# Mechanic Guide for EarthX batteries in GA Aircraft

# Why Switch to an EarthX Battery

- Powerful Cranking (No more fear of hot or cold starts)
- Significant weight savings (80% less than lead acid battery)
- Fuel savings with less weight
- Increased useful load
- 2-3X longer life span
- Does not freeze, boil over, or sulphate
- Engineered and Manufactured in the USA
- Smarter & Safe
  - BMS (battery management system)
  - No sulfuric acid, no hydrogen gas, no corroding, no toxicity, and no leaking
  - Environmentally friendly (nontoxic, nonhazardous)

# What you need to Install an EarthX Battery

- The corresponding TSO battery that fits the plane (ETX900-TSO for 12V or ETX680-24-TSO for 24V)
- STC kit for the corresponding aircraft
- You MUST get the STC kit for the first install

# How to know what Battery and Kit to Get

- Go to: WWW.EARTHXBATTERIES.COM
- "What battery fits my vehicle"
- Select make and model

# How do I know if I can install an EarthX Battery in a GA Aircraft?

- Go to: WWW.EARTHXBATTERIES.COM
- Look at the "List of Approved/Pending STCs"

# Where to Get Documentation for AML STC and Manuals

- Go to: WWW.EARTHXBATTERIES.COM
- On the products page of ETX900-TSO & ETX680-24-TSO, "documentation" tab

# How do you Install It?

- Installation instructions on Website: Resources > Manuals > Installation and Maintenance Manual

## Initial Installation

The initial installation of the EarthX battery requires the installation of battery vent tubing, and a Fault/Status LED in addition to the battery. See the Appendix for the aircraft specific initial installation process.

This article meets the minimum requirements of technical standard order (TSO) C179b. The article may be installed only according to 14 CFR part 43 on aircraft eligible IAW the Approved Model List for STC SA01005DE.

### Installation Limitations

Automatic over-voltage protection is required on the aircraft charging system. Do not install battery if the aircraft does NOT have over-voltage protection. See the Approved Model List (AML) STC document for all limitations.

## Maintenance Removal and Reinstallation

**Remove all metal objects from your person before handling the battery and use insulated tools for installation.**

**The power terminals are ALWAYS live. Do not short across the terminals. Use caution when handling the battery inside the aircraft around metallic structures.**

### Battery Removal

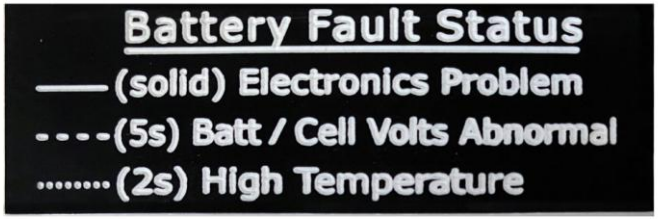
1. Access the battery compartment.
2. Disconnect the battery cables (remove the negative cable first).
3. Remove the tie down hardware, store for reuse.
4. Note the routing and placement of wires, cables, vent tube and foam insert (if installed). A typical battery box installation with a foam insert is shown below.

# What is Required?

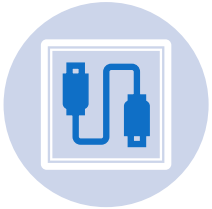
Battery mounting per EarthX installation instructions


Battery vent tubing installed

Battery fault/status indicating light (LED) installed & Placard



# Part 43.13 Rules Still Applicable



AC 43.13-1B guidance on storage batteries, wiring and tubing are still applicable.

Section 2 (11-19): battery maintenance, specifically, age, state of charge, mechanical integrity, inspection of vent lines and connections.

Section 2 (11-20, c.) battery venting.

Section 2 (11-22): installation practices to avoid inadvertent shorting, and properly securing the battery.

Section 3 (11-35): Monitoring the electrical load by warning lights and the use of placards.

