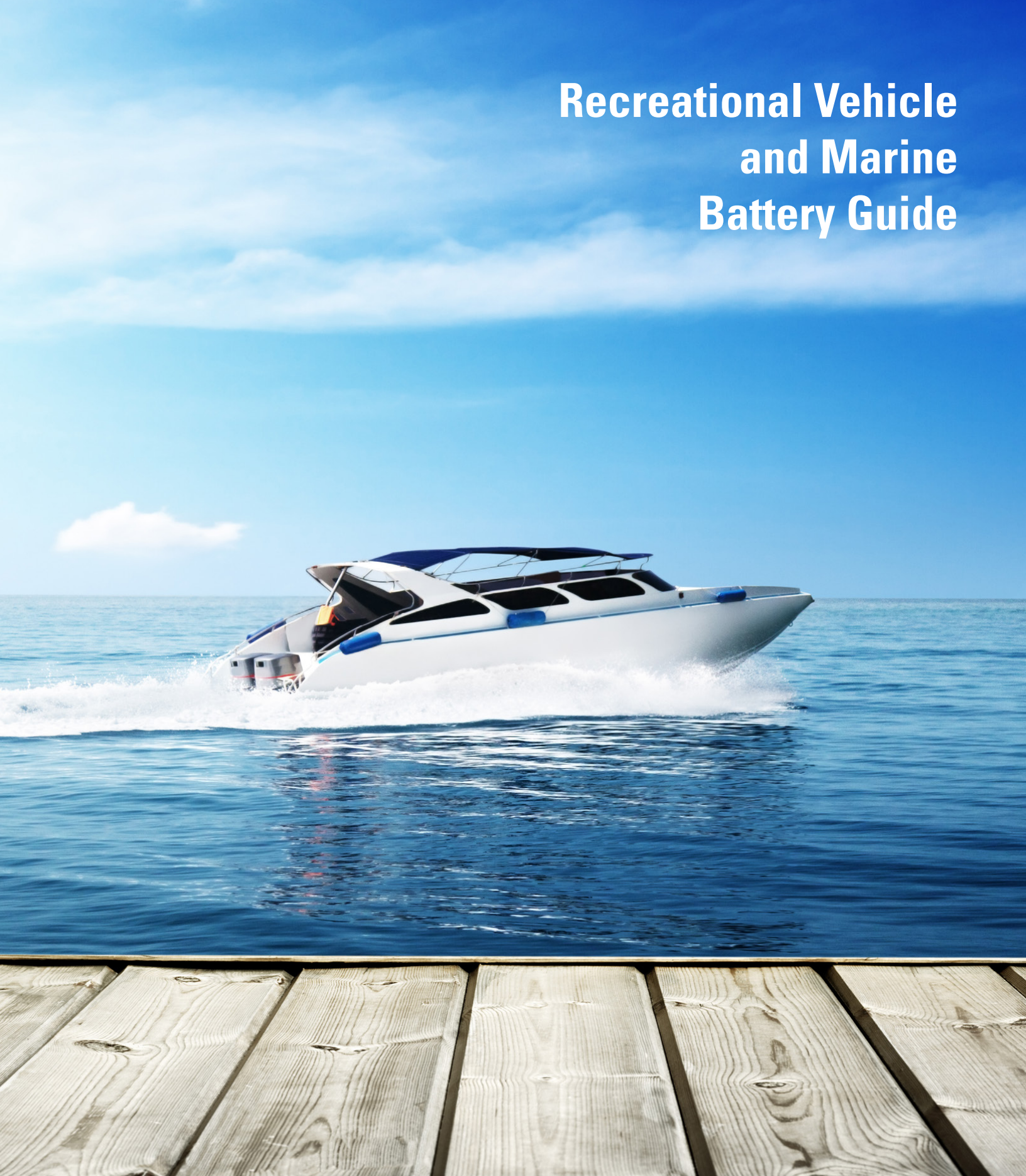


Recreational Vehicle and Marine Battery Guide



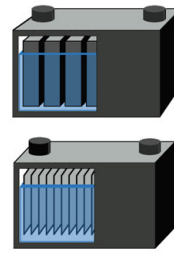
THE RIGHT RECREATION VEHICLE BATTERIES WHEN POWERING YOUR CAMPING AND BOATING LOADS

