Classic™

EXIDE TECHNOLOGIES
INDUSTRIAL ENERGY

81700705

Classic Solar EnerSol, EnerSol T, OPzS Solar Operating Instructions for stationary lead acid batteries

Nominal data

- Nominal voltage U_N : 2.0 V x number of cells
- Nominal capacity $C_N = C_{100}$ or C_{120} : 120 h discharge (see type plate 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_f : see technical data in these instructions
- Nominal temperature T_N : 25° C

Battery type: _____ Number of cells/blocks: _____

Assembly by: _____ Exide Technologies 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 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!

- 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!

- 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

Check all cells/blocks for mechanical damage, correct polarity and firmly seated connectors. The following torques apply to the cell types:

Ener Sol A-Pol	EnerSol T (M 10)	OPzS Solar (M 8)
8 Nm ± 1	25 Nm ±1	20 Nm ± 1

Put on the terminal covers if necessary. Check the electrolyte level in all cells and if necessary top up to maximum level with purified water 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 acc. to 2.2.

If there is only an alternative source of energy available, then the battery must be charged until the cell voltage is the same in all cells and the electrolyte density has reached the nominal value (see technical data). The loads must be switched off during charging. 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 should always be operated using a charge controller and deep discharge protection.

The battery must be installed so that it is not in direct sunlight and in a way which prevents ambiance-dependent temperature differences of > 3 K arising. The spacing between the cells or blocs 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. Discharge should not exceed the nominal capacity. Unless otherwise indicated by the manufacturer.

Recharge immediately following complete or partial discharge. A battery is regarded as discharged when the electrolyte density is < 1.13 kg/l at 25° C. This corresponds to a discharge level of ca. 80% of the nominal value. An electrolyte density of < 1.13 kg/l is a deep discharge. Deep discharge reduces the lifetime of the battery.

2.2 Charging

a) using an external charger

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. Depending on 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 causing possible damage (see point 2.5), which can shorten the battery life.

When charging with an external charger, the battery is disconnected from the load. The temperature must be monitored. 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 the float charge voltage as in table 1. For charge current see point 2.6.

b) with alternative power supply

When using power supply units with solar modules or wind generators, 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 2.23 V - 2.35 V x number of cells. This has to be carried out in

accordance with the manufacturers instructions.

Recommended charge voltage for cyclical application:
Depending on the depth of discharge and the load the charge voltage is adjusted according to the specified values on table 1.

Range	Charge voltage [Vpc]
EnerSol	2.32 - 2.40
EnerSol T	2.30 - 2.40
OPzS Solar	2.28 - 2.40

Table 1: Recommended charge voltage for cyclical application

The charge voltage has to be adjusted to reach the nominal value ± 0.01 kg/l (see technical data) once a month. If this is not the case, it is necessary to increase the recommended charge voltage stepwise by approximately 20 mVpc to a maximum of 2.40 Vpc according to table 1 or carry out an equalizing charge acc. to 2.4 every month.

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 as in table 2 and the electrolyte density should not decrease over a lengthy period, if necessary the charge voltage

Range	Float charge voltage [Vpc]
EnerSol	2.27
EnerSol T	2.25
OPzS Solar	2.23

Table 2: Float charge voltage

must be increased acc. to table 1.

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:

a) Using alternative form of power supply
   – at constant voltage of max. 2.4 Vpc up to 72 hours (the number of hours increases with less charging current acc.to table 3).
b) Using an external charger
   – 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 or boost charging up to 2.4 Vpc under operation modes 2.2 the value of the alternating current is occasionally permitted to reach 10 A per 100 Ah C_{10}.
In a fully charged state during float charge or standby parallel operation the value of the alternating current must not exceed 5 A per 100 Ah C_{10}.

2.6 Charging currents
When charging with the IU-characteristic, the charging current should be 10 A to 35 A / 100 Ah C_{10} *(reference values)*.
Exceeding this voltage of 2.4 Vpc increases water decomposition. Charging in cyclical application generates more heat. For that reason the charging currents shown in the following table 3 must not be exceeded.

Charging procedure	Max. charging current [A/100 Ah C_{10}]	Charging voltage [Vpc]
IU-characteristic	35	2.40
I-characteristic	5	2.60 - 2.75
W-characteristic	7 3.5	at 2.40 at 2.65

Table 3: Maximal charging currents with different characteristics

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 25° C. The ideal operating temperature is 25° C ± 5 K. (OPzS Solar =20° C)
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. If the temperature is constantly in excess of 40° C, the factor is -0.003 Vpc per K.