# Instructions for Continued Airworthiness

# Maintenance

Annual Capacity Test

Annual Inspection of battery and venting


Annual Testing of LED (push to test)

Battery Charging as needed (use a battery charger approved by EarthX)

# Annual Capacity Test

- Fully charge the battery
- Turn on all electrical loads for flight operation and start a timer.
  - Measure and record the battery's discharge amps using a DC clamp-on current meter at the positive terminal of the battery.
  - Using the measured amps in the previous step and the battery's nameplate rated capacity (in Ah), calculate the time to discharge the battery 80%.

$$\text{Time to discharge 80\% (Hours)} = \frac{Rated\ Capacity\ in\ Ah * .8}{Measured\ Discharge\ Amps}$$

$$\text{For Example, Time to discharge 80\%} = \frac{16 * 0.8}{5} = 2.56 \text{ hours}$$

- Terminate the test after the number of hours calculated in the previous step (or in minutes (hours * 60)) has expired or if the battery is over-discharged (shuts off discharge current). If the battery is still supplying power at the termination of the test, then the battery's capacity is greater than 80% and passed the test.

# LiFePO4 Battery Charging – What type plug-in charger is best?

- A modern charger; one built in the last ten years
- One that shuts off automatically at end of charge
- A maintenance mode that automatically starts and stops based on need; not continuous like old “float chargers”.
- No “De-sulfate” or lead acid “recondition” or “pulse” charging features
- <u>If in doubt, use the charger recommended by EarthX (Optimate for LFP)</u>

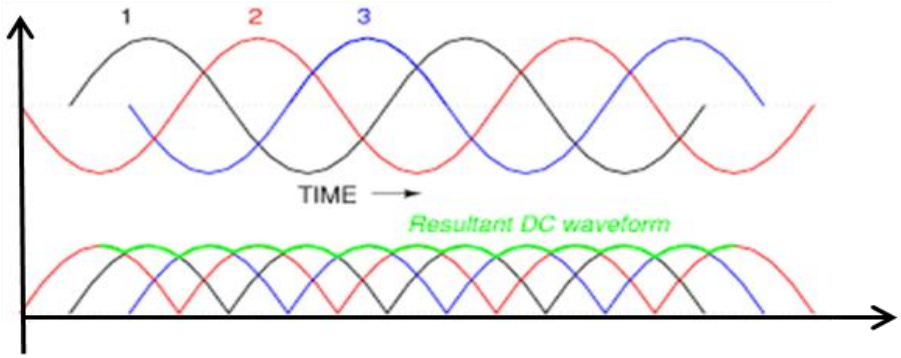
# When to Charge?

- If you fly every month, you do not need to leave it on a charger
- If it is going to sit for 6 months, disconnect the battery and top it off when ready to fly again.
- Does the aircraft use power when the master switch is off? If YES, leave it on an Optimate charger.

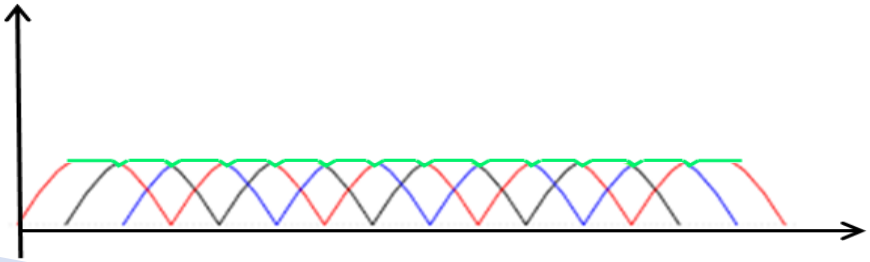
# Battery Charging from Aircraft

- Same charge voltage as lead acid battery
- Modern vehicle charging systems are rectified/regulated 3 phase AC (widespread use since the 1980s) --all belt driven alternators in use today are **acceptable.** (regulated voltage 13.8-14.5 volt).

