



Current Automation

CALCIUM BATTERY

ROYAL

*Complete protection against
reduction of sulfuric acid*

*Preventing electrolyte losses by collecting
and returning liquid to the reservoir*

Consistent starting performance

*High durability achieved by adoption of special
wrought lead calcium grids and low resistance
envelope separator*

Longer lifetime achieved

*Longer lifetime achieved by minimizing
vibration which reduces battery lifetime*

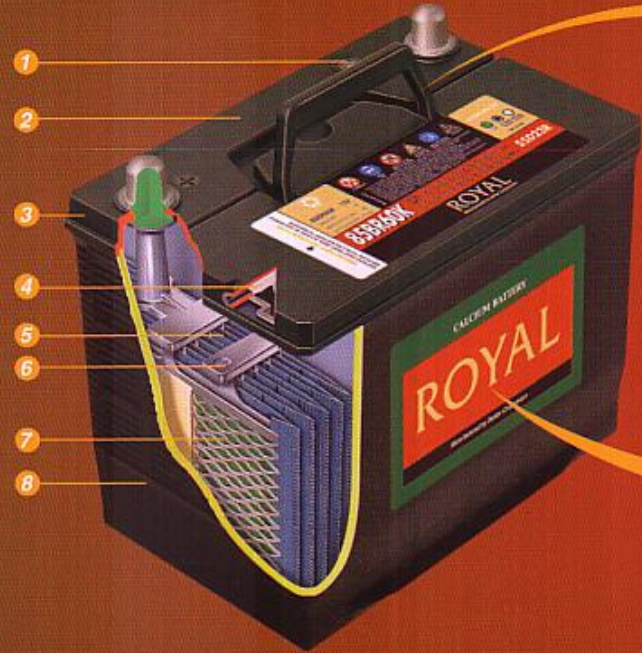


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ROYAL

CALCIUM BATTERY



1 Hydrometer

- at full charge, the electrolyte specific gravity is 1.280 while at 50% of charge considered the minimum serviceable condition, the specific gravity is typically 1.220. In a typical situation when the specific gravity drops to 1.100, the battery is fully discharged.



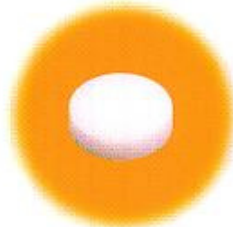
2 Heat-Sealed Covers

- prevents leakage and contamination.
- adds to case strength and rigidity.
- include permanent flame arresters to prevent an accidental explosion from external sparks or flame.
- have hydrometer built in for faster checking.



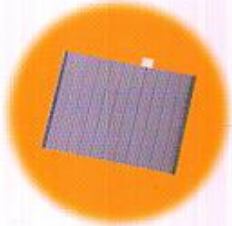
3 Exclusive Patented Liquid Gas Separator

- prevents electrolyte losses by collecting electrolyte vapor and returning liquid to the reservoir.
- vents allow the battery to "breathe" during temperature changes and charging



4 Flame Arrester

- safety system
- prevents possibility of explosion from spark of outside
- minimizes acid-leakage
- prevents inflow of dust



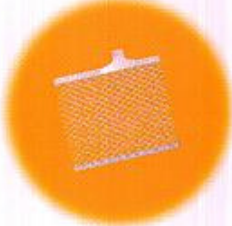
5 Low-Resistance Envelope Separators

- encapsulate negative plates
- improve vibration durability
- prevent "treeing" and internal shorting between positive and negative plates



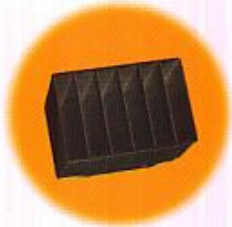
6 Centered Cast-on Plate Straps

- stronger than the thinner gas-burned conventional connectors.
- reduce the lever action movement resulting from road shock.



7 Wrought Lead-Calcium Grids

- offer considerable strength
- resistant to grid corrosion
- over-charge resistant
- minimal gassing and water usage
- less self-discharge
- resist thermal runaway



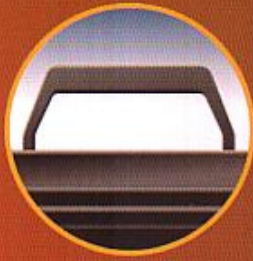
8 Polypropylene Case

- reinforced design is precisely tailored to support the battery elements for resistance to vibration and road shock damage.
- material is light weight, exceptionally strong, durable and resistant to handling and impact damage.

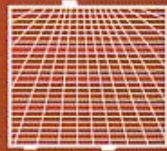
TECHNOLOGY OF THE GRID

CALCIUM BATTERY
ROYAL

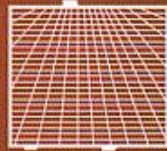
Plastic Handle



Wrought Calcium
ROYAL MF



Cast Calcium
(Hybrid MF)



Cast Antimony
(Dry/Conventional)

