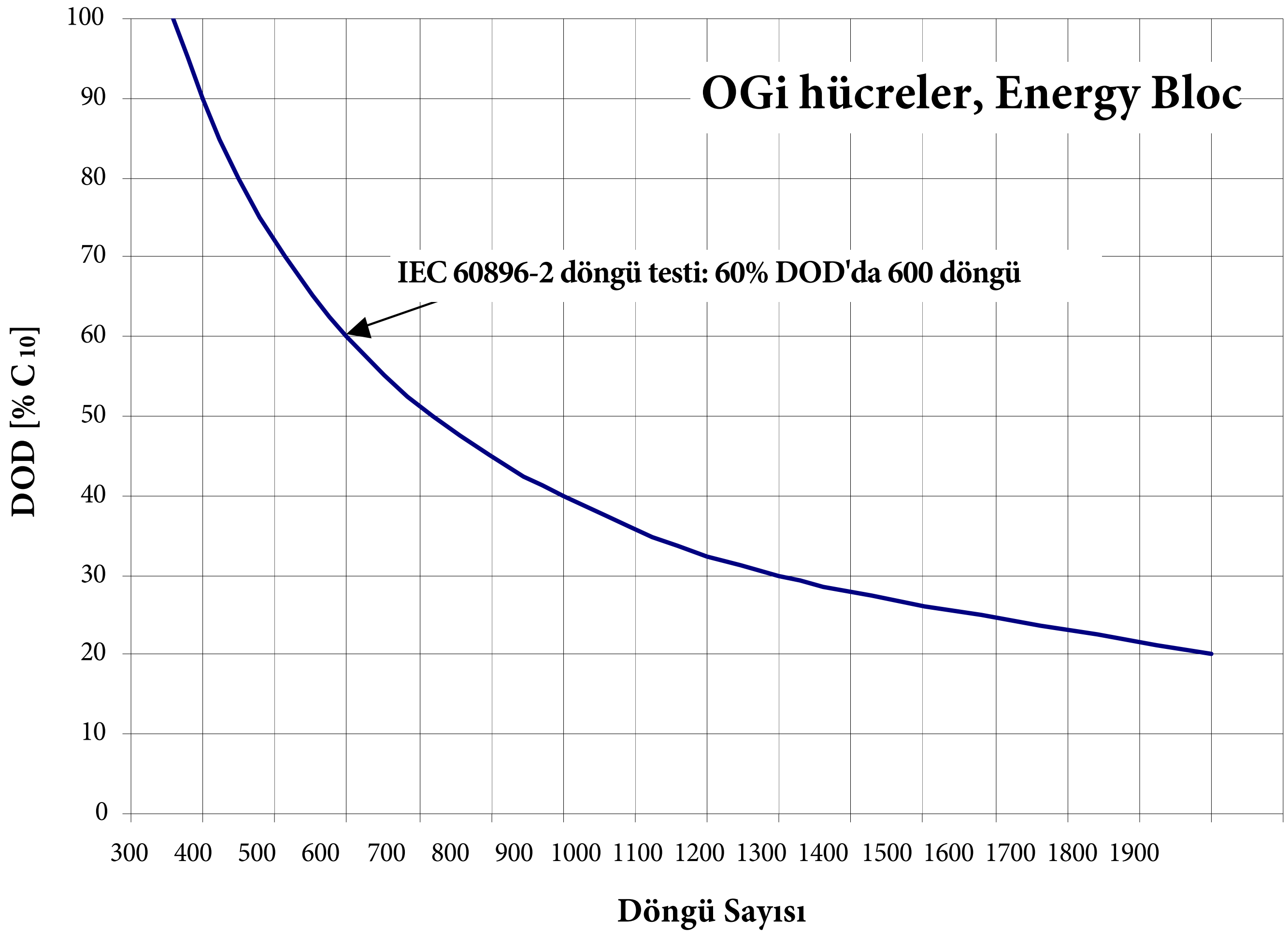
Giriş ve Genel bakış

Deşarj Derinliğine(DOD) karşı Döngü Sayısı



Giriş ve Genel bakış

Deşarj Derinliğine(DOD) karşı Döngü Sayısı



Giriş ve Genel bakış

Sülfürik asit içeriğine karşı Elektrolit yoğunluğu

20°C 'da Asit yoğunluğu[kg/l]	Sülfürik asit içeriği (H_2SO_4) Kütle kısmı [%]	Madde miktarı [mol/l]	Kütle konsantrasyonu [g/l]
1.100	15.18	1.704	166.98
1.110	16.45	1.863	182.60
1.120	17.80	2.034	199.36
1.130	19.15	2.208	216.40
1.140	20.47	2.381	233.36
1.150	21.81	2.558	250.70
1.160	23.11	2735	268.07
1.170	24.39	2.911	285.36
1.180	25.63	3.086	302.43
1.190	26.90	3.266	320.11
1.200	18.12	3.443	337.44
1.210	29.34	3.622	355.01
1.220	30.55	3.805	372.71
1.230	31.78	3.989	390.89
1.240	32.98	4.173	408.95
1.250	34.18	4.360	427.25
1.260	35.40	4.551	446.04
1.270	36.60	4.743	464.82
1.280	37.81	4.938	483.97
1.290	38.93	5.124	502.20
1.300	40.10	5.319	521.30
1.310	41.22	5.510	539.94
1.320	42.35	5.704	559.04
1.330	43.48	5.901	578.26
1.340	44.60	6.098	597.58
1.350	45.71	6.296	617.02

Asit doldurma/kullanmadaki kirlilikler

- Kurşun-asit akülerin doldurulması için kullanılan sülfürik asit berrak ve renksiz olmalıdır. Aside dahil edilen safsızlıklar, tablo l'de verilen hiçbir değeri aşmayacaktır.

- Elektrolitin kullanılması için, tablo 2'deki azami sınırlar geçerli olacaktır.

Giriş ve Genel Bakış

Asit doldurmadaki kirlilikler (tablo 1)

≤ 1,30 kg/l yoğunluk aralığında seyreltilmiş sülfürik asidin dolgu asidi olarak izin verilen safsızlığı

No.	Safsızlık	mg/l maks.
1	Platin grubunun metalleri	0.05
2	Renyum	0.1
3	Bakır	0.5
4	Hidrojen sülfid grubunun kurşun dışındaki diğer metalleri, örn. arsenik, antimon, bizmut, kalay, selenyum, tellür	
	tek tek	1.0
	hep birlikte	2.0
5	Manganez, krom, titanyum, nikel	
	tek tek	0.2
6	Demir	30
7	Amonyum sülfid grubunun alüminyum ve çinko dışındaki diğer metalleri, örn. kobalt	
	tek tek	1.0
	hep birlikte	2.0
8	Klorür olarak hesaplanan halojenler	5
9	Nitrat formunda azot	10
10	Diğer formdaki azot örn. amonyak	50
11	Asetik asit olarak hesaplanan uçucu organik asitler	20
12	Oksitlenebilir organik katsayıas $KMnO_4$ tüketimi olarak hesaplanmıştır.	30
13	Tavlama kalıntısı	250

Giriş ve Genel Bakış

Asit kullanımındaki kirlilikler (tablo 2)

≤ 1,30 kg/l yoğunluk aralığında seyreltilmiş sülfürik asidin dolgu asidi olarak izin verilen kirliliği

No.	Safsızlık		mg/l[2)] maks.
1	Platin grubunun metalleri		n.n[1)]
2	Renyum		n.n[1)]
3	Bakır		n.n[1)]
4	Tellurium and selenium individually		1.0
5	Hidrojen sülfür grubunun kurşun ve antimondan diğer metalleri, ör. arsenik, bizmut,		
		tek tek	3.0
		hep birlikte	6.0
6	Antimon		3
7	Manganez, krom, titanyum, nikel		
		tek tek	0.2
8	Demir		100
9	Amonyum sülfid grubunun alüminyum ve çinko dışındaki diğer metalleri, örn. kobalt	tek tek	1.0
		hep birlikte	2.0
10	Klorür olarak hesaplanan halojenler		50
11	Nitrat formunda azot		10
12	Diğer formdaki azot örn. amonyak		50
13	Asetik asit olarak hesaplanan uçucu organik asitler		30
14	Oksitlenebilir organik katsayıas $KMnO_4$ tüketimi olarak hesaplanmıştır.		50

1) Bu metaller negatif elektrot üzerinde neredeyse tamamen birikmiş kalır. Bu zararlı maddelerin reaksiyonu üzerine artmış bir kendi kendine deşarj gözlenir.

2) Metaller için genel olarak geçerli sınır değerler belirlemek mümkün değildir. Akülere zararlı içerik seviyeleri, hücrenin tipine, yaşına ve çalışma koşullarına bağlı olarak diğerleri arasındadır.

Arıtılmış suyun fiziksel gereksinimleri

Görünüm	temiz, renksiz, kokusuz, yağ damlamasız
pH değeri	5 ila 7 arası
20° C 'da elektrik iletkenliği	
- taze hazırlanmış - hücreye kadar	≤ 10 µ S/cm ≤ 30 µ S/cm

Giriş ve Genel Bakış

Doldurma suyundaki kirlilikler

Chemical requirements of purified water

The purified water shall not exceed the limit values given in table

Cons. No.	Impurities	mg/l max.
1	Buharlaşma kalıntısı	10
2	Hidrojen sülfid grubunun (Pb, Sb, As, Sn, Bi, Cu, Cd) her	20
3	elementinin $KMnO_4$ tüketimi olarak hesaplanan oksit edilebilir organik maddeler — tek tek	< 0.1
	hep birlikte	< 0.5
4	Amonyum sülfid grubunun metalleri (Fe, Co, Ni, Mn, Cr) — her element tek tek	< 0.1
	hep birlikte	< 0.5
5	Klorür olarak hesaplanan halojenler	0.5
6	Nitrat formunda azot	2.0
7	Diğer formdaki azot örn. amonyak	40

Konular

1. Giriş ve Genel Bakış
2. **Depolama**
3. Kurulum
4. Görevlendirmek
5. Şarj
6. Deşarj
7. Sıcaklığın Etkisi
8. Havalandırma
9. AC Dalgalanma
10. Bakım ve Kontrol
11. Soru & Cevap

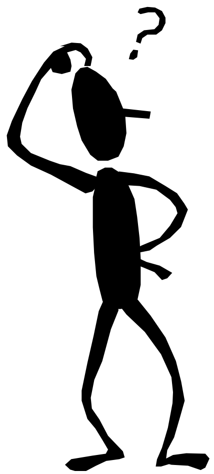
Stasyoner Sulu Tip Aküler

Konum / yenileme şarjı

- Konum: Kuru, donmaz oda, ≤20 °C

- Yenileme şarjı:
  - her 3 ayda veya…
  - “ Çalıştırma Talimatları ”na göre değişken şarj
    (şarj gerilimi = 2.23 Vpc (OCSM: 2.25 Vpc) ∗hücre sayısı)

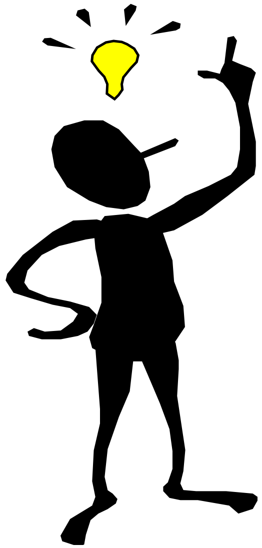
- Yüksek sıcaklıklarda ne olur ?



Stasyoner Sulu Tip Aküler

Kendi kendine deşarj

- Yüksek sıcaklıklar kendi kendine deşarjı hızlandıracaktır
- "Arrhenius" Kanunu:
  10 °C başına kendi kendine deşarj oranı
  - yenileme şarjı aralığı yarıya indirilmelidir.
- Örnek:
  30 °C → aralık şöyle olmalı
  3 ay yerine 1.5 ay



Stasyoner Sulu Tip Aküler

Şarj Durumu(SOC)

- Deşarj sırasında ve ayrıca kendi kendine deşarj sırasında elektrolit yoğunluğu azalır
- Açık Devre Gerilimi elektrolit yoğunluğuna bağlıdır

Konular

Stationary vented batteries

Installation

- Max. ambient temperature difference ≤ 10 °C (bottom ↔ top, left ↔ right)
- Distance between cells/blocks approx. 10 mm, at least 5 mm
- The battery must never be installed in an air-tight enclosure
- See “Installation/Operating Instructions” for details

Stationary vented batteries

Installation

Rule regarding OCV: The block tolerance correlates to the single cell by:

$Tolerance_{block} = Tolerance_{cell} * \sqrt{n}$ (n = Number of cells per block).

Basis: measured mean value

Unit	Number of cells	√n	Max. ± tolerance [V]	
			Vented Batt.	VRLA Batt.
2V-cell	1	1	0.02	0.03
4V-block	2	1.414	0.028	0.042
6V-block	3	1.732	0.035	0.052
8V-block	4	2	0.040	0.060
10V-block	5	2.236	0.045	0.067
12V-block	6	2.449	0.049	0.073

Stationary vented batteries

Installation

Example:

Vented battery, 12V-blocks

Measured U_0-mean: 12.84 V (= 2.14 Vpc)

Max. ± tolerance: 0.049 V

Permissible U_0- range:

$U_{0,max}$ = 12.84 V + 0.049 V = 12.889 V (= 2.148 Vpc)

$U_{0,min}$ = 12.84 V - 0.049 V = 12.791 V (= 2.132 Vpc)

Stationary vented batteries

Installation

81700094

Installation instruction

for stationary lead acid batteries
(Batteries / Stands / Cabinets)

GNB INDUSTRIAL POWER

- Observe these instructions and keep them located near the battery for future reference. Work on the battery should only be carried out by qualified
- personnel.
- Do not smoke.
- Do not use any naked flame or other sources of ignition.
- Risk of explosion and fire.
- While working on batteries wear protective eye-glasses and clothing.
- Observe the accident prevention rules as well as EN 50 272-2, EN 50110-1.
- An acid splash on the skin or in the eyes must be flushed with plenty of clean water immediately. Then seek medical assistance.
- Spillages on clothing should be rinsed out with water.
- Explosion and fire hazard, avoid short circuits.
- Avoid electrostatic charges and discharges / sparks!
- Electrolyte is very corrosive. In normal working conditions the contact with the electolyte is imposible. If the cell or monoblock container is damaged do not touch the exposed electrolyte because it is corrosive.
- Blocks/cells are very heavy! Make sure they are installed securely! Only use suitable means of transport!
- Block/cell containers are sensitive to mechanical damage.
- Handle with care
- Do not lift or pull up blocks/cells on the poles.
- Dangerous electric voltage!
  Caution! Metal parts of the battery are always alive, therefore do not place items or tools on the battery.

Non-compliance with installation instruction, installations or repairs made with other than original accessories and spare parts or with accessories and spare parts not recommended by the battery manufacturer or repairs made without authorization (e. g. opening of valves on VRLA batteries) and use of additives for the electrolytes on flooded batteries (alleged enhancing agents) render the warranty void.

1. Installation preconditions and preparations

1.1
Prior to commencing installation, ensure that the battery room is clean and dry and that it has a lockable door. The battery room must meet the requirements in accordance with EN 50 272-2 and be marked as such. Pay attention to the following aspects:

- Load bearing capacity and nature of the floor (transport paths and battery room)
- Electrolytic resistance of the area where the battery is to be installed
- Ventilation

To ensure trouble free installation, coordination should be made with other personnel working in the same area.

1.2
Check delivery for complete and undamaged components. If necessary, clean all parts prior to installation.

1.3
Follow instructions in the documentation supplied (e.g. installation drawings for battery, stand, cabinet).

1.4
Prior to removing old batteries always ensure that all of the leads have been disconnected (load-break switches, fuses, insulations). This must be carried out only by personnel authorised to perform circuit operations.

WARNING: Do not carry out any unauthorised circuit operation!

