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Content:

Special Conditions (SC)

B-01 (SC): Human Factors Assessment	
APPLICABILITY:	High Incidence Protection System (icing and non icing conditions)
REQUIREMENTS:	CS 25.21, 25.103, 25.105, 25.107, 25.121, 25.123, 25.125, 25.143, 25.145, 25.201, 25.203, 25.207, 25.1309, 25.1323
ADVISORY MATERIAL:	AMC 25.21(g)

SPECIAL CONDITION (SC)
Part I

Stall Protection and Scheduled Operating Speeds

0 – Foreword

In the following paragraphs, “In icing conditions” means with the ice accretions (relative to the relevant flight phase) as defined in CS 25 amendment 11 appendix C.

1 - Definitions

This Special Condition addresses novel features of the Falcon 5X and uses terminology that does not appear in CS 25.

The following definitions shall apply:

- High incidence protection system:

  A system that operates directly and automatically on the aeroplane's flying controls to limit the maximum angle of attack that can be attained to a value below that at which an aerodynamic stall would occur.

- Alpha-limit : The maximum angle of attack at which the aeroplane stabilises with the high incidence protection system operating and the longitudinal control held on its aft stop.

- Alpha-floor system : Not applicable

- Vmin : The minimum steady flight speed in the aeroplane configuration under consideration with the high incidence protection system operating. See paragraph 3 of this Special Condition.

- Vmin1g : Vmin corrected to 1g conditions. See section 3 of this Special Condition. It is the minimum calibrated airspeed at which the aeroplane can develop a lift force normal to the flight path and equal to its weight when at an angle of attack not greater than that determined for Vmin.

2 - Capability and Reliability of the High Incidence Protection System

Those paragraphs of CS 25 quoted in reference may be amended in accordance with this Special Condition provided that acceptable capability and reliability of the high incidence protection system can be established by flight test, simulation, and analysis as appropriate. The capability and reliability required are as follows:

(a) It shall not be possible during pilot induced manoeuvres to encounter a stall and handling characteristics shall be acceptable, as required by section 5 of this Special Condition.

(b) The aeroplane shall be protected against stalling due to the effects of wind-shears and gusts at low speeds as required by section 6 of this Special Condition.

(c) The ability of the high incidence protection system to accommodate any reduction in stalling incidence must be verified in icing conditions.

(d) The high incidence protection system must be provided in each abnormal configuration of the high lift devices that is likely to be used in flight following system failures

(e) The reliability of the system and the effects of failures must be acceptable in accordance with CS 25.1309.

3 - Minimum Steady Flight Speed and Reference Stall Speed

Delete existing CS 25.103 and replace as follows :

(a) The minimum steady flight speed, Vmin, is the final stabilised calibrated airspeed obtained when the aeroplane is decelerated until the longitudinal control is on its stop in such a way that the entry rate does not exceed 1 knot per second. (See Guidance Material Part I, paragraph 3)

(b) The minimum steady flight speed, Vmin, must be determined in icing and non icing conditions with:

(1) The high incidence protection system operating normally;

(2) Idle thrust;

(3) All combinations of flaps setting and, landing gear position for which Vmin is required to be determined;

(4) The weight used when V_{SR} is being used as a factor to determine compliance with a required performance standard;

(5) The most unfavourable centre of gravity allowable; and

(6) The aeroplane trimmed for straight flight at a speed achievable by the automatic trim system.

(c) The one-g minimum steady flight speed, Vmin1g, is the minimum calibrated airspeed at which the aeroplane can develop a lift force (normal to the flight path) equal to its weight, whiles at an angle of attack not greater than that at which the minimum steady flight speed of sub-paragraph (a) was determined. It must be determined in icing and non icing conditions.

(d) The reference stall speed, V_{SR}, is a calibrated airspeed defined by the applicant. V_{SR} may not be less than a 1-g stall speed. V_{SR} must be determined in non icing conditions and expressed as:

$$V_{SR} \geq \frac{V_{CL_{MAX}}}{\sqrt{n_{zw}}}$$

Where

$V_{C_{L_{MAX}}}$ = Calibrated airspeed obtained when the load factor-corrected lift coefficient ($\frac{n_{zw}W}{qS}$) is first a maximum during the manoeuvre prescribed in sub-paragraph (e)(7) of this paragraph;

n_{ZW} = Load factor normal to the flight path at $V_{C_{L_{MAX}}}$

W = Airplane gross weight;

S = Aerodynamic reference wing area; and

q = Dynamic pressure.

