



TERMS OF REFERENCE

Task Nr:	25.055
Issue:	1
Date:	1 October 2009
Regulatory reference:	CS-25 ¹
Reference documents:	Pre-RIA 25.055 dated 04 July 2006, CS-23 ² , CS-27 ³ , CS-29 ⁴ , Annex to Regulation (EC) 1702/2003 (Part-21) ⁵ , FAR Parts 23, 25, 27, 29 ⁶

1. Subject: Fuel System Low Level Indication/Fuel Exhaustion

2. Problem/Statement of issue and justification; reason for regulatory evolution (regulatory tasks):

2.1) Current regulatory frame

2.1.1) EASA regulations

CS-25 does not contain any specific provision for a low fuel level warning means on Large Aeroplanes.

Conversely, CS-23, CS-27 and CS-29 contain provisions for a low fuel level warning:

- CS-23 (Normal, Utility, Aerobatic, and Commuter Category Aeroplanes) requires for turbine engine-powered aeroplanes "A fuel low level warning means for any fuel tank that should not be depleted of fuel in normal operations" (refer to CS 23.1305(c)(4)).

¹ Decision No 2003/02/RM of the Executive Director of the Agency of 17 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for large aeroplanes (« CS-25 »). Decision as last amended by Decision 2009/010/R of the Executive Director of the European Aviation Safety Agency of 26 June 2009.

² Decision No 2003/14/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications, including airworthiness codes and acceptable means of compliance for normal, utility, aerobatic and commuter category aeroplanes (« CS-23 »). Decision as last amended by Decision 2009/001/R of the Executive Director of the European Aviation Safety Agency of 5 February 2009.

³ Decision No 2003/15/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications for small rotorcraft (« CS-27 »). Decision as last amended by Decision 2008/009/RM of the Executive Director of the European Aviation Safety Agency of 10 November 2008.

⁴ Decision No 2003/16/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications for large rotorcraft (« CS-29 »). Decision as last amended by Decision 2008/010/RM of the Executive Director of the European Aviation Safety Agency of 10 November 2008.

⁵ Commission Regulation (EC) 1702/2003 of 24 September 2003 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (OJ L 243, 27.9.2003, p. 6). Regulation as last amended by Regulation (EC) No 1057/2008 (OJ L 283, 28.10.2008, p. 30).

⁶ US Code of federal regulations, Title 14 Aeronautics and Space, Part 23 (Airworthiness standards: Normal, utility, acrobatic and commuter category airplanes), Part 25 (Airworthiness standards: Transport category airplanes), Part 27 (Airworthiness standards: Normal category rotorcraft), Part 29 (Airworthiness standards: Transport category rotorcraft).

- CS-27 (Small Rotorcraft) and CS-29 (Large Rotorcraft) require *"A low fuel warning device for each fuel tank which feeds an engine. This device must:*
 - *(1) Provide a warning to the flight crew when approximately 10 minutes of usable fuel remains in the tank; and*
 - *(2) Be independent of the normal fuel quantity indicating system".*

(Refer to CS 27.1305(l) and CS 29.1305(a)(4)).

The only CS-25 provision for fuel tank level monitoring is a fuel quantity indicator as provided in CS 25.1305(a)(2) and CS 25.1337(b):

"CS 25.1305 Powerplant instruments

The following are required powerplant instruments:

(a) For all aeroplanes

... (2) A fuel quantity indicator for each fuel tank."

"CS 25.1337 Powerplant instruments

(b) Fuel quantity indicator. There must be means to indicate to the flight-crew members, the quantity, in litres, (gallons), or equivalent units, of usable fuel in each tank during flight. In addition:

(1) Each fuel quantity indicator must be calibrated to read 'zero' during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under CS 25.959;

(2) Tanks with interconnected outlets and airspaces may be treated as one tank and need not have separate indicators; and

(3) Each exposed sight gauge, used as a fuel quantity indicator, must be protected against damage."

2.1.2) FAA regulations

The situation is identical in FAR Parts 23, 27 and 29 compared to CS-23, CS-27 and CS-29.

FAR Part 25 provisions are identical to CS-25 except that FAR Part 25 Appendix K contains the following fuel system alert provision only applicable to Extended Operations aeroplanes:

K25.1.4 (a)(3) *"An alert must be displayed to the flightcrew when the quantity of fuel available to the engines falls below the level required to fly to the destination. The alert must be given when there is enough fuel remaining to safely complete a diversion. This alert must account for abnormal fuel management or transfer between tanks, and possible loss of fuel. This paragraph does not apply to airplanes with a required flight engineer."*

Note: EASA will adopt a similar provision in the Type design approval chapter of the next revision of AMC 20-6 "Extended Range Operation with Two-Engine Aeroplanes ETOPS Certification and Operation" (refer to NPA 2008-01). The corresponding EASA ED Decision is planned to be issued by 2010/Q2.

2.2) Experience from in-service Large Aeroplanes

2.2.1) Despite the absence of provision for low fuel level warning in CS-25, many in-service Large Aeroplanes certificated against JAR-25, CS-25 or FAR Part-25 do have a low fuel level warning device installed; however, most of these devices are not independent from the normal fuel gauging system.

2.2.2) Various Large Aeroplane incidents and accidents occurred because of one or

several engine(s) flame-out which resulted from fuel starvation (either from fuel exhaustion or from improper fuel distribution in the fuel system).

The most recent and typical events include: the Tuninter ATR72 accident ditching off the coast of Capo Galo, Sicily on 6 August 2005; the Virgin Atlantic Airways Limited A340-600 incident in Amsterdam, Netherlands on 8 February 2005; the Aer Arann ATR42 serious incident near Dublin, Ireland on 8 August 2003; the TAM Fokker 100 accident in Birigui, Brazil on 30 August 2002; the Air Transat A330 accident in the Azores, Portugal on 24 August 2001; or the Air Canada B767 accident in Gimli, Canada on 23 July 1983.

