Proposed Deviation on Indication of gross fuel contamination

Applicable to Boeing 747-8 / -8F

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 02/04 dated 30 March 2004, 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

The mandatory EASA airworthiness standards for the B747-8/-8F are determined as being CS 25 Amendment 2 effective October 02, 2006, in accordance with Implementation Regulation Part 21 paragraph 21.101 and their related AMC and GM to Part 21.

The B747-8/-8F do not meet the requirements CS 25.1305(c)(6) and 25.1309(c) for indication of gross fuel contamination. Boeing has applied for a deviation to above mentioned CS 25 paragraphs with the argumentation as set up below.

Boeing 747-8 / -8F – Deviation E-21

- Indication of gross fuel contamination -

The FAA recently clarified what is required to show compliance to 14 CFR 25.1309(c) and 14 CFR 25.1305(c)(6) for indication of gross fuel contamination.
Given the advanced stage of the 747-8F and 747-8/GEnx-2B programs relative to gaining basic amended type design certification, Boeing has requested an FAA time-limited exemption to implement a robust, reliable design and verification of the subject alerting. Boeing agrees that severe fuel system contamination can lead to undesirable engine effects, such as loss of thrust. Likewise, Boeing is requesting EASA time-limited deviations to CS 25.1309(c) and CS 25.1305(c)(6) requirements.

The FAA has found the 747-8F and 747-8 /GEnx-2B design to be non-compliant to 14 CFR 25. 1309(c) and 14 CFR 25.1305(c)(6) for this issue. This FAA position is based on the lack of an unambiguous and timely annunciation to the flight crews of gross contamination of the airplane fuel supply. The engine fuel indication system does not currently directly address the basic problem of gross fuel system contamination indication.
Prior to the expiration of this FAA time-limited exemption, Boeing intends to comply with these requirements by providing a flight deck indication of gross fuel system

contamination using a sensor upstream of the main fuel filter. Additionally, Boeing will elevate the existing EICAS flight deck alert for a multiple-engine fuel filter impending bypass condition

The GEnx-2B engine fuel system design allows for the greatest possible tolerance to gross fuel contamination. Excessive fuel system component blockage of the GEnx-2B engine does not limit fuel flow to the engine due to multiple bypasses in the design.
The main fuel filter is sized for compliance to 14 CFR 33.67 and subsequently 14 CFR 25.997(d). The fuel strainer at the LP pump exit provides additional filtering capability for the system. The fuel strainer is sized to protect the heat exchangers and high pressure fuel pump gear stage from extreme / maintenance-induced contamination. The fuel strainer does not stop particles that are within the size range of expected contamination. This contamination is passed through the eductor pump and the heat exchangers to the filter. When the filter is exposed to contaminated fuel and debris accumulates to the point that it reaches impending blockage, an alert is provided to the flight deck via an advisory level message according to the requirements of CS 25.1305(c)(6).
The GEnx-2B fuel system indications provide flight crew warning information that an unsafe operating condition may exist via the main fuel filter advisory-level messages. This alerting scheme provides an adequate level of safety for the airplanes affected by this deviation. This is the same fuel filter alerting on all Boeing production airplanes.
The existing GEnx engine also incorporates a differential pressure sensor across the fuel strainer that under certain conditions provides EICAS Status messages and CMC messages for additional awareness beyond any previous GE powered airplane model.

Service history studies conducted showed that the fuel strainer / filter architecture used on GE90, GE90-115B, CF6-6, CF6-50, CF6-80A, CF6-80C2, and CF6-80E engines (similar architecture of the GEnx-2B engine) have had no known IFSD or power interruption events attributed to clogging of components upstream of the main fuel filter.
The proven service history of similar engine models, the maintenance actions defined to preclude the introduction of solid contamination into the fuel tanks and the existing flight deck messages and crew procedures from associated checklists provide an adequate level of safety for the airplanes affected by this deviation.

The requested EASA time-limited deviations will allow the Boeing Models 747-8F and 747-8 relief from the requirement of CS 25.1305(c)(6) and CS 25.1309(c) for an unambiguous and timely indication to the flight crew of gross fuel contamination.
The relief sought is limited to those 747-8F and 747-8 aircraft completed prior to the production incorporation of the compliant message. The production incorporation of the compliant message will be accomplished by 30 June 2014 delivery and all subsequent 747-8F and 747-8 airplanes. The Boeing Service Bulletin will recommend that all 747-8F and 747-8 airplanes delivered under this deviation be retrofitted by 31 December 2016.