(e) V_{CLMAX} is determined in non icing conditions with:

(1) Engines idling, or, if that resultant thrust causes an appreciable decrease in stall speed, not more than zero thrust at the stall speed;

(2) The aeroplane in other respects (such as flaps and landing gear) in the condition existing in the test or performance standard in which V_{SR} is being used;

(3) The weight used when V_{SR} is being used as a factor to determine compliance with a required performance standard;

(4) The centre of gravity position that results in the highest value of reference stall speed;

(5) The aeroplane trimmed for straight flight at a speed achievable by the automatic trim system, but not less than 1.13 V_{SR} and not greater than 1.3 V_{SR};

(6) Not applicable

(7) The high incidence protection system adjusted, at the option of the applicant, to allow higher incidence than is possible with the normal production system.

(8) Starting from the stabilised trim condition, apply the longitudinal control to decelerate the aeroplane so that the speed reduction does not exceed one knot per second.

4 - Stall Warning

Delete existing CS 25.207 and replace as follows:

4.1 Normal Operation

If the conditions of paragraph 2 are satisfied, equivalent safety to the intent of CS 25.207, Stall Warning, shall be considered to have been met without provision of an additional, unique warning device.

4.2 High incidence protection System Failure

Following failures of the high incidence protection system, not shown to be extremely improbable, such that the capability of the system no longer satisfies items (a), (b) and (c) of paragraph 2, stall warning must be provided and must protect against encountering unacceptable characteristics and against encountering stall.

(a) Stall warning with the flaps and landing gear in any normal position must be clear and distinctive to the pilot and meet the requirements specified in paragraphs (d) and (e) below.

(b) Stall warning must also be provided in each abnormal configuration of the high lift devices that is likely to be used in flight following system failures.

(c) The warning may be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself. If a warning device is used, it must provide a warning in each of the airplane configurations prescribed in paragraph (a) above and for the conditions prescribed below in paragraphs (d) and (e) below.

(d) In non icing conditions stall warning must provide sufficient margin to prevent encountering unacceptable characteristics and encountering stall in the following conditions:

   (1) In power off straight deceleration not exceeding one knot per second to a speed 5 knots or 5 per cent CAS, whichever is greater, below the warning onset.

(2) In turning flight stall deceleration at entry rates up to 3 knots per second when recovery is initiated not less than one second after the warning onset.

(e) In icing conditions stall warning must provide sufficient margin to prevent encountering unacceptable characteristics and encountering stall, in power off straight and turning flight decelerations not exceeding one knot per second, when the pilot starts a recovery manoeuvre not less than three seconds after the onset of stall warning.

(f) An aeroplane is considered stalled when the behaviour of the aeroplane gives the pilot a clear and distinctive indication of an acceptable nature that the aeroplane is stalled. Acceptable indications of a stall, occurring either individually or in combination are:

(1) A nose-down pitch that cannot be readily arrested;

(2) Buffeting, of a magnitude and severity that is strong and effective deterrent to further speed reduction; or

(3) The pitch control reaches the aft stop and no further increase in pitch attitude occurs when the control is held full aft for a short time before recovery is initiated.

(g) An aircraft exhibits unacceptable characteristics during straight or turning flight decelerations if it is not always possible to produce and to correct roll and yaw by unreversed use of aileron and rudder controls, or abnormal nose-up pitching occurs.

5 - Handling Characteristics at High Incidence

Delete existing CS 25.201, 203 and replace as follows:

5.1 High Incidence Handling Demonstrations in Icing and Non Icing Conditions

(a) Manoeuvres to the limit of the longitudinal control, in the nose up sense, must be demonstrated in straight flight and in 30° banked turns with:

(1) The high incidence protection system operating normally;

(2) Initial power conditions of :

i. Power off

ii. The power necessary to maintain level flight at 1.5 VSR1, where VSR1 is the reference stall speed with flaps in approach position, the landing gear retracted and maximum landing weight. (See Guidance Material Part I, paragraph 5)

(3) Not applicable

(4) Flaps, landing gear and deceleration devices in any likely combination of positions (see Guidance Material Part I, paragraph 6).

