Flight Design general aviation GmbH
Am Flugplatz 3, D-99820 Hörselberg Hainich
Airfield Eisenach-Kindel
Web: www.flightdesign.com; Phone: +49 36920 7530-10
E-mail: airworthiness@flightdesign.com

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Service Bulletin

Battery Installation on CT Series Aircraft

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SB-ASTM-CT-04	**SB-LTUL-CT-05**	**SB-SECS-CT-04**

Repeating Symbols:

Please pay attention to the following symbols throughout this document emphasizing particular information.

- ▲ **Warning:** Identifies an instruction, which if not followed may cause serious injury or even death.
- ■ **Caution:** Denotes an instruction which if not followed, may severely damage the aircraft or could lead to suspension of warranty.
- ● **Note:** Information useful for better handling.

1. Planning Information

1.1. Affected Aircraft

Type:	CT
Model:	CT/CT2k/CTSW/CTLS/CT Supralight
Serial Number:	all
Applicable Countries:	not limited

1.2. Concurrent Documents

none

1.3. Reason

Instruction on correct battery selection and on charging wire.

1.4. Subject

1.4.1. Battery Type

The POH of some CT series aircraft does not contain information on installation of the battery type that may be installed. With lithium based batteries installed, some inspectors/certifying staff refused to sign off the yearly condition inspection.

1.4.2. Charging Wire

The CT series of aircraft features a hot wire from the battery to the lower cowling air outlet. It can be used for charging the battery and for jump-starting (although this is not recommended). In case the customer uses an unprotected clamp on their charger and the clamp is touching the cowling, an electrical short can develop that may lead to uncontrolled electric discharge, and possible damage to the composites. In extreme cases, this may result in a fire.

1.5. Compliance

Compliance must be shown no later than the next annual inspection of the aircraft.

The owner of the aircraft is encouraged to comply with this Service Bulletin as soon as possible.

▲**Warning:** Non-compliance with these instructions could result in further damages, personal injuries or death.

1.6. Approval

For Ultralight:

Not applicable

For ASTM self-declaration basis:

This SB is approved by the aircraft manufacturer i.a.w. ASTM F3198 for conduct on aircraft as defined in 1.1. Subsequent to complete and correct conduct of this SB the aircraft will still meet the requirements of the applicable ASTM design and performance specification.

1.7. Type of Maintenance

Line

1.8. Personnel Qualifications

For Ultralight:

National maintenance and inspection regulations as applicable for maintenance.

For ASTM self-declaration basis:

For US LSA aircraft: Repairman, Light Sport Aircraft-Maintenance (RLSA-M) – holds a repairman certificate (light sport aircraft) with a maintenance rating, A&P, IA or an FAA repair station.

1.9. Release to Service

Conduct of this SB must be logged in the aircraft log book with date and signature of the responsible Person according to national regulations.

1.10. Weight and Balance

The effect to empty aircraft weight and cg is significantly below 0.45 kg (1 lb). Therefore, in compliance with FAA publication AC 43.13-1B reweighing of the aircraft is not required due to this measure alone.

▲**Warning:** When this exemption has been used already for earlier maintenance events on the aircraft, or when other maintenance events are conducted in parallel and the weight changes of the individual events add up to more than 0.45 kg (1 lb), re-weighing of the aircraft is required for the sum of the effects.

1.11. References

Drawings:

none

Documents:

none

1.12. Superseded Documents

none

1.13. Contact Details

For further information on conduct of this SB, or to report any Safety of Flight or Service Difficulty issues contact your Distributor responsible for your country. Your Distributor can be located via the Flight Design general aviation website: www.flightdesign.com under “Dealer Location”.

In cases where the local distributor is not known or available contact Flight Design general aviation GmbH directly: customer.care@flightdesign.com

Specific contact in USA:

Airtime Aviation inc.
8505 S. Elwood Ave. B135
Tulsa, OK. 74132

Tel: +1 860 963 7272

Web: www.flightdesignUSA.com
E-Mail: airworthiness@flightdesignUSA.com

In cases where the local distributor is not known or available contact Flight Design general aviation GmbH directly: airworthiness@flightdesign.com

1.14. Disclaimer

This Service Bulletin has been generated with utmost care. Nevertheless errors and misunderstandings can never be fully excluded. In case of any doubts the applicant of this Service Bulletin is requested to contact Flight Design immediately to clarify the issue.

2. Resources

2.1. Workshop Conditions

No specific conditions

2.2. Parts

2.2.1. Battery Type

None, if the battery is in compliance. Otherwise a new battery is required.

2.2.2. Charging Wire

None in case of removal of the hot wire. Otherwise, an insulated connector, app. 2m (80in) wire rated for a charging current of the charger and an inline fuse, see section 3.2.

2.3. Materials

None

2.4. Tools

Standard tools.

2.5. Special Tools

None

2.6. Manpower

2.6.1. Battery Type

None, if the battery is in compliance. Otherwise appx. 1 hour.

2.6.2. Charging Wire

Appx. 30 min.

2.7. Costs

2.7.1. Battery Type

None, if the battery is in compliance. Costs for a new battery depends on type and brand.

