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GENERAL FEATURES

Stable Quality & High Reliability

The **pbq** SLA battery has a stable and reliable performance. It can be easily maintained to permit proper operation of the equipment that it powers. The battery can withstand overcharge, over-discharge, vibration, and shock, and is capable of extended storage.

Sealed Construction

pbq's unique construction and sealing technique guarantee that no electrolyte leakage can occur from the terminals or case of any **pbq** battery. This feature insures safe, efficient operation of **pbq** batteries in any position. **pbq** batteries are classified as "Non-Spillable" and will meet all requirements of the International Air Transport Association.

Long Service Life, Float or Cyclic

The **pbq** SLA battery has long life in float or cyclic service. The expected life of float service is 5 years depending on temperature. The expected life of cyclic service will reach up to 600 cycles depending on discharge depth.

Maintenance-Free Operation

During the expected float service life of **pbq** batteries, there is no need to check the specific gravity of the electrolyte, or add water. In fact, there is no provision for these maintenance functions.

Low Pressure Venting System

pbq batteries are equipped with a safe, low pressure venting system, which operates at 1psi to 6psi, designed to release excess gas and reseal automatically in the event that gas pressure rises to a level above the normal rate. Thus, there is no excessive build up of gas in the batteries. This low pressure venting system, coupled with the extraordinary high recombination efficiency, make **pbq** batteries the safest sealed lead-acid batteries available.

Heavy Duty Grids

The heavy-duty lead calcium-alloy grids in **pbq** batteries provide an extra margin of performance and service life in both float and cyclic applications, even in conditions of deep discharge.

Low Self Discharge

Because of the use of Lead Calcium grids alloy, **pbq** SLA battery can be stored long periods of time without recharge.

U.L. Component Recognition

All of our **pbq** SLA batteries have passed UL tests.

APPLICATIONS

A **partial list** of common applications includes, but is not limited to, standby or primary power for:

- Alarm Systems
- Cable television
- Communications Equipment
- Control Equipment
- Portable Cine & Video Lights
- Electronic Cash Registers
- Electronic Test Equipment
- Electric powered Bicycle and Wheelchairs
- Emergency Lightning Systems
- Fire & Security Systems
- Geophysical Equipment
- Uninterruptible Power Supplies
- Marine Equipment
- Medical Equipment
- Micro Processor Based Office machines
- Computers
- Power Tools
- Solar Powered Systems
- Telecommunications Systems
- Vending Machines
- Toys

BATTERY STORAGE

It is recognized that **pbq** SLA batteries have excellent charge retention characteristics. That is, their self discharge rate is low and is typically less than 3% per month at 25°C. Although the self discharge rate is low, specific precautions must be taken to against the battery over discharging itself by self discharge when in storage or nor operating. It is necessary to understand what is meant by a fully discharged (flat) battery. A discharged battery may be determined by the voltage of that battery. The voltage of a battery that can be described as fully discharged varies with the discharge current. For example, the higher the discharge current for a battery, the quicker the battery reaches a fully discharged state and the lower the voltage will be for a battery to be described as fully discharged (flat). At all times a battery should be recharged immediately after discharge.

Storage temperature for SLA batteries

The **pbq** batteries can be stored in a temperature range of -25°C to +60°C.

Mechanical precautions

Storage at low temperatures is possible providing the battery is handled with some extra care since most plastics harden at low temperatures, the risk of damaging the battery container trough shock or dropping will increase. When stored at high temperatures ensure that the battery is on a flat and horizontal shelve to prevent warping of the plastic container.

Electrical precautions

Please note that the electrochemical processes in any battery will be influenced by the temperature. When taking a battery out of storage ensure proper functioning before connection it to your equipment. Check that the delivered voltage and current drain of your applications meets the specifications at the given temperature. The electric characteristics will be reduced at low temperatures, so in order to reach the full capacity of the battery it is recommended to let the battery warm up before use.

Storage at different temperatures will influence the self discharge. Below 20°C every 9 month the battery should be checked and recharged, above 30°C this should be done every 3 month. Storage at temperatures over 40°C will reduce the functional life of the battery. When charging batteries stored at other temperatures than room temperature, a temperature compensated charger should be used.

