



Initial Airworthiness Deviations

Deviation – Flight Crew Alerting



Consultation Paper Deviation UK.DEV.F.0001 Issue 1

Proposed: Final

Deadline for comments: 24 January 2025

SUBJECT: Flight Crew alerting
REQUIREMENTS incl. Amdt.: CS 25.1322 at Amendment 21
ASSOCIATED IM/MoC: Yes / No
ADVISORY MATERIAL: AMC 25.1322

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Introductory Note

The UK CAA has received the following request for Deviation from applicable CS-25 requirements in accordance with the provisions of point 21.A.15 of Part-21 (Annex I to UK Regulation (EU) No 748/2012).

In accordance with the UK CAA Design and Certification procedures, such Deviation requests shall be assessed by the authority and be subject to a period of public consultation of not less than 2 weeks except if they have been previously agreed and published by the UK CAA.

Interested persons submitted their comments on this Deviation Proposal online via the Deviation UK.DEV.F.0001 Consultation. The consultation period closed on 24 January 2025.

The final decision shall be published by the UK CAA.

Acronyms and Abbreviations

AFM	Aircraft Flight Manual
ALT	Altitude
AP	Autopilot
ATT	Attitude
B/C	Back Course
CAA	Civil Aviation Authority
CAS	Crew Alerting System
CS	Certification Specification
DEV	Deviation
DME	Distance Measuring Equipment
EASA	European Union Aviation Safety Agency
EU	European Union
FD	Flight Director
FPV	Flight Path Vector
G/S	Glideslope
HDG	Heading
IAS	Indicated Airspeed
ILS	Instrument Landing System

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LNAV	Lateral Navigation
LOC	Localiser
PFD	Primary Flight Display
RA	Radio Altitude
Reg	Regulation
SVS	Synthetic Vision System
TC	Type Certificate
UK	United Kingdom of Great Britain and Northern Ireland
VNAV	Vertical Navigation
VS	Vertical Speed

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Identification of Issue

UK CAA received an application from Dassault Aviation for validation of the Falcon 6X Type Certificate. During the compliance finding activities, several scenarios have been identified to be not directly compliant with CS 25.1322 at Amdt. 21 (requirement and AMC unchanged since CS25 Amdt.11).

CS 25.1322 at Amdt 21 specifies the following:

- a) ...
- b) Alerts must conform to the following prioritisation hierarchy based on the urgency of flight crew awareness and response:
 - (1) Warning: For conditions that require immediate flight crew awareness and immediate flight crew response.
 - (2) Caution: For conditions that require immediate flight crew awareness and subsequent flight crew response.
 - (3) Advisory: For conditions that require flight crew awareness and may require subsequent flight crew response.
- c) Warning and Caution alerts must:
 - (2) provide timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications.
- d) ...
- e) Visual alert indications must:
 - (1) conform to the following colour convention:
 - (i) Red for Warning alert indications.
 - (ii) Amber or yellow for Caution alert indications.
 - (iii) Any colour except red or green for Advisory alert indications.
- f) ...

An alerting system that aids the flight crew in identifying non-normal operational or aeroplane system conditions and in responding in an appropriate and timely manner is an essential feature of every flight deck design.

The design proposed by the Applicant Dassault Aviation for the Falcon 6X is not fully compliant with the paragraphs mentioned above as it retains the Legacy Falcon cockpit philosophy where:

- “Red” colour is used for situations associated with loss of basic features such as attitude, airspeed, altitude, guidance cues and AP disconnection.
- “Amber” colour is used for situations associated with non-normal system conditions (including miscompare of source data).

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The tables here below report the identified non-compliances along with the details on the flight phases in which they are identified.

Table 1 details the scenarios linked to System Status Flags, whilst Table 2 is about Approach Flags.

ID	Flight Phase	Abnormal condition	Non-Compliance (description)	Non-Compliance (req. para)
1	Take-Off	Miscompare of IAS (indicated airspeed) ATT (attitude) FPV (Flight Path vector)	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Warning whereas the alert has been designed as a Caution. This misclassification results in a non-compliance to CS25.1322(b)(1). Warning situations require a red visual indication as imposed by CS25.1322(e)(1)(i). 	CS25.1322(b)(1) CS25.1322(e)(1)(i)
2	Climb Cruise Descent	Miscompare of IAS (indicated airspeed) ATT (attitude) FPV (Flight Path vector)	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Warning whereas the alert has been designed as a Caution. This misclassification results in a non-compliance to CS25.1322(b)(1). Warning situations require a red visual indication as imposed by CS25.1322(e)(1)(i). 	CS25.1322(b)(1) CS25.1322(e)(1)(i)
3	Approach Landing	Miscompare of IAS (indicated airspeed) ATT (attitude) FPV (Flight Path vector) HDG (Heading) ALT (Altitude)	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Warning whereas the alert has been designed as a Caution. This misclassification results in a non-compliance to CS25.1322(b)(1). Warning situations require a red visual indication as imposed by CS25.1322(e)(1)(i). 	CS25.1322(b)(1) CS25.1322(e)(1)(i)
4	Take-Off	Loss of RA (radio altitude) ALT (altitude) HDG (Heading) VS (vertical speed) LOC (Localizer)	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Caution whereas the alert has been designed as a Warning. This misclassification results in a non-compliance to CS25.1322(b)(2). Caution situations require an amber visual indication as imposed by CS25.1322(e)(1)(ii). 	CS25.1322(b)(2) CS25.1322(e)(1)(ii)