2.9 Electrolyte
The electrolyte is diluted sulphuric acid. The nominal electrolyte density ± 0.01 kg/l (acc. to technical data) is based on 25° 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 40° C corresponds to a density of 1.24 kg/l at 25° C or an electrolyte density of 1.25 kg/l at 10° C corresponds to a density of 1.24 kg/l at 25° 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 clean water without additives.

Monthly measurements and recording:
- Battery voltage
- Voltage of some cells/block batteries
- Electrolyte temperature of some cells
- Battery-room temperature
- Electrolyte density of some cells

It is necessary to carry out an equalizing charge acc. to 2.4 if the cell/block average float charge voltages (see table 2) differ more than those in table 4 below and/or if the electrolyte density of the cells of a battery string deviates from the average-value more than ± 0.01 kg/l.

Tolerance	2 V-Cell	6 V-Block	12 V-Block
+	0.10 V	0.17 V	0.24 V
–	0.05 V	0.09 V	0.12 V

Table 4

Annual measurements 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 the battery room

4. Tests
Tests have to be carried out according to IEC 60896-11 and DIN 43539 Part1. Special instructions like VDE 0107 and EN 50172 have to be observed.

5. Faults
Call the service agents immediately if faults in the battery or charging unit are found. Recorded data as described in point 3 simplify the troubleshooting 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/blocs 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:

1. Equalizing 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
To prevent any leakage of electrolyte, the 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 rail (RID). They must be protected against short circuits, slipping, upsetting or damaging. Bloc 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/bloc batteries whose cases leak or are damaged must be packed and transported as class 8 hazardous goods under UN no. 2794.

8. Technical data
The nominal voltage, the number of cells, the nominal capacity (C_{100} or $C_{120} = C_N$) and the battery type are described on the type plates. See table 8.1.1 - 8.1.3 other capacities at different discharge currents with the corresponding discharge times.

8.1 Measurements, weights and capacities (C_n) at different discharge times (t_n) and final discharge voltage (U_f)

8.1.1 Stationary lead acid bloc batteries type EnerSol

with positive and negative grid plates, Nominal electrolyte density 1.28 kg/l

	Discharge data				Measurements and weights				
	Capacity [Ah]		Discharge current [A]		Length max.	Width max.	Height [1] max.	Weight including acid approx.	Weight acid approx
Discharge time [h]	120	100	120	100					
Final discharge voltage [Vpc]	1.85	1.85	1.85	1.85	[mm]	[mm]	[mm]	[kg]	[kg]
EnerSol 50	53	52	0.44	0.52	210	175	190	13.7	2.1
EnerSol 65	66	65	0.55	0.65	242	175	190	17.3	2.7
EnerSol 80	80	78	0.67	0.78	278	175	190	20.7	4.7
EnerSol 100	99	97	0.83	0.97	353	175	190	26.4	7.0
EnerSol 130	132	130	1.10	1.30	349	175	290	33.0	10.9
EnerSol 175	179	175	1.49	1.75	513	223	223	47.8	14.6
EnerSol 250	256	250	2.13	2.50	518	276	242	63.0	18.6

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

8.1.2 Stationary lead acid cells type EnerSol T

with positive and negative grid plates, Nominal electrolyte density 1.26 kg/l

	Discharge data								Measurements and Weights				
	Capacity [Ah]				Discharge current [A]				Length max.	Width max.	Height [1] max.	Weight including acid approx.	Weight acid approx.
Discharge time [h]	120	48	24	10	120	48	24	10					
Final discharge voltage [V]	1.85	1.80	1.80	1.80	1.85	1.80	1.80	1.80	[mm]	[mm]	[mm]	[kg]	[kg]
EnerSol T 370	367	361	333	280	3.06	7.52	13.88	28.0	83	198.5	445	17.3	5.1
EnerSol T 460	452	437	416	350	3.77	9.10	17.33	35.0	101	198.5	445	21.0	6.3
EnerSol T 550	542	524	499	425	4.52	10.92	20.79	42.5	119	198.5	445	24.7	7.5
EnerSol T 650	668	656	625	527	5.57	13.67	26.04	52.7	119	198.5	508	29.5	8.6
EnerSol T 760	779	766	729	615	6.49	15.96	30.38	61.5	137	198.5	508	31.0	10.0
EnerSol T 880	897	854	840	714	7.48	17.79	35.00	71.4	137	198.5	556	38.0	11.0
EnerSol T 1000	1025	1008	960	809	8.54	21.00	40.00	80.9	155	198.5	556	43.1	12.6
EnerSol T 1130	1154	1134	1080	910	9.62	23.63	45.00	91.0	173	198.5	556	47.7	14.1
EnerSol T 1250	1282	1260	1200	1011	10.68	26.25	50.00	101.1	191	198.5	556	52.8	15.6