1.5
Carry out open circuit voltage measurements on the individual cells or monoblock batteries. At the same time, ensure that they are connected in the correct polarity. As for unfilled and charged batteries, these measurements can only be taken after commissioning. The open-circuit voltages of fully charged cells at temperature of 20 °C are as follows:

Product range flooded (Classic)

OPzS-cells	DIN 40736	2.08 Vpc ± 0.01
OPzS-blocks	DIN 40737	2.08 Vpc ± 0.01
OCSM-cells		2.10 Vpc ± 0.01
GroE-cells	DIN 40738	2.06 Vpc ± 0.01
OGi-cells ≤ 250 Ah		2.08 Vpc ± 0.01
OGi-cells ≥ 260 Ah		2.10 Vpc ± 0.01
OGi-blocks		2.10 Vpc ± 0.01
Energy Bloc		2.08 Vpc ± 0.01

Product range VRLA (Gel, AGM)

OPzV-cells	DIN 40742	min. 2.12 Vpc
OPzV-blocks	DIN 40744	min. 2.12 Vpc
OGiV-blocks		min. 2.14 Vpc

The open-circuit voltage of the individual cells /blocks should not vary themselves from the measured average value by more than the plus/minus-tolerances listed in the table below (guide values).

	Max. ± tolerance [V]	
Unit	Vented	VRLA
2V-cells	0.020	0.030
4V-block	0.028	0.042
6V-block	0.035	0.052
8V-block	0.040	0.060
10V-block	0.045	0.067
12V-block	0.049	0.073

Higher temperatures cause the open-circuit voltage to be lower, whereas lower temperatures cause it to be higher. At a deviation of 15 K from the nominal temperature, the open-circuit voltage changes by 0.003 Vpc.

If the deviation is any higher than shown in the table, contact the supplier.

2. Stands

2.1
Locate the stands/racks within the battery room in accordance with the installation plan. If an installation plan does not exist, observe the following minimum distances:

- From the wall: 100 mm all around, with regard to cells or monoblocks, or 50 mm, concerning of the stands.
- At a nominal voltage or partial voltage >120 V: 1.5 metres between non-insulated leads or connectors and grounded parts (e.g. water pipes) and/or between the battery terminals. During the installation of the batteries, ensure that EN 50 272-2 part 2 is observed (e.g. by covering electrically conductive parts with insulating mats).
- Width of aisles: 1.5 x cell width (built-in depth), but not less than 500 mm.

2.2
Balance battery stands horizontally, using the balance parts supplied, or adjustable insulators. The distances of the base rails must correspond to the dimensions of the cells or monoblock batteries. For horizontal installation of blocks/cells please ensure, that the beam does not support the lid/cover of blocks/cells see drawing 1. Check the stands for stability and all screwed and clamped joints for firm connection. Earth (ground) the stand or parts of the stand, if required. Screwed joints must be protected against corrosion.

2.3
Check cells or monoblock batteries for perfect condition (visual check, polarity).

2.4
Place cells or monoblock batteries on the stand one after another, ensuring correct polarity. For large cells it is useful to start installing the cells in the middle of the stand:

- Align cells or monoblock batteries parallel to each other. Distance between cells or monoblock batteries approx. 10 mm, at least 5 mm.
- If necessary, clean the contacting surfaces of the terminals and connectors.
- Place and screw intercell or monoblock connectors, using an insulated torque wrench (for correct torque value refer to battery operating instructions). If applicable, observe special instructions with regard to the intercell connectors (e.g. welded connectors).
- Place the series, step or tier connectors supplied and screw them together, observing the given torque values.
- Avoid short circuits! Use leads of at least 3 kV breakdown voltage or keep an air distance of approx. 10 mm between the leads and electrically conductive parts, or apply additional insulation to the connectors. Avoid applying any mechanical force on the cell/battery poles.
- If applicable, remove transport plugs and replace by operational plugs.
- Check electrolyte level. (Observe operating instructions / commissioning instructions).
- Measure total voltage (nominal voltage: sum of open circuit voltages of the individual cells or monoblock batteries).
- If necessary sequentially number the cells or monoblock batteries in a visible place between the positive terminal of the battery and the negative terminal of the battery.
- Apply polarity signs for the battery leads.
- Attach safety marking, type lable and operating instructions in a visible place.
- If necessary, fit insulating covers for cell / monoblock connectors and terminals.

3. Cabinets

3.1
Cabinets with built-in battery:

- Install the battery cabinet at the location assigned, observing the accident prevention rules.
- Leave additional space from the wall for possible or planned cable entries.
- If applicable, remove transport protection from the built-in cells or monoblock batteries.
- Check cells or monoblock batteries for correct positioning and for any mechanical damage.

3.2
Cabinets with separately delivered cells or monoblock batteries:

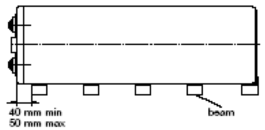
- Only filled and charged cells and/or monoblock batteries (vented or valve regulated) are built into cabinets.
- Assemble cabinet, place and align at the assigned location (observe the accident prevention rules).
- Place cells or monoblock batteries in the cabinet, in accordance with the installation plan, use the enclosed cellular rubber according drawing 2 and the defined distances, connect electrically and apply markings (see point 2.4).

4. CE marking

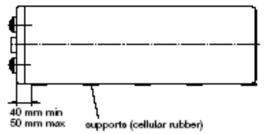
Batteries with a nominal voltage from 75 V onwards require an EC conformity declaration according to the low voltage directive 2006/95/EC (replaces 73/23/EEC), which entails that the CE marking is applied to the battery.
The company installing the battery is responsible for supplying the declaration and applying the CE marking.

WARNING:
Prior to connecting the battery to the charger, ensure that all installation work has been duly completed.

Drawing 1



Drawing 2



For drawing 1 and 2
Number of supports:

4 OPzV 200 - 6 OPzV 300 = 3 pieces
5 OPzV 350 - 7 OPzV 490 = 4 pieces
6 OPzV 600 - 12 OPzV 1200 = 5 pieces
15 OPzV 1500 - 24 OPzV 3000 = 6 pieces

GNB® INDUSTRIAL POWER
Headquarters Europe
Exide Technologies GmbH
Im Thiergarten
63654 Büdingen – Germany
Tel.: +49 (0) 60 42 / 81 544
Fax: +49 (0) 60 42 / 81 398
www.exide.com

GNB INDUSTRIAL POWER

Printed in Germany · Subject to change
81700094 5,0 III.10

Agenda

1. Introduction and General
2. Storage
3. Installation
4. **Commissioning**
5. Charging
6. Discharge
7. Influence of Temperature
8. Ventilation
9. AC Ripple
10. Maintenance and Control
11. Q & A

Commissioning Instructions and Report (dry-charged cells)

Mixing Instructions (to produce filling sulphuric acid for dry-charged cells)

Commissioning instructions and report
for a vented lead-acid battery

Nominal data

- Nominal voltage: ____________ V
- Nominal capacity: ____________ Ah
- Battery-no.: ____________
- Cells / block: ____________
- Type: ____________

Commissioned by ____________

Started on ____________ Completed on ____________

- Follow installation instructions! Work on batteries to be carried out only upon instruction by skilled personnel, whilst observing the
- commissioning and/or operating instructions!
- Do not smoke!
- Do not use any naked flame or other sources of ignition. Risk of explosion and fire!
- While working on batteries wear protective goggles and clothing!
- Observe the accident prevention rules as well as EN 50272-2, EN 50110-1!
- Any acid splashes on the skin or in the eyes must be rinsed with plenty of clean water immediately. Then seek medical assistance. Spillages on clothing should be rinsed out with water!
- Explosion and fire hazard, avoid short circuits.
- Avoid electrostatic charges and discharges/sparks!
- Electolyte is strongly corrosive!
- Blocks/cells are very heavy! Make sure they are installed securely! Only use suitable means of transport!
- Block/cell containers are sensitive to mechanical damage.
- Handle with care!
- Do not lift or pull up blocks/cells on the poles.
- Caution! Dangerous voltage.
- Metal parts of the battery are always alive, therefore do not place items or tools on the battery!

Non-compliance with commissioning instructions and installations or repairs made with other than original accessories and spare parts or with accessories and spare parts not recommended by the battery manufacturer or repairs made without authorization and use of additives for the electrolytes (alleged enhancing agents) render the warranty void.
The commissioning report must be filled in and returned to the battery manufacturer.

Spent batteries have to be collected and recycled separately from normal household wastes (EWC 160601). The handling of spent batteries is described in the EU Battery Directive (2006/66/EC) and their national transitions (UK: HS Regulation 1994 No. 232, Ireland: Statory Instrument No. 73/2000). Contact your supplier to agree upon the recollection and recycling of your spent batteries or contact a local and authorized Waste Management Company.

1. Checks
The battery system as well as the charger must be checked to be free from mechanical damage. All screws within the circuit must be tightened in accordance with the operating instructions for the battery, establishing safe contact.
The charger must be checked for its readiness for working. Check for correct polarity. Before filling the cells it has to be ensured that the guidelines of EN 50272-2 and EN 50110-1 regarding the installation and ventilation are observed. If the current applied during the commissioning is greater than what the ventilation system is designed for, the ventilation of the battery room must be increased for the duration of commissioning and for an hour afterwards depending on the charge current applied, e.g. by additional portable ventilators. The same applies to occasional special charging treatment of batteries.

2. Filling the cells
The filling acid with the density defined in table 1 must meet the purity standards laid down in DIN 43 530 part 2.
If concentrated sulphuric acid has been delivered, the mixing instructions must be observed.
The temperature of the filling acid shall range between 15° C and 30° C. Prior to filling, the temperature is to be measured and recorded in the commissioning report.
Upon removal of the transport plugs or upon opening the vent plugs, the cells shall be filled up to the lower electrolyte level indication.
Acid-resistant filling devices are to be used for this purpose.
Transport plugs may not be used during the battery operation. They must be replaced by vent plugs, which are included in the delivery.

Table 1: Electrolyte density in kg/l at 20° C

Cell type	Filling density [kg/l]	Nominal density [kg/l]	Temperature ° C
GroE	1.21	1.22	20
OPzS, EB, OGi ≤ 250 Ah	1.23	1.24	20
OCSM, OGi ≥ 260 Ah	1.25	1.26	20
OPzS SOLAR	1.23	1.24	25
EnerSol	1.27	1.28	25
EnerSolT	1.25	1.26	25

Higher temperature reduce the electrolyte density, lower temperatures increase it. The relevant correction factor is 0.0007 kg/l per K.

Example: Electrolyte density of 1.23 kg/l at 35° C corresponds to a density of 1.24 kg/l at 20° C.

3. Rest period
Once the cells have been filled, they must rest for a period of 2 hours. Afterwards the temperature and electrolyte density must be measured in at least 4 to 8 cells (pilot cells), depending on the total number, and the results must be entered in the commissioning report. If the temperature rise is less than 5 K and the electrolyte density has not decreased by more than 0.02 kg/l below the density of the filling acid, a simplified commissioning charge, as described at 4.1 and/or 4.2 is sufficient.
If one of the deviations is greater, an extended commissioning charge, as described at 4.3, is required.

4. Commissioning
The vent plugs in non-transparent containers stay open, in order to be able to see whether towards the end of charging all cells are gassing evenly. It is important that the first charging is carried out completely. This is possible only at a charge voltage greater than 2.35 V/cell.
Interruptions should be avoided if possible. The commissioning data shall be recorded in the commissioning report sheet overleaf. During commissioning the cell voltage shall be measured at the pilot cells and upon completion of commissioning, cell voltage, electrolyte density and temperature shall be recorded in the commissioning report, including indication of time.
The electrolyte temperature must not exceed 55° C. If necessary, the charging must be interrupted.

4.1 Commissioning charge at constant voltage (IU characteristics)
A charge voltage of 2.35 - 2.4 V/cell is required.
The initial charge current should be at least 5 A per 100 Ah C_{10}.
In the course of charging, the electrolyte density increases only slowly, therefore it may take several days of charging until a minimum density, i.e. the nominal electrolyte density -0.01 kg/l is reached. Afterwards the charger must be switched over to float charge operation as described in the operation instructions. During operation the electrolyte density will reach the nominal value.

4.2 Commissioning charge at constant current (I characteristics) or at descending current (W-characteristic)

Charging caracteristic	Charge current
I caracteristic	5 A
W caracteristic at:	
2.0 V/cell	14.0 A
2.4 V/cell	7.0 A
2.65 V/cell	3.5 A

The maximum admissible currents are shown in table 2.

Table 2: maximum admissible charge currents in A per 100 Ah C_{10} for I and W charging

Charging must be continued until
- all cells have reached a voltage of at least 2.6 V,
- the electrolyte density in all cells has increased to the nominal value ± 0.01 kg/l, and until these values do not increase any more for another 2 hours

Afterwards switch over to float charge voltage as described in the operating instructions.

4.3 Extended commissioning charge
Long storage periods or climatic influences (humidity, temperature variations) cause a decrease in the state of the charge of the cells.
In these cases an extended commissioning charge is required as follows:
1. Charge at 15 A per 100 Ah C_{10} until 2.4 V/cell are reached (approx. 3-5 hours).
2. Charge for 14 hours at 5 A per 100 Ah C_{10} (voltage rises higher than 2.4 V/cell)
3. Pause of one hour
4. 4 hours charging at 5 A per 100 Ah C_{10}

Points 3 and 4 are to be repeated until
- all cells have reached a voltage of at least 2.6 V/cell
- the electrolyte density in all cells has increased to the nominal value ± 0.01 kg/l, and until these values do not increase any more for another 2 hours.

Afterwards switch over to float charge voltage, as described in the operating instructions.

4.4 Electrolyte level adjustment
Once the commissioning is completed, the electrolyte level must be adjusted to the top level indication by using filling acid.

4.5 Electrolyte density adjustment
If at the end of commissioning the electrolyte density turns out to be too high, part of the electrolyte must be replaced by purified water pursuant to DIN 43 530 part 4.
The electrolyte density of the individual cells should not vary by more than 0.01 kg/l. If the variations are any greater, the electrolyte density must be adjusted and afterwards an equalising charge is to be carried out as described in the operating instructions.

5. Note:
Leaks or spills of acid must be carefully removed and/or neutralised. A soda solution (1 kg soda to 10 litres of water) or other neutralising agents can be used for this purpose. Neutralising agents must not get into the cell. Finally the battery surface is to be cleaned (ZVEI instruction leaflet "Cleaning of batteries" refers). The instructions given in the ZVEI leaflet "Safety data sheet for battery acid (dilute sulphuric acid)" are to be followed.
Concerning the operation of the battery the operating instructions apply.

6. Commissioning report

- Was the acid delivered by the battery manufacturer? yes ☐ no ☐
- If not, was the filling acid analysed for chlorine, iron or other detrimental metals? yes ☐ no ☐
- What was the test result? ____________
- What was the density of the new acid prior to filling? ______ kg/l at ______ ° C
- Filling with acid started on ____________ at ______ h at cell no. ______
- Filling with acid was completed on ____________ at ______ h at cell no. ______
- Average ambient temperature ____________ ° C

Pilot cells [1] Measurement 2 h after filling	No.	No.	No.	No.	No.	No.	No.	No.
Elektrolyte density [kg/l]								
Elektrolyte temperature [° C]								
Elektrolyte density corrected temperature (v. point 2) [kg/l]								

[1] Cell- or bloc-No.

The electrolyte density in monobloc batteries is to be measured in the cell next to the positive terminal.

Commissioning charge was carried out in accordance with paragraph 4.1 ☐ 4.2 ☐ 4.3 ☐

Commissioning charge was started on ____________ (date) at ____________ (time)

Once every hour during the first 6 hours of commissioning charge the cell voltage, electrolyte density and temperature are to be measured on at least 4 pilot cells and the results are to be recorded. At the end of commissioning another 3 measurements are to be taken once every hour.