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ID	Flight Phase	Abnormal condition	Non-Compliance (description)	Non-Compliance (req. para)
5	Take-Off	Loss of LOC (Localizer)	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Advisory whereas the alert has been designed as a Warning. This misclassification results in a non-compliance to CS25.1322(b)(3). Advisory situations require a visual indication not red or green as imposed by CS25.1322(e)(1)(iii). 	CS25.1322(b)(3) CS25.1322(e)(1)(iii)
6	Climb Cruise Descent	Loss of IAS (indicated airspeed) RA (radio altitude) ALT (altitude) HDG (Heading) VS (vertical speed)	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Caution whereas the alert has been designed as a Warning. This misclassification results in a non-compliance to CS25.1322(b)(2). Caution situations require an amber visual indication as imposed by CS25.1322(e)(1)(ii). 	CS25.1322(b)(2) CS25.1322(e)(1)(ii)
7	Approach Landing	Loss of RA (radio altitude) VS (vertical speed)	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Caution whereas the alert has been designed as a Warning. This misclassification results in a non-compliance to CS25.1322(b)(2). Caution situations require an amber visual indication as imposed by CS25.1322(e)(1)(ii). 	CS25.1322(b)(2) CS25.1322 (e)(1)(ii)

Table 1 – System Status Flags: Cases and Non-Compliances

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ID	Flight Phase	Abnormal condition	Non-Compliance (description)	Non-Compliance (req. para)
8	Non precision approaches: LOC B/C (Back Course) LOC/DME	Loss of ILS beam ¹ while flying the approach manually using FD or raw data. Red flag LOC displayed.	For this scenario the design is not compliant since there is a lack of attention getting through a second sense (only the visual cue is available).	CS25.1322(c)(2)
9	Precision approach: ILS CAT1	Loss of ILS beam ¹ while flying the approach manually using FD or raw data. Red flag LOC and G/S displayed.		
10	Non precision Approaches: LNAV LNAV/VNAV	Loss of a required system for approach Amber CAS Message displayed.	For this scenario the design is not compliant since: <ul style="list-style-type: none"> The applicant has declared this alert as a Warning whereas the alert has been designed as a Caution. This misclassification results in a non-compliance to CS25.1322(b)(1). Warning situations require a red visual indication as imposed by CS25.1322(e)(1)(i). 	CS25.1322(b)(1) CS25.1322(e)(1)(i)

Table 2 – Approach Flags: Cases and Non-Compliances

¹ The loss of ILS beam is not due to an airborne system failure.

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In order to address the above non-compliance cases, the applicant will develop, certify, and ensure full application of the necessary design changes to make all aeroplanes fully compliant with CS 25.1322 (Amdt 21) after the issuance of the UK CAA Type Certificate. For this reason, the applicant has requested a Deviation as explained in this paper.

The applicant has proposed that, per point 21.B.80(a)3(i) of Part 21, the following mitigating factors:

- addition of dedicated AFM memory items, notes, and tables to ensure adequate knowledge of the situation and a correct crew decision making procedures,
- addition of dedicated procedure and weather minima limitations to ensure adequate awareness due to lack of aural alert,

as detailed in appendix A to this paper, provide alternative means to ensure compliance with the applicable essential requirements for airworthiness (as defined in appendix A) laid down in Annex II of the Assimilated Regulation (EU) 2018/1139.

Considering all the above, the Deviation in appendix A is proposed, which is agreed by UK CAA.

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Appendix A - Deviation UK.DEV.F.0001

Flight Crew Alerting

1. APPLICABILITY

CS-25 large aeroplanes

1.1 AFFECTED CS

The following paragraphs of CS-25 are affected to which compliance cannot be demonstrated for the alerts and messages as detailed below:

- CS 25.1322 “Flight Crew Alerting”
 - a) ...
 - b) Alerts must conform to the following prioritisation hierarchy based on the urgency of flight crew awareness and response:
 - (1) Warning: For conditions that require immediate flight crew awareness and immediate flight crew response.
 - (2) Caution: For conditions that require immediate flight crew awareness and subsequent flight crew response.
 - (3) Advisory: For conditions that require flight crew awareness and may require subsequent flight crew response.
 - c) Warning and Caution alerts must:
 - (2) provide timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications.
 - d) ...
 - e) Visual alert indications must:
 - (1) conform to the following colour convention:
 - (i) Red for Warning alert indications.
 - (ii) Amber or yellow for Caution alert indications.
 - (iii) Any colour except red or green for Advisory alert indications.
 - f) ...