(5) Representative weights within the range for which certification is requested; and

(6) The aeroplane trimmed for straight flight at a speed achievable by the automatic trim system.

(b) The following procedures must be used to show compliance in non icing and icing conditions :

(1) Starting at a speed sufficiently above the minimum steady flight speed to ensure that a steady rate of speed reduction can be established, apply the longitudinal control so that the speed reduction does not exceed one knot per second until the control reaches the stop (see Guidance Material Part I, paragraph 3)

(2) The longitudinal control must be maintained at the stop until the aeroplane has reached a stabilised flight condition and must then be recovered by normal recovery techniques.

(3) Manoeuvres with increased deceleration rates:

i) In non icing conditions, the requirements must also be met with increased rates of entry to the incidence limit, up to the maximum rate achievable

ii) In icing conditions, with the anti-ice system working normally, the requirements must also be met with increased rates of entry to the incidence limit up to 3kt/s

(4) Manoeuvre with ice accretion prior to operation of the normal anti-ice system:

i. With the ice accretion prior to operation of the normal anti-ice system, the requirement must also be met in deceleration at 1kt/s up to full-back-stick.

5.2 Characteristics in High Incidence Manoeuvres in Icing and Non Icing Conditions

(see Guidance Material Part I, paragraph 7)

(a) Throughout manoeuvres with a rate of deceleration of not more than 1 knot per second, both in straight flight and in 30° banked turns, the aeroplane's characteristics shall be as follows:

(1) There shall not be any abnormal nose-up pitching.

(2) There shall not be any uncommanded nose-down pitching, which would be indicative of stall. However reasonable attitude changes associated with stabilising the incidence at Alpha limit as the longitudinal control reaches the stop would be acceptable. (See Guidance Material Part I, paragraph 7.3)

(3) There shall not be any uncommanded lateral or directional motion and the pilot must retain good lateral and directional control, by conventional use of the controls, throughout the manoeuvre.

(4) The aeroplane must not exhibit buffeting of a magnitude and severity that would act as a deterrent from completing the manoeuvre specified in § 5.1(a).

(b) In manoeuvres with increased rates of deceleration some degradation of characteristics is acceptable, associated with a transient excursion beyond the stabilised Alpha-limit. However the aeroplane must not exhibit dangerous characteristics or characteristics that would deter the pilot from holding the longitudinal control on the stop for a period of time appropriate to the manoeuvre.

(c) It must always be possible to reduce incidence by conventional use of the controls.

(d) The rate at which the aeroplane can be manoeuvred from trim speeds associated with scheduled operating speeds such as V2 and Vref down to Vmin shall not be unduly damped or be significantly slower than can be achieved on conventionally controlled transport aeroplanes.

5.3 Characteristics up to maximum lift angle of attack

(a) In non-icing conditions:

Manoeuvres with a rate of deceleration of not more than 1 knot per second up to the angle of attack at which V_{CLMAX} was obtained as defined in paragraph 3 must be demonstrated in straight flight and in 30° banked turns with:

(1) The high incidence protection deactivated or adjusted, at the option of the applicant, to allow higher incidence than is possible with the normal production system.

(2) Engines idling

(3) Flaps and landing gear in any likely combination of positions

(4) The aeroplane trimmed for straight flight at a speed achievable by the automatic trim system.

(b) In icing conditions:

Manoeuvres with a rate of deceleration of not more than 1 knot per second up to the maximum angle of attack reached during manoeuvres from 5.1(b)(3)ii) must be demonstrated in straight flight with:

(1) The high incidence protection deactivated or adjusted, at the option of the applicant, to allow higher incidence than is possible with the normal production system.

(2) not applicable

(3) Engines idling

(4) Flaps and landing gear in any likely combination of positions

(5) The airplane trimmed for straight flight at a speed achievable by the automatic trim system.

(c) During the manoeuvres used to show compliance with paragraphs (a) (b) above, the aeroplane must not exhibit dangerous characteristics and it must always be possible to reduce angle of attack by conventional use of the controls. The pilot must retain good lateral and directional control, by conventional use of the controls, throughout the manoeuvre.

6 - Atmospheric Disturbances

Operation of the high incidence protection system must not adversely affect aircraft control during expected levels of atmospheric disturbances, nor impede the application of recovery procedures in case of wind-shear. This shall be demonstrated in non icing and icing conditions.