There are many factors to consider when selecting a lead acid battery for your RV's house applications (fridges, electronics and accessories). It is important to look at battery type, technology, construction and maintenance when assessing your RV house battery needs in order to avoid battery failures, performance problems and to ensure that your battery is reaching its expected life and performance. Not all lead acid batteries are designed and manufactured equally, so we will compare the benefits and features of the available deep cycle battery types and technologies to identify which battery is the ideal solution for your RV 12V house applications.

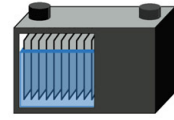


DEEP CYCLE BATTERIES

For optimal performance and to reduce premature battery failure, it is extremely important to determine your application needs first. To power the house portion of your RV, camper or boat, your house battery must be a true deep cycle battery. This will ensure that there is a steady amount of power being delivered to your applications over a long period of time without interruption or failure, and that the sizing of your battery selection is adequate for the depth of discharge you require. A starting battery will not be able to meet the needs of your 12V house applications and will only be able to provide high power and large starting currents in short bursts. A true deep cycle battery is designed and manufactured to store a large quantity of energy, to discharge deeply and recharge repeatedly. A deep cycle battery is able to achieve greater cycle capacity, and increased life because of its thicker plates compared to starting batteries (Figure 1). As you will see in Figure 2, thicker plates and a denser active material ratio provides deeper discharges, greater run times and increased life than a starting battery would.



Deep Cycle Battery
Has thicker plates for improved cycling abilities.



Starting Battery
Has many thin plates to achieve low resistance with high surface area. This battery is not designed for deep cycling.

Figure 1. Deep Cycle and Starting Battery Plates Thickness.

Depth of Discharge	Deep Cycle Battery*	Starting Battery*
100%	150-200 cycles	12-15 cycles
50%	400-500 cycles	100-120 cycles
30%	1000+ cycles	130-150 cycles

Figure 2. Deep Cycle Battery Cycles Versus Starting Battery Cycles.
*Approximate average based on manufacturers published data. It is recommended that DOD doesn't exceed 50% repeatedly.

DEEP CYCLE BATTERY TECHNOLOGIES

To understand the differences between deep cycle batteries, we will look at four different technologies: Flooded Lead Acid, Gel, AGM and Discover Dry Cell EV Traction batteries.

Flooded lead acid batteries contain liquid electrolytes that are completely free-flowing with removable watering fill caps for servicing. Because of their internal chemical reactions and heating during charging, they lose water that must be replaced through regular servicing and maintenance. Flooded lead acid batteries are considered a hazardous technology as they are spillable and produce off gassing which may result in corrosion and damage to the equipment and environment. Although flooded lead acid batteries have an initial lower cost to purchase, and are widely available, they require the most maintenance in terms of inspection, servicing and storage.

A **Gel battery** is a sealed valve-regulated lead acid recombinant

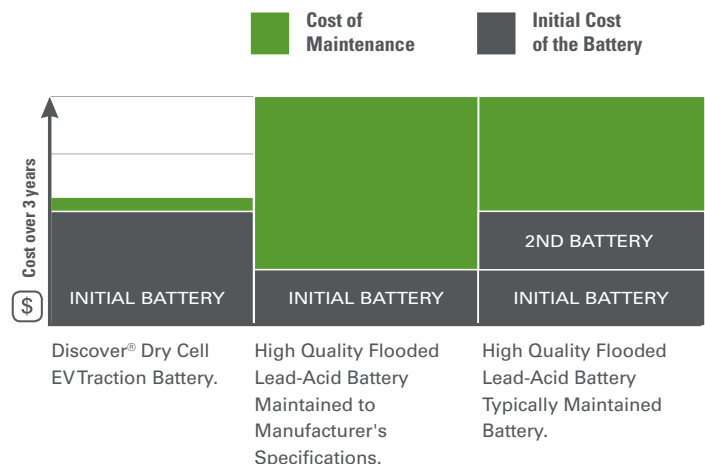


Figure 3. Overall Cost of Ownership.

