CHOOSING THE RIGHT BATTERY FOR A TRUCK AUXILIARY ELECTRIC HVAC SYSTEM

WHY CHOOSE THE TROJAN OVERDRIVE™ DEEP CYCLE BATTERY – THERE IS A DIFFERENCE

INTRODUCTION

Several states have either enacted or are planning legislation to discourage idling of trucks and buses. These *"anti-idling"* regulations apply to commercial vehicles weighing more than 10,000 pounds, regardless of where they are registered. Although these laws vary from state to state, typically, vehicles may not idle for more than five to ten minutes per hour. Violators could face fines from $40 to $1,000 and upwards, depending upon the state and previous idling citations. These laws particularly affect over-the-road drivers who also have to comply with mandated rest periods.

Accordingly, many truck owners are installing *"idle reduction equipment"* to provide power for sleeping berth heating and air conditioning without the main engine running. Some of the earlier systems utilized a small diesel engine to produce the needed electrical energy. More recently, however, battery-powered electric air conditioning power units have been developed to maintain sleeper compartment comfort.

BATTERY-POWERED HVAC SYSTEMS

Battery-powered, engine-off, heating, ventilation and air conditioning (HVAC) auxiliary power units (APU's) are efficient, reliable, easy to operate, environmentally "green" and the most cost effective choice for truck fleet owners/operators.

When the truck's engine is running, power from the alternator is used to charge the APU's separate battery pack. With the engine turned off and the APU turned on, energy stored within these batteries is used to power the truck's HVAC systems. The APU's battery operates separate from the truck's engine starting battery to avoid a "dead battery" condition that would prevent the truck from starting.

The battery pack in most electric APU units is sized to provide at least 10-hours of runtime before the battery is considered to be discharged. The battery pack typically consists of four Group 31 size, Absorbed Glass Mat (AGM) batteries, totaling more than 400 ampere-hours of capacity and storing up to 5-kWh of energy.

DEMANDS ON AN APU BATTERY

With a diesel engine, the energy source is the fuel stored in the vehicle's tanks; with an electric APU, all of the energy necessary for its operation is stored in its battery. When the battery is *charged,* the electric APU's "fuel tank" is full; when the battery is *discharged,* the APU's "fuel tank" is emptied. Each time the battery is discharged and then recharged (i.e., emptied and then refilled), it is said to have received a cycle. Repeated cycling of the battery, as when used with an electric APU, puts more rigorous and stressing demands on the battery than when used as an engine starting battery.

It is not just the number of times a battery is used, but rather, the total amount of energy that is cycled through the battery. Each Group 31 battery in a typical electric APU device for example, will deliver up to 1,000 watt-hours of energy during a 10-hour rest stop period. Compare this to the approximately only 10 watt-hours of energy delivered in a 5-second engine start cranking cycle. This 100-fold difference in energy throughput per cycle, as well as the rate at which the energy is withdrawn from the battery, requires that the battery in an electric APU be specially designed for this application.

CYCLING VS. STARTING BATTERY DIFFERENCE

Achieving optimum performance in the way a battery is used is driven by the battery's design.

To deliver the few seconds of hundreds of amps needed to start an engine, an *"SLI"* (starting, lighting and ignition) battery is constructed using a relatively thin, highly porous plate designed to maximize surface area. The small amount of energy used in starting an engine discharges the battery to a depth of only about 1% of its total available capacity. The result is that the battery's active materials are hardly changed at all – either chemically or physically – allowing the battery to survive thousands of these short, shallow cycles.

When operating in an electric APU device, the battery is discharged to 80% or more of its available capacity over a period of 10 hours or longer, causing significant changes to the chemical composition and physical makeup of the battery's active materials. Repeated discharging and recharging, and the corresponding swelling and shrinking of the active materials, stress the integrity of the battery's active materials that can cause a loss of overall capacity. The deeper the discharge, the more rapid this capacity loss can be. The design features that make the SLI battery more powerful in engine starting applications are the exact same features that make the SLI battery the wrong choice for use with an electric APU system. A *"cycling"* battery design is essential to survive these conditions.

Dual-purpose and *marine* batteries are compromise designs best suited for intermittent use applications requiring 20-25 amps of current for 3-hours or less per cycle (e.g., boat motor starting, trolling motors for moderate use, etc.).

THE "TRUE" DEEP CYCLE BATTERY

To withstand the rigors and abuse of a deep discharge, cycling application like an electric APU, Trojan Battery Company incorporated certain characteristics into the design of its OverDrive™ true "deep cycle" battery.

First, the OverDrive™ battery is designed with a plate construction thicker than that used in a typical starting battery. The thicker section of active material makes the plate more robust and more resistant to the stresses encountered during deep discharge cycling. In addition, the thicker plate allows the grid - the conductive framework that supports the active material – to be made with a larger cross-sectional area that can better withstand the corrosion that takes place in every battery. Combined, these enhancements result in a plate that is capable of providing a much

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longer lifetime than a typical starting or dual-purpose battery under the severe conditions of deep discharge cyclic operation ***(Figure 1)***.