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

8.1.3 Stationary lead acid bloc batteries type OPzS Solar bloc batteries and single cells

with positive tubular plates and negative grid plates, Nominal electrolyte density 1.24 kg/l

Bloc battery

			Discharge data								Measurements and Weights				
			Capacity [Ah]				Discharge current [A]				Length max.	Width max.	Height [1] max.	Weight including acid approx.	Weight acid approx.
Discharge time [h]			120	48	24	10	120	48	24	10					
Final discharge voltage [V]			1.85	1.80	1.80	1.80	1.85	1.80	1.80	1.80	[mm]	[mm]	[mm]	[kg]	[kg]
12V	OPzS Solar	70	82.7	78.4	69.4	51.5	0.7	1.6	2.9	5.2	275	208	385	35	15
12V	OPzS Solar	140	139.0	141.0	118.0	103.0	1.2	2.9	4.9	10.3	275	208	385	45	14
12V	OPzS Solar	210	210.0	200.0	177.0	154.0	1.8	4.2	7.0	15.5	383	208	385	64	19
6V	OPzS Solar	280	294.0	296.0	250.0	206.0	2.5	6.2	10.5	20.6	275	208	385	41	13
6V	OPzS Solar	350	364.0	374.0	311.0	257.0	3.0	7.8	13.0	25.8	383	208	385	56	20
6V	OPzS Solar	420	417.0	420.0	354.0	309.0	3.5	8.8	14.8	30.9	383	208	385	63	20

Single cell

	OPzS Solar	190	190	165	145.0	132.0	1.6	3.4	6.0	13.2	105	208	405	13.7	5.2
	OPzS Solar	245	245	215	190.0	173.0	2.0	4.5	7.9	17.3	105	208	405	15.2	5.0
	OPzS Solar	305	305	270	240.0	220.0	2.5	5.6	10.0	22.0	105	208	405	16.6	4.6
	OPzS Solar	380	380	330	300.0	273.0	3.2	6.9	12.5	27.3	126	208	405	20.0	5.8
	OPzS Solar	450	450	395	355.0	325.0	3.8	8.2	14.8	32.5	147	208	405	23.3	6.9
	OPzS Solar	550	550	480	430.0	391	4.6	10.0	17.9	39.1	126	208	520	26.7	8.1
	OPzS Solar	660	660	575	515.0	469	5.5	12.0	21.5	46.9	147	208	520	31.0	9.3
	OPzS Solar	765	765	670	600.0	546	6.4	14.0	25.0	54.6	168	208	520	35.4	10.8
	OPzS Solar	985	985	860	770	700	8.2	17.9	32.1	70.0	147	208	695	43.9	13.0
	OPzS Solar	1080	1080	940	845	773	9.0	19.6	35.2	77.3	147	208	695	47.2	12.8
	OPzS Solar	1320	1320	1150	1030	937	11.0	24.0	42.9	93.7	215	193	695	59.9	17.1
	OPzS Solar	1410	1410	1225	1105	1009	11.8	25.5	46.0	100.9	215	193	695	63.4	16.8
	OPzS Solar	1650	1650	1440	1290	1174	13.8	30.0	53.8	117.4	215	235	695	73.2	21.7
	OPzS Solar	1990	1990	1730	1550	1411	16.6	36.0	64.6	141.1	215	277	695	86.4	26.1
	OPzS Solar	2350	2350	2090	1910	1751	19.6	43.5	79.6	175.1	215	277	845	108.0	33.7
	OPzS Solar	2500	2500	2215	2015	1854	20.8	46.1	84.0	185.4	215	277	845	114.0	32.7
	OPzS Solar	3100	3100	2755	2520	2318	25.8	57.4	105.0	231.8	215	400	815	151.0	50.0
	OPzS Solar	3350	3350	2985	2740	2524	27.9	62.2	114.2	252.4	215	400	815	158.0	48.0
	OPzS Solar	3850	3850	3430	3135	2884	32.1	71.5	130.6	288.4	215	490	815	184.0	60.0
	OPzS Solar	4100	4100	3650	3355	3090	34.2	76.0	139.8	309.0	215	490	815	191.0	58.0
	OPzS Solar	4600	4600	4100	3765	3451	38.3	85.4	156.9	345.1	215	580	815	217.0	71.0

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

NXCSLOEPDF00710 · Druckhaus Bechstein · Printed in Germany · Subject to change without prior notice
81700705 0,5 III.09

Exide Technologies GmbH
Im Thiergarten
63654 Büdingen – Germany

Tel.: +49 (0) 60 42 / 81 544
Fax: +49 (0) 60 42 / 81 398

www.industrialenergy.exide.com

EXIDE TECHNOLOGIES
INDUSTRIAL ENERGY