1.2 Pre-Conditions for Application of the Deviation

Exceptional deviation with a limited number of CS 25.1322 non-compliances that can be well covered by adequate mitigations. Full CS 25.1322 Amdt. 20 or higher Amdt. compliance required with the next change to Type Certificate affecting alerting functions.

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2. APPLICABLE ESSENTIAL REQUIREMENTS FOR AIRWORTHINESS OF REGULATION (EU) 2018/1139 (Annex II)

The following paragraphs of the “Essential Requirements for Airworthiness” as defined in Annex II of Assimilated Regulation (EU) 2018/1139 are affected by the actual design:

Paragraph 1.3.4:

“Information needed for the safe conduct of the flight and information concerning unsafe conditions must be provided to the crew or maintenance personnel, as appropriate, in a clear, consistent and unambiguous manner. Systems, equipment and controls, including signs and announcements must be designed and located to minimise errors which could contribute to the creation of hazards.”

and

paragraph 2.3(c):

“Crew compartments, as appropriate to the type of operations, must be arranged in order to facilitate flight operations, including means providing situational awareness, and management of any expected situation and emergencies. The environment of crew compartments must not jeopardise the crew’s ability to perform their tasks and its design must be such as to avoid interference during operation and misuse of the controls.”

3. MITIGATING FACTORS

The following mitigating factors have been identified as alternative means to ensure compliance with the above identified essential requirements.

Table 3 details the mitigating factors for the non-compliances described in Table 1 (System Status Flags), whilst Table 4 details the mitigating factors for the non-compliances described in Table 2 (Approach Flags).

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ID	Flight Phase	Abnormal condition	Mitigation
1	Take-Off	Miscompare of IAS (indicated airspeed) ATT (attitude) FPV (Flight Path vector)	Addition of an AFM memory item for the identified Warnings linked to primary flight parameters, requesting the flight crew to immediately revert to the Electronic Stand-by Instrument
2	Climb Cruise Descent	Miscompare of IAS (indicated airspeed) ATT (attitude) FPV (Flight Path vector)	Addition of an AFM memory item for the identified Warnings linked to primary flight parameters, requesting the flight crew to immediately revert to the Electronic Stand-by Instrument
3	Approach Landing	Miscompare of IAS (indicated airspeed) ATT (attitude) FPV (Flight Path vector) HDG (Heading) ALT (Altitude)	Addition of an AFM memory item for the identified Warnings linked to primary flight parameters, requesting the flight crew to immediately revert to the Electronic Stand-by Instrument
4	Take-Off	Loss of RA (radioaltitude) ALT (altitude) HDG (Heading) VS (vertical speed) LOC (Localizer)	Addition in the AFM of the necessary crew instructions and information (e.g. memory item)
5			
6	Climb Cruise Descent	Loss of IAS (indicated airspeed) RA (radioaltitude) ALT (altitude) HDG (Heading) VS (vertical speed)	Addition in the AFM of the necessary crew instructions and information (e.g. memory item)
7	Approach Landing	Loss of RA (radioaltitude) VS (vertical speed)	Addition in the AFM of the necessary crew instructions and information (e.g. memory item)

Table 3 - System Status Flags: Cases and Mitigations

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ID	Flight Phase	Abnormal condition	Mitigation
8	Non precision approaches: LOC B/C (Back Course) LOC/DME	Loss of ILS beam ² while flying the approach manually using FD or raw data. Red flag LOC displayed.	Addition of dedicated mention in the AFM to detail the flight deck effect (removal of Flight Director / Raw data) which may stop the procedure. and
9	Precision approach: ILS CAT1	Loss of ILS beam ² while flying the approach manually using FD or raw data. Red flag LOC and G/S displayed.	Removal of the SVS (including the synthetic runway) on PFD to emphasize the visual cues indicating the loss of ILS data in case of manual CAT1 approach (or manual LOC, B/C or LOC/DME)
10	Non precision Approaches: LNAV LNAV/VNAV	Loss of a required system for approach. Amber CAS Message displayed.	Addition of dedicated mention in the AFM to detail the flight deck effect (amber CAS message) which may stop the procedure. This AFM mention will remind the current design specificities on the need for immediate actions with the goal to enhance the flight crew decision making.

Table 4 - Approach Flags: Cases

² The loss of ILS beam is not due to an airborne system failure.