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COMMENTARY / THE WORKBENCH

You and Your Battery

Take care of it and it will take care of you

BY STEVE ELLS

THE MAIN BATTERY in your airplane is like that relative who is always there for you. If you need a few bucks to get through your latest financial miscue, or you need a place to stay for a couple of weeks, all you need do is ask. There's only one catch: You need to pay attention to that relative. For your relative, that means sending cards and calling; for your battery, that means maintaining it and keeping it charged for safe operation.

THE JUMP-START TAKEOFF AND WHY IT'S A BAD IDEA

Never take off immediately after using an external power source to jump-start an engine when the aircraft battery is too weak to start the aircraft. You'll get the engine started, but if your alternator or generator fails soon after liftoff, you'll find yourself without backup electrical power for more than a few minutes. Day VFR in a fixed-gear airplane? No big deal. Any other situation; you can be in a heap of trouble.

This is especially critical if engine ignition is dependent on battery power as was shown in 2007 when the crew of a Diamond DA42 had to put it down in a field near the airport immediately after they selected gear up after takeoff. The load surge created by the gear motor lowered the bus voltage momentarily, which caused the engine control units to shut down both Thielert diesel engines.

Your battery stores electrical power. A perfect battery would never lose strength or capacity, but all batteries weaken and self-discharge. They need attention. If a battery is maintained, it delivers the electrical energy to start the engine; it also acts like an electrical shock absorber by dampening electrical system surges, and it is your ace-in-the-hole for electrical power when the alternator or generator gives up.

The old, familiar flooded-cell lead acid battery — also called a dry-charged lead acid battery — is still around, but in most cases, owners should install an RG (recombinant gas) battery. RG batteries are also known as valve regulated lead acid (VRLA) or absorbed glass mat (AGM) batteries. It's easy to tell the difference — flooded-cell batteries have one removable filler cap per cell, and AGM batteries are sealed.

RG batteries retain their charge more than three times better than flooded-cell batteries during periods of inactivity.

Flooded-cell batteries vent off acid during charging. This toxic corrosive cloud is controlled in older aircraft by a series of tubes that direct ram air through an enclosed battery box. Despite venting systems, it's common to see where the acid fog has stripped the paint off the lower fuselage aft of the battery box exhaust.

RG batteries are sealed; they don't vent anything. This, coupled with the elimination of the maintenance chores that are involved in the care and feeding of a flooded-cell battery, is why I installed an RG battery in my trusty Comanche.

Gill RG 7035-28

I DON'T NEED NO STINKING BATTERY BOX

RG batteries are so well-sealed that they can be mounted in any position, although upside down

PHOTOGRAPHY COURTESY OF **GILL BATTERY**

mounting is discouraged. There's no need for a battery box, but it's convenient to use an existing one. Box-free installations are common in kitbuilt aircraft.

RG batteries also retain their charge more than three times better than flooded-cell batteries during periods of inactivity.

Because the electrolyte (dilute sulfuric acid) in RG batteries is absorbed in glass mat separators, and because each cell has a pressure relief valve that's designed to maintain a positive pressure in each cell, the hydrogen and oxygen gases produced during the charge and discharge cycles are quickly reabsorbed (recombined). The glass mats provide support for the individual plates, so more plates can be packed into the same-size box, and plates are more resistant to shock and vibration damage than the plates in flooded-cell batteries.

RG batteries cost more. For example, the Gill RG 7035-28 is a direct replacement for its 12-volt, 35-amp-hour G-35 flooded-cell battery, and costs approximately 20 percent more.

THE INTERNAL-RESISTANCE EQUATION

Since the flooded-cell batteries have a higher internal resistance to electron flow than the RG batteries, they're best suited for airplanes with low-output generator-based charging systems. Skip Koss of Concorde Battery said any airplane with a generator that's rated at less than 50 amps (generator output is stamped on the data plate) should use flooded-cell batteries to prevent heat-related damage to the generator due to too high a charging rate.

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Concorde RG24-10

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However, this plus quickly turns to a minus if an RG-type battery is exposed to high voltages (15 volts for 12-volt battery and 30 volts for a 24-volt battery) since an excessively high charging voltage generates excessive internal case pressures that may crack the battery case or even blow it apart.

