

Proposed Equivalent Level of Safety to CS 23.1351 (c)(4) and CS 23.1351 (d)(1)

Electrical Generating System Indications

Introductory Note

The hereby presented Equivalent Level of Safety has been classified as an important Equivalent Level of Safety 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.), 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."

Background

The aircraft affected shall be equipped with a BRP Rotax 912 iSc Sport, Electronically controlled (ECU), and fuel injected spark ignition engine certified under CS-E (TC EASA.E.121). To function the engine requires an electrical source.

CS 23.1351 (c) (4) requires that there must be a means to give immediate warning to the flight crew of a failure of any generator/alternator.

CS 23.1351 (d) (1) requires a means must exist to indicate to appropriate flight-crew members the electric power system quantities essential for safe operation. (1) For normal, utility, and aerobatic category aeroplanes with direct current systems, an ammeter that can be switched into each generator feeder may be used and, if only one generator exists, the ammeter may be in the battery feeder.

The design proposed by the applicant does not includes an ammeter and does not provides an immediate warning in case of failure of generator B in Flight.

Proposed ELOS

The main safety feature of the proposed design is the addition of an external alternator on top of the two internal generators A and B. Further the capacity of the main battery was increased from 16Ah to 28Ah, exceeding the recommendation of the engine manufacturer by a factor of 1.75.

In case of a GEN A failure or the failure of the external alternator an immediate warning will be provided through the ECU controlled LANE A lamp respectively through the dedicated alternator warning lamp.

However in case of a failure of GEN B in flight, the GEN A will continue to provide electrical energy for the engine. The external alternator will provide sufficient energy to feed the aircraft consumers and to charge the battery. The GEN B failure will therefore not trigger the LANE B Lamp. The failure of GEN B will only be announced at the next engine test. e.g at start up. As such the failure will remain dormant maximum until the next flight.

If during the flight not only GEN B fails but also GEN A, the pilot will be informed trough the red LANE lamps. The AFMS forces the pilot to finish this flight. Until landing the engine and

the aircraft will receive electrical power from the external alternator (Battery Backup switch needs to be closed). Even if the external alternator would also quit, the 28Ah of the battery are capable to continue the flight only on battery for more than 30 minutes.

This is found to be equivalent safe than the requirement of 23.1351 (c) (4).

The requirement for an ammeter was established to indicate to the pilot, the electric power system quantities essential for safe operation of the aircraft. The essential systems required to fly this aircraft during day or night VFR are:

List: - Engine Ignition (ECU), EMU, EI. Fuel Pump, Nav Lights, Landing Light, NAV, COM and XPDR.

All the above consumers can be powered from either GEN A/B alone, or the external alternator alone, or the main battery alone (limited to more than 30 Minutes after EMU Alarm)

The proposed design is equivalent safe because the pilot will be informed as soon as the battery is not being charged anymore from one of the generators or the external alternator. The internal generator output voltage is 14.2 Vdc, the external alternator output voltage is 13.5Vdc. The alarm is triggered as soon as the A/C Voltage (not the ECU Bus Voltage) is below 12.7 Vdc. It will be shown that with the battery voltage of 12.7Vdc, flight can be continued for at least 30 min. Any load shed required will be specified in the AFMS.

The alarm is generated by the Stock EMU system. One must keep in mind, that in such a case (Battery discharge) all indications of GEN and ALT Warnings as described above, already informed the pilot of the critical situation.

This is found to be equivalent safe than the requirement of 23.1351 (d) (1)