

Proposed Equivalent Safety Finding on CS 23.1303(g)(3) at Amendment 3

Third Attitude Instrument Loss, Electronic Standby Instrument (ESIS) - Applicable to Pilatus PC-24

Introductory Note

The hereby presented Equivalent Safety Finding has been classified as an important Equivalent Safety Finding 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."

Statement of Issue

The PC-24 is a Part 23 commuter Jet with capacity for 10 or more passengers, capable of IFR operations and having a highly integrated glass avionic suite. Per CS 23.1303 (g)(3) Amdt 3, the aircraft must have a third attitude instrument that meets specific requirements.

The Electronic Standby Instrument System (ESIS) installed in the PC-24 is considered to be the third attitude indicator; however, it isn't fully in compliance with the regulation. The regulation requires a third attitude instrument to be operative after total failure of the electrical generating system. It was shown that the ESIS failed to be operative after losing the electrical generating systems. Pilatus's electrical system is designed to exclude the ESIS from being powered by the emergency power supply. And, the ESIS doesn't have a backup battery in it to remain operational after losing electrical power.

This Equivalent safety Finding (ESF) is based on the Certification Action Item that records the discussion on the loss of the ESIS instrument in case of dual generator failure.

The PC-24 architecture and the electrical system design don't have the designated third attitude instrument, ESIS, included as part of the essential load (i.e., avionics equipment) to be powered for continued safe flight and landing.

Due to past experiences with the complex avionics system, the PC-24 design raised the following concerns:

1. Not having an independent ESIS to rely on during critical flight phases when encountering blanking displays, which the APEX system exhibited on other previous installations.
2. Not able to mitigate unforeseen failure modes without independent ESIS when cockpit is equipped with highly complex, integrated system.

The following are the regulations that EASA identified the ESIS, a third attitude instrument, deemed non-compliant with:

CS23.1303(g)(3)(i): must have an independent power source.

*CS23.1303(g)(3)(ii): must continue its operation for 30 minutes after loss of all generated electrical power. *)*

CS23.1303(g)(3)(iv): must be operative without selection after loss of all generated electrical power.

Equivalent Safety Finding on CS 23.1303 (c) at Amendment 3

The PC-24 design includes three independent sources and displays of Attitude as required by 23.1303(g). These are the IRS/PPFD, AHRS/CPPFD and Electronic Standby Instrument, all three of these sources and displays operate independently.

In case of the PC-24, the ESIS does not have an internal battery. However, the PC-24 ESIS not having an internal battery does not undermine the intent of 23.1303(g)(3)(i) rule because safety equivalency to the rule is shown by having a different 3rd attitude system that is powered from an independent source.

In fact, the advancement of technology in Display systems, electronically regulated power generation systems, inertial reference systems and AHRS systems with MEMs gyros has made it possible for these systems to be powered from a battery source and meet the regulatory requirements for duration; in the case of the PC-24, a 60 minute duration as imposed by EASA through a special condition instead of the 30 minute duration in the 23.1303(g)(3)(ii) *).

The Pilatus PC-24 architecture does not power the ESIS in the event of a dual generator failure; Pilatus has chosen to power the pilot's primary sensors and displays from the battery for this failure event providing an equivalent level of safety to the requirement 23.1303(g)(3)(i). In regards to Display of Attitude, the Pilot PFD and Upper MFD are powered as well as MAU1a and the IRS. This combination of equipment constitutes an attitude system and is available without any pilot action after total failure of the power generating system and equivalent to the requirement of 23.1303(g)(3)(iv).

The ESIS is powered and available in all electrical failure cases with the exception of loss both generators.

In conclusion, Pilatus mitigates the risk of PC-24 ESIS not having an independent power source and has a superior level of safety to that required by FAR 23.1303(g)(3)(i), (g)(3)(ii) and (g)(3)(iv) for the 3rd attitude sensor.

The compensating factors for risk mitigation are described below:

- the continued use of the primary displays and sensors for a 60 minute duration after losing electrical generating power;
- the availability of the autopilot;
- PFI in the same format and location as in normal operation;

*) For information, EASA raised Special Condition SC-F23.1353-01 issue 2, to require 60 minutes of operation after the loss of all generated electrical power instead of the CS23.1303(g)(3)(ii) 30 minutes.

- Pilot does not have to re-orient to a new display format; eliminating delays in the pilot having to transition to a standby instrument
- The availability of the a second full PFD format on the upper MFD (PFD reversion) that can be used by the right seat pilot within their primary field of view;
- The design also has a higher availability and reliability rate compared to the stand-alone ESIS.
- Availability of FMS and Radio Navigation.
- These features greatly reduce pilot workload and fatigue.

In consideration of the “all-in-one” provision of the 3rd attitude function across the flight deck, getting now a certain agility between the ESIS and the PFDs, EASA can accept the equivalence safety proposal from Pilatus given that ESIS loss is an extremely rare occurrences (10^{-8}).