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The C1 rate is equal to the rated capacity of the battery in amp-hours. This simply means that a 25-amp-hour battery is discharged at 25 amps and a 35-amp-hour battery at 35 amps.

CAPACITIES LESSEN WITH AGE

FAR 23.1353(h) requires that aircraft storage batteries "must be capable of providing at least 30 minutes (60 minutes for airplanes certified for operation above 25,000 feet) of electrical power to those loads that are essential to continued safe flight and landing." This is termed the "essential power requirement."

Bob Nuckolls, author of *The AeroElectric Connection: Information Service and Guide to Theory, Operation, Design, and Fabrication of Aircraft Electrical Systems*, said that a voltage reading across the terminals of a discharged battery will only be 10 percent or so less than the voltage reading of a fully charged battery, therefore static voltage readings are worthless in determining the health and capacity of a battery.

Capacity testing requires a fully charged battery be discharged at the C1 rate until the battery voltage drops to what's called the "end point voltage" (EPV), or "cut-off voltage," which is 10 volts (for 12-volt batteries) or 20 volts (for 24-volt batteries). The C1 rate is equal to the rated capacity of the battery in amp-hours. This simply means that a 25-amp-hour battery is discharged at 25 amps and a 35-amp-hour battery at 35 amps.

The Concorde Instructions for Continued Airworthiness (ICA) requires a capacity test once at 800 hours or around 11 months since new, whichever comes first, and then every 400 hours or around six months. During the test, the time it takes to go from fully charged to the EPV (at the C1 discharge rate) is noted. A fully charged 35-amp-hour battery should supply 35 amps for one hour. It's deemed to pass the essential power regulation if it can supply the 35 amps for 51 minutes (85 percent of 60 minutes) or more.

If the residual capacity falls below 85 percent of new battery capacity after the test, manufacturers require battery replacement.

Gill and Concorde manufacture and sell industrial-quality battery capacity testers that make battery maintenance tasks such as the residual capacity testing and battery charging easy on both flooded-cell and RG batteries. The Gill battery capacity tester/charger for 12- and 24-volt batteries retails for around $1,300. This is a little rich for many small maintenance facilities (and many owners), but there are options. Nuckolls published a parts list and schematic for a tester that compares the present capacity to the capacity of the battery when it was new.

Nuckolls also suggested a simple load test protocol that consists of using a voltmeter at the battery positive terminal when the battery is under load during an engine start. Grab the new battery reading when the fully charged battery is first installed and then compare that new battery voltage to the current battery voltage during the starting cycle at regular intervals.

Odyssey PowerSafe SBS-J16

MAINTENANCE

To extend the life of my RG battery I bought a small portable BatteryMINDer charger/maintainer/desulfator from VDC Electronics. It automatically charges the battery at a safe rate, adjusts the rate to compensate for ambient temperature changes, maintains a float rate to keep it charged, and has a pulse-type profile to address sulfation. I keep it connected to my battery through a simple plug I installed in the back wall of the airplane baggage compartment. I figure it's money well spent when I see the little green LED blinking because it means my battery is fully charged and being maintained at a float rate.

NEW BATTERIES

Gill and Concorde have been the go-to aircraft battery suppliers. Recently RG batteries by Odyssey PowerSafe have started to grab some market share.

Gill sells both flooded-cell and RG batteries. Concorde no longer sells flooded-cell batteries but has an RG battery for virtually every make and model of light airplane.

The Odyssey PowerSafe SBS-J16 battery is gaining popularity due to its smaller size and weight, ability to maintain a charge, short recharge times, and excellent cold cranking performance. This battery is FAA-PMA approved for installation in Piper PA-18 aircraft when installed in conjunction with an STC. STCs are for installation in some Piper PA-18 aircraft by Dan's Aircraft Repair in Anchorage and some Cessna 170s, most 172s, 180s, and 185s by F. Atlee Dodge Aircraft Services in Anchorage. Svenn's Aviation in Menomonie, Wisconsin, holds STCs to install the SBS-J16 in Piper PA-12, -14, -16, -18, -19, -20, and -22 airplanes.

The SBS-J16 weighs 15 pounds, about half the weight of other RG batteries, only measures 7 inches by 3 inches by 7 inches, is less expensive by around 25 percent, and is getting rave reviews due to those factors and a very slow discharge rate.

Take care of your battery, and it will take care of you. EAA

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