Operating Instruction
Stationary valve-regulated lead-acid batteries

SOLAR
SOLAR BLOCK
A600 SOLAR
PowerCycle

Instructions for use en 5–7

GNB INDUSTRIAL POWER
A Division of Exide Technologies

Sonnenschein SOLAR, SOLAR BLOCK, A600 SOLAR, PowerCycle
Operating Instruction
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Sonnenschein

Nominal data

- Nominal voltage U_N : 2.0 V x number of cells
- Nominal capacity $C_N = C_{100}$ or C_{120} : 100 h or 120 h discharge (see type plate on cells/blocks and technical data in these instructions)
- Nominal discharge current $I_N = I_{100}$ or I_{120} : $I_{100} = C_{100}$ /100 h or $I_{120} = C_{120}$ /120 h
- Final discharge voltage U_S : 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: _____

Security signs attached by: _____ date: _____

- Observe these Instructions and keep them located near the battery for future reference.
- Work on the battery should be carried out by qualified personnel only.

- 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 50272-2, EN 50110-1.

- Any acid splashes on the skin or in the eyes must be flushed with plenty of clean water immediately. Then seek for medical assistance.
- Spillages on clothing should be rinsed out with water!

- Warning: Risk of fire, explosion or burns. Do not disassemble, heat above 60 °C, or incinerate. Avoid short circuits.
- Avoid electrostatic charges and discharges/sparks!

- Electrolyte is very corrosive. In normal working conditions the contact with the electolyte is impossible. If the cell/block 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.**

- Caution! Metal parts of the battery are always alive, therefore do not place items or tools on the battery.

- Keep children away from batteries.

Non-compliance with operating instructions, 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) 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.

Stationary valve regulated lead acid batteries do not require topping-up water. Pressure valves are used for sealing and can not be opened without destruction.

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. Apply the following torques for screw connectors:

G-M5	G-M6	A	F-M8	M-M8-45°
5 ± 1 Nm	6 ± 1 Nm	8 ± 1 Nm	20 ± 1 Nm	8 ± 1 Nm

Rubber covers shall be fitted to both ends of the connector cables (pole covers) before installation.

Control of insulation resistance:
New batteries: > 1M Ω
Used batteries: > 100 Ω/Volt.

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.

2. Operation

For the installation and operation of stationary batteries EN 50 272-2 is mandatory.
Battery installation should be made such that temperature differences between individual cells/ blocks do not exceed 3 degrees Celsius (Kelvin).

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 (special features see 2.4 and 2.5).

2.2 Charging

All charging must be carried out acc. to DIN 41773 (IU-characteristic).

Recommended charge voltages for cyclical application: See fig. 1 and item 2.8.

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 from the loads may lead to an additional temperature increase of the battery, and strain the electrodes with possible damages (see 2.5), which can shorten the battery life.

2.3 Maintaining the full charge (float charge)

Devices complying with the stipulations under DIN 41773 must be used. They are to be set so that the average cell voltage is 2.30 Vpc ± 1% (within temperature range 15 to 35 °C).

2.4 Operating in uncontrolled partial state of charge

Solar batteries have to be operated also at states of charge less than 100% due to seasonal or other conditions, for instance summer: 80 to 100% state of charge, winter: down to 20% state of charge. Therefore, depending on the state of charge an equalizing charge must be carried out at least every 3 months.