Stationary vented batteries

Commissioning of dry-charged cells/block batteries

Time	Pilot cell / bloc 1			Pilotcell / bloc 2			Pilot cell / bloc 3			Pilotcell / bloc 4		
	d [kg/l]	δ [°C]	U [V]	d [kg/l	δ [°C]	U [V]	d [kg/l	δ [°C]	U [V]	d [kg/l]	δ [°C]	U [V]

Time	Pilot cell / bloc 5			Pilotcell / bloc 6			Pilot cell / bloc 7			Pilotcell / bloc 8		
	d [kg/l]	δ [°C]	U [V]	d [kg/l	δ [°C]	U [V]	d [kg/l]	δ [°C]	U [V]	d [kg/l	δ [°C]	U [V]

At monobloc batteries the cell voltage (if not possible, the monobloc voltage) and the electrolyte density are to be measured in the cell next to the positive terminal

Cell/bloc voltages and electrolyte densities of all cells at a mean electrolyte temperature of __________ °C at the end of commissioning charge before switching over to float charge operation.

1)	Voltage [V]	Density [kg/l]	1)	Voltage [V]	Density [kg/l]	1)	Voltage [V]	Density [kg/l]	1)	Voltage [V]	Density [kg/l]	1)	Voltage [V]	Density [kg/l]
1			46			91			136			181		
2			47			92			137			182		
3			48			93			138			183		
4			49			94			139			184		
5			50			95			140			185		
6			51			96			141			186		
7			52			97			142			187		
8			53			98			143			188		
9			54			99			144			189		
10			55			100			145			190		
11			56			101			146			191		
12			57			102			147			192		
13			58			103			148			193		
14			59			104			149			194		
15			60			105			150			195		
16			61			106			151			196		
17			62			107			152			197		
18			63			108			153			198		
19			64			109			154			199		
20			65			110			155			200		
21			66			111			156			201		
22			67			112			157			202		
23			68			113			158			203		
24			69			114			159			204		
25			70			115			160			205		
26			71			116			161			206		
27			72			117			162			207		
28			73			118			163			208		
29			74			119			164			209		
30			75			120			165			210		
31			76			121			166			211		
32			77			122			167			212		
33			78			123			168			213		
34			79			124			169			214		
35			80			125			170			215		
36			81			126			171			216		
37			82			127			172			217		
38			83			128			173			218		
39			84			129			174			219		
40			85			130			175			220		
41			86			131			176			221		
42			87			132			177			222		
43			88			133			178			223		
44			89			134			179			224		
45			90			135			180			225		

1) Cell or bloc no.

[illegible] · Druckhaus Bavenstein · Printed in Germany · Änderungen vorbehalten

Stationary vented batteries

Commissioning of dry-charged cells/block batteries

- … should take place as soon as possible after receipt because cells/block batteries have lost charge already due to transport and temporary storage.

- Before acceptance tests, the battery must be fully charged by the following method:
  - Float charge, ≥ 72 hours,
  - or 2.40 Vpc, ≥ 16 hours (max. 48 h), followed by float charge, ≥ 8 hours
  - Charge current always ≥ 10 A/100 Ah

Agenda

1. Introduction and General
2. Storage
3. Installation
4. Commissioning
5. **Charging**
6. Discharge
7. Influence of Temperature
8. Ventilation
9. AC Ripple
10. Maintenance and Control
11. Q & A

Stationary vented batteries

Charging

Issues:

- Charging regime
- Charge voltages and temperature compensation
- Charge current
- Charging time
- Float current
- Initial charge, equalizing charge

Stationary vented batteries

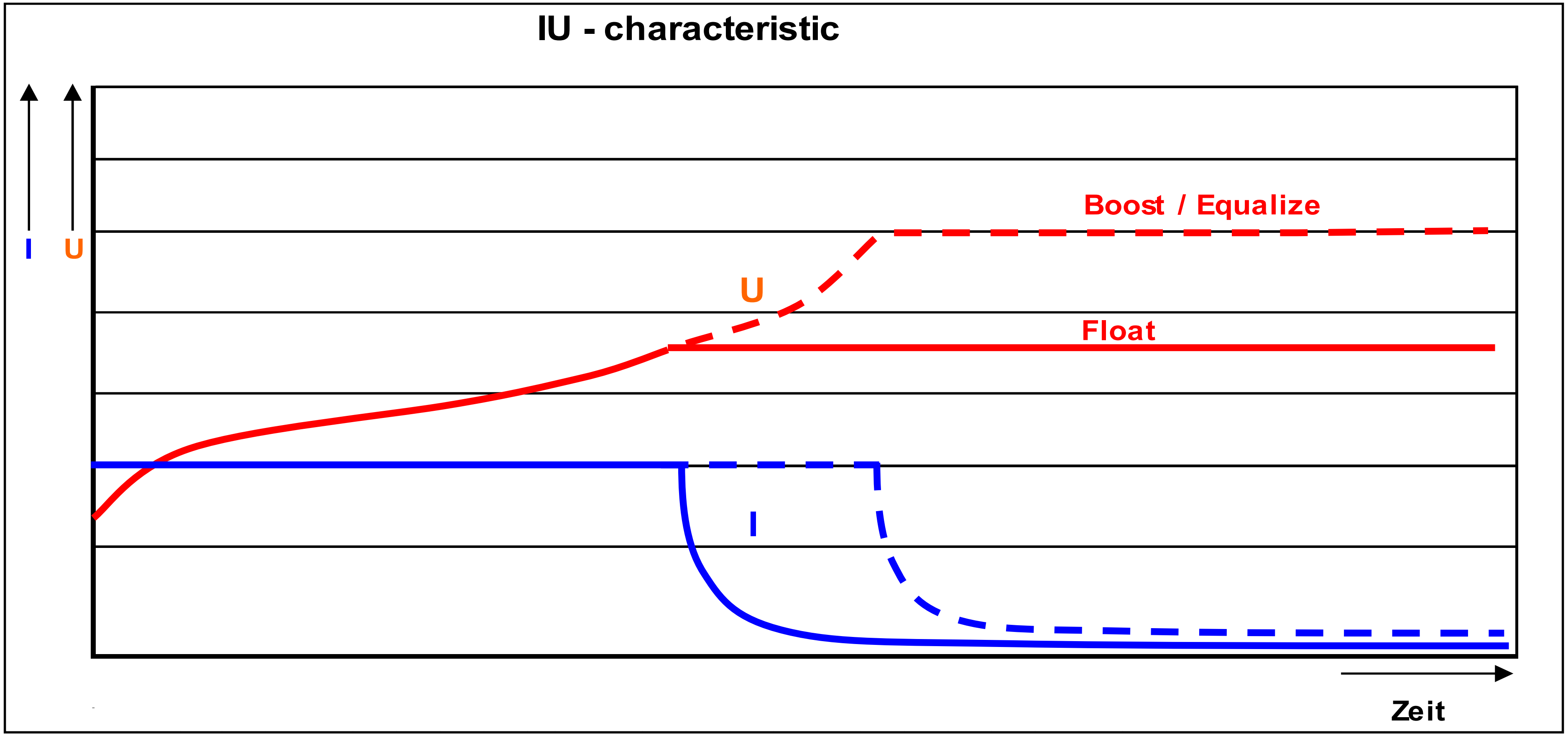
Charging regime

- **IU-characteristics:**
  - for stand-by parallel operation
    (float charge)
  - commissioning charge
  - equalizing charge

- **I- or W-characteristics**
  (load disconnected)
  - for commissioning charge and equalizing charge only

Stationary vented batteries

Charging regime



Stationary vented batteries

Charge voltage

- IU-charging (temperature from +10 °C to +30 °C)

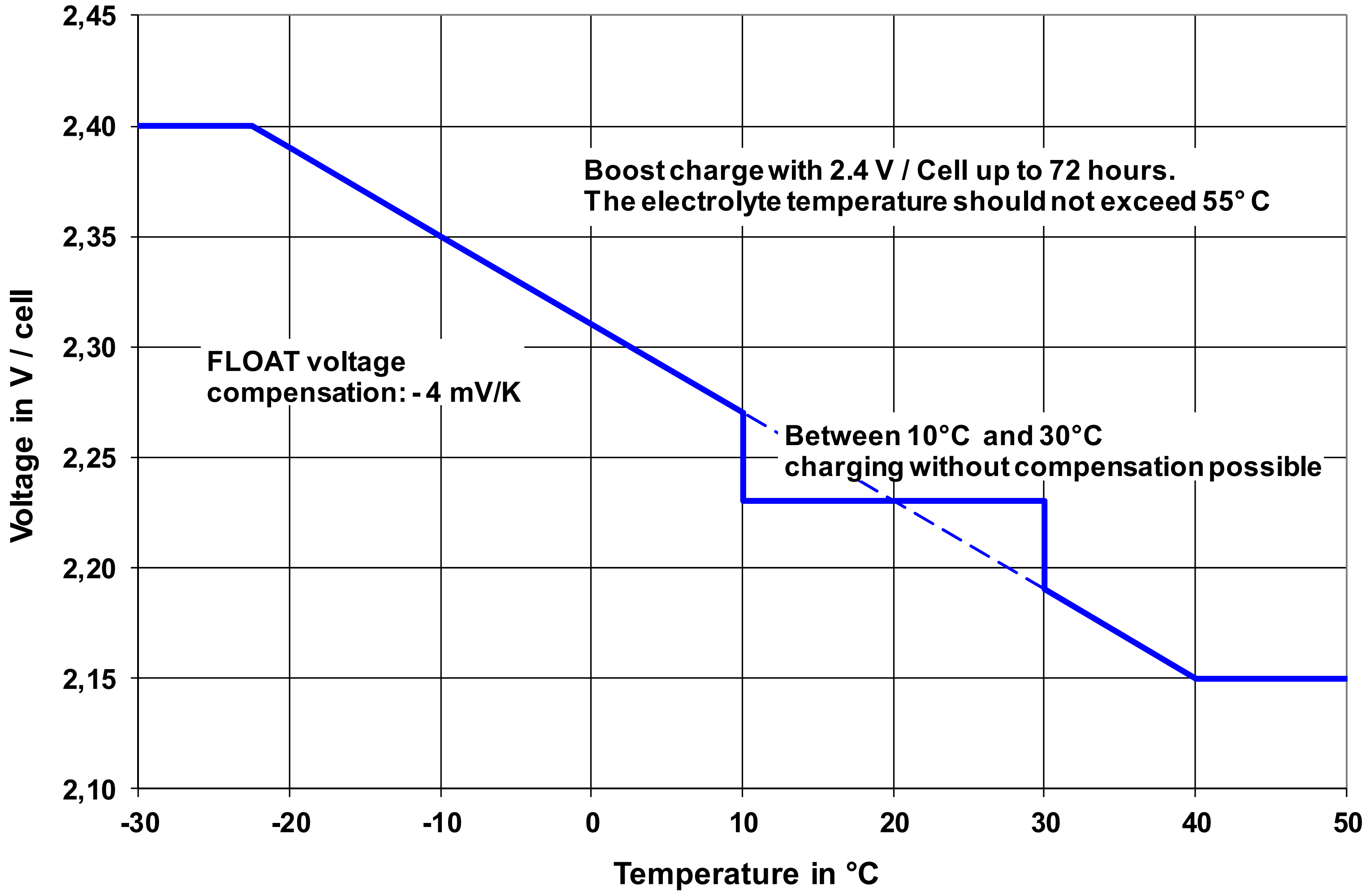
Float charge	Boost charge
2.23 Vpc (OCSM: 2.25 Vpc)	max 2.40 Vpc

- Tolerance of rectifier: ± 1 %

- Must be temperature compensated in specified ranges...
  (see diagram “Charge Voltage vs. Temperature”)

Stationary vented batteries

Charge voltage



Stationary vented batteries

Charge current

- IU-charging
  - Current is not limited in float charge and buffer operation
  - Recommended value: 10 A to 35 A / 100 Ah
  - Higher currents will not lead to relevant gain of recharging time
  - Lower currents will prolong the recharging time significantly

Stationary vented batteries

Charge current

› I-constant charging, W-charging
(Current per 100 Ah C10)

Charging	Cell type		Cell voltage
operation	GroE	OGi, OPzS, OCSM	
I-characteristic	6.5 A	5.0 A	2.6 - 2.75 Vpc
W-characteristic			
Decreasing from	9.0 A	7.0 A	at 2.40 Vpc
to	4.5 A	3.5 A	at 2.65 Vpc

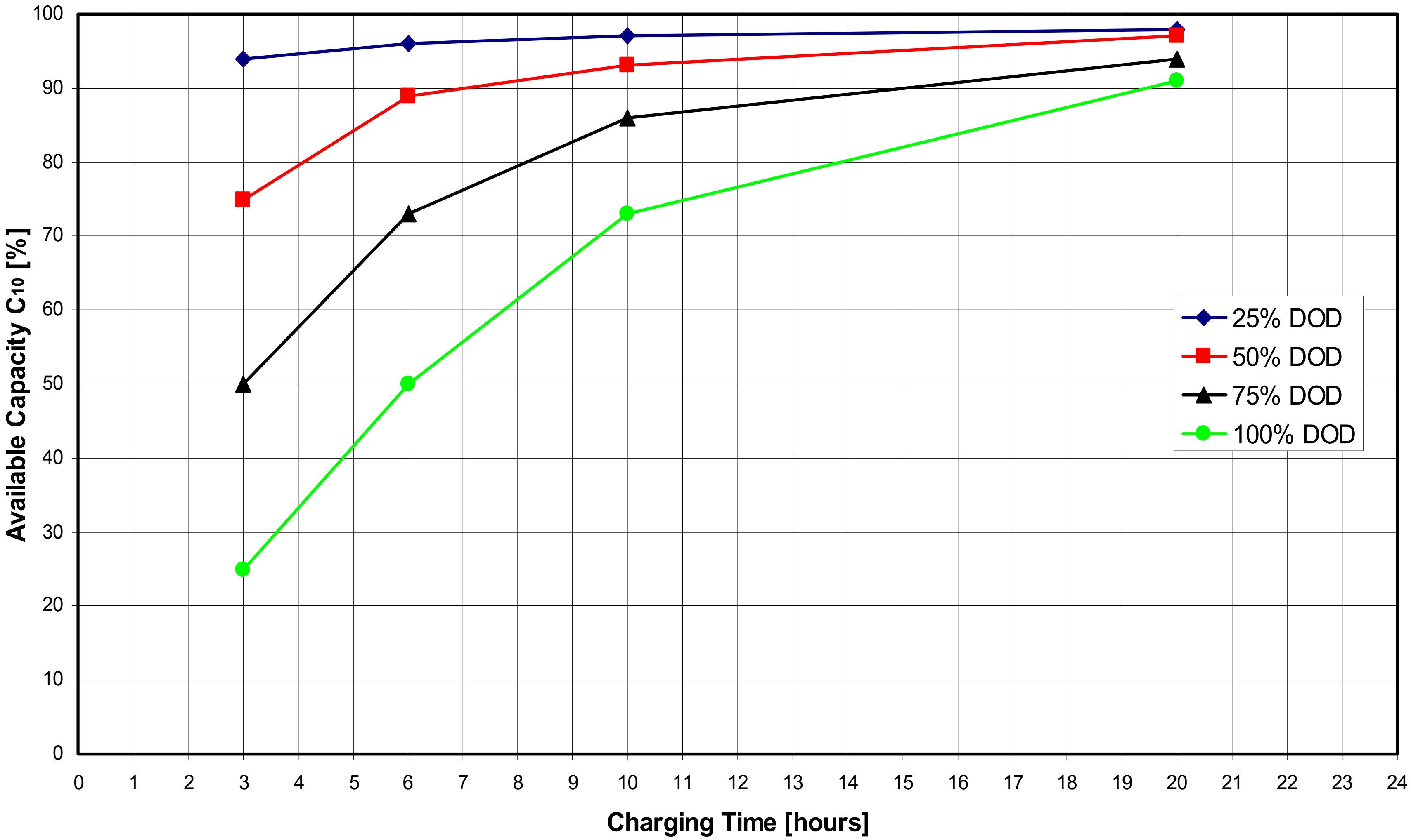
Stationary vented batteries

Available Capacity C_{10} vs. Charging Time

- Different graphs are available
- Parameters:
  - IU-Charging characteristic
  - Typical charge voltages:
    2.23 Vpc,
    2.30 Vpc and
    2.40 Vpc
  - Typical charge currents: 0.5 / 1 / 1.5 / 2 $* I_{10}$
  - 20 °C
- Following two examples...

