POWER

Power for a World of Applications

LOW MAINTENANCE STANDBY POWER BATTERIES

Installation, operating and maintenance instructions

CONTENTS

1. INTRODUCTION

Standby batteries are generally used as back-up power, to support all those users who need a reliable service continuity in case of black-out of the distribution network of electricity.
Lead-acid standby batteries are components of a system and they require the observance of suitable precautions and behavioural norms to guarantee safe working conditions and to ensure the best performance of the battery during its entire life.
Scope of this document is to supply the necessary instructions for the correct cure, handling, installation, use and maintenance of Power low maintenance standby power batteries.

2. RECOMMENDATIONS

Carefully read this manual in all its parts upon receipt of Power TS/TSB standby batteries.
The non-compliance with the instructions given herein may cause injury to people and damages to the equipment, as well as the bad operation of the battery.
Keep this manual in the battery room in a place easily accessible to the staff.

3. SAFETY RULES

Batteries may give off explosive gasses.
They are filled with diluted sulphuric acid (electrolyte), which is a corrosive substance. When handling and working with electrolyte always use protective equipment, such as protective clothing, goggles and gloves.
Exposed metal parts of the battery always carry a voltage and are electrically live with the risk of short circuits.
Avoid any electrostatic charge; before starting your work on the battery, first discharge any possible electricity from yourself by touching an earth-connected part; repeat this action occasionally until the work is complete.

Always take the following precautions:

- Use insulated tools
- DO NOT place or drop metal objects on top of the battery
- DO NOT wear rings or bracelets. Remove any articles of clothing with metal parts that might come in contact with the battery terminals
- DO NOT smoke and DO NOT use open flames or create electric sparks
- Take all precautions when using the main supply
- Make sure that the first aid kits and fire extinguishers are easily accessible

- Make sure that water and neutralizing products are easily accessible in case accidental contact with acid or spillage occurs.
  In all cases obtain immediate medical attention.

Used batteries contain recyclable materials. They must not be disposed with the house waste but as a special waste. Methods of return and recycling must conform to the regulations in operation at the site where battery is located.

4. DELIVERY AND STORAGE

Unpack the batteries as soon as they are delivered.
Verify that the equipment has been delivered in good condition. Any damage must be reported immediately to the carrier and the damaged items retained for inspection by the carrier's representative.
For cells supplied in filled and charged conditions, check that the acid level in all the cells is at the "MAX" level. If necessary, fill them in with diluted sulphuric acid with the correct specific gravity (see characteristics described under section 5).

If the battery cannot be immediately installed, store it in a dry, cool and clean place. Do not expose the battery to direct sunlight, to avoid any damage to containers and lids.

Storage time for **filled and charged cells** is limited. It is essential that they are placed on charge at the latest within 90 days from the date of shipment. Failure to observe this condition may result in a greatly reduced capacity and service life or in permanent damage to the cells.

The charge shall be carried out according to the instructions given under section 8. Charge should be carried out with the shipping cases open, or the cells completely unpacked, and with adequate ventilation to disperse the gases formed on charging.

If continuous charging is not possible, the battery should be given a freshening or equalize charge at least every 60 days and whenever distilled water is added.

If the battery is supplied in **dry charged** conditions, it can be stored for periods up to 3 years, provided that it is adequately protected against condensation and the effects of high humidity. For filling and commissioning of dry charged batteries, see instructions given under sections 8.1 and 8.2.

5. ELECTROLYTE

The following table gives specific gravity data at 20°C for fully charged low maintenance standby power cells with the electrolyte at the maximum level:

Nominal Specific Gravity Kg/l	Specific Gravity Range Kg/l	Specific Gravity for Filling Dry Charged Cells Kg/l
1.240	1.230 – 1.250	1.230
1.210	1.200 - 1.220	1.205

High quality electrolyte for standby lead-acid batteries (which is a solution of pure sulphuric acid diluted with distilled water to the correct specific gravity) is required for the first filling dry charged cells. If the electrolyte has been supplied by Power Battery , store it in a safe place until required.