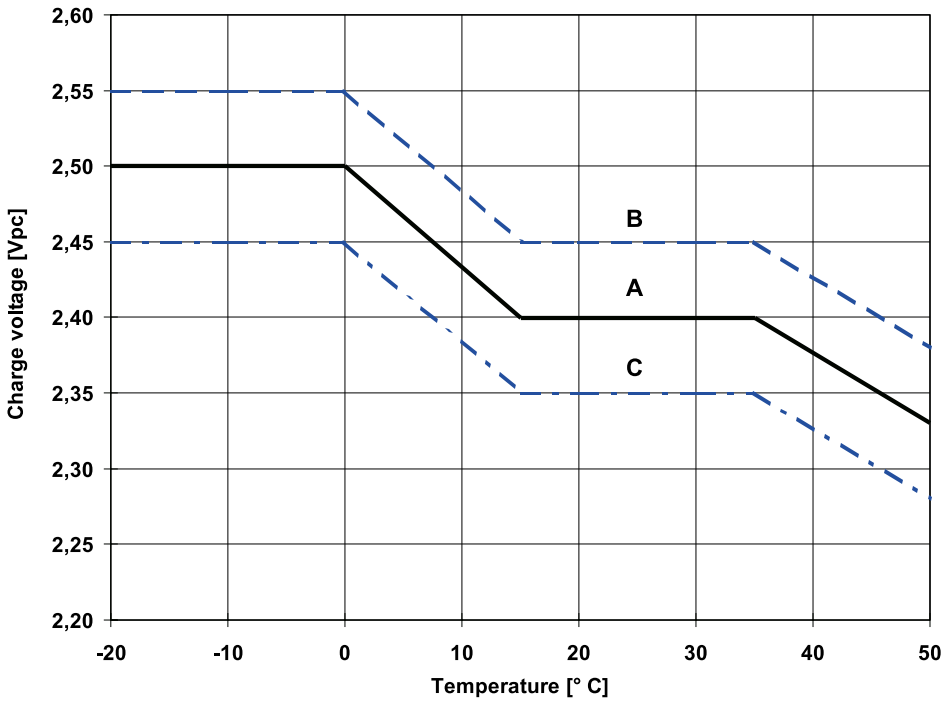

Fig. 1: Charge voltage vs. temperature for solar mode. Charge modes:
1) With switch regulator (two-step controller): Charge on curve B (max. charge voltage) for max. 2 hrs per day, then switch over to continuous charge – Curve C
2) Standard charge (without switching) – Curve A
3) Boost charge (Equalizing charge with external generator): Charge on curve B for max. 5 hrs per month, then switch over to curve C.

2.5 Operating in controlled partial state of charge

The cycle life during daily cyclical application can be increased when working in partial state of charge if the installation and operating instructions, a maximum depth of discharge 80% C_{10} and following special operating conditions are fulfilled:
Carrying-out of full re-charge plus equalizing charge at 2.4 Vpc for at least 12 h (better 24 h) and a current of at least 20 A /100 Ah C_{10} (max. 35 A/100 Ah C_{10})
- at least weekly with daily recharging up to 90% C_{10}
- at least every 14 days with daily recharging up to 95% C_{10}

2.6 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, e.g. as described in item 2.4. They can be carried out as follows: Up to 48 hours at max. 2.40 Vpc and with unlimited current. The cell/block temperature must never exceed 45 °C. If it does, stop charging or revert to float charge to allow the temperature to drop.
For system voltages ≥ 48 V every one to three months:

Method 1: IUI
I-phase = up to voltage acc. to fig.1 at 20 °C
U-phase = until switching at a current of 1.2 A/100 Ah to the second I-phase
I-phase = 1.2 A/100 Ah for 4 hours

Method 2: IUI pulse
I-phase = up to voltage acc. to fig. 1 at 20 °C
U-phase = until switching at a current of 1.2 A/100 Ah to the second I-phase (pulsed)
I-phase = charging of 2 A/100 Ah for 4-6 hours where the pulses are 15 min. 2 A/100 Ah and 15 min. 0 A/100 Ah.

2.7 Alternating currents

When recharging acc. to fig.1 the actual value of the alternating current is occasionally permitted to reach 10 A (RMS)/ 100 Ah C_{10}-capacity. In a fully charged state during float charge the actual value of the alternating current must not exceed 5 A (RMS)/ 100 Ah C_{10}-capacity.

2.8 Charging currents

The charging current should range between 10 A to 35 A / 100Ah C_{10}-capacity (guide values). 35 A/100 Ah C_{10}-capacity must not be exceeded in cyclical operation.

2.9 Temperature

The recommended operation temperature range for lead acid batteries is 10 °C to 30 °C (best 20 °C ± 5 K). Higher temperatures will seriously reduce the service life. Lower temperatures reduce the available capacity. The absolute maximum temperature is 55 °C and should not exceed 45 °C in service.

2.10 Temperature-related charge voltage

The temperature related adjustment has to be carried out acc. to fig. 1. An adjustment of the charge voltage must not be applied within a temperature range 15 °C to 35 °C.

2.11 Electrolyte

The electrolyte is diluted sulphuric acid and fixed in a gel.

3. Battery maintenance and control

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 several blocks/cells during discharge
- Surface temperature of several blocks/cells
- Battery-room temperature

If during the discharge the voltage of one or more cells/blocks differs from the average discharge voltage more than shown in the following table or if the surface temperature difference between cells/blocks exceeds 5 K an equalizing charge acc. to item 2.6 shall be carried out.

Type	deviation
2 V cells	-0.2 V
6 V blocks	-0.35 V
12 V-blocks	-0.49 V

In addition, annual measurements and recording:
- Battery voltage
- Voltage of all blocks/cells during discharge
- Surface temperature of all blocks/cells
- Battery-room temperature

Annual visual checks:
- Screw connections
- Screw connections without locking device have to be checked for tightness.
- Battery installation and arrangement
- Ventilation

4. Tests

Tests have to be carried out according to IEC 60896-21.

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 item 2.3), ≥ 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 should be between 10 A/100 Ah and 35 A/100 Ah of the C_{10}-capacity.

5. Faults

Call the service agents immediately if faults in the battery or the charging unit are found. Recorded data as described in item 3. must be made available to the service agent. It is recommended that a service contract is taken out with your agent.