CAST GRID TECHNOLOGY

WROUGHT GRID TECHNOLOGY

TYPE	Cast Antimony (Dry/Conventional)	Cast Calcium (Hybrid MF)	Wrought Expanded Lead Calcium Alloy ROYAL MF
Technology	<ul style="list-style-type: none"> •Large Grain Size •Poor Resistance to Deep Corrosion •Poor Resistance to "Buckling" •Loss of Physical & Electrical Integrity •Poor Resistance to Cycling 	<ul style="list-style-type: none"> •Poor High Temperature Performance 	<ul style="list-style-type: none"> •Fine Grain Structure •High Resistance to Corrosion •High Resistance to "Buckling" •Retain Physical & Electrical Integrity •Eliminates Electro Chemical Effect of Arsenic-Antimony(Gassing,Water Loss, Self-Discharge) •Improved High Temperature Performance

ONE YEAR GRID COMPARISON

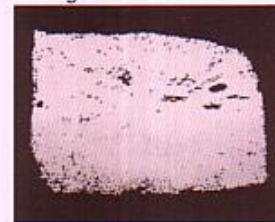
Cast Grid	Wrought Grid
<ul style="list-style-type: none"> •Deep Penetrating Corrosion •Reduced Electrical Performance •Reduced Physical Strength (Broken Grid Wire-Loss of Electrical Contact) 	<ul style="list-style-type: none"> •No Deep Intergranular Corrosion •No Loss in Performance

Cast



Corrosion

Wrought



No Corrosion

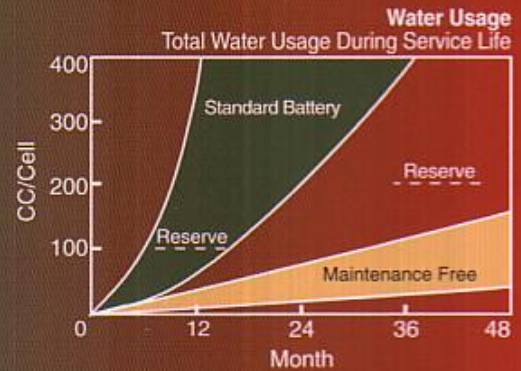
ONE YEAR GRID CORROSION

ROYAL

BENEFITS OF CALCIUM LEAD GRID TECHNOLOGY

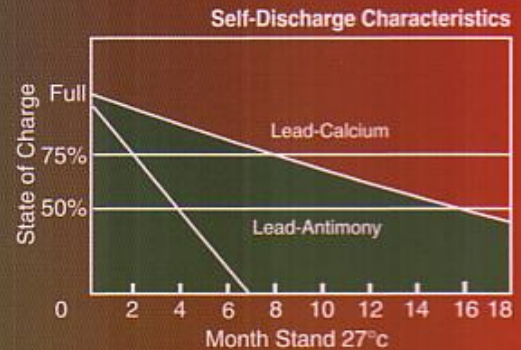
Benefit 1. Distilled water supplementation free

As the lead-antimony conventional battery incurs unnecessary local action inside battery due to the effects of antimony ion during battery use and discharges gas by electrolyzing water contained in electrolyte, the amount of electrolyte is decreased rapidly. The battery performance is deteriorated and operating life reduced unless distilled water is supplemented frequently to compensate for such decrease of electrolyte. ROYAL battery, however, uses specially alloyed calcium-lead, which leads to extremely low level of electrolyte decrease. Hence, if the charging system of vehicle remains error-free until the battery is worn out there is no need to supplement distilled water at all.



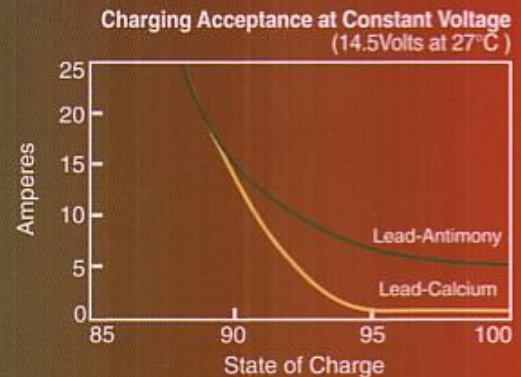
Benefit 2. Recharging free

Due to the phenomenon of self-discharge, the lead-acid battery is characterized by its charged power being consumed even when the battery is not in use, such as during storage. The reason behind such phenomenon is that the impurities contained in lead alloy induces local action, causing electric energy to be consumed. Compared with the lead-acid battery, ROYAL battery uses carefully selected, highly refined lead alloy, rendering extremely low rate of self-discharge, and maintaining high performance even during long-term standing.



Benefit 3. Overcharge risk free

The battery mounted on vehicles can always be charged while vehicles are in operation. In general, the current being charged is adjusted to high or low level by the regulator which controls the size of voltage. When battery is in the state of near full charge under the condition of voltage already set, the value of current being charged must be decreased to prevent battery from being overcharged to maintain high performance for a long time. As shown on graph, the charging current of ROYAL's Calcium battery is reduced to extremely low level when the battery is in near full-charge state, eliminating to near zero the danger of battery being overcharged.



Benefit 4. Thermal runaway free

When battery is in near full-charge state while battery is being used in hot places (temperature approximately 70°C), the current being charged must be decreased to prevent battery damage resulting from overcharging. The charging current level of lead-acid battery decreases at initial stage but rises again soon due to the effects of a few kinds of substance contained in the grid alloy, and the grid is damaged and performance deteriorated due to this thermal phenomenon. ROYAL battery, however, is free of substance containing such harmful effects, and the current being charged becomes extremely low level when battery is fully charged in high-temperature, leading to the prevention of overcharging.