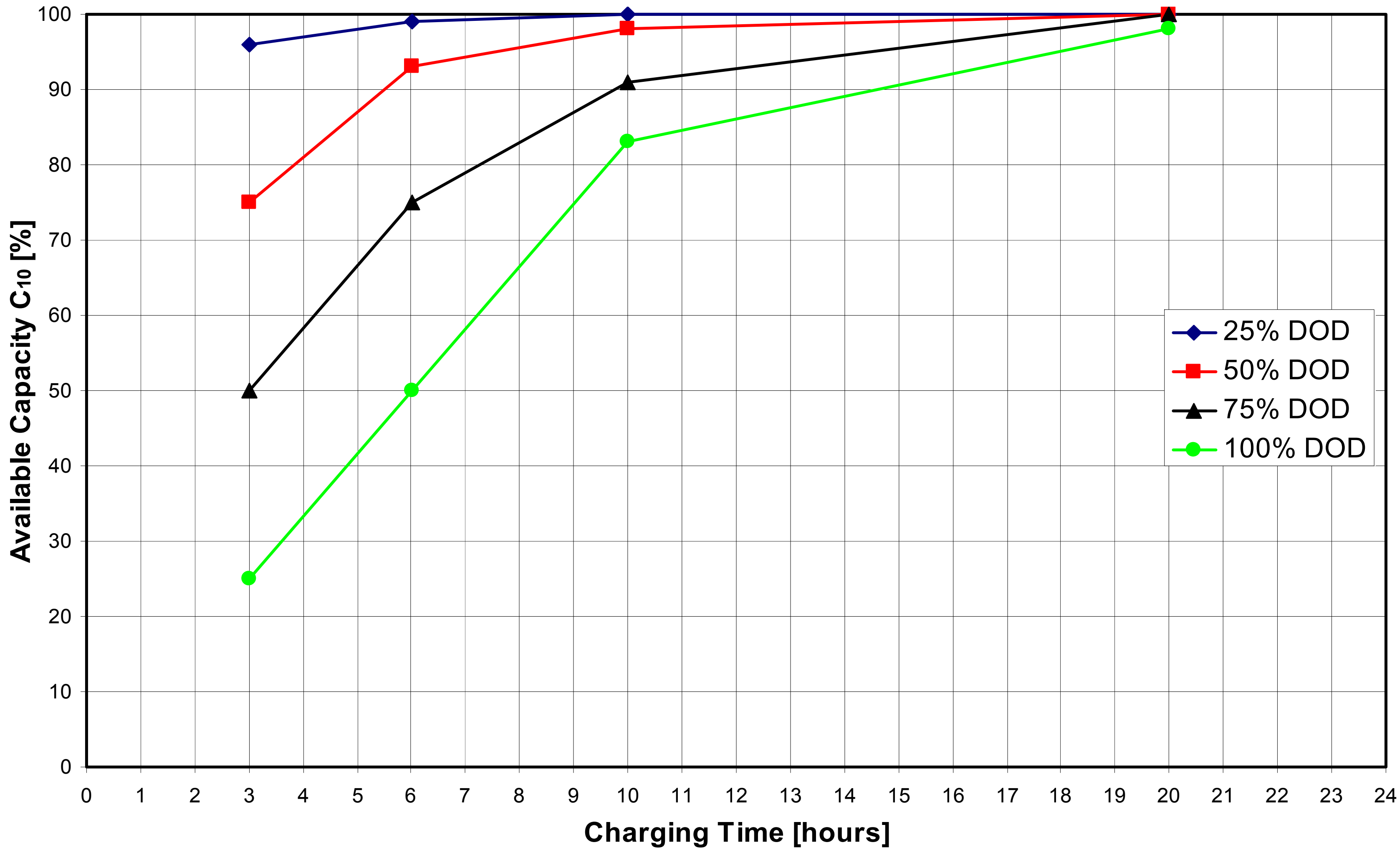
Stationary vented batteries

Recharge: 2.23 Vpc,1 $*$ I_{10}



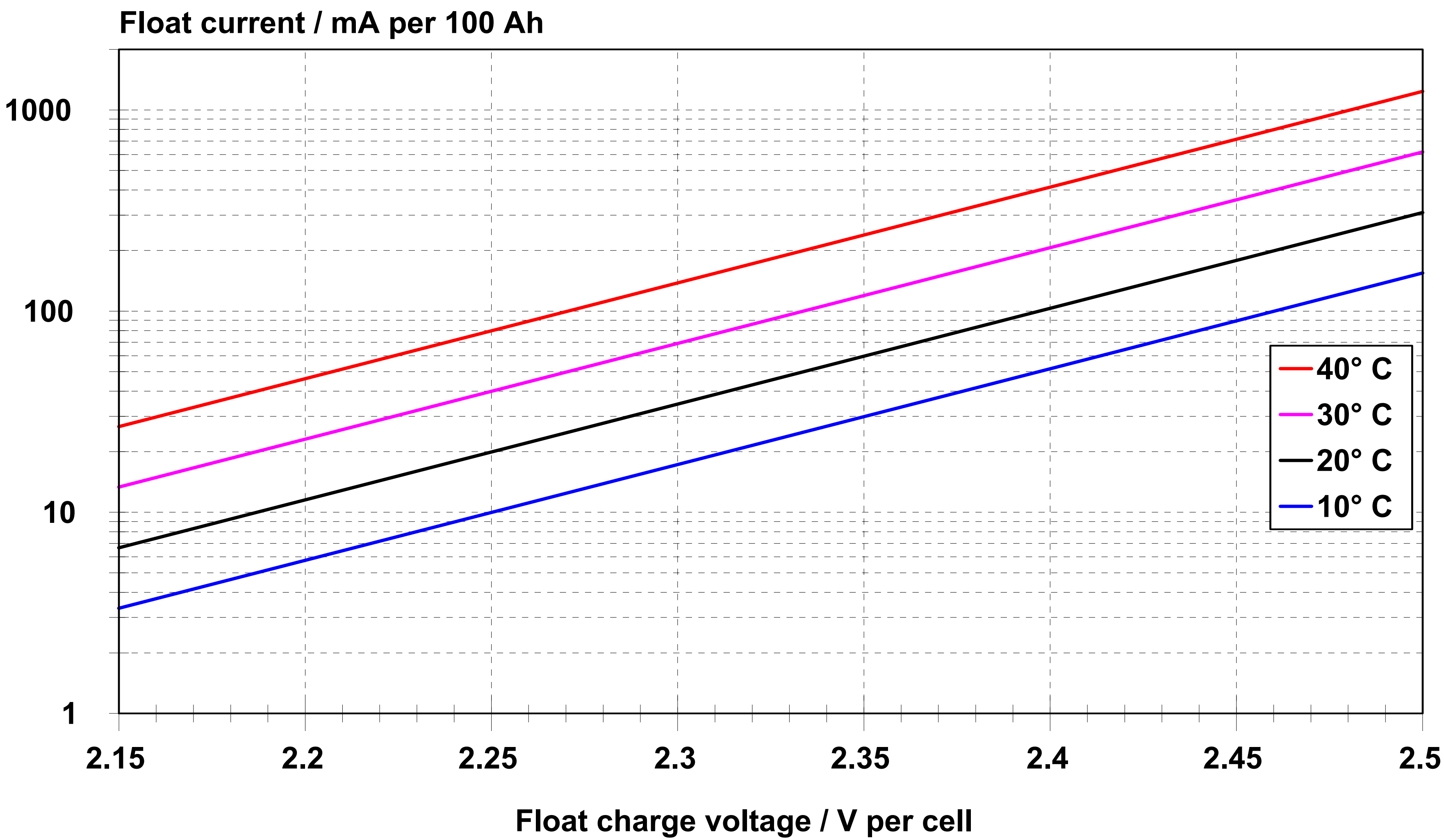
Stationary vented batteries

Recharge: 2.40 Vpc,1 $*$ I_{10}



Stationary vented batteries

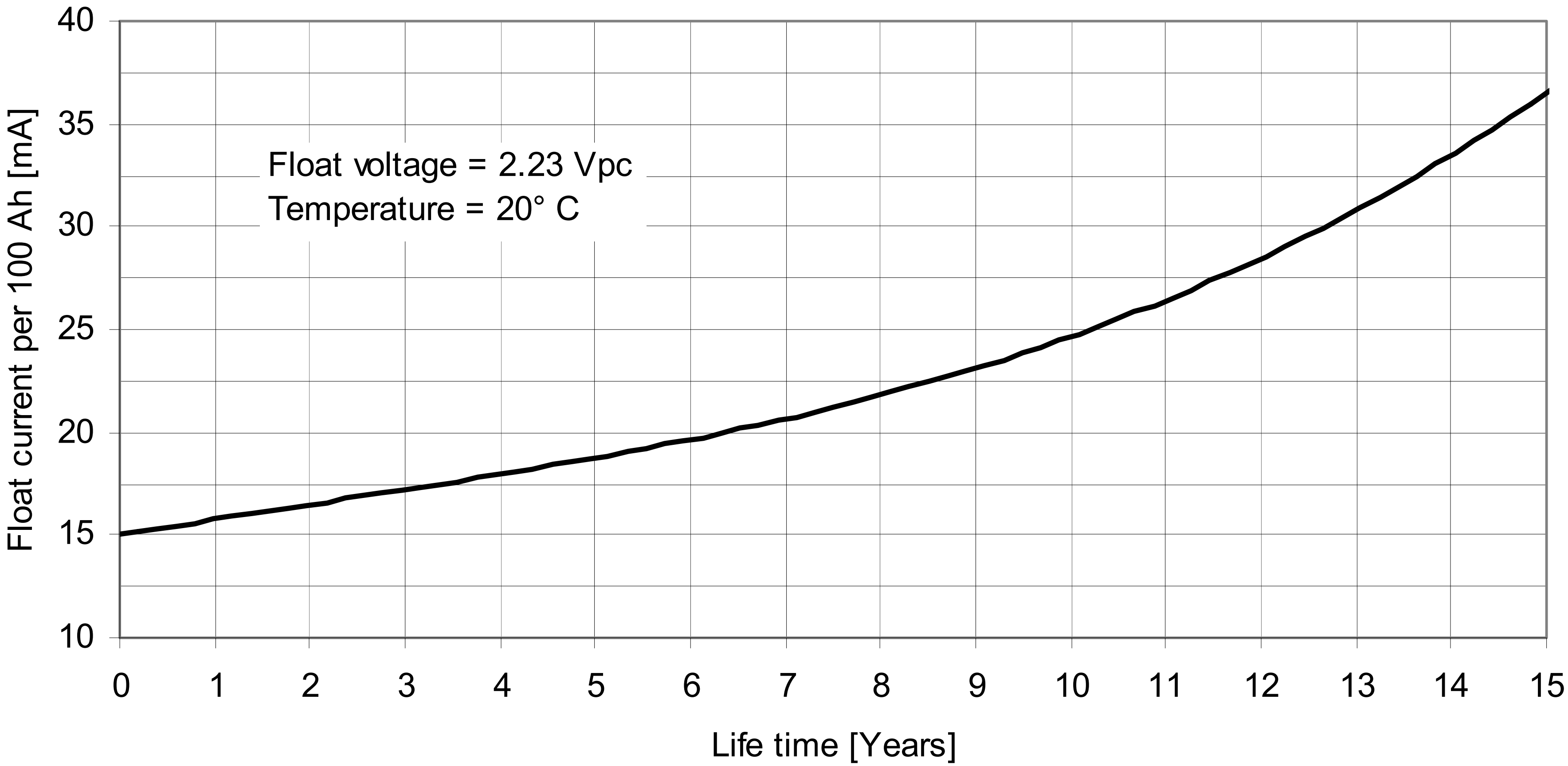
Float current (new cells, type OPzS LA)



Stationary vented batteries

Float current (cell type OPzS LA)

Float current versus life time



Stationary vented batteries

Initial charge, equalizing charge

- Initial charge:
  E.g. before an acceptance test on site, make sure the battery is fully charged

- Equalizing charge:
  …only necessary
  - After exhaustive discharges
  - In case of inadequate charges
  - If the individual cell/block voltages and/or electrolyte densities are outside the specified range

Stationary vented batteries

Equalizing charge

- ..By the following charge methods:
  - IU-charging: 2.40 Vpc, max. 72 hours.
  - I- or W- charging as described before (load disconnected):

    fully charged state if

    electrolyte density and **cell voltage** don't

    increase anymore **within 2 hours**

- Temperature must not exceed 55 °C

Agenda

1. Introduction and General
2. Storage
3. Installation
4. Commissioning
5. Charging
6. **Discharge**
7. Influence of Temperature
8. Ventilation
9. AC Ripple
10. Maintenance and Control
11. Q & A

Stationary vented batteries

Discharge

- …never below the expected final battery voltage assigned for the chosen discharge current
- Not more than the nominal capacity shall be consumed, unless otherwise specified by GNB Industrial Power

Capacity test acc. to IEC 60896-11:

- The test shall be terminated, if one of the following criteria is fulfilled, which ever comes first:
- The battery voltage has achieved $n * U_f$ [Vpc] with n = number of cells per string and U_f = final voltage per cell.

Example:

U_f = 1.75 Vpc, n = 24 cells

battery voltage = 24 cells * 1.75 Vpc = 42 V

Stationary vented batteries

Discharge (cont'd)

- The voltage of the weakest cell is fallen to
  U_{min} = final voltage U_f [Vpc] - 0.2 V

- Example:
  Final voltage $U_f = 1.75$ Vpc
  → Weakest cell can have
  $U_{min} = U_f - 0.2\ V = 1.55\ V$

Stationary vented batteries

Discharge (cont'd)

- U_{min} weakest block = U_f per block - 0.2 • √n [V]
  (n = number of cells per block)

	12 V block	6 V block
0.2 • √n =	0.49 V	0.35 V

- Example for 6 V block:
  Final voltage U_f = 5.25 V (1.75 Vpc)
  → Weakest block can have
  U_{min} = 5.25 V – 0.35 V
  = 4.9 V

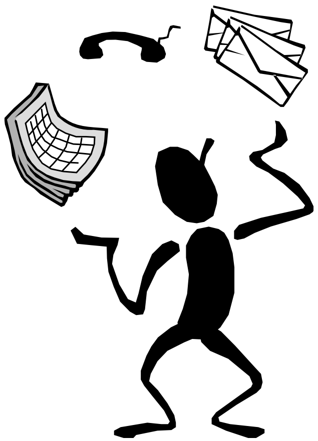
Agenda

1. Introduction and General
2. Storage
3. Installation
4. Commissioning
5. Charging
6. Discharge
7. **Influence of Temperature**
8. Ventilation
9. AC Ripple
10. Maintenance and Control
11. Q & A

Stationary vented batteries

Influence of temperature - General

- Nominal temperature is 20 °C and
  the optimal temperature regarding lifetime and capacity
- Higher temperatures
  reduce the lifetime and number of cycles
- Lower temperatures
  reduce the available capacity
- Let’s have a look into the details...