If electrolyte is purchased locally, make sure that its characteristics are in accordance with the following table:

Impurity	Electrolyte for first filling (mg/l)	Electrolyte for refilling (mg/l)
Copper	0.5	0.5
Heavy metals (As, Bi, Sn, Sb)	2	6
Iron	30	100
Chlorine	5	200
Total azote	60	60
Organic substances	50	50
Other impurities	250	800

When electrolyte is sourced locally, we recommend an additional 10% spare is purchased to cover any loss or spillage during handling and filling.
For quantity of electrolyte needed, please refer to cell technical data given under section 13.

Always check the specific gravity of the electrolyte before filling the cells. Minor adjustments may be made by adding water to lower the specific gravity or by adding acid to raise the specific gravity.

6. BATTERY ROOM

The battery room must be dry, clean and not subject to vibrations. It must be properly sized to enable installation, inspection, topping up and maintenance. Also it must be duly ventilated, especially during charge, and provided with explosion-proof electrical equipment. Its temperature should be as moderate as climate allows, preferably between +10° and +30° C. The battery will give its best performance when working in a temperature of +20° - +25° C, but will be functioning satisfactorily even operating in temperatures between –20°C and +60°C. Please consider anyway that high temperatures increase the performance but reduce battery life, while low temperatures reduce the performance.

The entry doors of battery room must be provided with warning signs banning smoking, sparks and naked flames.

The batteries should be installed on suitable stands properly sized in loading capacity and dimensions. The layout must enable easy access to all cells.
Stands can be made of wood or metal with acid-proof coating. If metal stands are used, they must be equipped with rubber or plastic insulators to avoid any contact between the battery and the metal.

NOTE: Pay also special attention to battery room Standards, effective at the moment of the installation of the battery.

7. INSTALLATION

Before installing the cells, clean and dry all parts. In particular: clean and dry lids and jars. Remove the protections from the terminal posts and clean them with a soft clean cloth. In presence of spilled acid, dip a rag into a non-caustic alkali solution (diluted ammonia or baking soda) and rub the posts body and the terminal inserts. If spilled acid is found into the post inserts, soak the part with this solution and than dry. Do not let the solution get into the cells.

If the terminal posts surface is slightly white, lightly abrade it with a grit abrasive paper and remove oxidation. Wipe off any dust and protect the post body to the lid with a thin coating of no-oxide grease.

Put the cells on the stand and make sure that the spacing allows the accommodation of the supplied inter-cell connectors. Cells supplied in dry charged conditions must be filled-in with electrolyte after installation on battery stands.

WARNING
NEVER LIFT CELLS BY THE TERMINAL POSTS. ALWAYS USE APPROPRIATED DEVICES (SUCH AS LIFTING STRAPS AND SUITABLE MECHANICAL LIFTING DEVICES) TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO THE CELLS.

For batteries to be installed on multiple tiers, start by placing the cells on the lower tier on either side of the frame where the stand sections meet. Any unused stand space should be on the upper tier.

For batteries on stepped stands, leave any unused space on the back (top) step.

Make sure that the positive terminal (marked "+") of one cell is connected to the negative terminal (marked"-") of the adjacent one and continue in the same way.
Take particular care to preserve the positive to negative sequence when using flexible inter-tier or inter-step connectors between rows of cells. Leave the main positive and negative terminals of the battery free for connection to the charging source.
Check cell alignment.

Fit the inter-cell and inter-tier connectors. Use the insulated wrenches supplied to tighten the parts firmly together.
Check tightness and cleanliness.

Pay special attention to avoid short-circuiting the cells with any of the battery hardware.

Make sure that all vent caps are closed.

Number the cells by using the set of numbering stickers supplied with the battery. It is common practice to number the cells beginning with #1 at the positive end of the battery and following the sequence of electrical connection of the cells, through to the negative end of the battery.

8. BATTERY CHARGING

8.1 Filling of dry charged cells

Always use glass or plastic jugs and funnels to fill the cells. Never use metallic materials; electrolyte may corrode them or react by contact. Fill the cells to reach the "MAX" line level and wait to allow the acid soak into separators and plates.
This operation should take approx. 3 hours; then, due to absorption, the electrolyte level will drop allowing topping up to the "MAX" level line.