7 – Not applicable

8 – Proof of compliance

Add the following paragraph 25.21 (b):

The flying qualities will be evaluated at the most unfavourable CG position.

9 – Miscellaneous

Change CS 25.145(a), CS 25.145(b)(6) and CS 25.1323(d) as follows:

CS 25.145(a)	Vmin in lieu of “stall identification”
CS 25.145(b)(6)	Vmin in lieu of Vsw
CS 25.1323(d)	"From 1.23 V_{SR} to Vmin" in lieu of "1.23 V_{SR} to stall warning speed" and "speeds below Vmin" in lieu of "speeds below stall warning"

Special Condition (SC)
Part II

Credit for robust envelope protection in icing conditions

1-Proof of compliance

Change CS 25.21(g)(1) to read as follows:

Each requirement of this subpart, except SC 25.121(a), 25.123(c), 25.143(b)(1) and (b)(2), 25.149, 25.201(c)(2), and 25.251(b) through (e), must be met in icing conditions. SC 25.207 (c) and (d) (as amended by this Special Condition Part I) must be met in the landing configuration in icing conditions but need not be met for other configurations. Compliance must be shown using the ice accretions defined in Appendix C, assuming normal operation of the aeroplane and its ice protection system in accordance with the operating limitations and operating procedures established by the applicant and provided in the Airplane Flight Manual.

2-Stall Speed

Change and replace CS 25.103 to read as defined in Part I of this Special Condition.

3-Take-off

Change and replace CS 25.105(a)(2)(i) to read as follows:

(a) The take-off speeds prescribed by CS 25.107, the accelerate-stop distance prescribed by CS 25.109, the take-off path prescribed by CS 25.111, and the take-off distance and take-off run prescribed by CS 25.113, and the net take-off flight path prescribed by CS 25.115, must be determined in the selected configuration for take-off at each weight, altitude, and ambient temperature within the operational limits selected by the applicant -

(2) In icing conditions, if in the configuration of SC 25.121(b) with the “Take-off Ice” accretion defined in Appendix C:

i) the V2 speed scheduled in non icing conditions does not provide the manoeuvring capability specified in SC 25.143(h) for the takeoff configuration; or

4- Take-off speeds

Change CS 25.107(c) and (g) and add CS 25.107(c’) and (g’) to read as follows:

(c) in non icing conditions V2, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by CS 25.121(b) but may not be less than –

(1) V2MIN;

(2) VR plus the speed increment attained (in accordance with CS 25.111(c)(2)) before reaching a height of 11 m (35 ft) above the takeoff surface; and

(3) A speed that provides the manoeuvring capability specified in CS 25.143(h).

(c’) in icing conditions with the “take-off ice” accretion defined in Appendix C, V2 may not be less than –

(1) the V2 speed determined in non icing conditions

(2) A speed that provides the manoeuvring capability specified in CS 25.143(h).

(g) in non icing conditions, VFTO, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by CS 25.121(c), but may not be less than –

(1) 1.18 V_{SR}; and

(2) A speed that provides the manoeuvring capability specified in CS 25.143(h).

(g') in icing conditions with the "Final take-off ice" accretion defined in Appendix C, VFTO may not be less than –

(1) the VFTO speed determined in non icing conditions

(2) A speed that provides the manoeuvring capability specified in CS 25.143(h).

5- <u>Climb: one-engine inoperative</u>

Change and replace CS 25.121(b)(2)(ii)(A), CS 25.121(c)(2)(ii)(A), and CS 25.121(d)(2)(ii) to read as follows:

(b) *Take-off; landing gear retracted.* In the take-off configuration existing at the point of the flight path at which the landing gear is fully retracted, and in the configuration used in CS 25.111 but without ground effect,

(2) The requirements of subparagraph (b)(1) of this paragraph must be met:

(ii) In icing conditions with the "Take-off Ice" accretion defined in Appendix C, if in the configuration of CS 25.121(b) with the "Take-off Ice" accretion:

(A) The V2 speed scheduled in non icing conditions does not provide the manoeuvring capability specified in CS 25.143(h) for the take-off configuration; or

(c) *Final take-off.* In the en-route configuration at the end of the take-off path determined in accordance with CS 25.111:

(2) The requirements of subparagraph (c)(1) of this paragraph must be met:

(ii) In icing conditions with the "Final Take-off Ice" accretion defined in Appendix C, if:

