

Subject: Light Sport Aircraft – Electric Propulsion Powerplant

Requirements: CS-LSA amendment 1, dated 29 July 2013

Advisory Material: ASTM F2245-12d, ASTM F2840-11

Introductory Note:

The following Special Condition has been classified as an important Special Condition and as such shall be subject to public Consultation in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

“2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.”

Statement of issue:

CS-LSA Amendment 1 provides a set of requirements for the certification of an EPU (Electric Propulsion Unit) powerplant.

The requirements are recorded in the CS-LSA amendment 1, dated 29 July 2013, associated with two ASTM Standards documents:

- CS LSA Amendment 1 Subpart B requires that the installed EPU shall comply with the ASTM F2245-12d, Standard Specification for Design and Performance of a Light Sport Airplane
- CS LSA Amendment 1 Subpart H requires that the installed EPU shall comply with the ASTM F2840-11, Standard Practice for Design and Manufacture of Electric Propulsion Units for Light Sport Aircraft

Electric Propulsion for aircraft being still a novelty, the following points have been raised during recent certification process of LSA projects:

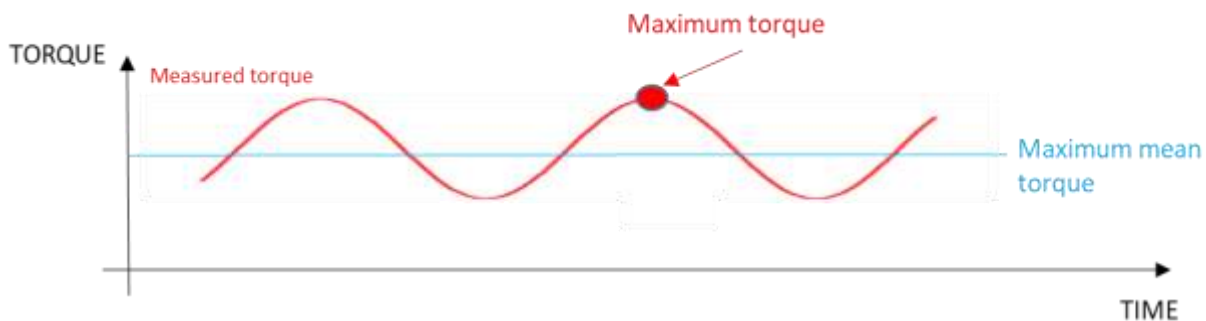
- some safety requirements are missing in these two standards,
- there is no clear guidance how these two ASTM standards shall be used,
- new set of requirements have been published by EASA for the lithium batteries in the frame of a Light Sport Aircraft certification (SC-LSA-F2840-01).

The aim of this special condition is to provide a full set of certification requirements in the frame of the certification of a LSA electric propulsion powerplant, starting from the ASTM standards F2245-12d and ASTM F2840-11.

EASA Position

The LSA electric propulsion powerplant shall comply with CS-LSA amendment 1 with the following clarifications:

- **ASTM F2245-12d chapter 5** with the following clarifications:
 - The requirement 5.2.9.3 shall be replaced with the following wording:
 - 5.2.9.3 For electrical engines with positive drive to the propeller, the limit torque to be accounted for in 5.2.9.1 and 5.2.9.2 is obtained by multiplying the mean torque by one of the following factors:
 - (1) 1.25 for engines for which torque oscillations as a function of time are shown to be negligible, i.e. in the same range as a turbine engine
 - (2) $x+0.25$ for engines for which torque oscillations as a function of time cannot be considered as negligible. X , expressing the amplitude of the torque oscillations around a mean value as shown below



$$x = \frac{\text{Maximum torque}}{\text{Maximum mean torque}}$$

- The following requirements shall be added
 - 5.2.9.4 A limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure (such as rotor jamming). For loads calculation, an engine deceleration time of 0,3s can be assumed unless it is demonstrated that this value is not appropriate for the intended application.
- **ASTM F2245-12d chapter 7** with the following clarifications:
 - The following requirements do not apply:
 - 7.3.3
 - 7.3.4
 - 7.3.5
 - 7.3.6
 - 7.3.7
 - 7.3.7.1

- 7.3.7.2
 - 7.3.9
 - 7.3.10
 - 7.4
 - 7.4.1
 - 7.4.2
 - 7.5
- The following requirements shall be read as follows:
- 7.1.3 Propeller-Engine-Airframe Interactions — In the absence of a more rigorous approach, powerplant installations must be shown to have satisfactory endurance in accordance with the requirements of 7.1.3.1 through 7.1.3.3 without failure, malfunction, excessive wear, or other anomalies.
 - 7.1.3.1 Complete 100 hours of flight operations for any approved propeller, engine, and engine mount combination. The testing must be completed on a single set of hardware, inclusive of engine, propeller, and engine mount.
 - 7.1.3.2 A modification to an existing installation that complies with 7.1.3.1 involving only a propeller or engine mount change shall complete 25 hours of flight operations. For the purposes of this requirement, propeller pitch changes to an otherwise approved installation are not considered to be a propeller change.
 - 7.1.3.3: Flight operations such as performance, controllability, manoeuvrability, structural flight testing or the flights required by 7.5.1.1 and 7.5.1.2 of ASTM F2840-11 may be counted toward the requirements of this section (and vice versa).
 - Note 8: Compliance with 7.1.3 is considered an acceptable demonstration that the engine, propeller, airframe interaction does not exhibit vibration or other operational anomalies.
- The requirement 7.3, 7.3.1, 7.3.2, 7.3.8 and 7.6 shall be replaced with the following wording:
- 7.3: Energy Storage System
 - 7.3.1: The energy storage system shall be constructed and arranged in such a way to safely ensure a flow of energy as required for the proper engine functioning under any normal operating conditions, including any manoeuvre for which certification is requested and during which the EPU is permitted to be in operation.
 - 7.3.2: The unusable energy quantity must be established by tests and shall not be less than the quantity at which the first evidence of engine malfunction occurs under each intended flight operation and manoeuvre.
- NOTE: In the case where the energy storage system in 7.3 is composed of one or several lithium batteries, lithium batteries shall comply with the requirements

defined in the EASA special condition SC-LSA-F2840-01, LSA Propulsion Lithium Batteries.

- 7.3.8: the electrical cables must be properly supported and protected from vibrations, wear and chafing.
 - 7.6 *Fire Prevention*—The engine, if enclosed and if there is the risk of a sustaining fire, must be isolated from the rest of the airplane by a firewall or shroud. It must be constructed as far as practical to prevent liquid, gas, or flames, or a combination thereof, from entering the airplane. The use of any one of the following materials shall be acceptable without further testing:
 - The following requirements shall be added
 - 7.7.1.3: If liquid cooling is a flammable fluid or if a leakage of liquid cooling can lead to fire, coolant lines located in an area subject to high heat (engine compartment) must be fire resistant or protected with a fire-resistant covering.
- **ASTM F2245-12d chapter 8.3** with the following clarifications:
- The following requirements do not apply:
 - 8.3.1:
 - The following requirement shall be added:
 - 6.8.1: the aircraft controls shall prevent inadvertent sudden engine operation when not expected by the pilot and in particular during the aircraft supply power-on.