Always fill the cells with electrolyte after installation on battery stands.

Note: Cells filled on site must be given an initial charge as soon as possible. **Do not store filled cells for more than 18 hours without charging them.**

8.2 First charge of dry charged cells

An initial or freshening charge must be given to all batteries before being put into service. This is most important for cells supplied in dry charged conditions and filled on site.

Before starting the charge, check that electrolyte temperature does not exceed 35° C. If necessary let the battery rest until this temperature is reached.
Take individual cell readings of voltage, specific gravity and temperature before starting initial charge.
It is advisable to use a constant voltage charger, with constant adjustable voltage from 2.23 to 2.6 VpC and with an available adjustable current from 0 to 0.15 C_{10}.Amps. If the charger does not allow any current adjustment, the max. current should not exceed 0.10 C_8 Amps.
Charge the battery with a current rate of 0.10 C_8 Amps for approx. 15 ÷ 16 hours. During this operation take voltage and specific gravity readings every 3 hours.
Voltage readings must be taken on every cell; specific gravity readings can be taken on sample cells (for example one out of five).
Monitor also electrolyte temperature (select 2 or 3 pilot cells). Should the temperature exceed 45° C then:

- decrease the charging current to a lower rate (50%)
  or
- discontinue the charge and let the battery stand on open circuit until the temperature falls down to 35° C; after that, the charging process can be resumed.
  In this case, please consider the charging time to be extended proportionally.

At the end of this process, the Ah delivered to the battery must be 1.5 ÷ 1.6 times the C_8 rated capacity.

Charging is to be deemed as completed when:

- the specific gravity readings in the cells have reached the nominal specific gravity (1.24 Kg/litre or 1.21 Kg/litre)
- the cell voltage is equal or greater than 2.6 VpC
- Both above values (voltage per cell and specific gravity) remain constant for at least two or more hours under charge.

If the charger characteristics do not allow to reach 2.6 VpC, the charging time shall be extended in order to deliver to the battery at least 1.5 or 1.6 times the nominal Ah capacity. In any case a minimum constant voltage of 2.4 VpC should be available for first charge process.

8.3 Filled and charged cells

For batteries which have been supplied in a filled and charged condition, a lower charging voltage (down to a minimum of 2.33 VpC) may be used, but this will extend the duration of the initial charge to as much as 100 hours.
The initial charge may be terminated when the specific gravity readings of all cells have remained constant for at least 2 hours.
At the end of this initial charge, set the battery voltage to the POWER recommended float voltage (see section 8.4.1).

8.4 Charging in service

Once put into service, Power low maintenance standby power batteries should be charged as follows:

8.4.1 Float charge at constant voltage

To maintain the battery in fully charged condition during normal battery operation or, after a discharge, to recover 90% of 8hrs capacity within 20 hours, a recommended float charge has to be applied.
Recommended float voltage settings are as follows:

2.22 ÷ 2.23 VpC with electrolyte sp.gr. 1.24 ± 0.01 Kg/l at 20°C,
2.18 ÷ 2.19 VpC with electrolyte sp.gr. 1.21 ± 0.01 Kg/l at 20°C.

With the method described above, the effective charging current is limited to very low values; Such current increases as a function of temperature and age of the battery. Gassing and water consumption are also minimized.

To verify the charge efficiency of the battery, the constant control of the electrolyte specific gravity and temperature is essential.
Decreasing of specific gravity is symptom of insufficient charge.
Increasing of specific gravity and decreasing of electrolyte level are indication of excessive charge.

For comparison of electrolyte specific gravity vs. temperature, please refer to the table shown in section 10.

8.4.2 Boost charge

Chargers have usually two adjustable charging voltages: one for the “floating” charge and one for the “boost” and “equalizing” charge.

The boost charge is normally used for fast recharging after an emergency discharge.

Boost charge (IU method) consists of two phases:

- 1st phase: constant current – recommended rate: 0.1 x C_{10} Amps. The voltage increases up to the limited voltage of 2.38 VpC;

- 2nd phase: constant voltage of 2.38 VpC. The absorbed current decreases. Once the current has reached a low and constant value (approx. 0.03 Amps per Ah) the charge continues in floating.