(A) The V_{FTO} speed scheduled in non icing conditions does not provide the manoeuvring capability specified in CS 25.143(h) for the en-route configuration; or

(d) *Approach.* In a configuration corresponding to the normal all-engines operating procedure in which V_{SR} for this configuration does not exceed 110% of the V_{SR} for the related all-engines-operating landing configuration:

(2) The requirements of sub-paragraph (d)(1) of this paragraph must be met

ii) In icing conditions with the approach Ice accretion defined in Appendix C, in a configuration corresponding to the normal all-engines-operating procedure in which Vmin1g for this configuration does not exceed 110% of the Vmin1g for the related all-engines-operating landing configuration in icing, with a climb speed established with normal landing procedures, but not more than 1,4 V_{SR} (V_{SR} determined in non-icing conditions).

6- <u>En-route flight paths</u>

Change and replace CS 25.123 (b)(2)(i) to read as follows:

(b) The one-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 1·1% for two-engined aeroplanes, 1·4% for three-engined aeroplanes, and 1·6% for four engined aeroplanes.

(2) In icing conditions with the "En-route ice" accretion defined in Appendix C if:

(i) The minimum en-route speed scheduled in non icing conditions does not provide the manoeuvring capability specified in CS-25.143(h) for the en-route configuration, or"

7- Landing

Change and replace CS 25.125(b)(2)(ii)(B, and remove paragraph CS 25.125(b)(2)(ii)(C) to read as follows:

(b) In determining the distance in (a):

(1) The aeroplane must be in the landing configuration.

(2) A stabilised approach, with a calibrated airspeed of not less than VREF, must be maintained down to the 15 m (50 ft) height.

(ii) In icing conditions, VREF may not be less than:

(A) The speed determined in sub-paragraph (b)(2)(i) of this paragraph;

(B) A speed that provides the manoeuvring capability specified in CS 25.143(h) with the landing ice accretion defined in appendix C.

8- Controllability and Maneuvrability

Change CS 25.143(j)(1) to read as follows:

(j) For flight in icing conditions before the ice protection system has been activated and is performing its intended function, it must be demonstrated in flight with the ice accretion defined in appendix C, part II(e) that:

(1) The airplane is controllable in a pull-up manoeuvre up to 1.5 g load factor or lower if limited by AOA protection; and

9- Stall Warning

Change CS 25.207 Stall warning to read as defined in Part I of this Special Condition

ANNEX

Appendix 1	Intepretative Material to SC-B01 Part I
Appendix 2	Intepretative Material to SC-B01 Part II

Appendix 1

Interpretative Material (IM)

Part I

Stall Protection and Scheduled Operating Speeds

1 - Introduction

This Guidance Material expands various aspects of Special Condition Part I and replaces the Acceptable Means of Compliance and Flight Test Guide sections that are no longer applicable due to the amendments introduced by Special Condition Part I.

2 - High incidence protection tolerances

Flight testing for handling characteristics should be accomplished with the airplane build and high incidence protection system tolerances set to the most adverse condition for stall protection. Flight testing for minimum steady flight speed and reference stall speed may be made with nominal airframe tolerances and high incidence protection system settings if the combined root-sum-square (square root of the sum of the squares of each tolerance) effect of the tolerances is less than ±1 knot. If the effect is greater than ±1 knot, the most adverse airframe build and high incidence protection system tolerance should be used.

3 - Minimum Steady Flight Speed Entry Rate

(See CS 25.103(a) and CS 25.203(a) as amended by paragraphs 3 and 5.2 of Special Condition Part I)

The minimum steady flight speed entry rate is defined as follows:

$$\text{Entry rate} = \frac{1.15\ V_{min1g} - 1.05\ V_{min\ 1g}}{\text{Time to decelerate from } 1.15\ V_{min1g} \text{ to } 1.05\ V_{min1g}}\ \text{(knot CAS/sec)}$$

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4 - Manoeuvring Capabilities at Scheduled Operating Speeds

(See CS 25.143 (h))

(1) The manoeuvre capabilities specified in CS 25.143 (h) shall be achieved at constant CAS.

(2) A low thrust or power setting normally will be the critical case for demonstrating the required manoeuvre capabilities. The thrust/power settings specified in CS 25.143 (h) are the maximum values that may be used in such cases. However, if the angle of attack at which the stick stop is reached (or other relevant characteristic occurs) is reduced with increasing thrust or power, it should be ensured that the required manoeuvre capabilities are retained at all higher thrust or power settings appropriate to the flight condition.