2.7.2. Charging Wire

Depending on option selected as per section 3.2.

3. Instructions

3.1. Battery Type

Many different batteries (model, type, and capacity) and voltage regulators have been installed in the past. Today, new aircraft are equipped with LiFePO4 batteries. In the past, sealed lead batteries have been installed. Today, many owners retrofit their aircraft with a LiFePO4 battery in order to benefit from their lower weight and higher power output. However, not every kind of battery has shown to be suitable for installation on the CT aircraft.

Lead Batteries: A lead battery is still a suitable battery, today. Compared to all other battery types, they are the cheapest. The downside of a lead battery is the comparatively high weight, a slightly lower voltage, and higher internal resistance, leading to lower cranking amps. Of the four different types of lead batteries on the market, only three are suitable for installation on the CT series aircraft:

- wet cell battery: Also known as flooded battery. As the name expresses, this batt is wet, filled with acid. It is not suitable for installation on the CT series aircraft, as they may not installed in any position. The acid may flow out when placed upside down, which may also occur in negative g condition. Do not install wet cell lead batteries.
- VRLAB: Valve Regulated Lead Acid Battery. They are position independent. Usually, they do not emit any gas. Only in case of severe overcharging or in case of a single cell failure, hydrogen will develop and is blown out through the valve. This kind of lead battery may be installed.
- gel battery: In lead-gel batteries, the electrolyte is bound between the lead plates in gel form. As a result, they can store more electricity and deliver it for longer and is position independent. In addition, lead-gel batteries can be discharged more deeply than wet-acid batteries. This type of battery is available completely sealed or equipped with a safety valve. Use batteries with safety valves only. Do not used fully sealed gel batteries. In case of severe overcharge or a single cell failure the emerging hydrogen can be blown out rather than blowing up the battery uncontrolled.
- AGM battery: Absorbed-glass-mat batteries. This is the latest generation of lead batteries. In the AGM battery, the electrolyte is completely bound in a glass fiber fleece. The AGM battery is leak-proof and can also withstand inclined positions without any problems. Compared to gel batts, they can put out more power, which good for cranking. Just as gel batteries, this type of batt is usually completely sealed, but there are also versions with a safety valve. Use batteries with safety valves only. Do not used fully sealed gel batteries. In case of severe overcharge or a single cell failure the emerging hydrogen can be blown out rather than blowing up the battery uncontrolled.

Failure of the voltage regulator is not critical regarding safety with this lead batteries.

With the voltage regulator failing in a mode that it does not charge anymore, then this will just lead to draining the battery, leaving the aircraft ultimately without any electric power. In case the voltage regulator fails in a mode where it routes unregulated voltage directly into the electric system, then the electric components (such as avionics) may be damaged by overvoltage. The battery may also be damaged in such a case, but it will not smoke or catch fire by releasing excess energy. The small amount of hydrogen that might be emitted is not critical and vented over board through the lower cowling opening. Therefore, an overvoltage protection is recommended, though not mandatory.

▲ **Warning:** Do not install wet cell lead batteries.

■ **Caution:** Install VRLAB, gel, AGM batteries with safety valve only. Do not install fully sealed batteries!

● **Note:** VRLAB, gel, AGM batteries may be used without further limitations. Installation of an overvoltage protection is recommended, but not mandatory.

Li-Ion or LiPo:

Lithium batteries of this kind (Li-Ion or Li-Po) have an excellent power-to-weight ratio. Unfortunately, some failure modes may lead to thermal and/or mechanic instabilities. These batteries must only be charged with special chargers in a safe environment.

On high thermal or electric stress, Li-Ion and LiPo batteries tend to self-ignite. Mechanical damage, such as punctures, scrubbing through the plastic pouch, or bending the cells is extremely dangerous. In such a case, the cells will for sure impose a fire hazard. Such a fire is highly energetic and cannot be extinguished in flight. Huge amounts of toxic smoke and gas may be emitted. Li-Ion or Li-Po batteries are not suitable at all for installation on a Flight Design aircraft and may never be installed.

▲ **Warning:** Do not install Li-Ion or LiPo batteries.

Lithium-Iron-Phosphate

Lithium-Iron-Phosphate or Lithium-Ferrophosphate batteries (LiFePO4) exhibit a much less dangerous characteristic in case of a failure. However, in case of a failed voltage regulator or excessive overstress, even this kind of battery may emit toxic smoke or gas when not properly protected. As long as certain conditions and guidelines are followed during installation, this kind of battery is well suited as an aircraft battery:

- The battery must have an integrated battery management system in order to balance the single battery cells.
- The battery shall have an integrated overload protection.
- The battery shall have an integrated overcharge protection.
- A deep-discharge protection is recommended, though not mandatory.
- According to the battery manufacturer, the battery must comply with UN Manual of Test and Criteria, Part III, Subsection 38.3 (abbreviated: UNT38.3).
- Installation of an external overvoltage protection is highly recommended, but not mandatory.