battery that is non-spillable and maintenance-free. In this battery, the plates are thinner and the electrolyte is mixed with an additive which changes it into a gelled consistency. The issues with Gel batteries are that they require precise charging, slower charging voltage rate and time and can easily be damaged if they are overcharged. When taking charging time, maintenance and performance into consideration, their overall cost of ownership increases.

An **AGM battery** is also a sealed valve-regulated lead acid recombinant battery that is non-spillable and maintenance-free. The difference between an AGM battery and a Gel battery is that its electrolyte composition is not a gel substance. The AGM battery electrolytes are absorbed and are trapped in a matted glass fibre separator material. The AGM battery has thinner plates and their grid structure cannot handle being cycled to a depth of discharge greater than 50%. Users will be required to replace batteries more frequently to compensate for their shorter life span and performance.

A **Discover Dry Cell EV Traction** battery has the thickest plates out of the four batteries we are looking at, along with higher density and active materials, resulting in higher performance, greater capacity and longer life. These batteries are also completely sealed and maintenance-free and designed to eliminate corrosion due to off-gassing, and safeguard against spills and corrosion related issues. Although **Discover Dry Cell EV Traction** batteries are initially more expensive to purchase, they offer a lower total cost to own over the life of the battery when maintenance, performance, health and safety are taken into consideration. Selected battery chargers with an optimized **Discover Dry Cell EV Traction** algorithm will maximize the run time and service life performances that they are designed for.

As you will see in **Figure 4**, when it comes to performance, run times, discharging, life span and shorter charging times, the **Discover Dry Cell EV Traction** battery outperforms these other technologies and provides the greatest value for your application and cycling needs.



SELECTING THE RIGHT DEEP CYCLE BATTERY

Now that we have a better understanding of the different deep cycle battery technologies, we will look at how to select the right battery for your application. When purchasing a new battery for your 12V RV appliances, you will need to identify how you are going to be using your RV, whether you are primarily plugging into an electrical source, or dry camping, and how many house appliances you need to power. Once this has been established, you will need to make sure that your Ampere-Hour (AH) or

PERFORMANCE AND VALUE

	HIGH QUALITY DEEP CYCLE TECHNOLOGIES			Discover® DRY CELL
	FLOODED	GEL	AGM	
Designed for longer run times	✓	-	-	✓
Designed for high-rate/long duration discharges	-	-	-	✓
Designed for long life	✓	-	-	✓
Good charge retention	-	✓	✓	✓
Shorter charging time	-	-	✓	✓
Maintenance Required: A. Inspection B. Cleaning C. Watering	OFTEN A, B, C	PERIODIC A	PERIODIC A	PERIODIC A
Initial purchase price	\$	\$\$	\$\$\$	\$\$\$
Lowest cost to own	-	-	-	✓

Reserve Capacity (RC) rating of the battery will meet or exceed your application requirements. An AH rating refers to how many amps the battery can deliver for a certain number of hours before it is discharged. For example, a battery that can deliver 5A for 20 hours before it is discharged, would have a 100AH rating. An RC rating refers to the number of minutes that a fully charged battery at 27°C/80°F can deliver 25A until it drops below 10.5V. Within a specific battery type, footprint or industry group, a battery with a higher AH rating will deliver longer discharge times.

After determining your power needs, you will need to look at your available space, weight and size restrictions to ensure that your application will be able to accommodate the battery block. You will also need to consider whether you need multiple batteries for your house appliances, how accessible the battery installation location is, and how much servicing is required. It is important to look at what type of battery you are currently using, and what type of charging system you have available.