(3) The thrust or power setting for the all-engines operating condition at V2+xx should include any value used in noise abatement procedure.

5 – Power Setting for power-on Handling to High Incidence

(See CS 25.201(a) (2) as amended by paragraph 5.1 of Special Condition Part I)

The power for power-on manoeuvre demonstrations to high incidence is that power necessary to maintain level flight without ice at a speed of 1.5 V_{SR1} at maximum landing weight, with flaps in the approach position and landing gear retracted, where V_{SR1} is the reference stall speed without ice in the same conditions (except power and effect of ice). The flap position to be used to determine this power setting is that position in which the reference stall speed does not exceed 110% of the reference stall speed with the flaps in the most extended landing position.

6 - Position of Deceleration Devices During Handling to High Incidence

(See CS 25.201 as amended by paragraph 5.1 of Special Condition Part I)

Demonstrations of manoeuvres to high incidence for compliance with CS 25.201 should include demonstrations with deceleration devices deployed for all flap positions unless limitations against use of the devices with particular flap positions are imposed. "Deceleration devices" include spoilers when used as air brakes (aileron and flaperon on 5X), and thrust reversers when use in flight is permitted. High incidence manoeuvres demonstrations with deceleration devices deployed should normally be carried out with an initial power setting of power off, except where deployment of the deceleration devices while power is applied is likely to occur in normal operations (e.g. use of extended air brakes during landing approach).

7 - Characteristics During High Incidence Manoeuvres

(See CS 25.203, as amended by paragraph 5.2 of Special Condition Part I)

(1) The behaviour of the aeroplane includes the behaviour as affected by the normal functioning of any systems with which the aeroplane is equipped, including devices intended to alter the high incidence handling characteristics of the aeroplane.

(2) Unless the design of the automatic flight control system of the aeroplane protects against such an event, the high incidence characteristics, when the aeroplane is manoeuvred under the control of the automatic flight control system should be investigated.

(3) Any reduction of pitch attitude associated with stabilising the incidence at Alpha limit should be achieved smoothly, at a low pitch rate, such that it is not likely to be mistaken for natural stall identification.

8 - Atmospheric Disturbances

(See paragraph 6 of Special Condition Part I)

In establishing compliance with paragraph 6 of Special Condition Part I, the high incidence protection system shall be assumed to be operating normally.

Simulator studies and analyses may be used but will need to be validated by limited flight testing to confirm handling qualities, at critical loadings, up to the maximum incidence shown to be reached by such studies and analyses.

9 – *Not applicable*

Appendix 2

Interpretative Material (IM)

Part II

Credit for robust envelope protection in icing conditions

1- Introduction – AMC 25.21(g)

This Guidance Material modifies the Acceptable Means of Compliance for Performance and Handling Characteristics in the Icing Conditions Contained in Appendix C of CS25 that are no longer applicable due to the amendments introduced by Special Condition Part I and II.

AMC 25.21(g) paragraph 6 "Acceptable Means of Compliance – Flight Test Programme" is modified according to the following paragraphs.

2- Minimum Steady Flight Speed and Reference Stall Speed

AMC 25.21(g) paragraph 6.2 is not applicable.

Refer to Special Condition Part I paragraph 3 and Interpretative Material Part 1 paragraphs 2 and 3

3- Takeoff Path

Change AMC 25.21(g) paragraph 6.4 to read as follows:

If V2 speed scheduled in icing conditions is greater than V2 in non icing conditions take-off demonstrations should be repeated to substantiate the speed schedule and distances for take-off in icing conditions. The effect of the take-off speed increase, thrust loss, and drag increase on the take-off path may be determined by a suitable analysis.

4- Sideslips

Change AMC 25.21(g) paragraph 6.9.4.3 (d) to read as follows:

Conduct steady heading sideslips to full rudder authority, 801 N. (180 lbf) rudder force or full lateral control authority (whichever comes first), with highest lift landing configuration, at a trim speed of 1.23 VSR or the minimum AFM speed, and the power or thrust for a minus 3° flight path angle.