When properly installed, LiFePO4 batteries offer a lot of advantages. They are significantly lighter, have a very low internal electric resistance, and a slightly higher voltage (about 1 Volt). That leads to higher cranking amps and easier engine starting, especially in the cold season of the year. The inevitable losses of the electric system are covered a bit, so that the entire system is more stable.

▲ **Warning:** Installation of LiFePO4 batteries that do not comply with the specifications above may lead to severe damage of the aircraft, may cause serious injury or even death.

■ **Caution:** Denotes an instruction which if not followed, may severely damage the aircraft or could lead to suspension of warranty.

NiCd or NiMH:

There is no experience with this type of battery. Such batteries have never been installed on Flight Design aircraft. This type of battery may not be installed.

▲ **Warning:** Do not install NiCd or NiMH batteries.

Voltage Regulator

All versions of the ROTAX 912 engine put out a non-stabilized DC voltage that is too high for the electric system of the aircraft, which is designed for 12…15V. A voltage regulator provides a constant DC voltage of about 14V, suitable for the aircraft electric system. This voltage allows operation of the system and, if excess power is available, charges the battery.

Voltage regulators have several failure modes.

1. high Ohm failure mode

   This is a non-critical failure mode. The voltage regulator does not put out power anymore and the battery is drained. The aircraft systems will slowly fail once this is the case. Follow applicable emergency procedures for generator failure provided in the pilot operating handbook.

2. low Ohm failure mode

   In such a case, the regulator will route the unregulated voltage of the generator directly into the electric system. Most of the aircraft systems and the avionics may be damaged in such a case as they are designed for 12…14V only. Some components are also designed for a 28V aircraft system and they may survive this failure. Nevertheless, in most cases even this kind of equipment may be damaged.

There are multiple reasons why a voltage regulator can fail. The most common reason is due to excessive temperature and/or electric load. Experience has shown that the standard ROTAX regulator (manufacturer: Ducati) on the carbureted 912 engines is comparatively low priced, but tends to fail early due to temperature and electric load.

LiFePO4 batteries have a low internal resistance. This allows high cranking amps and rapid re-charging in flight. However, these high charging currents may overstress the voltage regulator.

Overvoltage Protection:

It is now easy to understand that the electric system must sufficiently be protected from overvoltage. This is done by electric components called overvoltage protection. They are installed in the wiring between the voltage regulator and aircraft battery and will cut off the voltage regulator from the electrical system.

In case LiFePO4 batteries shall be used, the installation of an overvoltage protection is highly recommended, it is also beneficial in case lead batteries are used.

3.2. Charging Wire

Many CT aircraft have a wire installed that allows charging of the battery without removing the cowling. This wire runs from the battery to the lower side of the cowling and is attached with a bracket on the right side of the nose landing gear.

This wire is not fused, it is a hot wire.

Although it is not permitted in the aircraft manual, some customers have used this wire to jump-start the engine in case of a drained battery. This bears the danger of serious injury of getting struck by the propeller or getting otherwise injured by the exhaust.

▲ **Warning:** Never use this wire to jump-start the aircraft.

As the wire is properly attached, there is no possibility to touch the airframe and cause an electric short. However, in case an uninsulated clamp is used and this is contacting electrically conductive parts, such as the landing gear or the cowling (the carbon composite will conduct electricity), then an electric short occurs resulting in uncontrolled electric discharge. The size of that wire allows high currents that may exceed the capability of the wire and/or the battery, leading to thermal damage, battery damage or fire.

Flight Design herewith raises attention to this wire, providing the following advice:

General: Check the wire for correct installation, wear and tear. Is it properly attached? Is there any chance that its open end can contact any part of the aircraft? In doubt, repair the installation of the wire.

▲ **Warning:** Never allow the open end of the wire to touch any part of the aircraft.

Option 1: NEVER use an uninsulated clamp on this wire. Make absolutely sure that the clamp attached cannot touch any part of the aircraft.

▲ **Warning:** Never allow a clamp attached to the wire to touch any part of the aircraft.

Option 2: Remove the wire altogether and install an appropriately sized wire with a proper and insulated plug that matches your external charger. It is recommended to either fix it close to the battery, e.g. with tie-wraps. It is also acceptable to fix the connector on the lower opening of the cowling, on the bracket where the hot wire was installed previously. Make sure the connector is properly installed, i.e. not on its charging wire, but on its own housing. Use the gauge of wire defined by the manufacturer of the charger. In any case, install an inline fuse into the charging wire next to the battery in case sized for the charging current expected.

4. Selection of Suitable Batteries

General: The following list is not a complete list of suitable batteries, as the market is very dynamic. On release of this service bulletin the following batteries have been found suitable for installation. If you are changing the type of battery, pay attention to the dimensions of your battery bracket as installed. If other brackets are installed the new bracket must follow standard industry practice as judged by the mechanic performing the installation:

Lead Batteries:

- Hawker Powersafe SBS-8 or SBS-15
- Hawker Odyssey PC310 or PC545
- Hawker Genesis 12EP13
- other batteries as per specification from section 3.1.

LiFePO4 Batteries:

- EarthX EXT680C
- other batteries as per specification from section 3.1.