



Federal Aviation Administration

Memorandum

Date: October 24, 2011

To: Manager, Atlanta Aircraft Certification Office, ACE-115A

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Darby Mirocha, ACE-118A

Subject: INFORMATION: Equivalent Level of Safety (ELOS) for the Fuel Filter Indicator on Gulfstream Model GVI Series Aircraft (FAA Project Number TC8700AT-T)

Memo No.: TC8700AT-T- P-7

Reg. Ref.: §§ 21.21(b)(1), 25.997(d) and 25.1305(c)(6)

The purpose of this memorandum is to inform the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Gulfstream Model GVI series of aircraft.

Background

The Rolls-Royce engine installed on the Gulfstream GVI model aircraft incorporates a two-filter fuel system. A small-micron main fuel filter (LP fuel filter), with a bypass, is located between the fuel tank outlet and the inlet of the engine pump. Impending bypass of the LP filter is indicated on the airplane flight deck display system by an amber caution message and an audible chime. A large-micron secondary filter (HP fuel filter), located between the fuel flow meter and the combustor, has no bypass means, and no indication to the flight crew of excessive pressure drop across the filter stage. Therefore, the fuel filtration system does not directly comply with the provisions of Title 14, Code of Federal Regulations (14 CFR) 25.1305(c)(6).

Gulfstream has proposed to establish an ELOS with § 25.1305(c)(6) which requires the following is provided "An indicator for the fuel strainer or filter required by § 25.997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with § 25.997(d)."

Applicable regulation(s)

§§ 21.21(b)(1), 25.997(d) and 25.1305(c)(6)

Regulation(s) requiring an ELOS

§ 25.1305(c)(6)

Description of compensating design features or alternative standards which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The LP fuel filter is sized at 40 microns and fully complies with § 25.1305(c)(6) requirements. It is the primary source of protection from debris residing in the supply fuel system. The LP Fuel Filter removes debris from the fuel prior to the fuel entering the HP pump.

Each engine has two pressure transducers sensing the pressure differential across the LP fuel filter, which is used by the electronic engine controller (EEC) to indicate a fuel filter blockage or bypass valve operation. An advisory crew advisory system (CAS) message will be generated when the EEC has detected an impending fuel filter blockage. This message is designed to be displayed before a filter bypass occurs. In addition, an audio chime also accompanies the CAS message. The LP fuel filter has a bypass valve that, when opened, replaces the blue message with an amber cautionary CAS message and audible chime. The maintenance procedure associated with a blocked LP filter includes inspecting the HP filter.

In-service experience of the Rolls-Royce BR710 and Trent family engines, utilizing the same fuel filter design, confirm that the HP filter is not susceptible to blockage under normal engine operation. In addition, contaminated fuel testing will be carried out by Rolls-Royce as part of the engine certification to show compliance to CS-E 670, which states that *"it will be possible for the Engine to complete a period equal to at least half the maximum flight duration of the aeroplane in which it is likely to be installed, with the same contaminant level, from the point at which indication of impending filter blockage is first given"*.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

Although the design does not directly comply with the regulation, the addition of the secondary filter and the engine fuel filtration system features are considered to provide adequate compensation for the lack of indication of an HP fuel filter blockage. Relevant compensating features include: (1) indication of an impending bypass operation of the LP fuel filter prior to operation of the fuel filter bypass, (2) indication of a bypass operation of the LP fuel filter (3) blockage of the HP filter may occur due to engine fuel system contamination and lead, at worst, to a complete single engine thrust loss, but the same contamination without such a filter, but fully compliant with § 25.1305(c)(6), could result in an engine case burn-through, which may be considered to have more adverse consequences on the aircraft than a single engine thrust loss, (4) in-service experience with the same LP/HP filtration system shows that the HP filter is not susceptible to blockage under normal in-service operation, and (5) maintenance procedures include checking the HP filter when an impending blockage of the LP filter generates a CAS message.

Furthermore, the HP filter does not require a separate indication as the primary purpose is to provide a final protection for the fuel burners when the LP fuel filter is in bypass mode, which is already indicated to the flight crew by means of CAS messages.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned ELOS finding in project Issue Paper P-7. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The TAD has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS memorandum number should be listed in the type certificate data sheet under the certification basis section. An example of an appropriate statement is provided below.

Equivalent Safety Findings have been made for the following regulation(s):

§ 25.1305(c)(6), “Powerplant Instruments” (documented in TAD ELOS Memo TC8700AT-T-P-7).

Original Signed by

Victor Wicklund

November 7, 2011

Manager, Transport Airplane Directorate,
Aircraft Certification Service

Date

ELOS Originated by ACO:	Darby Mirocha, ACE-118A	
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