Stationary vented batteries

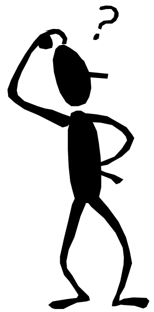
Influence of temperature - General

› According to law of “Arrhenius”:

Self-discharge, float current, corrosion rate
double per 10 degrees Celsius

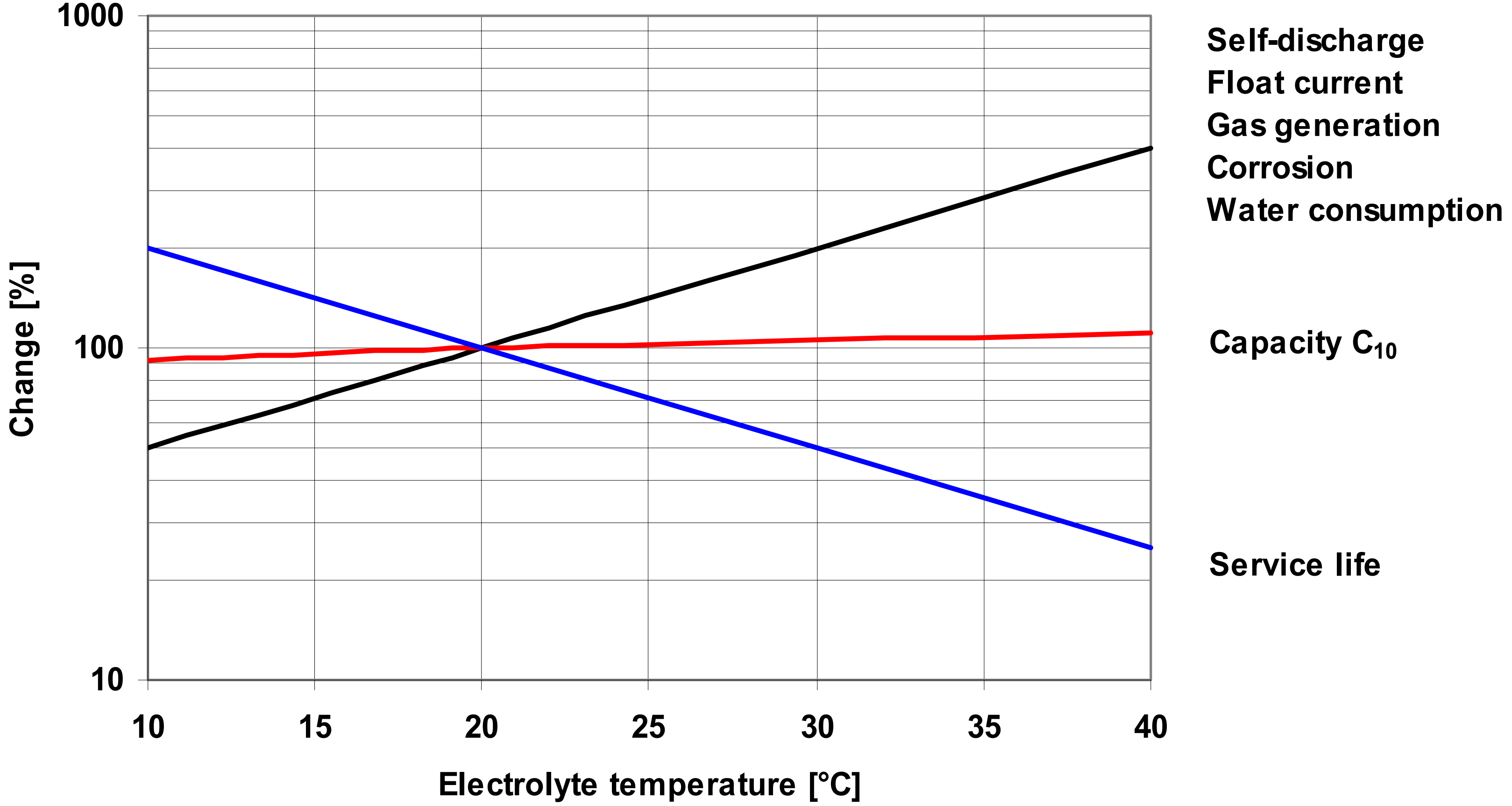
› Therefore...

Service life halved per 10 degrees Celsius
Example:
15 years at 20 °C become reduced to
7.5 years at 30 °C



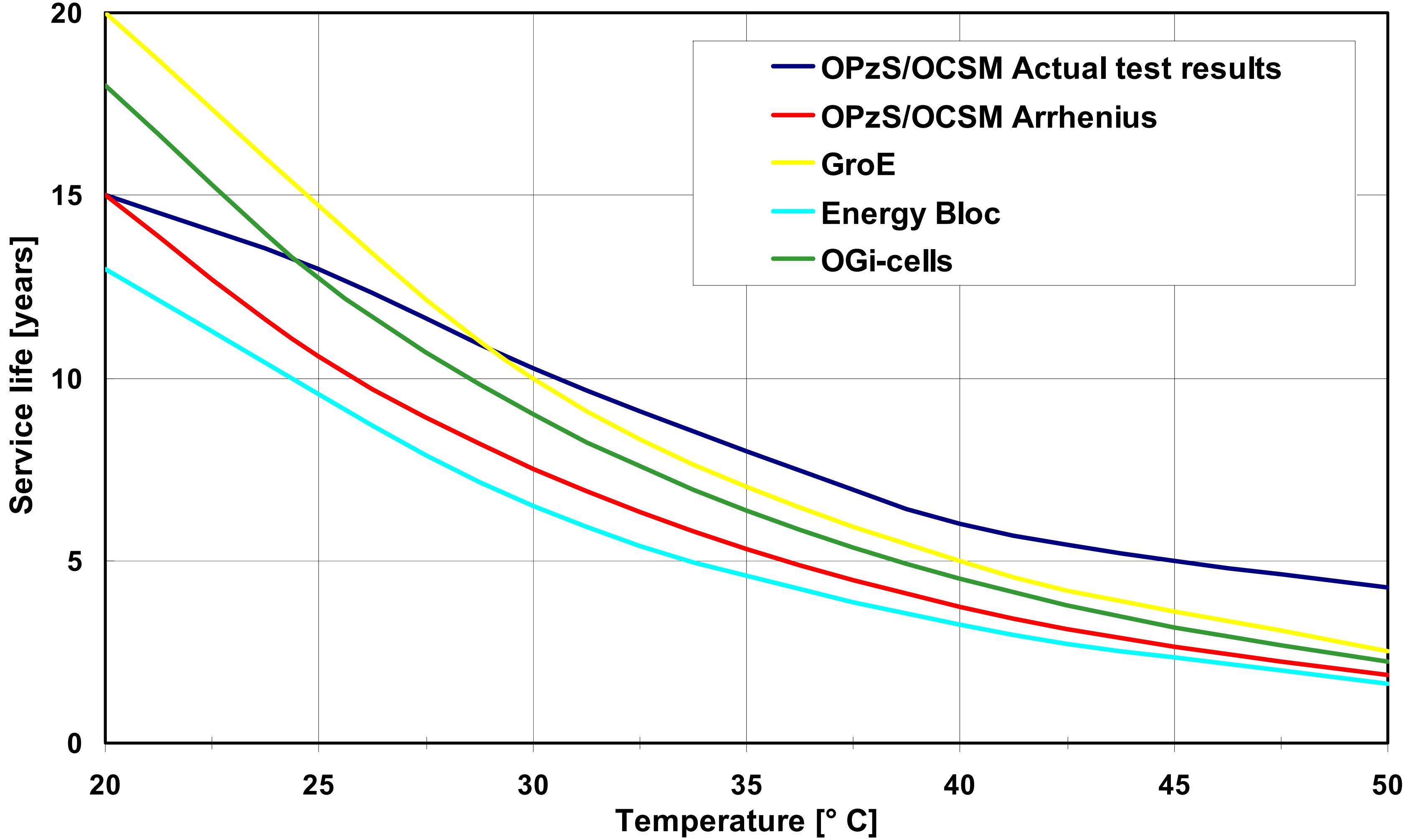
Stationary vented batteries

Influence of temperature - General



Stationary vented batteries

Service live vs. temperature



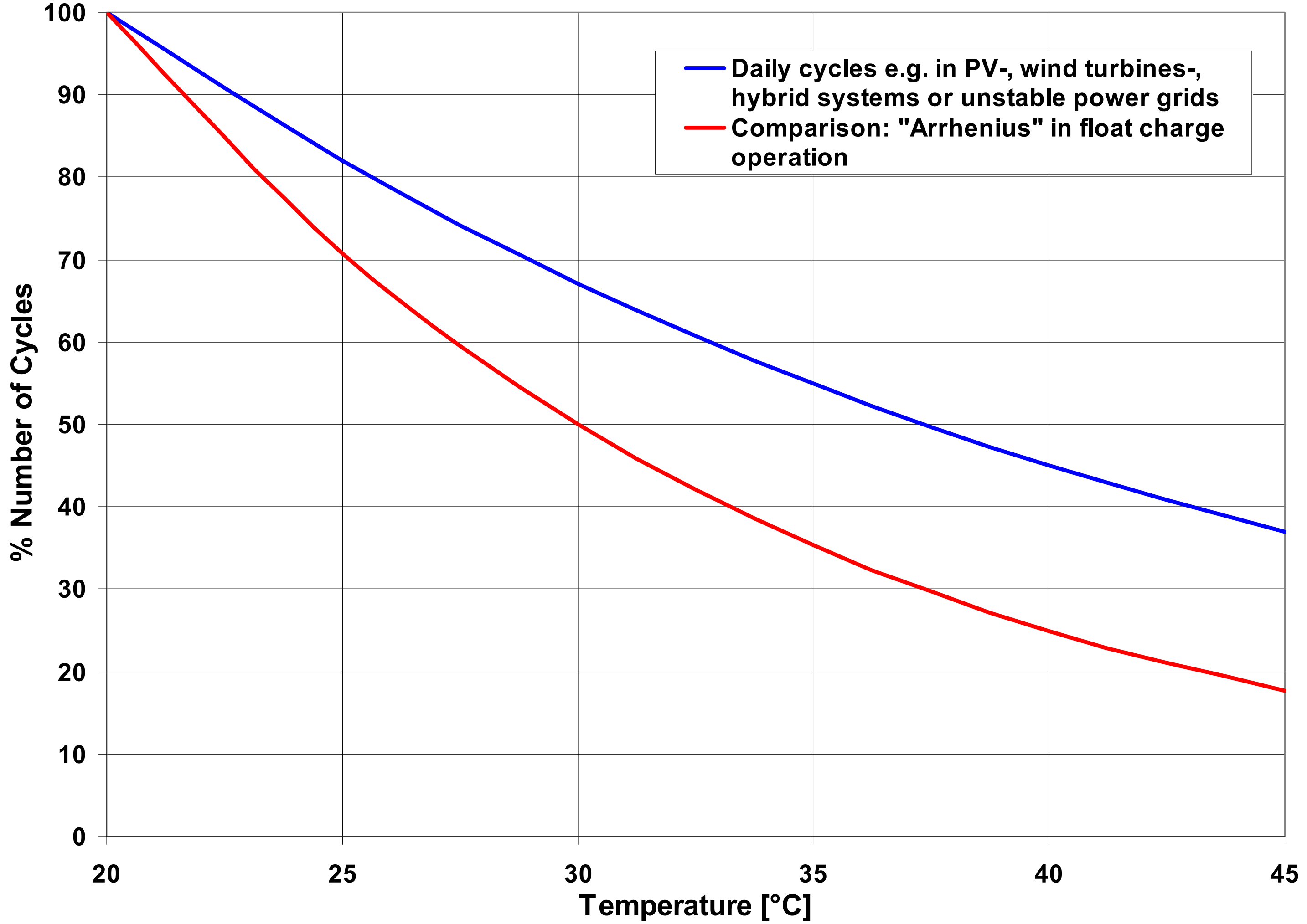
Stationary vented batteries

Endurance in cycles vs. temperature

- Common rough formula (law of “Arrhenius”) doesn’t work anymore.
- The influence of temperature is not as strong as in float charge operation because negligible corrosion during discharges in comparison to re-charging.