Safety recommendations from accident investigation bodies indicate that there is a need to better inform flight crew of low fuel level conditions or fuel system discrepancies:

- SR 10 of 2005 from the Irish AAIU final report (ATR42 serious incident, Dublin, 8 August 2003): *"The European Air Safety Agency (EASA) should review the certification criteria for public transport aircraft low fuel contents warning systems, with a view to requiring such systems to be independent of the main contents gauging systems."*
- Safety recommendation ANSV-13/443-05/3/A/05 from the Italian ANSV final report (ATR72 accident, Sicily, 6 August 2005): *"European Aviation Safety Agency should consider the possibility to change the fuel system certification regulation for public transport aircraft, in order to require that the fuel low level warning be independent from the fuel gauging systems."*
- Safety recommendation AB/2004 from the Portuguese GPIAA final report (A330 accident, Azores, 24 August 2001): *"It is also recommended that the civil aviation authorities of other transport aircraft categories manufacturing States such as Canada, United States of America, and United Kingdom, as well as the European Aviation Safety Authority:*
 - *Review the adequacy of aircraft indications and warning systems and procedures to detect fuel-used/fuel-loss discrepancy situations;*
 - *Review the capability of these systems to provide clear indications as to the causes of these situations; and*
 - *Review the capability of these systems to provide alerts at a level commensurate with the criticality of a fuel-loss situation."*
- UK AAIB final report No: 4/2007 (A340-642 incident, Amsterdam, 8 February 2005):
 - *"Safety recommendation 2005-108: It is recommended that the European Aviation Safety Agency introduces into CS-25 the requirement for a low fuel warning system for each engine feed fuel tank; this low fuel warning system should be independent of the fuel control and quantity indication system(s)."*
 - *Safety recommendation 2005-109: It is recommended that the European Aviation Safety Agency should review all aircraft currently certified to EASA CS-25 and JAR-25 to ensure that if an engine fuel feed low warning system is installed, it is independent of the fuel control and quantity indication system(s)."*

2.2.3) Other events have been reported where substantial fuel leaks occurred without being identified by flight crews which managed the fuel imbalance situation, and finally made a diversion without isolating the fuel leak. For example, the B777 Trent800 experienced 6 such fuel leaks events between August 2002 and February 2009.

2.2.4) Investigations of these events revealed that the associated root causes can be various. The main identified ones, which mostly imply both technical and operational aspects, are:

- Fuel leaks which are not detected in time or incorrectly managed (flight crew focussing on management of the fuel imbalance instead of focussing on the fuel

leak),

- Increased fuel consumption in combination with incorrect fuel management,
- Fuel system failures, with improper failure recognition and accommodation,
- Incorrect fuel quantity management before departure (upload and distribution).

In addition, some contributing factors may include: lack of adequate fuel system information and warnings, including lack of fuel low level warning (which should not be affected by a failure or an error of the normal fuel gauging system); flight crews lack of confidence in the fuel system information and warnings, which may play a role in correcting an indicated low fuel level state.

2.3) EASA actions

2.3.1) In order to address new Large Aeroplane types (or Large Aeroplane types subject to major changes requiring certification to the last CS-25 amendment), the introduction of new provisions in CS-25 will be studied and proposed through this rulemaking task, taking into account above recommendations and investigations.

In the meantime before this CS-25 amendment, EASA is following the provision of paragraph 21A.16B of Part-21, which mentions that "*The Agency shall prescribe special detailed technical specifications, named special conditions, for a product, if the related airworthiness code does not contain adequate or appropriate safety standards for the product, because:*

...3. Experience from other similar products in service or products having similar design features has shown that unsafe conditions may develop."

Special Conditions have thus been raised on new Large Aeroplane projects.

2.3.2) For in-service Large Aeroplanes, EASA has initiated an action with TC holders and foreign aviation authorities to review in-service experiences concerning fuel exhaustion events, fuel system design and information available to flight crew, flight crew procedures related to fuel leaks or fuel low level; the results of this review will permit to assess if measures need to be taken for the corresponding fleet. These measures are not part of this rulemaking task and will be treated separately.

3. Objective:

Amend CS-25 by introducing new provisions and associated AMC addressing above recommendations in order to better protect Large Aeroplanes against fuel exhaustion/fuel low level scenarios.

Harmonisation with FAA and TCCA is also an objective of this rulemaking task.

4. Specific tasks and interface issues (Deliverables):

- 4.1) Analyse recommendations from incidents and accidents caused by fuel exhaustion/fuel low level.
- 4.2) Consider any lessons learnt from in-service aeroplanes design review.
- 4.2) Review the existing Special Conditions raised for new projects.
- 4.3) Based on 4.1, 4.2 and 4.3 analysis, prepare a revision of CS-25 applicable to any new Large Aeroplane types (or Large Aeroplane types subject to major changes requiring certification to the last CS-25 amendment). Several options may be proposed. This may include: requirements for reliable detection and indication of any inappropriate fuel loading or utilisation (e.g. automated weight and balance checks), leaking or trapped fuel, or any other fuel system condition where flight crew awareness is required to avoid fuel starvation for one or more engines; and appropriate indications whenever the fuel available for engine feed is below that

required to safely complete the flight with adequate fuel reserves.

4.4) Prepare a Notice of Proposed Amendment (NPA) to publish the CS-25 amendment proposals issued from 4.3, including a Regulatory Impact Assessment (RIA).

5. Working Methods (in addition to the applicable Agency procedures):

Group

6. Time scale, milestones:

NPA publication: 2011/Q1

Executive Director decision for CS-25 amendment: 2012/Q1