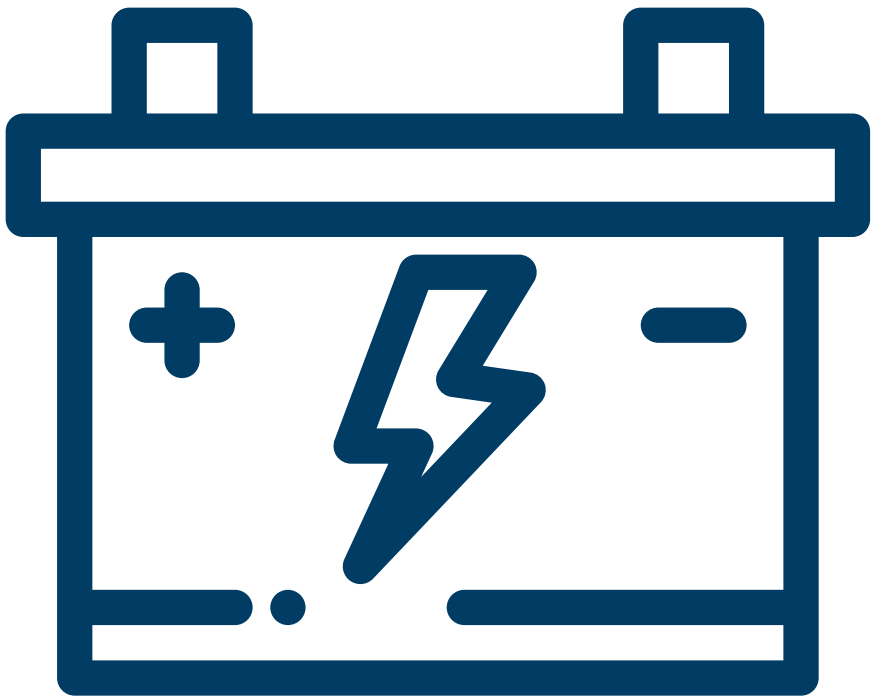
THE SHOCKING **TRUTH** ABOUT AIRCRAFT **BATTERIES**



Putting a little thought and time into the care of your battery can ensure years of performance and reliability.

By Dale Smith

The next time you're sitting around with a few of your flying buddies, and it's time to tally up the tab, challenge them to this little riddle with the bill in the balance: "What's the oldest non-combustion component under your airplane's cowling?"

The answer is the ship's battery.

The basic technology behind today's rechargeable lead-acid batteries was invented in 1859 by a French physician named Gaston Planté.

Yet, even with its 164-plus year run, your trusty battery's technology hasn't changed much since, for good or for bad. Yes, lithium technology is a hot topic, but we'll get more into that later. For now, let's stick with the battery you've got, and how you can get the most out of it.

We first need to cover exactly what your aircraft's battery does. While technology hasn't changed, its list of duties certainly has grown quite a bit.

"Pilots need two things from their batteries today. The first is sufficient starting power," explained Chris Holder, Concorde Battery Corporation's Eastern U.S. Sales Manager. "The second, and least understood, is that the aircraft's manufacturer has a minimum requirement for stored current that they need to power your essential instruments and systems should the alternator or generator fail.

"Depending on the aircraft, there can be anywhere from a few to a lot of things that you need to keep running to get you home safely," he continued. "For our batteries, we want 85% of battery capacity. That's about 51 minutes of available power at normal consumption. Of course, that's if you have a healthy, fully charged battery. If the battery is less than 100% healthy, that available power goes down."

While Concorde's recommendation is for 51 minutes of power, the requirements stated by your aircraft's manufacturer may be different. Another thing to consider is whether you've had your avionics upgraded recently—that can make a huge difference in the power needs of your panel.

Your aircraft's battery is arguably one of the most relied-on and least-understood components in your aircraft. All it takes is a little thought and care to ensure it provides the years of performance and reliability it was designed to deliver.

If you're still not quite sure, you can always refer to CFR (Code of Federal Regulations) Section 23.1353(h), which states, "In the event of a complete loss of the primary electrical power generating system, the battery must be capable of providing electrical power to those loads that are essential to continued safe flight and landing for at least 30 minutes for airplanes that are certificated with a maximum altitude of 25,000 feet or less."

Holder said that reserve energy is something most aircraft owners he talks to don't understand. They expect the battery to provide the power they need regardless of age or condition. Unfortunately, that may be a mistake you only make once.