Stationary vented batteries

Endurance in cycles vs. temperature



Stationary vented batteries

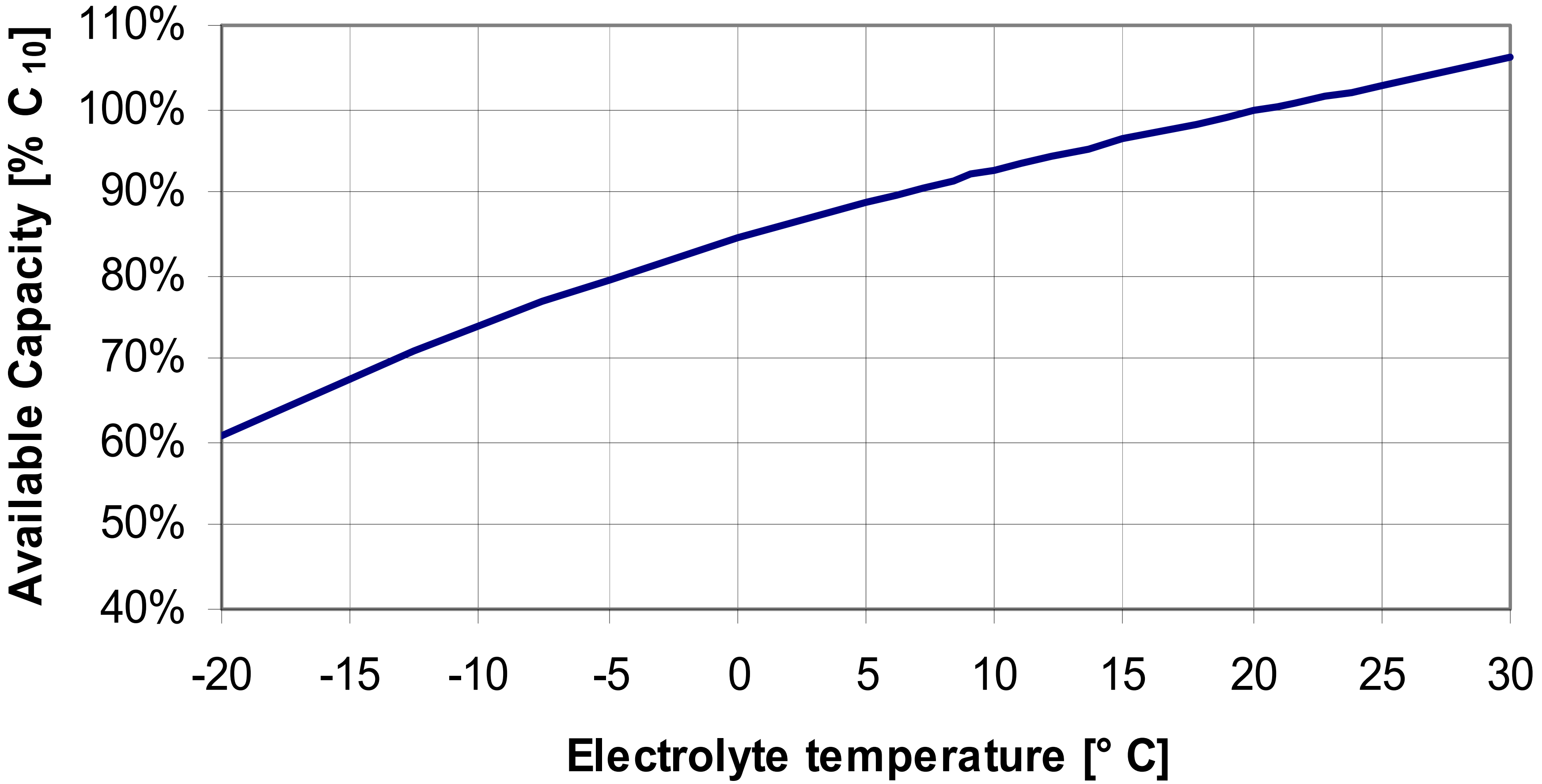
Capacity vs. temperature

- International standards
  - IEEE 485
  - IEC 60896-11

- Manufacturers' guidelines/rules
  … see following specific diagram

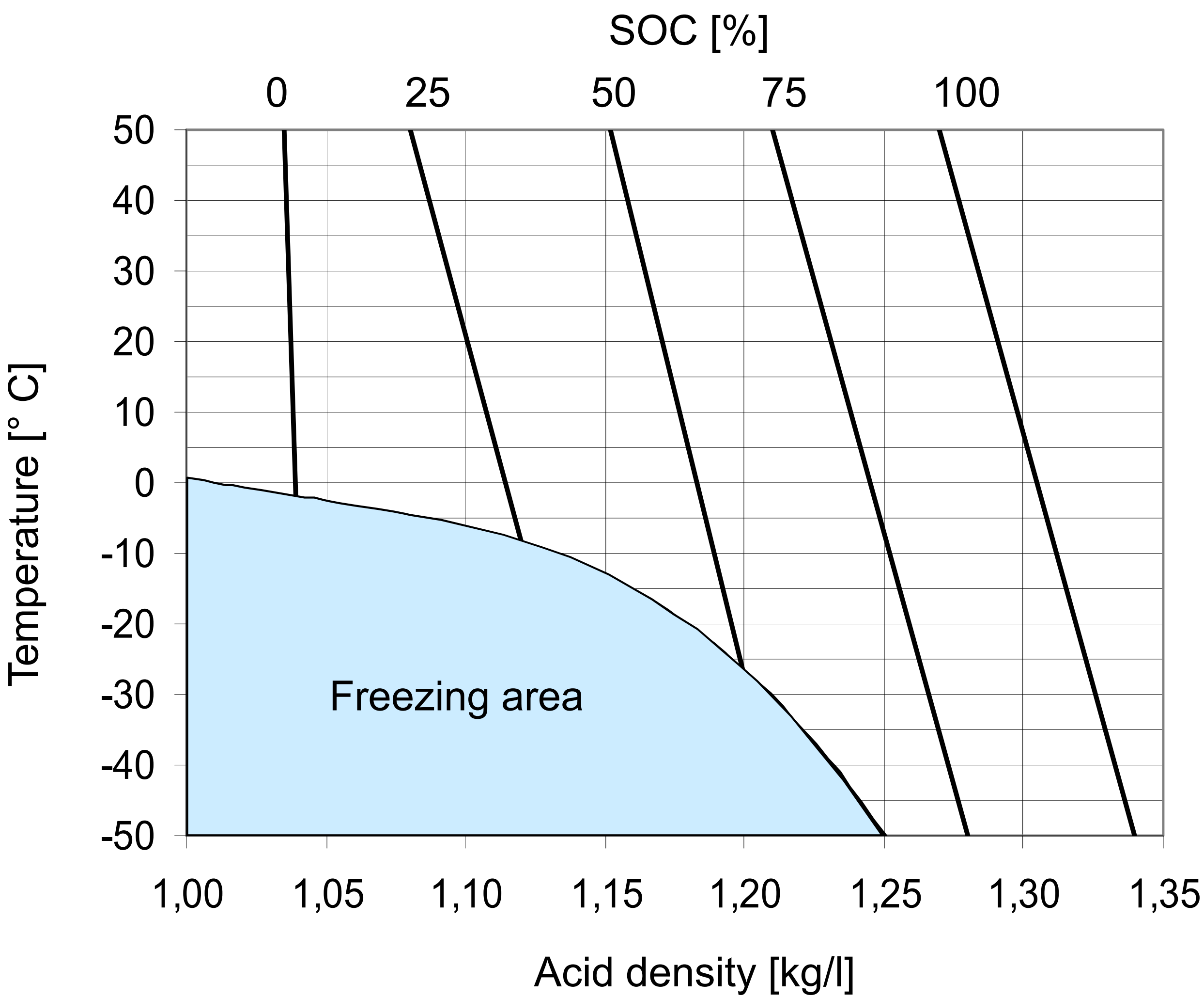
Stationary vented batteries

Capacity vs. temperature



Stationary vented batteries

Freezing point of sulphuric acid



Stationary vented batteries

Electrolyte density vs. temperature

- The electrolyte density is
  - reduced at higher temperatures, and
  - increased at lower temperatures.

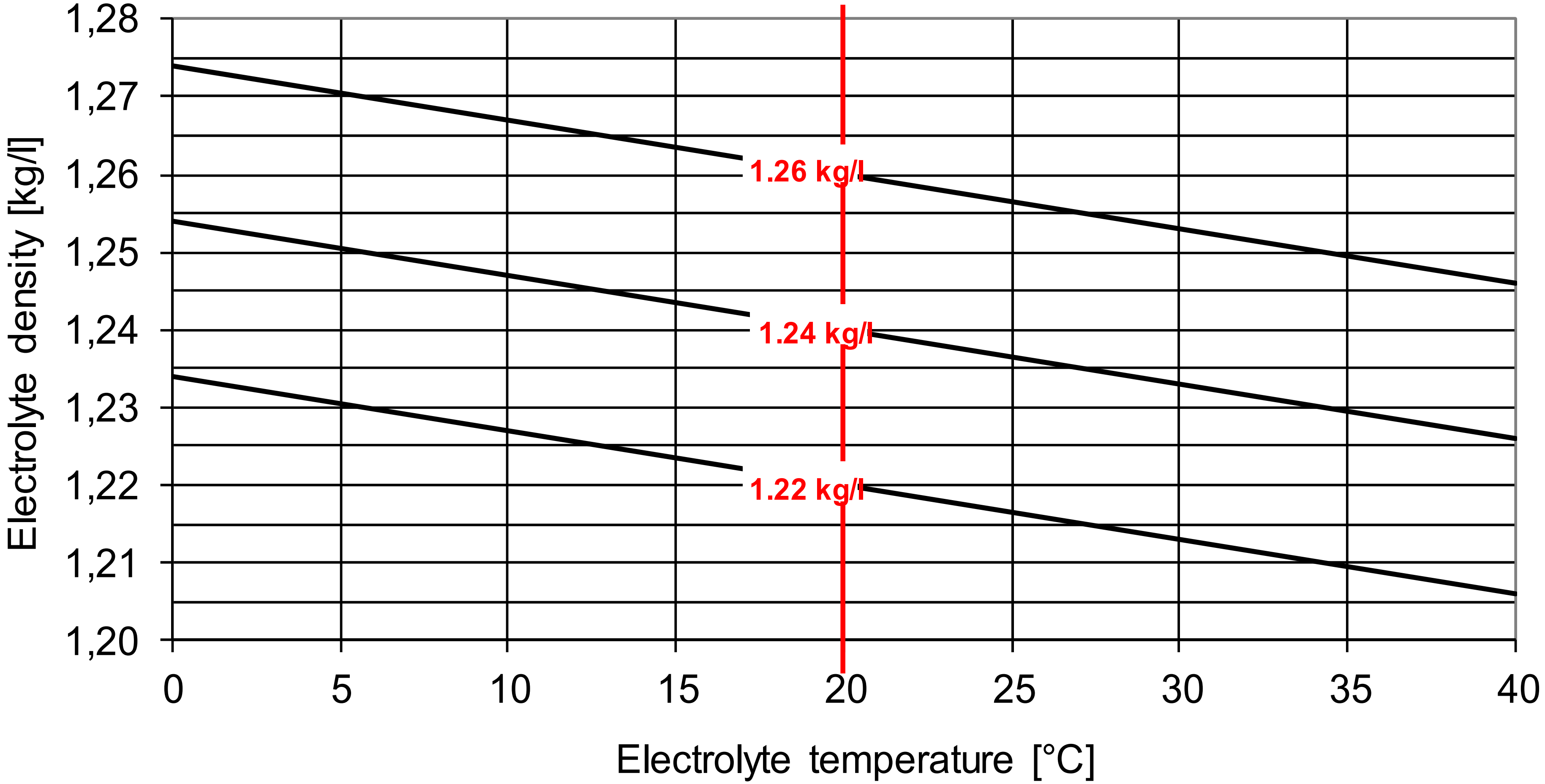
- The appropriate coefficient is:
  - 0.0007 kg/l per K

- Examples:

Temperature [°C]	Electrolyte density kg/l]
5	1.25
20*	1.24*
35	1.23

Stationary vented batteries

Electrolyte density vs. temperature



Agenda

1. Introduction and General
2. Storage
3. Installation
4. Commissioning
5. Charging
6. Discharge
7. Influence of Temperature
8. **Ventilation**
9. AC Ripple
10. Maintenance and Control
11. Q & A

Stationary vented batteries

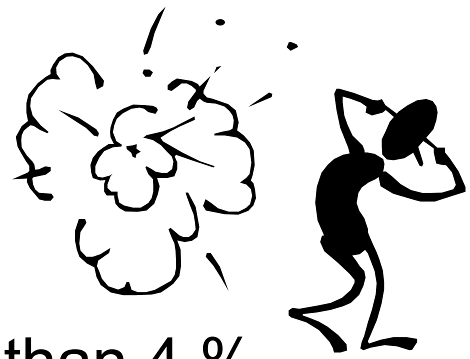
Ventilation – Why?

- Lead acid batteries generate hydrogen and oxygen during overcharging

  (electrolysis → water decomposition)

- 1 Ah decomposes 0.336 g water and generates 0.00042 m³ H_2

- Air becomes explosive if hydrogen content ≥ 4 % and when ignited by a spark



- Dilution by fresh air necessary to bring H_2 to less than 4 %

Stationary vented batteries

Ventilation acc. to EN 50272-2 respectively IEC 62485-2

- $Q = v \cdot q \cdot s \cdot n \cdot I_{gas} \cdot Crt \cdot 10\text{-}3$ [m3/h]

  with

  - Q = Quantity fresh air [m³/h]
  - v = necessary dilution of H_2 → factor 24 ← $\frac{(100\% - 4\%)}{4\%} = 24$
  - q = $0.42 \cdot 10^{-3}$ m³/ Ah generated H_2
  - s = 5, general safety factor
  - n = number of cells
  - I_{gas} = current producing gas in mA per Ah rated capacity for float or boost charge current
  - C_{rt} = capacity C_{10} [Ah] to 1.80 Vpc @ 20 °C

Stationary vented batteries

Ventilation acc. to EN 50272-2 respectively IEC 62485-2

GNB INDUSTRIAL POWER
A Division of Exide Technologies

- Simplified formula:
  $Q = 0.05 \cdot n \cdot I_{gas} \cdot C_{rt} \cdot 10^{-3}$ [m³/h]

- I_{gas} = values [mA per Ah] to be used:

	Float	Boost
Vented (Sb < 3%)	5	20
VRLA	1	8

(values take into account temperatures up to a max. of 40 °C)

Stationary vented batteries

Ventilation acc. to EN 50272-2 respectively IEC 62485-2:

- The amount of ventilation air flow shall preferably be ensured by natural ventilation, otherwise by forced (artificial) ventilation.

- Battery rooms or enclosures require an air inlet and an air outlet with a free area of opening calculated by

$$A \geq 28 * Q \ [cm^2]$$

with

Q = ventilation air flow $[m^3/h]$

Note: For the purpose of this calculation the air velocity is assumed to be 0.1 m/s

Stationary vented batteries

Ventilation acc. to EN 50272-2 respectively IEC 62485-2:

Close vicinity to the battery

- „… In the close vicinity of the battery the dilution of explosive gases is not always secured. Therefore a safety distance extending through air must be observed within which sparking or glowing devices (max. surface temperature 300 °C) are prohibited. The dispersion of explosive gas depends on the gas release rate and the ventilation close to the source of release. For calculation of the safety distance d from the source of release the following formula applies assuming a hemispherical dispersal of gas. …“

Stationary vented batteries

Ventilation acc. to EN 50272-2 respectively IEC 62485-2:

Close vicinity to the battery

“ … $$d = 28.8 \cdot \sqrt[3]{I_{gas}} \cdot \sqrt[3]{C_{rt}}\ mm$$ 5)

with: I_{gas} = current producing gas (mA per Ah)

C_{rt} = rated capacity (Ah)

NOTE The required safety distance d can be achieved by the use of a partition wall between battery and sparking device.

Where batteries form an integral part of a power supply system, e.g. in a UPS system the safety distance d may be reduced according to the equipment manufacturers safety calculations or measurements. The level of air ventilation rate must ensure that a risk of explosion does not exist by keeping the hydrogen content in air below 1%vol plus a safety margin at the potential ignition source. …

5) Depending on the source of gas release the number of cells per monobloc battery (N) or vent openings per cell (1/N) involved must be taken into consideration, i.e. by a factor of $\sqrt[3]{N}$, respectively $\sqrt[3]{1/N}$. …”

Agenda

1. Introduction and General
2. Storage
3. Installation
4. Commissioning
5. Charging
6. Discharge
7. Influence of Temperature
8. Ventilation
9. **AC Ripple**
10. Maintenance and Control
11. Q & A

Stationary vented batteries

Superimposed AC ripple

- … comes rather from the inverter than caused by the rectifier → UPS!
- …depends on the “State-of-Art” of the electrical equipment

Stationary vented batteries

Superimposed AC ripple

- …causes heating-up and shallow cycling
  - Overcharging and accelerated corrosion of positive grids
  - And especially in case of VRLA-batteries:
    - Hydrogen generation (water loss, drying out)
    - Capacity drop by insufficient charge factor

- Influence depends on amplitude, frequency and waveform

Stationary vented batteries

Superimposed AC ripple

- After recharging and during float charge operation the effective value (RMS) of the AC shall be as low as possible but

  never exceed 5 A/100 Ah
  (acc. to EN 50272-2 respectively
  IEC 62485-2)

- Vented batteries:
  No problems with criterion as mentioned above

- Effects are not fully clarified regarding
  VRLA batteries…

Agenda

1. Introduction and General
2. Storage
3. Installation
4. Commissioning
5. Charging
6. Discharge
7. Influence of Temperature
8. Ventilation
9. AC Ripple
10. **Maintenance and Control**
11. Q & A

Stationary vented batteries

Maintenance and control

GNB® INDUSTRIAL POWER
A Division of Exide Technologies

Classic™

Classic Range: GroE, OPzS-LA, OCSM-LA, OGi-LA, Energy Bloc
Operating Instructions
for stationary lead acid batteries

Nominal data
- Nominal voltage U_N : 2.0 V x number of cells
- Nominal capacity $C_N = C_{10}$: 10 h discharge (see type plate on cells and technical data in these instructions)
- Nominal discharge current $I_N = I_{10}$: C_N / 10 h
- Final discharge voltage U_f : see technical data in these instructions
- Nominal temperature t_N : 20° C

Battery type: ______ Number of cells/blocks: ______
Assembly by: ______ GNB order no.: ______ date: ______
Commissioned by: ______ date: ______
Safety signs attached by: ______ date: ______

- Observe these instructions and keep them located near the battery for future reference!
- Work on the battery should only be carried out by qualified personnel.
- Do not smoke!
- Do not use any naked flame or other sources of ignition.
  Risk of explosion and fire!
- While working on batteries wear protective goggles and clothing!
- Observe the accident prevention rules as well as EN 50272-2, EN 50110-1!
- Any acid splashes on the skin or in the eyes must be rinsed with plenty of clean water immediately. Then seek medical assistance. Spillages on clothing should be rinsed out with water!
- Explosion and fire hazard, avoid short circuits.
- Avoid electrostatic charges and discharges/sparks!
- Electrolyte is strongly corrosive!
- Blocks/cells are very heavy! Make sure they are installed securely! Only use suitable means of transport!
- Block/cell containers are sensitive to mechanical damage.
- Handle with care!
- Do not lift or pull up blocks/cells on the poles.
- Caution! Dangerous voltage.
- Metal parts of the battery are always alive, therefore do not place items or tools on the battery!

Non-compliance with operating instructions and installations or repairs made with other than original accessories and spare parts or with accessories and spare parts not recommended by the battery manufacturer or repairs made without authorization and use of additives for the electrolytes (alleged enhancing agents) render the warranty void.

Spent batteries have to be collected and recycled separately from normal household wastes (EWC 160601). The handling of spent batteries is described in the EU Battery Directive (2006/66/EC) and their national transitions (UK: HS Regulation 1994 No. 232, Ireland: Statory Instrument No. 73/2000). Contact your supplier to agree upon the recollection and recycling of your spent batteries or contact a local and authorized Waste Management Company.