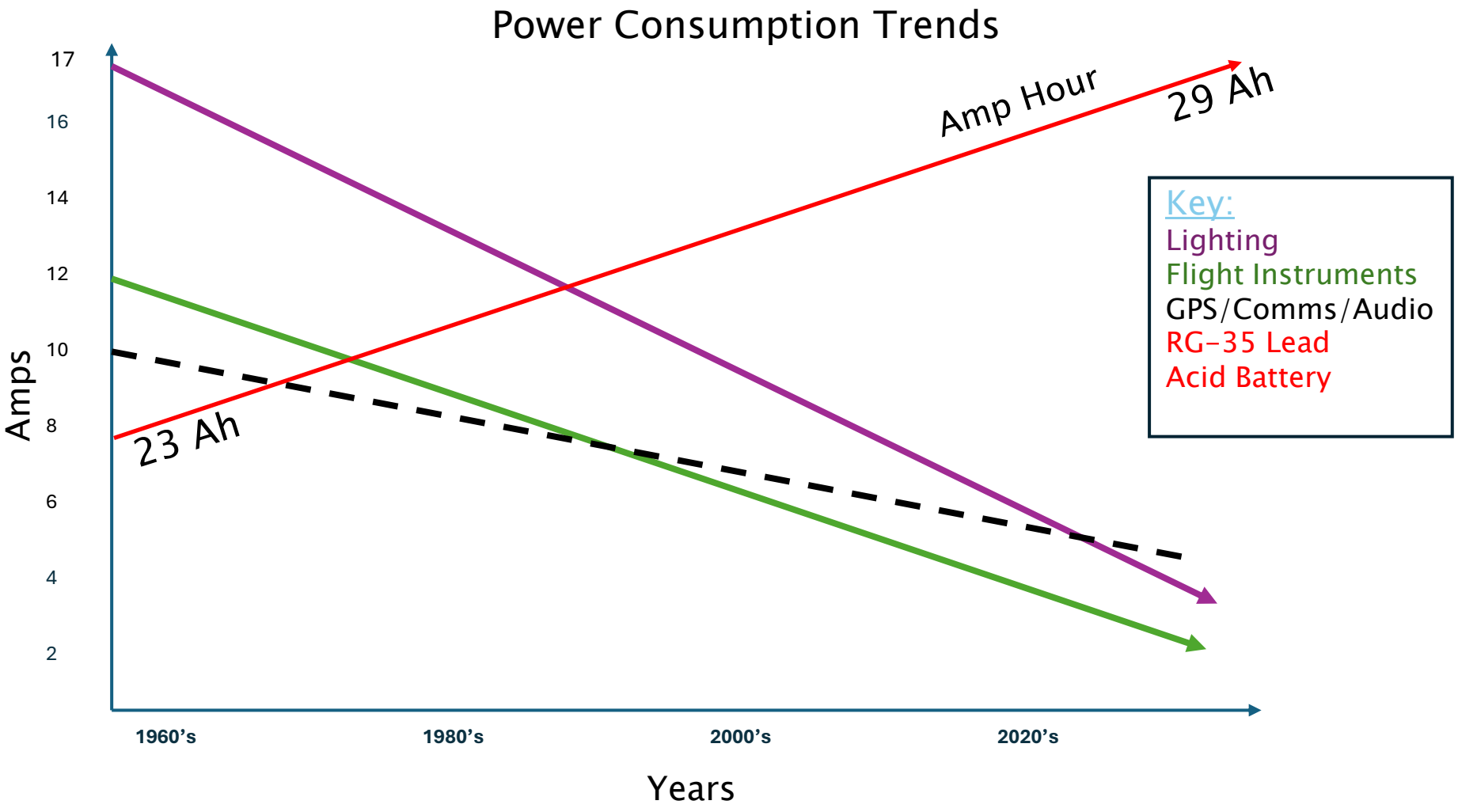
Rectified




Regulated



# Amp-hour needs over the years (why the smaller Ah)



# Battery Life

Lithium batteries have a longer lifespan than a lead acid (2,000 charge cycles vs 500 charge cycles), but like all batteries, life is dependent on many factors.

Age is a factor; EarthX has an average 6-year life

Depth of discharge (20% Depth of Discharge gives longer life than 80%)

Temperature (moderate temperature is better), and the hotter the environment, the shorter the life

Charge voltage (higher voltages shorten life, > 14.5V)

# How do I know when I'm at the end of the battery life?

Lithium batteries end of life warning signs are like lead acid batteries!

- A batteries cranking power decreases with age.
- The capacity (Ah) decreases with age. (End of life typically 80% of original capacity).
- EarthX batteries have fault monitoring to report cell to cell charge mismatch (an early indication of end of life).
- Battery will not hold a charge.

*If a battery will not hold a charge (week to week), it should be replaced regardless of chemistry*

# How to Dispose an EarthX Battery

A lithium battery should be fully discharged before disposal

Lithium batteries are classified by the federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream

These batteries, however, do contain recyclable materials and are accepted for recycling by the Rechargeable Battery Recycling Corporation's (RBRC) Battery Recycling Program

You can safely recycle your lithium battery for free. Just go to www.call2recycle.org to find a local drop off site near you.