Final Acceptable Discharge Voltages

Discharge Current		*Final Discharge (vpc)*
Up to 0,1	CA	1,75
0,11 – 0,17	CA	1,70
0,18 – 0,25	CA	1,67
0,26 – 0,6	CA	1,60
3	CA	1,30
Above 3	CA	Refer for advice

The slowest practical rate of discharge for a lead acid battery is self discharge. As the current is very low the fully discharged voltage is high, i.e. the battery is flat at 2.00 – 2.03 Vpc. Therefore a program of stock control must be introduced to ensure that batteries are recharged well before that voltage is reached.

Supplementary Charge Advice

Storage Temperature	*Charging Interval*
20°C or less	Every 9 months
20 - 30°C	Every 6 months
30 or more	Every 3 months

In discharging a battery, lead sulphate (sulpation) is formed. If the battery is recharged as soon as discharging is completed, then the lead sulphate is converted to active material. However on self discharge the lead sulphate that is formed may become inactivation, so that it cannot be reconverted. The lower the voltage that a battery is allowed to fall to under self discharge, the more likely it is that the sulphate formation will not be able to be reversed and the battery damaged beyond recovery.

Precautions Against Over Self Discharge

- ✘ The batteries should not be subjected to an external heat source.
- ✘ The batteries should not be stored in direct sunlight.
- ✓ The batteries should be stored in a cool, dry place
- ✓ The voltage of batteries in stock should be regularly checked.

Precautions for Pre-Installed Batteries

When batteries are installed in a product the following precautions to avoid over discharge during storage must be taken:

- ✓ Only new or freshly recharged batteries should be used.
- ✓ Any load that is on the battery in the product must be FULLY DISCONNECTED. Any discharge on the battery other than self-discharge will quickly flatten the battery and cause the formation of lead sulphate which, if left in this state for too long, will irreversibly damage the battery.
- ✓ The first operating instruction for equipment fitted and sold with a rechargeable lead acid batter must be “The battery must be fully charged before use”.

Self Discharge Characteristics

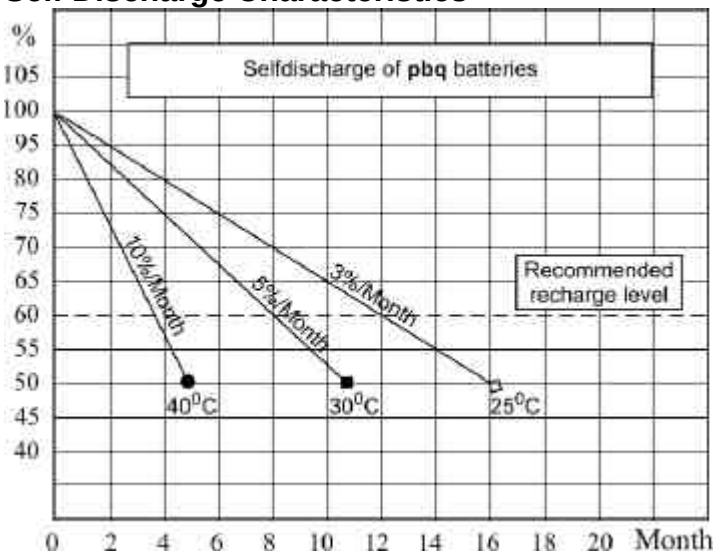


Figure 1: Discharge versus temperature

Open Circuit Voltage and Remaining Capacity

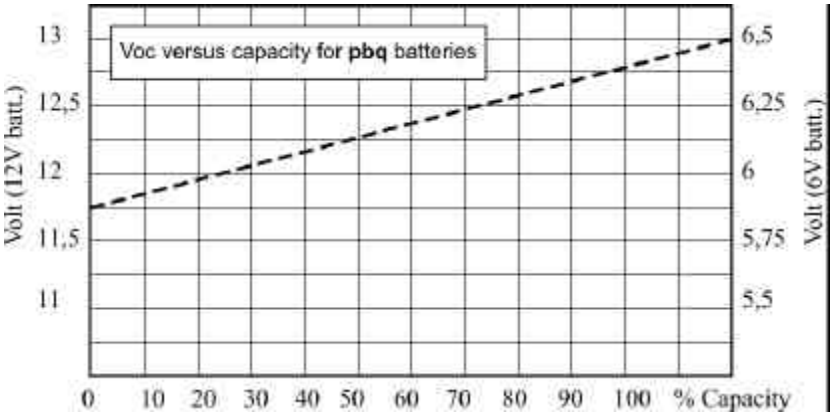


Figure 2: Capacity versus Voc (at 20°C)

Recharging a Self Discharging Battery

When it is necessary to give a self discharging battery a "top up" charge the following procedures should be observed:

1. Ensure the Voc of the battery is greater than 2 Vpc. If the voltage is lower than 2 Vpc please refer the problem to your **pbq** distributor before attempting to recharge.
2. Constant voltage charging recommended.