Selecting the right battery is critical to the longevity and expected performance of your battery and applications. Without proper charging, maintenance and knowledge, batteries may fail prematurely, resulting in more time and money spent on servicing and replacements.

BATTERY ISSUES

Many RVers are experiencing battery failures and other battery related issues long before they expect their house batteries to die. How you charge, discharge, recharge, maintain and store your house batteries on and off season will determine the performance and life expectancy of your battery.

The most common causes for premature battery failure and inadequate performance are sulfation, corrosion, vibration related problems as a result of improper charging and a lack of maintenance knowledge.

When a battery is improperly charged or if it has been discharged for a long period of time, sulfation occurs; this happens when small crystals of sulfuric acid from the battery's electrolyte start to form on the plates. This acts as a barrier, impedes the opportunity for chemical reaction, and stops the battery from a full charge.

Over time, the sulfation that has been collected cannot be converted back into active plate material. The sooner a battery is recharged after it is discharged, the better. Undercharging your battery happens when your deep cycle battery is repeatedly discharged without being fully recharged between cycles. A full battery cycle is

on complete discharge from 100% to about 50% then recharged back up to 100%. This helps extend your battery's life and helps prevent sulfation and performance issues. Refer to **Figure 5** to see cycle life in relation to depth of discharge.

CYCLE LIFE IN RELATION TO DEPTH OF DISCHARGE (25°C)

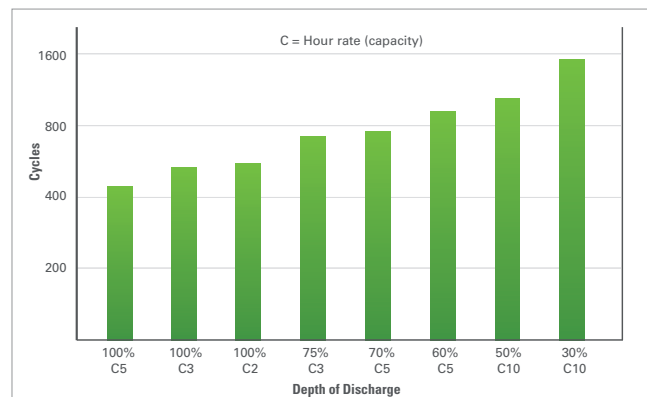


Figure 5. Cycle Service Life in Relation to Depth of Discharge. Cycle life is a function of discharge rates, temperature and remaining capacity.

Overcharging a battery occurs when you leave your 12V battery plugged into the charger during storage that is not temperature compensated or set under the proper configurations.

Vibration in an RV can also create performance issues. With high vibration, lead from the plates begin to fall off and pile up at the bottom of the battery. This builds up, decreases performance and power and shorts out on the adjacent plate. This is why it is important to ensure that the construction of the deep cycle battery you purchase is built to withstand vibration. **Discover Dry Cell EV Traction** batteries can inherently withstand vibration due to the electrolyte being absorbed into the glass mat separators, surrounding the plates. In **Discover Dry Cell EV Traction** batteries, the electrolyte is not free flowing, and is absorbed into the glass matt separators, whereas a flooded battery has free flowing electrolyte surrounding the plates for less vibration protection.

To avoid sulfation, corrosion and vibration issues which can ruin your battery, it is important to employ correct battery charging and maintenance practices (see **Figure 6**).

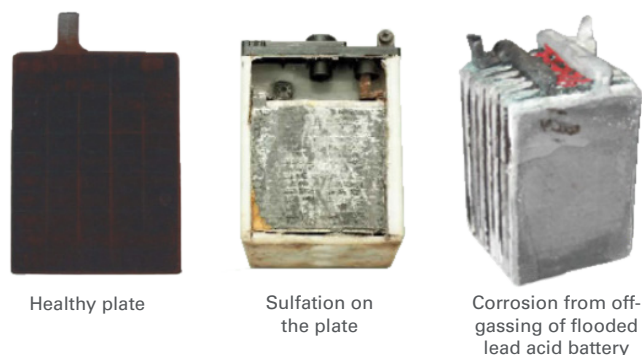


Figure 6. Plate and Battery Damage.