# Safety

# Battery Management System

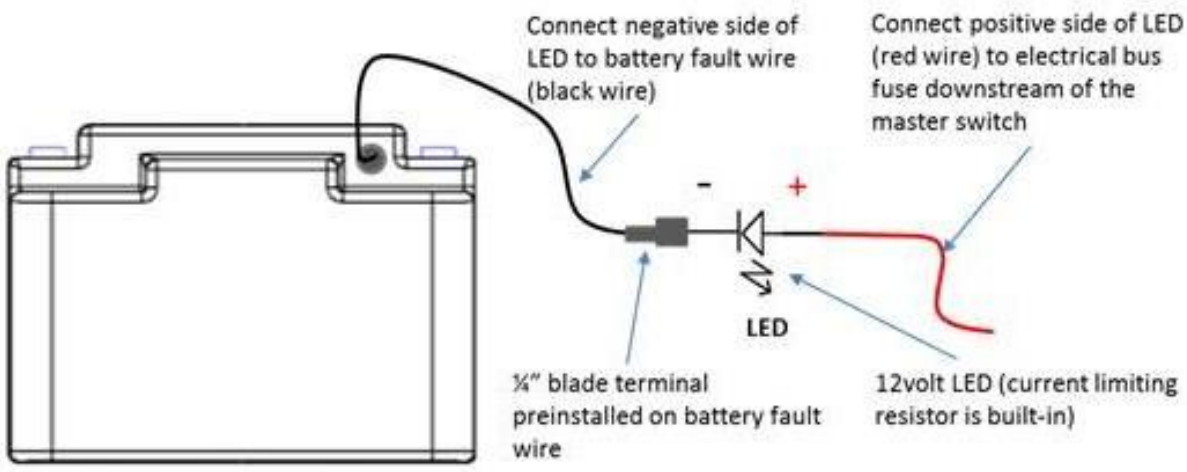
**The Battery Management System (BMS) keeps the battery cells within their safe operation range for optimal performance and longevity.**

- Over-discharge protection
- Over-charge protection (>16volt or >32 volt)
- Cell charge level balancing
- Excessive cranking protection (cell temperature protection)
- Short circuit protection (cell temperature protection)
- Remote Fault monitoring (from the cockpit)

# EarthX (BMS) Fault Monitoring

The Battery Management System (BMS) reports three basic fault conditions to the flight deck.

- BMS electronics failure (electronics self-diagnostics detected an issue).
- Cell to cell charge level mismatch (cell not charging up or not holding a charge).
- High battery temperature (exceeding operating limits and will shorten life span).



# Additional Aircraft System Protection

The EarthX LED remote fault indication **MUST** be installed.

Automatic over-voltage protection (crowbar) is required. This is an important safety feature to protect all the aircraft's expensive electrical systems from an over-voltage events.

An EFIS system, or amp meter or digital voltage meter to alert the pilot of an alternator failure.

# Battery Safety (Maximum Safe Temperature )

EarthX LiFePO4 Ceramic Separator Cell:
1hour at 347 °F, no venting, no thermal runaway

Other LiFePO4 Cell:
30minutes at 175 °C, vent and thermal runaway, no flame outside cell

# EarthX Lithium Battery Vs. Lead Acid

# Benefits of a Lithium Aircraft Battery

- **Temperature Range:** our lithium battery has a higher operating temperature than lead acid. 150°F (lithium) versus a 120 °F (lead acid)
- **Extremely light weight:** (up to 80% lighter)
  - *Increase useful load*
  - *Save fuel costs*
  - *Shorter take off roll*
- **Powerful cranking:** faster prop speeds during crank, better starts (hot and cold starts)
- **Compact size**
- **Low self-discharge rate:** can sit on shelf for 1 years
- **Long Life:** (6-year average) cycle life
- **Does NOT:** freeze, corrode, sulfate, or boil over