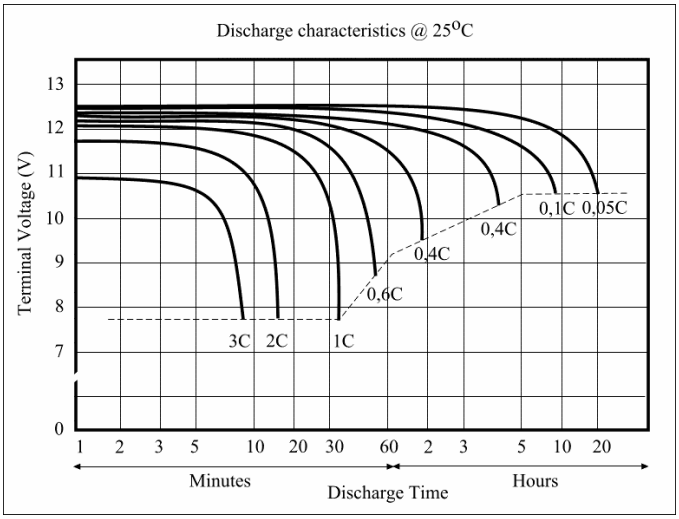
Storage Time		*Top Up Charging Recommendation*
Less than 6 months from manufacture or previous top up charge	-	Maximum of 20 hours at a constant voltage of 2,4 Vpc.
Up to 12 months after manufacture or previous top up charge.	-	Maximum of 24 hours at a constant voltage of 2,4 Vpc

Note: A faster recharge may be obtained by using the constant current method of charging. This requires a closer supervision of the charging procedures.

Less than 6 months from manufacture or previous top up charge	-	Maximum of 6 hours at a constant current of 0,1C Amps.
Up to 12 months after manufacture or previous top up charge.	-	Maximum of 10 hours at a constant current of 0,1 C Amps.

BATTERY DISCHARGE CHARACTERISTICS

The discharge capacity of a lead acid battery varies and is dependant on the discharge current. **pbq** CP SLA batteries use a rate at the 20 hour rate. I.e. the capacity of the battery at 20 hours discharged to an end voltage of 1,75 Vpc at a temperature of 25°C.



General Comments

The discharge curves (Figure 3) show the minimum design parameters for each fully charged **pbq** battery after installation. Full capacity is reached after some initial service.

Float Service	*Cycle Service*
One month after installation and recharging.	Within three to five cycles after initial charge and service entry.

Technical Terms

1. Battery capacity for small SLA batteries by accepted convention worldwide is described in “Ampere Hour” at the 20-hour rate C_{20} when discharged at 25°C. A **pbq**4-12 at 4,0 Ah at C_{20} that is the battery will deliver 200mA current for 20 hours to a cut-off voltage of 1,75 volts per cell (10,5 volts per battery).
2. Battery load, by convention is described in terms of a multiple of C, in amps, where C is the capacity at 25°C, i.e. for a 4,5 Ah battery.
3. Battery cut-off voltage is the volts per cell to which a battery may be discharged safety to maximize battery file, this data is specified according to the actual discharge load and run time. As a rule of thumb high amp loads and short run times will tolerate a lower cut-off voltage (eg 0,05C at 1,75V/C).

Battery Selection

The battery discharge graph (Figure 3) may be utilized in battery selection. However it is suggested that a review is made of the data sheet for each battery type or the chart showing the actual ampere hour capacity of each battery type at various discharge times.

Effect of Temperature on Battery Capacity

The nominal battery capacity is based on the temperature of 25°C. Above this temperature the capacity increases marginally but it must be noted that the working battery should be kept within the temperature design limitations of the product.