Starting is just the beginning

Before we get too far afield, let's look at Holder's two points again—they're worth repeating. Having the required energy to crank your engine is pretty basic; you either have it, or you don't.

But just because the battery gives life to your Continental or Lycoming, don't make the mistake of believing the battery has enough stored power (his second point) if something goes wrong with the alternator or generator right after takeoff.

"A mistake many pilots make, especially in technically advanced aircraft, is to go to the airport on Friday afternoon, flip on the master switch, and spend an hour or so updating their avionics, charts, or whatever," he says. "They just don't realize that they ran the battery all that time without doing anything to replace the charge.

"Sure, the battery may start the engine, but it won't have any reserve power—at least not for a good while into the flight," Holder continued.

"It's an especially difficult problem if the airplane isn't flown regularly. You need to run the engine for at least an hour a week to achieve a battery capable of staying fully charged when not in use."

He also stressed that although an hour of flight time a week is ideal, most owners can't do that consistently. In

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those events, he recommends hooking your aircraft's battery up to a high-quality battery maintainer. Holder said that Concorde's recommendation is VDC Electronics' BatteryMINDer unit.

"We've recommended this unit for the past 12 years. Our team worked with VDC to develop that particular unit, and we feel it's still the best," Holder said. "The unit's voltage set points are perfectly aligned, allowing it to be left connected to the battery for extended periods (if need be) without overcharging it. That is the key point here.

"Over time, continually overcharging a lead-acid battery will dry out the AGM mats," he continued. "That will shorten the battery's life, rather than extend it."

Another need for a battery tender is to help mitigate temperature-related issues. For example, Holder said that all batteries self-discharge, even with no loads. And the higher the temperature, the faster this happens. How fast?

Well, a lead-acid battery will typically lose 25% of its available power every:

- 90 days when stored at 77 F.
- 45 days when stored at 95 F.
- 21 days when stored at 115 F.

And that's an estimate for a very healthy battery. The estimated peak available power gets much lower as the battery ages or if it's subject to any parasitic drain.

And while we're going to talk about lithium batteries later, we'll mention now that according to EarthX, their lithium-iron-phosphate batteries will typically lose about 1 to 2% of their available power in a month.

While all the above information can help you maximize your battery's life span, it's an excellent idea to start by knowing your battery's health at this particular time.

The unit's condition (how many times it's been charged/discharged), environment (indoors or outdoors, in the heat and/or cold), and the state of the alternator/generator as well as the various cables and connectors, along with other variables, will all play a role in how long your battery will reliably meet your needs.

You can't judge the unit's condition by looking at it or by its age. Batteries lead a hard life. Holder said the only way to know your battery's condition for sure is to have your A&P perform a battery capacity test.

"It's the only way to determine the airworthiness and the minimum of 51 minutes of capacity that we recommend," he said.

Parasitic load really sucks

Having all the latest avionics capabilities in your aircraft is a great way to fly smarter and safer. But all those fancy gizmos do come with a price—the increased chance for parasitic load.

And, while it's not typically an issue with newer airplanes, the chances for this kind of drain increase when the aircraft's avionics are modified and updated.

"A parasitic load occurs when a load on the battery exists even when everything is turned off inside the aircraft," Holder said. "It's one of the more common causes of premature battery failure.

"These loads are generally low amperage—typically under 50 milliamperes—but since they are continually present, they can deplete the battery's capacity if the aircraft is inactive for long periods," he continued.

But, according to Holder, you can

take steps to stop a parasitic load before it gets you. The first step is to determine if it's a problem that's occurring in your airplane.

The process is relatively simple. First, you'll need a multimeter capable of measuring current (amps and milliamps). Disconnect the aircraft's negative lead and connect your multimeter's negative lead to the negative terminal on the battery itself.

Then connect the multimeter's positive lead to the battery's positive terminal. Next, set your multimeter at its highest setting and then slowly adjust it to the lower settings.

"If you see the current start to show up on the multimeter, then you have a parasitic load. That's the easy part," Holder said. "The hard part is finding the cause. That can take a lot of time and effort. Until the cause can be determined, it's a good idea to disconnect the battery when you're not going to fly for a while.

"We recommend, however, that before you do that, you consult with your aircraft's manufacturer to make sure this is a safe process and will not harm any components in the airplane," he added. "In some cases, modifications may be available to help reduce the parasitic load."