5- Controllability prior to Normal Operation of the Ice Protection System

Change AMC25.21(g) paragraph 6.9.5.2 (a) to read as follows:

Where the ice protection system is activated as described in paragraphs A1.2.3.4.b, c, d or e of Appendix 1 of this AMC, it is acceptable to demonstrate adequate controllability with the ice accretion prior to normal system operation, as follows:

1. In the configurations listed below, trim the aeroplane at the specified speed. Conduct pull up to 1.5g or lower if limited by Stall Protaction and pushover to 0.5g without longitudinal control force reversal.
   I. High lift devices retracted configuration (or holding configuration if different), holding speed, power or thrust for level flight.
   II. Landing configuration, VREF for non-icing conditions, power or thrust for landing approach (stop pull up after achievement of 1.5g or peak load factor with Full Back Stick).

6 - Longitudinal Control – Acceptable Test Programme

Change AMC 25.21(g) paragraph 6.10.2 to read as follows as follows:

The following represents an acceptable test programme for compliance with CS-25.145(a):

a) "Holding ice."

b) Medium to light weight, aft centre of gravity position, symmetric fuel loading.

c) In the configurations listed below, trim the aeroplane at the minimum AFM speed. Reduce speed using elevator control to minimum steady achievable speed, and demonstrate prompt recovery to the trim speed using elevator control.
   i. High lift devices retracted configuration, maximum continuous power or thrust.
   ii. Maximum lift landing configuration, maximum continuous power or thrust.

7- <u>Handling Characteristics at High Incidence</u>

AMC 25.21(g) paragraph 6.17 is not applicable.

Refer to Special Condition Part 1 paragraph 5.2 and Interpretative Material Part 1 paragraphs 5, 6, 7 and 8.

8- <u>Stall Warning</u>

AMC 25.21(g) paragraph 6.18 is not applicable.

Refer to Special Condition Part 1 paragraph 4.

9- <u>Natural Icing Conditions</u>

Change ice accretion Tables 3 & 4 of AMC 25.21(g) paragraph 6.21 as follows:

Configuration	***CG***	***Trim speed***	***Manoeuvre***

Flaps up, gear up	Optional (aft range)	Holding, except at Minimum AFM speed for the **high AoA** manoeuvre	• Level, 40° banked turn, • Bank-to-bank rapid roll, 30° -30°, • Speed-brake extension, retraction, • Deceleration to alpha-max (1 knot/second deceleration rate, wings level, power off).
Flaps in intermediate positions, gear up	Optional (aft range)	Minimum AFM speed	Level deceleration in a 1 knot/second deceleration to Full Back Stick
Landing flaps, gear down	Optional (aft range)	VREF (Minimum AFM speed)	• Level, 40° banked turn, • Bank-to-bank rapid roll, 30° - 30°, • Speed-brake extension, retraction (if approved), • Deceleration to alpha-max (1 knot/second deceleration rate, wings level, power off).

TABLE 3: Holding Scenario - Manoeuvres

Test Condition	***Ice accretion thickness (*)***	***Configuration***	***CG***	***Trim speed***	***Manoeuvre***
-	First 13 mm (0.5 inch)	Flaps up, gear up	Optional (aft range)	Holding	No specific test.
1	Additional 6.3 mm (0.25 in) (19 mm (0.75 in) total)	First intermediate flaps, gear up	Optional (aft range)	Minimum AFM speed	• Level 40° banked turn, • Bank-to-bank rapid roll, 30°-30°, • Speed brake extension and retraction (if approved), • 1kt/s Level deceleration to Full Back Stick
2	Additional 6.3 mm (0.25 in) (25 mm (1.00 in) total)	Furher intermediate flaps, gear up (as applicable)	Optional (aft range)	Minimum AFM speed	• Bank-to-bank rapid roll, 30°-30°, • Speed brake extension and retraction (if approved), • 1kt/s Level deceleration to Full Back Stick
3	Additional 6.3 mm (0.25 in) (31 mm (1.25 in) total)	Landing flaps, gear down)	Optional (aft range)	VREF (Minimum AFM speed)	• Bank-to-bank rapid roll, 30°-30°, • Speed brake extension and retraction (if approved), • bank to 40° • Deceleration to alpha-max

TABLE 4: Approach/Landing Scenario - Manoeuvres

(*) The indicated thickness is that obtained on the parts of the unprotected aerofoil with the highest collection efficiency.