8.4.3 Equalizing charge

A short equalizing charge is usually required after addition of distilled water to make sure the acid and water are well mixed.
Furthermore, equalizing is needed when the total voltage spread between the cells is greater than 0.05 Volts under float charging conditions.

Equalizing charge consists of two phases with the following max. rates:

- 1st phase: starting current – recommended rate: 0.15 x C_8 Amps- Voltages and specific gravity increase until gassing;
- 2nd phase: final current – recommended rate: 0.05 x C_8 Amps. The cycle ends after 2 hours from stabilization of specific gravity and voltages.

9. DISCHARGE

During discharge, cell voltages must not drop under the values stated in the applicable standards to avoid stressing and critical conditions. After a discharge, recharge immediately the battery. If during a 8 hour discharge test, sensible deviations in voltage readings between cells (over 0.1 V) are detected, recharge for 8 hours

10. SPECIFIC GRAVITY READINGS

Before taking readings of specific gravity value, ensure that the electrolyte level inside the cells is at the “MAX” level line and that any recent topping-up of distilled water has properly mixed-in, by equalizing for about 30 minutes (for equalizing charge methods, see section 8.4.3).

The specific gravity of the electrolyte may change with temperature; consequently, specific gravity readings must be corrected according to the following table:

Temp. °C	Batteries with electrolyte sp.gr. 1.240 Kg./litre	Batteries with electrolyte sp.gr. 1.210 Kg./litre
5	1.250	1.221
6	1.250	1.220
7	1.249	1.219
8	1.248	1.218
9	1.248	1.218
10	1.247	1.217
11	1.246	1.216
12	1.246	1.216
13	1.245	1.215
14	1.244	1.214
15	1.243	1.214
16	1.243	1.213
17	1.242	1.212
18	1.241	1.211
19	1.241	1.211
20	**1.240**	**1.210**
21	1.239	1.209
22	1.239	1.209
23	1.238	1.208
24	1.237	1.207
25	1.237	1.207
26	1.236	1.206
27	1.235	1.205
28	1.234	1-204
29	1.234	1.204
30	1.233	1.203

The specific gravity of the electrolyte in new cells should be as listed in section 5. During the course of years there may be a slight fall in the maximum specific gravity values obtainable at the end of charge.
The specific gravity may range ± 0.01 points within a cell at the nominal temperature of 20° C.

NEVER TRY TO INCREASE SPECIFIC GRAVITY READINGS BY ADDING ELECTROLYTE

11. BATTERY MAINTENANCE

The efficiency and the conditions of the battery and the emergency system are based on a correct check and maintenance plan. Try to follow as much carefully as possible the following routine activities:

Every month

- Check the voltages of a significant number of cells during float operations
- Check the electrolyte level of a significant number of cells
- Check the electrolyte temperature of a pilot cell
- Check the electrolyte specific gravity of a significant number of cells
- Check the total battery floating voltage
- Clean and dry the cell lids and connectors
- Inspect the charging system

Every year

- Check the voltages of all the cells during float operations
- Check the electrolyte level of all the cells
- Check the electrolyte temperature of a pilot cell
- Check the electrolyte specific gravity of all the cells
- Check the total battery floating voltage
- Clean and dry the cell lids and connectors
- Control the conditions of the connection
- Tighten all connectors (torque setting: 25 Nm)
- Check the charging current
- Inspect the charging system
- Check the condition of the battery stand

ATTENTION

CARRY OUT AN "EQUALIZING CHARGE", whenever the following deviations between cells are detected:

- **0.02 Kg/litre or more in electrolyte specific gravity,**
- **0.05 Volt or more in cell voltage.**

Topping-up

Power low maintenance standby power batteries in float at 20° C do not require topping-up for three or more years.
The water consumption increases with higher temperature, overcharge or other stressing conditions.
Never allow the electrolyte level to fall below the "MIN" level line. Whenever it's necessary, top up the cells with pure distilled or demineralised water.
NEVER ADD ELECTROLYTE

Pilot Cell

For regular monitoring of the battery condition, select one cell near the middle of the battery string as a "pilot" cell (for batteries consisting of more than 60 cells, it is advisable to select one pilot cell out of 60).
The electrolyte specific gravity of the pilot cell(s) will be indicative of the state of charge of the whole battery.