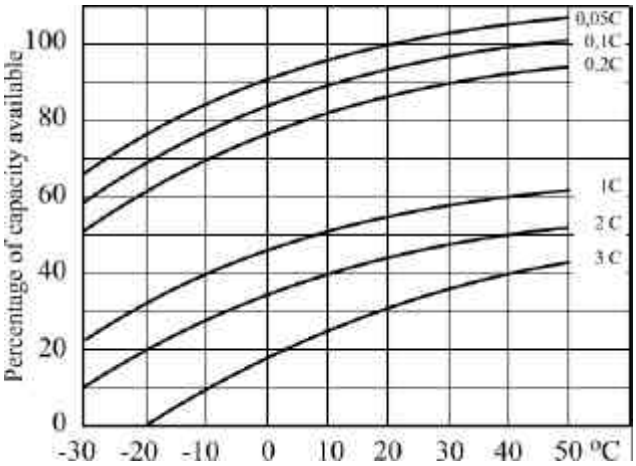


Figure 4: Capacity versus temperature

Below 25°C the capacity decreases. This decrease in capacity becomes large at temperatures below 0°C and in heavy discharge rates.

The graph (Figure 4) illustrates the situation and the decrease in capacity with the decrease in operating temperature. Temperature must be taken into capacity design calculations in applications where the operating temperature of the system is below 20°C.

BATTERY CHARGING

Correct battery charging ensures the maximum possible working life for the battery. There are four major methods of charging:

- *Constant Voltage Charging*
- *Constant Current Charging*
- *Two Stage Constant Voltage Charging*
- *Taper Current Charging*

Constant Voltage Charging

This is the recommended method of charging for SLA batteries. It is necessary to closely control the actual voltage to ensure that it is within the limits advised.

Float service: 2,27 – 2,30 Vpc at 25°C.
Cycle service: 2,40 – 2,45 Vpc at 25°C.

It is suggested that the initial current be set within 0,3 C Amps. The attached graph indicates the time taken to fully recharge the battery. It should be noted that the graph illustrated is for a fully discharged battery, i.e.; a battery that has reached the minimum cell voltage recommended for its discharge time. It is also seen that it is necessary to charge a greater amount of energy into the battery than was taken out o the battery on discharge. The actual current indicating that the battery is fully charged is approx 5mA/Ah undercharging voltage is 2,30 Vpc.

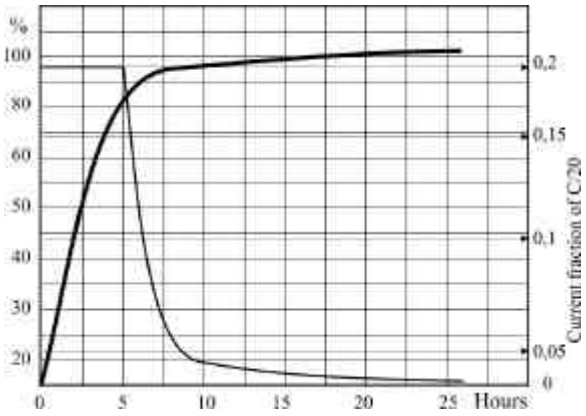


Figure 5: Float use; charge 0,2C & 2,3Vpc following full discharge

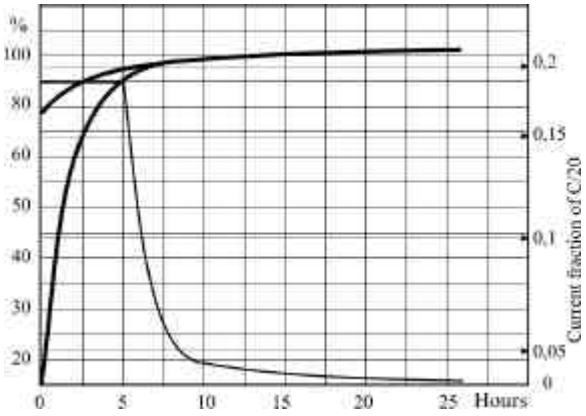


*Figure 6: Time to 2,4 C/Cell * charge recover @ 0,177 C/20 current*

Note: It is necessary to ensure that the voltage is correctly set. A charging voltage set too high will increase the corrosion of the positive plates and shorten the battery life. A charging voltage set too low will lead to sulphation of the plates causing loss of capacity and ultimately shortening the life of the battery.

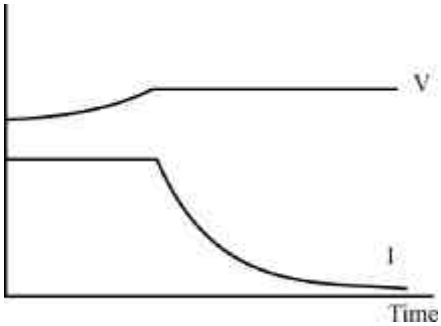


Figure 7: Constant-voltage charge with current lmiting

Constant Current Charging

This method of charging is generally not recommended for SLA batteries. It is necessary to understand that if the batteries are not removed from the charger as soon as possible after reaching a state of full charge, considerable damage will occur to the batteries due to overcharging.