Don't try this at home—or anywhere else

Earlier in the story, we highlighted the common situation where a pilot would use the aircraft's battery to update the avionics, etc., and then have battery issues the next time they flew. The accepted remedy for a "dead battery" is to use a ground power cart to "jump-start" the airplane.

In Holder's opinion, that can be a very bad idea.

"Except in the most extreme situations, you should never jump-start an aircraft battery," he said. "If there is not enough stored power to close the battery's relay when you go flying, and suddenly the alternator or generator fails with the relay open, the battery has not taken on any charge. There is nothing to power the critical instruments and systems.

"We tell people to resist the urge to do a ground power start if the battery is the

Top 11 tips to better aircraft battery health.

#1: Never jump-start your aircraft's battery. If it's dead, either remove and have it adequately charged or exchange it with a fully charged unit.

#2: Only use a ground power start in extreme situations. If you do, make sure to monitor your battery's charge rate during the flight.

#3: Monitor your battery's charge rate on every flight. Any exceedance of the OEM's guidelines will shorten the battery's life.

#4: If your engine doesn't catch in the first 10 seconds, stop cranking it. Stop and wait 30 seconds before trying again. Continual cranking causes overheating, and that's a battery killer.

#5: If you've used battery power to update your avionics, take time to have the battery fully recharged before you fly again.

#6: Speaking of charging, if you can't fly frequently, use an approved trickle charger. If you can't get on out to your airplane, remove the battery and hook the charger up in a hangar.

#7: Have your A&P perform a battery capacity test during the annual; it's the only way to determine the battery's airworthiness.

#8: It's also good to have your A&P test the system for parasitic loads. This is especially true if you've had any work done on your avionics or instruments.

#9: Visit your battery manufacturer's website for tips and notices about your specific battery model.

#10: Make sure your battery cables, leads, and connectors are in top condition and are free of corrosion.

#11: For heaven's sake, turn off the master switch when you shut the engine down. It's the most straightforward yet most often overlooked step in keeping an aircraft's battery healthy.

problem," Holder continued. "The best two options are to remove it and have it properly charged or to replace it with a new one."

Unraveling the lithium conundrum

OK, here's the portion of the story you've been waiting for: What's the deal with lithium batteries? Well, the technology has received much attention in the aviation press over the past few years—some of it good, and the rest was not.

"Lithium-ion is a top-level, generic description of a battery's chemistry, and there are dozens of different types in many applications today," explained Kathy Nicoson, Global Sales Director for EarthX. "Lithium batteries are the most widely used types in the world and are used in everything from pacemakers to cellphones to cars, and now as a starter battery for your 14- or 28-volt aircraft.

"There are many advantages to the Lithium-iron-phosphate (known as LFP or LiFePO4) technology that EarthX uses, including the fact that they do not freeze, boil over, or sulfate [a leading cause of early battery failure]," she said. "They're also typically up to 80% lighter, have a two- to three-times longer life span, and charge faster than a lead-acid battery."

The downside is that they are much more expensive and are less tolerant of abuses like leaving it in a discharged state for too long.

And, of course, they can suffer from thermal runaway (which can also happen to lead-acid batteries), which leads to numerous issues, including overheating followed by a lot of smoke.

The condition has led to some very bad press for lithium batteries in airplanes. (Point of fact here: most of the negative press about "lithium batteries" has been about lithium cobalt technology. Yes, the same technology used to power the cellphone in your pocket.)

The rundown on thermal runaway

By far, the industry's lack of understanding of thermal runaways has done the most to dampen the aviation market's excitement about lithium batteries. Nicoson stated that while anything's possible, EarthX has taken added precautions to minimize the conditions for which these events can occur.

"EarthX batteries are LFP chemistry, the most abuse-tolerant, and require a lot of energy to force them into thermal runaway," she explained. "The term thermal runaway can mean different things, and for an LFP battery, it does not mean a three-foot tall explosion of flames; it means it will produce a lot of smoke for about 10 minutes.

"To cause a thermal runaway with the EarthX ETX900-TSO battery, many things in your aircraft, as well as the pilot, would have failed," Nicoson said.

"First, your regulator would have to fail. Then, your overvoltage protection on your aircraft would have to fail. Then, the pilot would have to fail and not turn your charging system off (alternator off) as you see the voltage and amps climb and destroy all your electronics on your panel while popping fuses everywhere in the process."