

Proposed Equivalent Safety Finding on FAR/CS 29.1555(c)(1) Usable Fuel Capacity Marking

Consultation Paper

1 Introductory Note

The hereby presented Equivalent Safety Finding (ESF) request shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004 as amended by EASA Management Board Decision No 12-2007 products certification procedure dated 11th September 2007, 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."

2 Deviation Request

Summary of Deviation

Statement of Issue

An Applicant has applied for approval of a Major Change concerning the installation of an auxiliary fuel tank inside the cabin of a rotorcraft.

FAR/CS 29.1555 (c) belongs to Subpart G – OPERATING LIMITATIONS AND INFORMATION subsection MARKINGS & PLACARDS – FAR/CS 29.1555 Control markings.

FAR/CS 29.1555(c) (1) states the following:

(c) Usable fuel capacity must be marked as follows:

(1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator.

Current design change is considered having no selector control and therefore FAR/CS 29.1555(c) (1) is applicable.

Background

The regulatory review shows that traces of this rule genesis starts from CAR 7. As an example with CAR 7 – PART 7 ROTORCRAFT AIRWORTHINESS; TRANSPORT CATEGORIES. CAR 7.737(b)(4) CONTROL MARKINGS –Power-plant fuel controls subparagraph (4) as amended to August 1, 1956 issue, the rule states:

(4) The capacity of each tank shall be indicated adjacent to or on the fuel tank selector control.

With FAR29 initial release FEB/01/1965, the wording slightly evolved with FAR 29.1555(c):

(c) The capacity of each tank must be marked on or near each selector controlling that tank.

Subsequently, and still not changed at time of writing, FAR 29.1555(c) wording was revisited with Amdt 29-12 in FEB/01/1977 - (Notice of Airworthiness Review Program No. 2; Notice No. 75-10; Issued on FEB/27/75) as is :

(c) Usable fuel capacity must be marked as follows:

(1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator.

(2) For fuel systems having selector controls, the usable fuel capacity available at each selector control position must be indicated near the selector control.

This rule wording is harmonized with CS-29 Amdt 3 – 11DEC2012 up to CS-29 Amdt Initial release - 14NOV2003. Limited research on JAR 29.1555(c) historic rule wording tends to indicate that wording used was based on FAR 29.1555(c) Amdt 29-12. The associated NPRAM No2 – Notice No 75-10 - Issued on FEB/27/75 provides the following FAA comment :

Explanation. The FAA believes that the proposed rule would provide for more relevant information than the present rule.

Ref. Proposal No. 968; Sec. 29.1555(c).

It shall be noted that FAR 23.1155(d) and FAR 27.1555(c) evolved similarly within the relative same timeframe of 1977-1978.

Interestingly, the FAR23.1155(d) rule, that was harmonized with CS 23.1555(d) / CS27.1555(c) / CS 29.1555(c), evolved with Amdt 23-62 Eff JAN/31/2012 by introducing a new subparag. FAR 23.1555(d)(3), that states:

(3) For fuel systems having a calibrated fuel quantity indication system complying with Sec. 23.1337(b)(1) and accurately displaying the actual quantity of usable fuel in each selectable tank, no fuel capacity placards outside of the fuel quantity indicator are required

A few ELOS have been released by FAA on FAR23 (prior to Amdt 23-62) and FAR29 products for similar issues.

Applicant's Proposal

The compensating factors proposed by the Applicant are the following:

On the concerned rotorcraft the actual usable fuel capacity for each tank, incl. the Aux. Fuel Tank, is shown both in digital value and graphically on the fuel quantity indicator on the VMD page of the Helionix avionics suite. This indication complies with FAR/CS29.1337(b).

Due to the capacitive measuring system, this indication is by itself mostly compensating the influence of temperature variation of the fuel. Hence, the indicated fuel quantity is more accurate than analogue volumetric measuring systems used on previous helicopters.

A placard stating the total fuel capacity of the Aux. Fuel Tank is located near the filler port of the Aux. Fuel Tank (see next page) and therefore visible during refuelling, where it is needed. The same applies for the Basic Fuel System, where the corresponding placard is also located near the filler port.

Explanation of Equivalent Level of Safety:

The actual usable fuel amount is essential for flight planning of the flight crew before and during flight. This information was in the past provided by an analogue indicator in combination with the placard for max. fuel capacity acc. to FAR/CS29.1555(c)(1).

The digital fuel quantity indication on the BK117 D-2 provides the actual usable fuel amount - which is also mostly compensated for fuel temperature variation - to the crew directly in digital values (kg, litres, ...) and in addition graphically.

The fuel quantity indication is calibrated to show the actual usable fuel amount within the accuracy as imposed in AC29.1337 to comply with FAR/CS29.1337(b). The indication reads "zero" in level flight when the unusable fuel amount as determined acc. to FAR/CS29.959 is reached to comply with FAR/CS29.1337(b)(1).

For ground crew information during refuelling there is a dedicated placard located directly near the filler port and stating the total fuel capacity of the tank/system.

AHD is of the opinion that the digital fuel quantity indication as currently done on BK117 D-2 (and EC135 and BK117 C-2) together with the placard at the filler port provides an equivalent level of safety to the requirement of FAR/CS29.1555(c)(1).

Applicants Safety Equivalency Demonstration

The applicant shall substantiate compliance to the compensating factors to justify an equivalent level of safety.

EASA Position

Based on the regulatory review, it is assumed that initial rule intend, where fuel quantity indication was performed by analogue fuel gauge dials, was to ensure that the total amount of usable fuel available can be determined by looking at the fuel quantity indicator, for instance, marked in fractional/percentage tank units (i.e EMPTY, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and FULL marks or % marks) and referenced to the maximum fuel tank capacity marked next/at the fuel quantity indicator. There were also product where analogue fuel gauge information, with limited accuracy / range imposed a marking/placard with usable total fuel capacity in order to be able to assess the actual fuel quantity by the analogue indicator.

The previously granted FAR23 / FAR29 ELOS despite placards or markings were either not present or present but not placed at the quantity indicator or present but not permanently displayed (numeric display) had in common use of numerical fuel system displays. The recent FAR23 rule evolution is relieving a fuel quantity system indicator giving an accurate and direct reading of actual usable fuel quantity from having the permanent/fix information of the usable fuel capacity.

EASA do recognize that, during flight, the usable fuel quantity awareness remains of higher importance than the usable fuel capacity (of a full fuel tank), unless this capacity is necessary to define the usable fuel quantity.

Therefore, the digital fuel quantity indication on the BK117 D-2 that provides the actual usable fuel amount accurately, i.e compensated for fuel temperature variation, allowing information presentation to the crew directly in digital values (kg, litres, ...) and graphically is an acceptable compensating factor.

The direct digital fuel quantity system compliance to CS 29.1337(b) and its compliance demonstration using AC 29.1337, that establishes criteria for gauging accuracy and "zero" calibration to the unusable fuel quantity, are deemed contributing to provide an accurate and readily fuel quantity information to the crew. Finally, the provision of fuel tank capacity labels at fuel tank fillers is providing the necessary information for refueling .

EASA is prepared to accept the proposal of the applicant subject however to the inputs from this public consultation which will be taken into consideration.