1. Start Up
The commissioning should take place as soon as possible after receipt of the battery. If this is not possible, advises acc. to item 6. shall be taken into account. Check all cells/blocks for mechanical damage, correct polarity and firmly seated connectors. The following torques apply to the cell types:

GroE, OCSM-LA, OPzS-LA Cells	Energy Bloc OPzS Block	OGi-LA Cells ≤ 250 Ah	OGi-LA Cells ≥ 250 Ah
20 Nm	12 Nm	8 Nm	20 Nm

Table 1: Torques with a tolerance of ± 1 Nm

Put covers on the terminals if necessary. Check the electrolyte level in all cells and if necessary top up to maximum level with purified water as acc. to DIN 43530 Part 4. Connect the battery with the correct polarity to the charger (pos. pole to pos. terminal). The charger must not be switched on during this process, and the load must not be connected. Switch on charger and start charging following item 2.2.
The insulation resistance measured at the disconnected loads and charger should be ≥ 100 Ω per volt nominal voltage.

2. Operation
For the installation and operation of stationary batteries EN 50 272-2 is mandatory.

The battery must be installed in a way which prevents ambiance-dependent temperature differences of > 10 K arising. The spacing between the cells or blocks should be 10 mm and at least 5 mm in rack mounting.

2.1 Discharge
Discharge must not be continued below the voltage recommended for the discharge time. Deeper discharges must not be carried out unless specifically agreed with the manufacturer. Recharge immediately following complete or partial discharge.

2.2 Charging
All charging characteristics with their specific data, described in
DIN 41773 (IU-characteristic, I-const.: ± 2%, U-const.: ± 1%)
DIN 41774 (W-characteristic, ± 0.05 Vpc)
DIN 41776 (I-characteristic, I-const.: ± 2%)
may be used. According to the charging equipment, specification and characteristics alternating currents flow through the battery superimposing onto the direct current during charge operation.
Alternating currents and the reaction of the loads may lead to an additional temperature increase of the battery, and strain the electrodes with possible damage (see point 2.5), which can shorten the battery life. Depending on the installation, charging (acc. to EN 50272-2) may be carried out in following operations:

a) Standby Parallel Operation
Here the load, battery and battery charger are continuously in parallel. Thereby, the charge voltage is the operation voltage and at the same time the battery installation voltage.
With the standby parallel operation, the battery charger is capable, at any time, of supplying the maximum load current and the battery charging current. The battery only supplies current when the battery charger fails. The float charge voltage measured at the end terminals of the battery should be set at the values in table 2. To reduce the charging time, a boost-charging stage can be applied in which the charge voltage of 2.33 V - 2.40 V x number of cells can be adjusted (standby parallel operation with boost recharging stage). Automatic changeover to float charging voltage acc. to table 2.
With buffer operation, the battery charger is not able to supply the maximum load current at all times. The load current intermittently exceeds the nominal current of the battery charger. During this period the battery supplies power. This results in the battery not being fully charged at all times. Therefore, depending on the load the charge voltage must be set at 2.25 V - 2.30 V x number of cells. This has to be carried out in accordance with the manufacturers instructions.

8

en

Range	Float charge voltage per cell
GroE, OPzS-LA, Energy Bloc, OGi-LA block / cell	2.23 V
OCSM-LA	2.25 V

Table 2: Float charge voltage

b) Switch mode operation
When charging, the battery is separated from the load. Towards the end of the charging process the charge voltage of the battery is 2.6 V - 2.75 V times the number of cells. The charging process must be monitored (see points 2.4, 2.5 and 2.6)! On reaching a fully charged state, the charging process must be stopped or switched to float charge as in point 2.3.

c) Battery Operation
(charge-/discharge operation)
The load is supplied by the battery only, whereby the charge voltage of the battery towards the end of the charging process can be 2.6 V - 2.75 V times the number of cells. The charging process must be monitored (see points 2.4, 2.5 and 2.6)! On reaching a fully charged state, the charging process must be switched off. The battery can be switched to the load as required.

2.3 Maintaining full charge
(float charging)
The devices used must comply with the stipulations under DIN 41773. They are to be set so that the average cell voltage is see table 2 and the electrolyte density should not decrease over a lengthy period.

2.4 Equalizing charge
Because it is possible to exceed the permitted load voltages, appropriate measures must be taken, e.g. switch off the load.
Equalizing charges are required after deep discharges and/or inadequate charges. They can be carried out as follows:
- at constant voltage of max. 2.4 Vpc up to 72 hours
- with I- or W-characteristic as in point 2.6.

The electrolyte temperature must never exceed 55° C. If it does, stop charging or revert to float charge to allow the temperature to drop.
The end of the equalizing charge is reached when the electrolyte density and the cell voltages no longer increase over a period of 2 hours. (2 h -criterion only applies to I- and W-characteristics).

2.5 Alternating currents
When recharging up to 2.4 Vpc under operation modes 2.2 the value of the alternating current is occasionally permitted to reach 10 A (RMS) per 100 Ah nominal capacity.
In a fully charged state during float charge or standby parallel operation the actual value of the alternating current must not exceed 5 A (RMS) per 100 Ah nominal capacity.

2.6 Charging currents
The charging currents are not limited during standby parallel operation or buffer operation (IU-charge characteristic) with voltages up to 2.4 Vpc (reference values 10 A up to 35 A per 100 Ah nominal capacity).
Charging by I- or W-characteristic results in voltages higher than 2.4 Vpc and therefore increased decomposition of water. The charging currents per 100 Ah nominal capacity shown in the following table must not be exceeded.

Charging procedure	Range: GroE	Range: OGi-LA, OPzS-LA, OCSM-LA, Energy Bloc (OGi-LA Block)	Cell voltage
IU-characteristic*)	10 A to 35 A		up to 2.40 V
I-characteristic	6.5 A	5.0 A	2.60 V-2.75 V
W-characteristic	9.0 A 4.5 A	7.0 A 3.5 A	at 2.40 V at 2.65 V

*Table 3: Permissible charging currents per 100 Ah nominal capacity; *) = recommended values*

2.7 Temperature
The recommended operating temperature range for lead acid batteries is 10° C to 30° C. All technical data apply to the nominal temperature 20° C.

The ideal operating temperature is 20° C ± 5 K. Higher temperatures will seriously reduce service life. Lower temperatures reduce the available capacity. The absolute maximum temperature is 55° C.

2.8 Temperature-related charge voltage
A temperature related adjustment of the charge voltage within the operating temperature of 10° C to 30° C is not necessary. If the operating temperature is constantly outside this range, the charge voltage has to be adjusted.
The temperature correction factor is -0.004 Vpc per K. Thereby 2.4 Vpc must not be exceeded and the voltage must not come below 2.15 Vpc (OCSM: 2.17 Vpc).

2.9 Electrolyte
The electrolyte density is diluted sulphuric acid. The nominal electrolyte density ± 0.01 kg/l (acc. to technical data) is based on 20 °C when fully charged and with the maximum electrolyte level. Higher temperatures reduce electrolyte density, lower temperatures increase electrolyte density. The appropriate correction factor is -0.0007 kg/l per K.
Example: electrolyte density of 1.23 kg/l at 35° C corresponds to a density of 1.24 kg/l at 20° C or an electrolyte density of 1.25 kg/l at 5° C corresponds to a density of 1.24 kg/l at 20° C.

3. Battery maintenance and control
The electrolyte level must be checked regularly. If it drops to the lower electrolyte level mark, purified water must be added in accordance with DIN 43530 Part 4 (maximum conductivity 30 µS/cm). Keep the battery clean and dry to avoid leakage currents. Plastic parts of the battery, especially containers, must be cleaned with pure water without additives.

At least every 6 months measure and record:
- Battery voltage
- Voltage of some cells/block batteries
- Electrolyte temperature of some cells
- Battery-room temperature
- Electrolyte density of some cells

If the cell voltages deviate by more than + 0.1 V or - 0.05 V (for blocks see table 4) from the average charge retention voltage (see table 2), and/or if the electrolyte density of the cells of a battery string deviates from the average-value more than - 0.01/+ 0.02 kg/l (reference values), call customer service.

Tolerance	4 V-Block	6 V-Block	10 V-Block	12 V-Block
+	0.14 V	0.17 V	0.22 V	0.24 V
-	0.07 V	0.09 V	0.11 V	0.12 V

Table 4: Permissible deviation from the average charge retention for block batteries

Annual measurement and recording:
- Voltage of all cells/block batteries
- Electrolyte temperature of all cells
- Electrolyte density of all cells

Annual visual check:
- Screw connections
- Screw connections without locking devices have to be checked for tightness
- Battery installation and arrangement
- Ventilation

4. Tests
Tests have to be carried out according to IEC 60896-11. Special instructions like DIN VDE 0107 and DIN EN 50172 have to be observed.

Capacity test, for instance, acceptance test on site: In order to make sure the battery is fully charged the following IU-charge methods must be applied: Option 1: float charge (see table 2), ≥ 72 hours. Option 2: 2.40 Vpc, ≥ 16 hours (max. 48 hours) followed by float charge (see item 2.3), ≥ 8 hours. The current available to the battery must be between 10 A / 100 Ah and 35 A / 100 Ah of the C_{10}-capacity.

5. Faults
Call the services agents immediately if faults in the battery or charging unit are found. Recorded data as described in point 3. simplify the trouble-shooting and fault clearance. A service contract for example with Exide Technologies facilitates detecting faults in time.

6. Storage and taking out of operation
To store or decommission cells/blocks for a longer period of time they should be fully charged and stored in a dry and cold but frost-free room, away from direct sunlight. To avoid damage the following charging methods can be chosen:
To prevent damage, choose the following charging methods:
1. Refreshing charges every three months as described under point 2.4.
   At average ambient temperatures of more than the nominal temperature shorter intervals can be necessary.
2. Float charging as under point 2.3.

7. Transport
Cells/block batteries must be transported in an upright position. Cells/block batteries without any visible damage are not defined as hazardous goods under the regulations for transport of hazardous goods by road (ADR) or by railway (RID). They must be protected against short circuits, slipping, upsetting or damaging. Block batteries may be suitably stacked and secured on pallets (ADR and RID, special provision 598). It is prohibited to stack pallets. No dangerous traces of acid may be found on the exteriors of the packing units. Cells/block batteries whose cases leak or are damaged must be packed and transported as class 8 hazardous goods under UN no. 2794.
In case of air transport, batteries which are part of any equipment must be disconnected at their terminals, and the terminals must be protected against short-circuits. This is in order to avoid the risk of any incidents like fire etc.

8. Technical data
The nominal voltage, the number of cells, the nominal capacity ($C_{10} = C_N$) and the battery type are described on the type plate. Other capacities (C_n) at different discharge currents (I_n) with the corresponding discharge times (t_n) see table 8.1.1 - 8.1.5.

9

en

Stationary vented batteries

Maintenance and control

GNB INDUSTRIAL POWER
A Division of Exide Technologies

9.1 Measurements, weights and capacities at different discharge times and final discharge voltage

9.1.1 Stationary lead acid batteries type OPzS-LA acc. to DIN 40736 and DIN 40737
with positive tubular plates and negative grid plates, Nominal electrolyte density 1.24 kg/l

Blocks

	Discharge data								Measurements and weights				
	Capacity [Ah]				discharge current [A]				Length max. [mm]	Width max. [mm]	Height [1] max. [mm]	Weight with acid approx. [kg]	Weight acid approx. [kg]
Discharge time [h]	10	5	3	1	10	5	3	1					
Final discharge voltage [Vpc]	1.80	1.80	1.75	1.65	1.80	1.80	1.75	1.65					
12V 1 OPzS 50 LA	59.0	47.5	42.0	27.9	5.90	9.50	14.0	27.9	273	204	358	35	15
12V 2 OPzS 100 LA	101	85.5	77.7	55.5	10.1	17.1	25.9	55.5	273	204	358	45	14
12V 3 OPzS 150 LA	150	128	112	83.0	15.0	25.7	37.5	83.0	381	204	358	64	19
6V 4 OPzS 200 LA	203	174	150	113	20.3	34.9	50.0	113	273	204	358	41	13
6V 5 OPzS 250 LA	255	214	186	135	25.5	42.8	62.0	135	381	204	358	56	20
6V 6 OPzS 300 LA	303	255	223	165	30.3	51.0	74.5	165	381	204	358	63	20

Cells

2 OPzS 100 LA	128	113	102	71.8	12.8	22.6	34.3	71.8	105	208	395	13.7	5.2
3 OPzS 150 LA	168	147	134	91.7	16.8	29.5	44.9	91.7	105	208	395	15.2	5.0
4 OPzS 200 LA	214	188	171	118	21.4	37.6	57.1	118	105	208	395	16.6	4.6
5 OPzS 250 LA	265	231	210	145	26.5	46.3	70.0	145	126	208	395	20.0	5.8
6 OPzS 300 LA	316	274	247	171	31.6	54.9	82.6	171	147	208	395	23.3	6.9
5 OPzS 350 LA	380	325	291	211	38.0	65.0	97.3	211	126	208	511	26.7	8.1
6 OPzS 420 LA	455	389	348	246	45.5	77.8	116	246	147	208	511	31.0	9.3
7 OPzS 490 LA	530	453	408	280	53.0	90.6	136	280	168	208	511	35.4	10.8
6 OPzS 600 LA	680	560	501	364	68.0	112	167	364	147	208	686	42.9	13.0
7 OPzS 700 LA	750	615	552	401	75.0	123	184	401	147	208	686	47.2	12.8
8 OPzS 800 LA	910	760	678	502	91.0	152	226	502	212	193	686	59.9	17.1
9 OPzS 900 LA	980	820	729	541	98.0	164	243	541	212	193	686	63.4	16.8
10 OPzS 1000 LA	1140	945	843	620	114	189	281	620	212	235	686	73.2	21.7
12 OPzS 1200 LA	1370	1125	1008	733	137	225	336	733	212	277	686	86.4	26.1
12 OPzS 1500 LA	1700	1385	1239	853	170	277	413	853	212	277	836	108.0	33.7
14 OPzS 1750 LA	1800	1465	1311	904	180	293	437	904	212	277	836	114.0	32.7
16 OPzS 2000 LA	2250	1835	1641	1180	225	367	547	1180	215	400	812	151.0	50.0
18 OPzS 2250 LA	2450	1995	1785	1250	245	399	595	1250	215	400	812	158.0	48.0
20 OPzS 2500 LA	2800	2280	2040	1465	280	456	680	1465	215	490	812	184.0	60.0
22 OPzS 2750 LA	3000	2445	2187	1570	300	489	729	1570	215	490	812	191.0	58.0
24 OPzS 3000 LA	3350	2730	2442	1710	335	546	814	1710	215	580	812	217.0	71.0

[1] Includes installed connector, the above mentioned height can differ depending on the used vent(s)

10
en

9.1.2 Stationary lead acid cells type OCSM-LA
with positive tubular plates and negative copper stretch metal grid plates, Nominal electrolyte density 1.26 kg/l

	Discharge data								Measurements and weights				
	Capacity [Ah]				discharge current [A]				Length max. [mm]	Width max. [mm]	Height [1] max. [mm]	Weight with acid approx. [kg]	Weight acid approx. [kg]
Discharge time [h]	10	5	3	1	10	5	3	1					
Final discharge voltage [Vpc]	1.80	1.80	1.75	1.70	1.80	1.80	1.75	1.70					
2 OCSM 160 LA	170	144	129	91.2	17.0	28.8	43.2	91.2	126	208	522	19.8	8.4
3 OCSM 240 LA	255	216	194	137	25.5	43.2	64.7	137	126	208	522	22.6	8.2
4 OCSM 320 LA	340	288	259	182	34.0	57.5	86.3	182	126	208	522	25.1	7.9
5 OCSM 400 LA	425	360	324	228	42.5	71.9	108	228	126	208	522	28.3	8.2
6 OCSM 480 LA	510	432	388	274	51.0	86.3	129	274	147	208	522	33.1	9.7
7 OCSM 560 LA	595	503	453	319	59.5	101	151	319	168	208	522	37.9	11.1
5 OCSM 575 LA	591	514	467	338	59.1	103	156	338	147	208	698	41.8	13.4
6 OCSM 690 LA	709	616	560	406	70.9	123	187	406	147	208	698	45.4	13.3
7 OCSM 805 LA	827	719	653	474	82.7	144	218	474	215	193	698	58.3	17.3
8 OCSM 920 LA	946	822	747	541	94.6	164	249	541	215	193	698	61.9	17.7
9 OCSM 1035 LA	1064	925	840	609	106	185	280	609	215	235	698	71.6	21.6
10 OCSM 1150 LA	1182	1027	933	676	118	205	311	676	215	235	698	75.7	21.8
11 OCSM 1265 LA	1300	1130	1027	744	130	226	342	744	215	277	698	86.3	26.5
12 OCSM 1380 LA	1418	1233	1120	812	142	247	373	812	215	277	698	88.9	26.4
11 OCSM 1595 LA	1743	1468	1289	891	174	294	430	891	215	277	848	106	33.3
12 OCSM 1740 LA	1902	1602	1406	972	190	320	469	972	215	277	848	110	32.8
14 OCSM 2030 LA	2219	1869	1640	1134	222	374	547	1134	215	400	824	143	47.8
16 OCSM 2320 LA	2536	2136	1874	1296	254	427	625	1296	215	400	824	152	46.9
18 OCSM 2610 LA	2853	2403	2108	1458	285	481	703	1458	215	490	824	178	57.9
20 OCSM 2900 LA	3170	2670	2343	1620	317	534	781	1620	215	490	824	186	55.6
22 OCSM 3190 LA	3487	2937	2577	1782	349	587	859	1782	215	580	824	224	68.0
24 OCSM 3480 LA	3804	3204	2811	1944	380	641	937	1944	215	580	824	222	67.1