Two Stages Constant Voltage Charging

This method should not be used where the battery and load are connected in parallel. If this method is to be used, it is suggested that the PSE technical department is contacted.

Taper Current Charging

This method is not recommended for SLA batteries, however, if this method is to be used it is suggested that the PSE technical department is contacted.

Effect of Temperature on Charging Voltage

As temperature rises, electrochemical activity in a battery increases. Similarly, as temperature falls, electrochemical activity decreases. Therefore, conversely, as temperature rises charging voltage should be reduces to prevent overcharge, and increased as temperature falls to avoid undercharge. In general, to assure optimum service life, use of a temperature compensated charger is recommended.

The recommended compensation factor for CP batteries is –3mV/°C/Cell (stand by) and –4mV/°C/Cell (cyclic use). The standard centre point for temperature compensation is 20°C.

Figure 8 shows the relationship between temperatures and charging voltages in both cyclic and standby applications.

Effect of Voltage on battery Gassing

Although the batteries are of the recombination type and the amount of gassing at normal operating voltages and temperature is negligible, if the charging voltage is increased, gassing will occur despite the recombination design of the product. Gassing does not normally occur while the battery is operating under float conditions and normal constant voltage recharge of 2,27 – 2,30 vpc at 25°C. Very little gassing occurs when the battery is recharged under normal cycling recharge procedures.

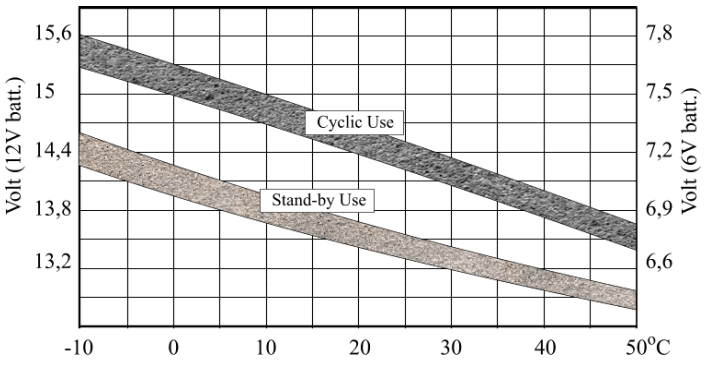


Figure 8: Relation between charging voltage and temperature

However, it can be seen on the accompanying graph the higher voltages that this especially under conditions of constant current charging will substantially increase the volume of gas.

BATTERY LIFE

Battery life depends on a number of key factors. These include:

- *Operating temperature of the battery*
- *Method of charging utilized*
- *Actual use of the product i.e.: float or cycle*

Float Service

The estimated life under float service is 5 years. The float service is effected by the factors listed above and the number and depth of discharges the battery suffers during its life time. Basically; the more discharges suffered and the deeper the discharges, the shorter the battery life

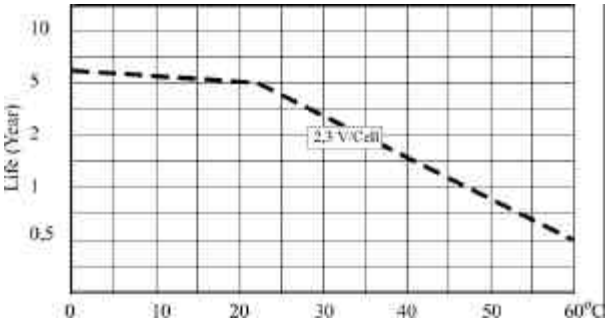


Figure 9: Effect of temperature on long term float

Cycle Service

Giving due consideration to the above factors, the actual life of a battery in cycle service is dependant of the depth of discharge of each cycle. The greater the depth of discharge of each cycle, the lesser the number of cycles available from the battery.