6. Storage and taking out of operation

Refreshening charge shall be carried out latest if the open circuit voltage is decreased to the following guide values: 2.115 Vpc respectively 6.345 V (6V-block), 12.69 V (12V-block).
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 sun light. To avoid damage the following charging methods can be chosen:
1. Maximum storage time is 17 months at ≤ 20 °C. Equalizing charges acc. to item 2.6 will be required at higher temperatures, for instance, after 8.5 months at 30 °C.
2. Float charging as detailed in 2.3.

7. Transport

Cells/block batteries must be transported in an upright position. Batteries without any visible damage are not defined as dangerous goods under the regulations for transport of dangerous goods by road (ADR) or by railway (RID). They must be protected against short circuits, slipping, upsetting or damaging. Cells/block batteries may be suitable stacked and secured on pallets (ADR and RID, special provision 598). It is prohibited to staple pallets.
No dangerous traces of acid shall be found on the exteriors of the packing unit.
Cells/block batteries whose containers leak or are damaged must be packed and transported as class 8 dangerous 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:

Capacities at different discharge times and final discharge voltage.
All technical data refer to 20 °C.

8.1 Sonnenschein SOLAR

Discharge time	1 h	5 h	10 h	20 h	100 h
Capacity	C_1 [Ah]	C_5 [Ah]	C_{10} [Ah]	C_{20} [Ah]	C_{100} [Ah]
S 12 / 6.6 S	2.90	4.60	5.10	5.70	6.60
S 12 / 17 G5	9.30	12.6	14.3	15.0	17.0
S 12 / 27 G5	15.0	22.1	23.5	24.0	27.0
S 12 / 32 G6	16.9	24.4	27.0	28.0	32.0
S 12 / 41 A	21.0	30.6	34.0	38.0	41.0
S 12 / 60 A	30.0	42.5	47.5	50.0	60.0
S 12 / 85 A	55.0	68.5	74.0	76.0	85.0
S 12 / 90 A	50.5	72.0	78.0	84.0	90.0
S 12 / 130 A	66.0	93.5	104	110	130
S 12 / 230 A	120	170	190	200	230
U_f (cell)	1.7 Vpc	1.7 Vpc	1.7 Vpc	1.75 Vpc	1.80 Vpc

8.2 Sonnenschein SOLAR BLOCK

Discharge time	1 h	5 h	10 h	20 h	100 h
Capacity	C_1 [Ah]	C_5 [Ah]	C_{10} [Ah]	C_{20} [Ah]	C_{100} [Ah]
SB 12 / 60	34.0	45.0	52.0	56.0	60.0
SB 12 / 75	48.0	60.0	66.0	70.0	75.0
SB 12 / 100	57.0	84.0	89.0	90.0	100
SB 12 / 130	78.0	101	105	116	130
SB 12 / 185	103	150	155	165	185
SB 06 / 200	104	153	162	180	200
SB 06 / 330	150	235	260	280	330
U_f (cell)	1.7 Vpc	1.7 Vpc	1.7 Vpc	1.75 Vpc	1.80 Vpc

8.3 Sonnenschein A600 SOLAR

Discharge time	1 h	3 h	5 h	10 h	100 h	120 h
Capacity	C_1 [Ah]	C_3 [Ah]	C_5 [Ah]	C_{10} [Ah]	C_{100} [Ah]	C_{120} [Ah]
A 602 / 295 Solar	124	167	193	217	285	294
A 602 / 370 Solar	155	209	241	272	357	367
A 602 / 440 Solar	186	251	289	326	428	440
A 602 / 520 Solar	229	307	342	379	505	519
A 602 / 625 Solar	275	369	410	455	606	623
A 602 / 750 Solar	321	431	479	531	707	727
A 602 / 850 Solar	368	520	614	681	822	845
A 602 / 1130 Solar	491	694	818	908	1096	1126
A 602 / 1415 Solar	614	867	1023	1135	1370	1408
A 602 / 1695 Solar	737	1041	1228	1362	1644	1689
A 602 / 1960 C Solar	867	1222	1371	1593	1957	1994
A 602 / 2600 Solar	1047	1548	1782	2024	2547	2613
A 602 / 3270 Solar	1309	1935	2227	2530	3184	3266
A 602 / 3920 Solar	1571	2322	2673	3036	3821	3919
U_f (cell)	1.67 Vpc	1.75 Vpc	1.77 Vpc	1.80 Vpc	1.85 Vpc	1.85 Vpc

8.4 Sonnenschein PowerCycle

Discharge time t_n	10 min	30 min	1h	3h	5h	10h	length	width	height	weight
Capacity C_n [Ah]	$C^1/_6$	$C^1/_2$	C1	C3	C5	C10	max [mm]	max [mm]	max [mm]	approx. [kg]
PC12/180 FT	57.1	95.5	113	143	155	165	569	128	321	58.4

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