12. MAINTENANCE REPORT

It is advisable to keep a record of the battery maintenance operations, which will be helpful to monitor long-term changes of the battery condition.

The following inspection procedures are recommended:

- **WEEKLY:** Check and record the overall float voltage at the battery terminals (not at the charger!), and take readings of the pilot cell voltage
- **MONTHLY:** Record the battery voltage, specific gravity and the temperature of the pilot cell(s)
- **QUARTERLY:** Record the voltage, specific gravity and temperature of all the cells.

Keep a log book where the measured values as well as power cuts, discharge tests, equalizing charges, topping-up dates etc. can be noted. A sample maintenance record is included in the Appendix (pages 15 to 17).

It is also advisable to give the battery a full discharge test at 5-year intervals until signs of degradation are observed or until the battery has reached 85 per cent of its original capacity. Once this stage has been reached, yearly capacity tests should be performed until the battery has reached the end of its useful life.

13. TECHNICAL DATA

BATTERY SPECIFICATIONS

CELL MODEL	NOMINAL VOLTAGE	CAPACITY AT C/8 AH	I.R. MOHMS	DIMENSIONS (INCHES/MM)			WEIGHT (LBS/KGS)		ELECTROLYTE		TERMINALS M10, NUMBER
				LENGTH	WIDTH	HEIGHT	W/ELEC.	EMPTY	WEIGHT LB/KG	VOLUME G/L	
TS 100	2	99	1.57	4.1/103	8.1/206	16.9/430	33.4/15.2	20.9/9.5	12.5/5.7	1.3/4.6	2
TS 150	2	149	1.09	4.1/103	8.1/206	16.9/430	37.216.9	26.4/12	10.8/4.9	1.1/3.9	2
TS 200	2	198	0.96	4.1/103	8.1/206	16.9/430	40.7/18.5	31.7/14.4	9/4.1	0.88/3.3	2
TS 250	2	247	0.77	4.9/124	8.1/206	16.9/430	49.1/22.3	37.6/16.8	11.4/5.2	1.1/4.2	2
TS 300	2	297	0.64	5.7/145	8.1/206	16.9/430	57/25.9	43.3/19.7	13.6/6.2	1.3/5	2
TS 350	2	346	0.55	4.9/124	8.1/206	21.5/546	64.7/29.4	48.6/22.1	16.1/7.3	1.6/5.9	2
TS 420	2	415	0.46	5.7/145	8.1/206	21.5/546	75.5/34.3	55.4/25.2	20/9.1	1.9/7.3	2
TS 490	2	484	0.39	6.5/166	8.1/206	21.5/546	86.7/39.4	64.7/29.4	22/10	2.2/8.1	2
TS 600	2	605	0.43	5.7/145	8.1/206	28.4721	104/747.6	76.3/34.7	28.4/12.9	2.8/10.4	2
TS 700	2	706	0.37	8.3/210	7.5/191	28.4/721	123.4/56.1	90.9/41.3	32.6/14.8	3.2/11.9	4
TS 800	2	807	0.33	8.3/210	7.5/191	28.4/721	104.4/63.8	104.7/47.6	35.6/16.2	3.5/13.1	4
TS 900	2	908	0.29	8.3/210	9.2/233	28.4/721	156.6/71.2	114.8/52.2	42/19.1	4.1/15.4	4
TS 1000	2	1008	0.26	8.3/210	9.2/233	28.4/721	174.9/79.5	128.7/58.5	46.2/21	4.5/16.9	4
TS 1100	2	1109	0.24	8.3/210	10.8/275	28.4/721	185/84.1	134.9/61.3	50.2/22.8	4.9/18.4	4
TS 1200	2	1210	0.22	8.3/210	10.8/275	28.4/721	198.7/90.3	144.5/65.7	54.1/24.6	5.3/19.8	4
TS 1500	2	1513	0.24	8.3/210	10.8/275	34.3/871	249/113.2	188.3/85.6	60.7/27.6	5.9/22.3	4
TS 1625	2	1639	0.22	8.4/214	15.7/399	33.3/847	275.4/125.2	209.7/95.3	65.8/29.9	6.4/24.1	6
TS 1750	2	1765	0.21	8.4/214	15.7/399	33.3/847	302/137.3	228.4/103.8	73.7/33.5	7.2/27	6
TS 1875	2	1891	0.19	8.4/214	15.7/399	33.3/847	324.3/147.4	241.1/109.6	83.2/37.8	8.1/30.5	6
TS 2000	2	2017	0.14	8.4/214	15.7/399	33.3/847	344.5/156.6	257.4/117	87.1/39.6	8.5/31.9	6
TS 2500	2	2521	0.11	8.3/212	19.2/487	33.3/847	432.1/196.4	322.7/146.7	109.3/49.7	10.7/40.1	8
TS 3000	2	3024	0.1	8.3/212	22.7/576	33.3/847	505.3/229.7	367.8/167.2	137.5/62.5	13.4/50.4	8
TSB 12100	12	99	9.44	10.7/272	8.1/205	14.7/373	94.4/42.9	68.4/31.1	25.9/11.8	2.5/9.2	2
TSB 12150	12	149	6.57	15/380	8.1/205	14.7/373	159/72.3	125.8/57.2	33.2/15.1	3.3/12.2	2
TSB 6200	6	198	2.84	10.7/272	8.1/205	14.7/373	111.5/50.7	84.7/38.5	26.8/12.2	2.6/9.8	2
TSB 6250	6	247	2.27	15/380	8.1/205	14.7/373	152.9/69.5	118.8/54	34.1/15.5	3.3/12.5	2
TSB6300	6	297	1.89	15/380	8.1/205	14.7/373	163.5/74.3	130.9/59.5	32.56/14.8	3.2/11.9	2