# RG-35A vs. ETX900-TSO


Weight: 29.5 lbs CCA-390 Ah-29
Lifespan: 3-4 years Price: $460


Weight: 5.4 lbs CCA-390 Ah-15.6
Lifespan 4-6 years Price $699

**LOSE 24.1 lbs instantly**

# RG-25 vs. ETX900-TSO

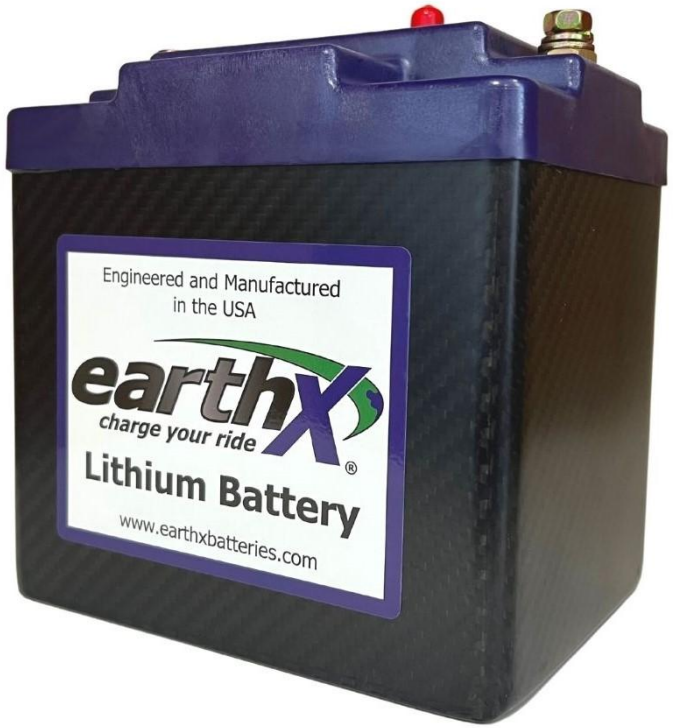

Weight: 22.75lbs CCA-225 Ah-22
Lifespan: 3-4 years Price: $375


Weight: 5.4 lbs CCA-390 Ah-15.6
Lifespan 4-6 years Price $699

## LOSE 17.35 lbs instantly

# RG24-11M vs. ETX680-24-TSO


Weight: 26.5lbs CCA-160 Ah-11
Lifespan: 3-4 years Price: $900




Weight: 7.2 lbs CCA-400 Ah-11.7
Lifespan 4-6 years Price $999

**LOSE 19.3 lbs instantly**

# EarthX TSO Batteries

**12 Volt**
ETX900-TSO


Weight: 5.4 lbs CCA-390 Ah-15.6
Lifespan 4-6 years Price $699

**24 Volt**
ETX680-24-TSO


Weight: 7.2 lbs CCA-400 Ah-11.7
Lifespan 4-6 years Price $999

# Battery Warranty

- ETX Series 2-year full coverage


EarthX, Inc. (Manufacturer) warrants its ETX-Series lithium batteries and the EarthX Jump Pack to be free of defects in material and workmanship for a period of two years. EarthX, Inc. warrants the ETZ-Series to be free of defects in material and workmanship for a period of 1 year. A dealership/OEM/retailer is not authorized to issue a replacement battery without prior authorization from EarthX, Inc.

The applicable Warranty period begins from the date of purchase with original receipt, or, if no receipt is available, from the manufacturing date on the battery. The warranty is non transferable and for the original purchaser. Batteries determined to meet the conditions of this warranty will be replaced free of charge **one time**. Batteries for warranty replacement are to be returned after receiving an RMA from EarthX. If the warranty has been voided or there is nothing wrong with the battery, you can choose to pay shipping to have it returned to you. EarthX's acceptance of any items shipped to EarthX for warranty replacement shall not be deemed an admission that the item(s) are defective. For international warranty returns, customer will pay the shipping expenses.

Before submitting a warranty, please read the FAQ section as most issues are easily remedied by reading this section.

If your battery is reading 0 volts or close to 0 volts, please got to: https://earthxbatteries.com/our-batteries/battery-charging. Note the ETZ-Series does not have over discharge protection so if this battery is zero volts, do not attempt to charge.

SUBMIT A CLAIM

# Last Remarks

- Use the proper charger
- Never use a lithium battery that will not charge up properly or hold a charge
- Jump starting a “healthy” battery is ok, but jump starting a faulty battery is a problem (with like size battery)
- A well-maintained charging system is important – alternator over-voltage protection is required
- EarthX aircraft batteries have fault monitoring – it needs to be installed.

# Contact Info

- Phone: 970 674-8884
- Email: techsupport@earthxbatteries.com or sales@earthxbatteries.com
- Website: www.earthxbatteries.com

earthX
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www.earthxbatteries.com