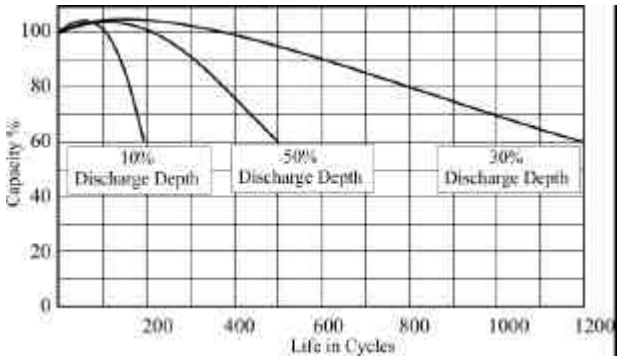


Figure 10: Life versus discharge depth

PROLONGING BATTERY LIFE

Charging instruction

1. Always recharge the battery immediately after use.
2. Constant voltage charging is recommended at 25º, 2,27-2,30vpc for float use and 2,40-2,45Vpc for cycle use.
3. The maximum initial charging current should be 0,4CA.
4. If batteries are used in series or parallel, the correct size cabling should be used.
5. Don't charge the battery in upside-down position.
6. The battery requires approx. 110% of the total discharging energy to fully recharge.

Supplementary charge advice

Storage Temp.	Charging Interval.
20º C or Less	Every 9 months.
20-30º C	Every 6 months.
30-40º C	Every 3 months.

1. Never leave a battery in a discharging condition.
2. Never allow a battery to fall below 2 vpc in storage. The full capacity may not be able to be reached and actual service life decreased.
3. Maximum continuous discharge current is 5CA. For greater continuous discharge currents please consult our technical staff.
4. Avoid over discharging the battery.
5. Stored batteries should receive a supplementary charge at intervals suggested.

Other consideration

Ensure the operating temperature is below 40ºC.

Storage

1. When storing the batteries, be sure to remove them from the equipment, or disconnect them from the charger and load. Keep them in a place where the air is dry and the temperature is sufficiently low.
2. Charge the batteries, at least once, every six months during storage.
3. The batteries gradually deteriorate even during storage.

Other cautions

1. when cleaning the batteries, use soft cloth only. Use of organic solvents such as gasoline or thinner, and application or adherence of oil to the batteries must be avoided. Do not clean the batteries using dirty or oily cloth. Also contact with soft polyvinyl chloride or the like must be avoided.
2. Batteries may generate inflammable gas in some cases. Do not expose them to flame or excess heat. Do not short batteries.
3. Do not attempt to disassemble the batteries. Avoid contact with sulphuric acid leaking from broken batteries. If contact is made with skin or clothes, rinse the area generously with water. If eyes contact, wash eyes with clean water, and consult a physician immediately.
4. Batteries may explode if put into the fire. Never dispose of batteries in fire.
5. Mixed usage of batteries differing in capacity, type, manufacturer or history of use (charge/discharge operation) may damage the batteries and the equipment due to the difference in characteristic values. This must not be attempted anyhow.

6. While our batteries are exceptionally dependable, we do not recommend use in life support medical applications unless there is an alternate battery or back-up power supply.
7. When the batteries come to their end of life, discharge duration time becomes short remarkably. And finally, batteries lose their available capacity by internal short-circuit and/or dry out of electrolyte. Therefore, please consider the design of the charger for the battery some care regarding above battery damage modes, such as short-circuit protection for out put.

SPECIAL MODELS

LL Series

The **pbq** 'long life-series' is designed for a functional life of 10 years under float conditions. The LL-series has been build and tested in conformance to the Eurobat specifications to live up to the most demanding applications in the fields of:

- Telecommunications
- UPS systems
- Emergency power supplies
- Fire protection and alarm systems
- Etc.

Features

- High Reliability and Good Quality
- Deep Discharge Recovery
- High Power Density
- Long Service Life, in Float or Cyclic
- International Standard, JIS and DIN

Models available

Battery Type	Nominal Voltage (V)	20h Rate Capacity (AH)	Dimensions(mm)			Weight (Approx) kg	Terminal Type & Terminal
			L	W	H		
pbq33-12LL	12	33	195	130	159	10,2	F7
pbq40-12LL	12	40	197	165	170	13,5	F4
pbq65-12LL	12	65	335	167	179	22,2	F5
pbq90-12LL	12	90,0	328	174	240	30,0	F5
pbq100-12LL	12	100,0	330	174	240	33,0	F5
pbq120-12LL	12	120,0	405	174	240	39,0	F5
pbq150-12LL	12	150,0	495	174	245	47,0	F5
pbq200-12LL	12	200,0	520	238	240	65,0	F5