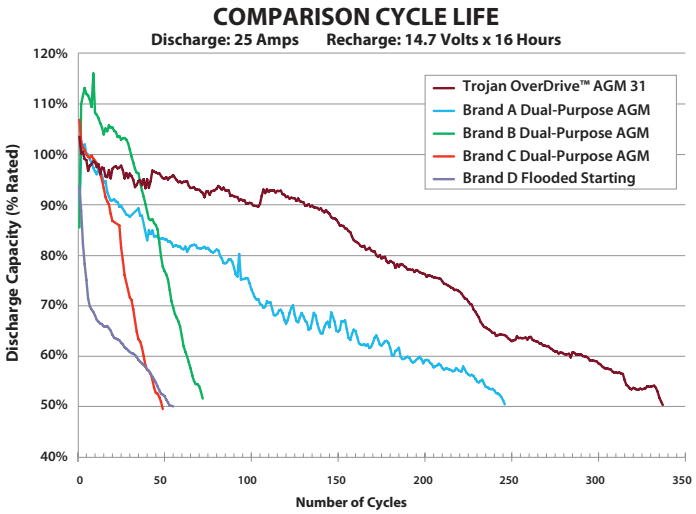

Figure 1. OverDrive™ Outperforms Other Battery Types

Next, the Trojan OverDrive™ battery is made with a robust plate structure like that shown in ***(Figure 2)*** with large crystals, small pores and a high-density paste to prevent the active materials from being eroded away by the constant stresses of deep discharge cycling.

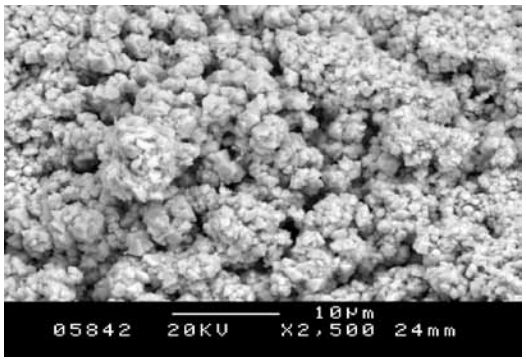

Figure 2. Structure of Trojan's OverDrive™ Battery Plate

The long needle-shaped, alpha lead dioxide crystal structure acts like rebar in concrete, interlocking and strengthening the plate's active material structure. Unlike the highly porous active material structure that gives the starting battery its initial high cranking capacity, but then continuously weakens and deteriorates loosing capacity with use, the reinforced structure of Trojan's OverDrive™ deep-cycle plate is maintained, even with repeated discharging and recharging, giving the battery a longer lifetime with a stable capacity in APU applications.

Finally, Trojan's OverDrive™ AGM battery is packaged in a rugged, thick-walled container: rigid enough to keep the internal components of the battery compressed; resistant to oil, gasoline and other road chemicals; and durable enough to withstand the shock and vibration in over-the-road truck APU applications without rupturing even in the coldest temperatures. Unlike some materials used to encase batteries (e.g., ABS, polycarbonate, etc.) that can fail under some of these conditions, the OverDrive's container is molded with polypropylene to satisfy all of these demands.

SUMMARY

Battery-powered HVAC auxiliary power units offer truck operators the comforts and conveniences of having onboard power while complying with recently enacted anti-idling laws. To realize the maximum benefit of their APU investment however, owners need to carefully select the best battery. Selecting the wrong type of battery will cause disappointing operation, shortened lifetime and wasted money. Trojan's OverDrive™ battery is a true deep cycling battery designed for the heavy-duty use in an electric heating, ventilation and air conditioning APU system.

FEATURES AND BENEFITS COMPARISON – TROJAN OVERDRIVE™ VS. STARTING/DUAL-PURPOSE BATTERY

	Trojan OverDrive™ Battery	Starting / Dual-Purpose Battery
Typical Use	Long duration / Energy storage / Low to medium discharge rate Cycle: 8 – 10 hours / < 10 amps Discharge Depth: 80 – 100%	Short duration / Engine cranking / High discharge rate Cycle: 5 – 10 seconds / > 500 amps Discharge Depth: 1 – 5%
Design Features	Thick plate construction Heavy-duty, corrosion resistant grid Strong, dense active materials	Thin, high surface area plates Thin, low electrical resistance grid Low density, high porosity active materials
Performance	Cranking Amps: 600-700 / Initial C/20 Capacity: 90 – 95% Cycle Capacity Trend: Stable over lifetime Cycle Life at 100% DOD: 300 cycles Cycle Life at 80% DOD: 500 cycles Cycle Life at 50% DOD: 800 cycles	Cranking Amps: 800 – 1,000 / Initial C/20 Capacity: >100% Cycle Capacity Trend: Decreases with use Cycle Life at 100% DOD: Not Recommended Cycle Life at 80% DOD: <200 cycles Cycle Life at 50% DOD: <300 cycles
Operation	Mode: Deep discharge, cycle Recharge Voltage: 2.45VPC / 14.7V Application Suited: Electric AC/APU	Mode: Shallow discharge, float Recharge Voltage: 2.30VPC / 13.8V Application Suited: Engine Start

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Clean energy for life™

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We offer outstanding technical support, provided by full-time application engineers.

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