[1] The above mentioned height can differ depending on the used vents

9.1.3 Stationary lead acid block batteries Energy Bloc (OGi-Block battery)
with positive and negative grid plates, Nominal electrolyte density 1,24 kg/l

	Discharge data								Measurements and weights				
	Capacity [Ah]				discharge current [A]				Length max. [mm]	Width max. [mm]	Height [1] max. [mm]	Weight including acid approx. ca. [kg]	Weight of acid approx. ca. [kg]
Discharge time [h]	10	5	3	1	10	5	3	1					
Final discharge voltage [Vpc]	1.80	1.80	1.80	1.75	1.80	1.80	1.80	1.75					
EB 1230	30.0	26.5	23.1	17.3	3.00	5.30	7.70	17.3	273	204	358	28.7	12.7
EB 1260	61.0	52.5	46.2	34.7	6.10	10.5	15.4	34.7	273	204	358	33.9	11.8
EB 1285	85.0	75.5	66.6	50.3	8.50	15.1	22.2	50.3	273	204	358	39.1	10.7
EB 12110	105	96.0	84.9	64.7	10.5	19.2	28.3	64.7	273	204	358	44.2	10.6
EB 12145	141	126	111	83.8	14.1	25.2	37.0	83.8	381	204	358	57.8	15.2
EB 12160	158	144	127	97.1	15.8	28.8	42.5	97.1	381	204	358	64.2	15.1
EB 6215	211	184	162	121	21.1	36.9	54.0	121	273	204	358	41.2	11.6
EB 6230	226	201	177	134	22.6	40.3	59.2	134	273	204	358	42.4	11.1
EB 6240	237	216	191	145	23.7	43.2	63.7	145	273	204	358	46.0	11.0
EB 6310	302	263	231	173	30.2	52.7	77.2	173	381	204	358	55.9	16.80
EB 6335	332	290	255	190	33.2	58.0	85.0	190	381	204	358	59.6	16.40
EB 6350	339	302	266	201	33.9	60.5	88.,8	201	381	204	358	62.3	15.80

[1] Includes installed connector, the above mentioned height can differ depending on the used vent(s)

11
en

Stationary vented batteries

Maintenance and control

9.1.4 Stationary lead acid batteries type GroE acc. to DIN 40 738
with positive plates and negative grid plates, Nominal electrolyte density 1.22 kg/l

	Discharge data								Measurements and weights				
	Capacity [Ah]				discharge current [A]				Length max.	Width max.	Height [1] max.	Weight with acid approx.	Weight acid approx.
Discharge time [h]	10	5	3	1	10	5	3	1					
Final discharge voltage [Vpc]	1.80	1.80	1.775	1.75	1.80	1.80	1.775	1.75	[mm]	[mm]	[mm]	[kg]	[kg]
3 GroE 75	75	76.5	68.4	50.7	7.50	15.3	22.8	50.7	182	153	411	17.5	6.6
4 GroE 100	100	102	91.2	67.6	10.0	20.4	30.4	67.6	182	153	411	19.7	6.4
5 GroE 125	125	127	114	84.5	12.5	25.5	38.0	84.5	182	153	411	21.9	6.2
6 GroE 150	150	153	136	101	15.0	30.6	45.6	101	182	153	411	24.1	6.0
7 GroE 175	175	178	159	118	17.5	35.7	53.2	118	182	153	411	26.3	5.8
8 GroE 200	200	204	182	135	20.0	40.8	60.8	135	182	228	411	33.2	9.4
9 GroE 225	225	229	205	152	22.5	45.9	68.4	152	182	228	411	35.4	9.2
10 GroE 250	250	255	228	169	25.0	51.0	76.0	169	182	228	411	37.6	9.0
11 GroE 275	275	280	250	185	27.5	56.1	83.6	185	182	228	411	39.8	8.8
12 GroE 300	300	305	273	202	30.0	61.2	91.2	202	182	228	411	42.0	8.6
13 GroE 325	325	331	296	219	32.5	66.3	98.8	219	182	338	411	52.5	14.1
14 GroE 350	350	357	318	236	35.0	71.4	106	236	182	338	411	54.7	13.8
15 GroE 375	375	382	342	253	37.5	76.5	114	253	182	338	411	56.9	13.6
16 GroE 400	400	408	363	270	40.0	81.6	121	270	182	338	411	59.1	13.3
17 GroE 425	425	433	387	287	42.5	86.7	129	287	182	338	411	61.3	13.0
18 GroE 450	450	459	408	304	45.0	91.8	136	304	182	338	411	63.5	12.7
5 GroE 500	500	462	438	307	50.0	92.5	146	307	328	268	590	95	34
6 GroE 600	600	555	525	369	60.0	111	175	369	328	268	590	104	33
7 GroE 700	700	645	612	430	70.0	129	204	430	328	268	590	113	32
8 GroE 800	800	740	699	492	80.0	148	233	492	328	268	590	122	31
9 GroE 900	900	830	786	553	90.0	166	262	553	328	268	590	131	30
10 GroE 1000	1000	925	876	615	100	185	292	615	328	268	590	140	29
11 GroE 1100	1100	1015	963	676	110	203	321	676	328	268	590	149	28
12 GroE 1200	1200	1110	1050	738	120	222	350	738	328	348	590	170	39
13 GroE 1300	1300	1200	1137	799	130	240	379	799	328	348	590	179	38
14 GroE 1400	1400	1295	1224	861	140	259	408	861	328	348	590	188	37
15 GroE 1500	1500	1385	1314	922	150	277	438	922	328	348	590	197	36
16 GroE 1600	1600	1480	1401	984	160	296	467	984	328	438	590	222	49
17 GroE 1700	1700	1570	1488	1045	170	314	496	1045	328	438	590	231	48
18 GroE 1800	1800	1655	1575	1107	180	333	525	1107	328	438	590	240	47
19 GroE 1900	1900	1755	1662	1168	190	351	554	1168	328	438	590	249	46
20 GroE 2000	2000	1850	1752	1230	200	370	584	1230	328	438	590	258	45
21 GroE 2100	2100	1940	1839	1291	210	388	613	1291	328	528	590	285	58
22 GroE 2200	2200	2035	1926	1353	220	407	642	1353	328	528	590	294	57
23 GroE 2300	2300	2125	2013	1414	230	425	671	1414	328	528	590	303	56
24 GroE 2400	2400	2220	2100	1476	240	444	700	1476	328	528	590	312	55
25 GroE 2500	2500	2310	2190	1537	250	462	730	1537	328	573	590	325	60
26 GroE 2600	2600	2405	2277	1599	260	481	759	1599	328	573	590	334	59

[1] Includes installed connector, the above mentioned height can differ depending on the used vent(s)

12

en

9.1.5 Stationary lead acid batteries type OGi (LA)
with positive and negative grid plates, Nominal electrolyte density 1.26 kg/l,
* Nominal electrolyte density 1.24 kg/l

Single cell

	Discharge data								Measurements and weights				
	Capacity [Ah]				discharge current [A]				Length max.	Width max.	Height [1] max.	Weight with acid approx.	Weight acid approx.
Discharge time [h]	10	5	3	1	10	5	3	1					
Final discharge voltage [Vpc]	1.80	1.77	1.75	1.67	1.80	1.77	1.75	1.67	[mm]	[mm]	[mm]	[kg]	[kg]
2 OGi 50 LA*	50	45.0	36.6	26	5.0	9.0	12.2	26	69	160	351	6.30	2.30
3 OGi 75 LA*	75	67.5	54.6	39	7.5	13.5	18.2	39	69	160	351	7.00	2.10
4 OGi 100 LA*	100	90.0	71.4	51	10.0	18.0	23.8	51	125	160	384	11.5	4.90
6 OGi 150 LA*	150	135.0	107.4	75	15.0	27.0	35.8	75	125	160	384	13.3	4.60
8 OGi 200 LA*	200	177.5	143.1	98	20.0	35.5	47.7	98	155	160	384	16.8	5.80
10 OGi 250 LA*	250	222.5	178.8	120	25.0	44.5	59.6	120	194	160	384	20.9	7.30
4 OGi 260 LA	260	224.5	186.3	129	26.0	44.9	62.1	129	124	206	511	20.8	8.20
5 OGi 325 LA	325	280.0	233.1	161	32.5	56.0	77.7	161	124	206	511	22.9	7.90
6 OGi 370 LA	370	312.5	268.2	192	37.0	62.5	89.4	192	124	206	511	24.7	7.50
7 OGi 410 LA	410	347.5	303.0	224	41.0	69.5	101.0	224	124	206	511	26.6	7.30
8 OGi 440 LA	440	382.5	339.0	255	44.0	76.5	113.0	255	124	206	511	28.5	7.10
9 OGi 470 LA	470	417.5	375.0	287	47.0	83.5	125.0	287	124	206	511	30.6	6.90
10 OGi 530 LA	530	465.0	420.0	316	53.0	93.0	140.0	316	145	206	511	34.0	8.10
11 OGi 580 LA	580	515.0	465.0	346	58.0	103.0	155.0	346	166	206	511	38.3	9.80
12 OGi 620 LA	620	562.5	513.0	375	62.0	112.5	171.0	375	166	206	511	40.0	9.40
12 OGi 730 LA	730	585.0	579.0	383	73.0	117.0	193.0	383	210	254	511	50.3	17.5
14 OGi 800 LA	800	715.0	636.0	482	80.0	143.0	212.0	482	210	254	511	52.6	15.9
16 OGi 880 LA	880	770.0	687.0	520	88.0	154.0	229.0	520	210	254	511	56.6	15.5
19 OGi 1000 LA	1000	857.5	762.0	578	100.0	171.5	254.0	578	210	254	511	62.5	14.9
16 OGi 1260 LA	1260	1117.5	1002.0	718	126.0	223.5	334.0	718	210	233	688	78.2	18.3
18 OGi 1340 LA	1340	1187.5	1065.0	763	134.0	237.5	355.0	763	210	233	688	85.2	19.7
20 OGi 1520 LA	1520	1347.5	1209.0	869	152.0	269.5	403.0	869	210	275	688	95.2	22.3
22 OGi 1600 LA	1600	1420.0	1272.0	915	160.0	284.0	424.0	915	210	275	688	103	23.3

[1] The above mentioned height can differ depending on the used vent(s)

13

en

Stationary vented batteries

Maintenance and control

- Non-compliance with installation instruction, installations or repairs made with other than original accessories and spare parts or with accessories or spare parts not recommended by the battery manufacturer or repairs made without authorization render the warranty void.

- Avoid electrostatic charges and discharges / sparks!

Stationary vented batteries

Maintenance and control

- To avoid leakage currents keep the battery clean and dry. Plastic components, e.g. cell containers must be cleaned with pure water only
- Acc. to EN 50272-2:
  Minimum insulation resistance between the batteries circuit and other local conductive parts should be > 100 Ohm per Volt (of nominal battery voltage) corresponding to leakage currents < 10 mA
- Tests, e.g. capacity tests, must be carried out according to IEC 60896-11.
- In addition...

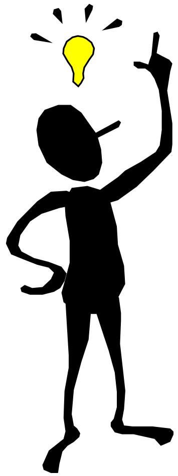
Stationary vented batteries

Maintenance and control: Checks

- Check electrolyte level regularly and refill with purified water

- Checks at least every six months:
  - Battery terminal voltage
  - Individual voltages, electrolyte densities and electrolyte temperatures of a few (approx. 20 %) selected cells (blocks)
  - Temperature in the battery room

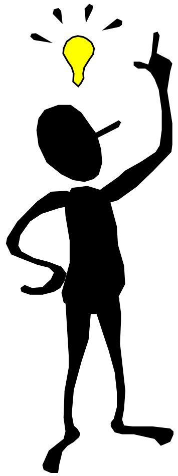
- ... must be measured and **recorded**



Stationary vented batteries

Maintenance and control: Checks

- Annual checks:
  - Battery terminal voltage
  - Individual voltage and electrolyte density of all cells (blocks)
  - Electrolyte temperature of some cells
  - Temperature in the battery room
- ... must be measured and **recorded**



- Visual checks:
  - Screw- connections,
  - battery installation,
  - ventilation

Stationary vented batteries

Maintenance and control: some criteria

- Permissible deviations of individual cells/block from the average value
  - Float voltage per cell: + 0.1 Vpc; - 0.05 Vpc
  - Float voltage per block:

	12 V block	10 V block	6 V block	4 V block
+	0.24 V	0.22 V	0.17 V	0.14 V
-	0.12 V	0.11 V	0.09 V	0.07 V

  - During the assessment the battery voltage must be within the ± 1% tolerance.
  - Electrolyte density: ± 0.01 kg/l

If outside these limits, call our service-agent

Stationary vented batteries

Maintenance and control: measuring instruments

- Digital multimeter, accuracy class 0.5 or better.
- Liquid-in-glass thermometer, 0 to 60 °C. Scale marks not more than 1 K.
- Digital thermometer. Scale marks not more than 1 K. Absolute accuracy at least 1 K. Touch probe or IR-sensor.
- Clip-on ammeter, accuracy class 0.5 or better. Up to 500 A. DC/AC measurable separately.
- Accuracy classes acc. to IEC 60896-11, -21.

Stationary vented batteries

Maintenance and control: protective clothing (ref. EN 50272-2)

In order to avoid personal injury from electrolyte splashes when handling electrolyte and/or vented cells or batteries, protective clothing shall be worn, such as

- protective glasses (see EN 166) or masks for eyes or face,
- protective gloves and aprons for skin protection.

In the case of valve-regulated or gastight sealed batteries, at least protective glasses and gloves shall be worn.

Stationary vented batteries

Checks: general advices

- Measure the temperature first! Important in case of cabinets, - opening can distort the measurement by heat exchange.

- Strong inserting of the test probes into the measuring openings of the pole screws whilst rubbing slightly. Hereby, oxide layers will be removed from the measuring point, and the voltage will be measured accurately.

Stationary vented batteries

Checks: replacement – of single cells/blocks or completely?

- Recommendation for new single cells/blocks:
  - AGM: max. 25%
  - Gel: max. 33%
  - Vented: max. 33%

- In case of 4 units per system, e.g. 4 ∗12 V = 48 V: Replace 1 block only or all 4.

- > 50% service life: Complete replacement.

- Spare cells/blocks must be fully charged!

Questions & Answers

Thank you for your attention

Contact:

Exide Technologies GmbH
Im Thiergarten
D - 63654 Büdingen

Siegfried Miller

Application Engineer Network Power
Application Engineering
Phone: +49 (0) 6042 / 81-121
Mobile: +49 (0) 170 / 2270229
siegfried.miller@eu.exide.com