BATTERY RECORD SHEET

Customer ref.: _____

Site: _____

Battery type: _____ **No. of cells:** _____

Date of installation: _____

Engineer in charge: _____

IMPORTANT: Equalize battery for 30 minutes after water addition. Do not take any reading until battery has stabilized on float charge

WATER ADDED:			
Date		Quantity	
Date		Quantity	
Date		Quantity	
Date		Quantity	

BATTERY DISCHARGED:			
Date		Duration	
Date		Duration	
Date		Duration	
Date		Duration	

BATTERY EQUALIZED:			
Date		Duration	
Date		Duration	
Date		Duration	
Date		Duration	

REMARKS:

BATTERY RECORD SHEET

Customer ref.: _____

Site: _____

Battery type: _____ **No. of cells:** _____

Date of installation: _____

Engineer in charge: _____

WEEKLY / MONTHLY REPORT

Pilot cell No. : _____

DATE	BATTERY VOLTAGE (V)	PILOT CELL		
		VOLTAGE (V)	TEMPERATURE (° C)	SP.GR. (Kg/l)

REMARKS : _____

_____

_____

BATTERY RECORD SHEET

Customer ref.: _____

Site: _____

Battery type: _____ **No. of cells:** _____

Date of installation: _____

Engineer in charge: _____

QUARTERLY REPORT

DATE:			
TIME:			
BATTERY FLOAT VOLTAGE:	**V**	**BATTERY CHARGING CURRENT:**	**A**
AMBIENT TEMPERATURE:	**°C**	**AVERAGE VpC:**	

Cell No.	Sp.Gr. (Kg/l)	Voltage (V)	Temperature (° C)	Cell No.	Sp.Gr. (Kg/l)	Voltage (V)	Temperature (° C)
1				31			
2				32			
3				33			
4				34			
5				35			
6				36			
7				37			
8				38			
9				39			
10				40			
11				41			
12				42			
13				43			
14				44			
15				45			
16				46			
17				47			
18				48			
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22				52			
23				53			
24				54			
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28				58			
29				59			
30				60			