CHARGING AND MAINTENANCE

Proper charging is important to prevent premature failure. To ensure your battery meets its intended performance expectations and life span, you need an RV three stage charger that provides a bulk, absorption and float charge. When selecting a charger, the charge rate should be between 10-13% of the battery's 20 AH capacity. Your battery should be charged as soon as possible after each use, and should not discharge below 10.5V.

Batteries that are discharged to 50-80% will last much longer than if they are not. You should also disconnect your house batteries when your RV is in storage or not in use to prevent premature discharging. Lead acid batteries by nature, will also self-discharge up to 10% a month (flooded lead acid types), so it is important to check batteries frequently especially when in storage.

Discover Dry Cell EV Traction batteries have a much lower self-discharge rate of 2% per month, so will save on additional charging maintenance required. Depending on your application, batteries that have reached a performance level of 50% or less of their original capacity will not meet your operational needs. A battery that does not reach 80% of your original capacity should be replaced.

DISCOVER DRY CELL EV TRACTION BATTERY. THE DEFINITIVE CHOICE FOR RECREATIONAL VEHICLE AND MARINE APPLICATIONS.

Using a reliable deep cycle battery will reduce the risk of your battery failing prematurely and not meeting its intended performance outcome. The **Discover Dry Cell EV Traction** battery technology can solve many of the RV house battery issues users face. Its construction features and engineering design are proven to outperform other battery types and technologies (see **Figure 7**).

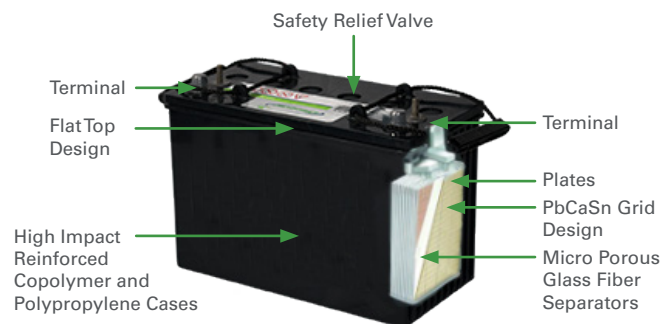


Figure 7. Dry Cell EV Traction Battery Construction Features.

Discover's batteries are sealed, non-spillable, non-gassing and non-hazardous. They are completely maintenance-free and have a gas recombination of 99.9%. They are constructed with the thickest plates, and the highest oxide densities to increase life and capacity. These features

protect against deep discharge damage. Discover batteries have a high active material to acid ratio which provides longer battery life than the standard deep cycle battery technology.

Because Discover batteries are extremely acid starved, their technology uses more active material per amp hour of battery capacity, so even when the battery is discharged deeply, the active material utilization is kept to a minimum. In addition, their PbCaSn grid design provides consistent and active material adhesion to resist corrosion, and their tightly packed and compressed plates prevent separation and guard against vibration damage.

Although **Discover Dry Cell EV Traction** batteries have an initial higher cost to purchase, when proper maintenance, care, safety and correct charging protocol are taken into consideration, users can save up to 1/3rd of their total cost of ownership, compared to other battery technologies.

With a deeper understanding of a deep cycle battery, its different technologies and their benefits and features, you will discover that the **Discover Dry Cell EV Traction** battery is the definitive choice for 12V house applications. This technology is designed for greater run times, longer discharges and deep cycling. Selecting a battery that has these key features will mitigate the risk of premature battery failure, batteries not reaching their performance expectations and spending more time and money on maintenance, servicing and replacement units.





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information visit:
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