10- Failures Conditions – Acceptable programme

Change AMC 25.21(g) paragraph 6.22.2 d) to read as follows:

In the configurations listed below, trim the aeroplane at the Minimum AFM speed. Decrease speed to minimum steady achievable speed, plus 1 second, and demonstrate prompt recovery using the same test technique as for the non-contaminated aeroplane. Natural stall warning is acceptable for the failure case.

i. High lift devices retracted configuration: Straight/Power Off.

ii. Landing configuration: Straight/Power Off.

– END –

B-02 (SC): Motion and Effect of Cockpit Controls	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.143
ADVISORY MATERIAL:	--

Special Condition (SC)

Motion and Effect of Cockpit Controls

Introduce new paragraph CS 25.143(m):

When a flight case exists where, without being commanded by the crew, control surfaces are coming so close to their limits that return to normal flight condition and (or) continuing of safe flight needs a specific crew action, a suitable flight control position annunciation shall be provided to the crew, unless other existing indications are found adequate or sufficient to prompt that action.

– END –

B-03 (SC): Flight Envelope Protection	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.143
ADVISORY MATERIAL:	--

Special Condition (SC)

Flight Envelope Protection

Add a new paragraph CS 25.143 (n).

Normal operation:

1) Onset characteristics of each envelope protection feature must be smooth, appropriate to the phase of flight and type of manoeuvre and not in conflict with the ability of the pilot to satisfactorily change aeroplane flight path, or attitude as needed.

2) Limit values of protected flight parameters must be compatible with:

   a) aeroplane structural limits,

   b) required safe and controllable manoeuvring of the aeroplane and

   c) margin to critical conditions.

   Unsafe flight characteristics/conditions must not result from:

   - dynamic manoeuvring,
   - airframe and system tolerances (both manufacturing and in-service), and
   - non-steady atmospheric conditions, in any appropriate combination and phase of flight, if this manoeuvring can produce a limited flight parameter beyond the nominal design limit value.

   Note: Reference may be made to FAA Advisory Circular AC 120-41 for guidance on atmospheric conditions.

3) The aeroplane must respond to intentional dynamic manoeuvring within a suitable range of the parameter limit. Dynamic characteristics such as damping and overshoot must also be appropriate for the flight manoeuvre and limit parameter concerned.

4) When simultaneous envelope limiting is engaged, adverse coupling or adverse priority must not result.

Failure states:

EFCS (including sensor) failures must not result in a condition where a parameter is limited to such a reduced value that safe and controllable manoeuvring is no longer available. The crew must be alerted by suitable means if any change in envelope limiting or manoeuvrability is produced by single or multiple failures of the EFCS not shown to be extremely improbable.

– END –

B-05 (SC): Protection from Effects of HIRF	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.171, 25.173, 25.175, 25.177, SC B-01
ADVISORY MATERIAL:	--

Special Condition (SC)

Static Directional, Lateral and Longitudinal Stability and Low Energy Awareness

1) Replace CS 25.171 by the following :

"The aircraft must be shown to have suitable lateral, directional and longitudinal stability in any condition normally encountered in service, including the effects of atmospheric disturbances.

The aircraft, fitted with flight control laws presenting neutral static longitudinal stability significantly below the normal operating speeds, must provide adequate awareness to the pilot of a low energy state. "

2) Remove CS 25.173

3) Remove CS 25.175

4) Remove CS 25.177 (b)

5) Replace CS 25.177 (c) by the following :

(c) In straight, steady sideslips over the range of sideslip angles appropriate to the operation of the aeroplane, but not less than those obtained with one-half of the available rudder control input or a rudder control force of 801 N (180 lbf), the rudder control movements and forces must be substantially proportional to the angle of sideslip in a stable sense; and the factor of proportionality must lie between limits found necessary for safe operation. This requirement must be met for the configurations and speeds specified in sub-paragraph (a) of this paragraph. (see AMC 25.177 (c))

ANNEX

Appendix 1 Intepretative Material to SC-B05

Appendix 1

Interpretative Material B-05

Static Directional, Lateral and Longitudinal Stability and Low Energy Awareness

I. Lateral-directional stability

Positive static directional stability is defined as the tendency to recover from a skid with the rudder free. Positive static lateral stability is defined as the tendency to raise the low wing in a sideslip with the aileron controls free. These control criteria are intended to accomplish the following:

1) Provide additional cues of inadvertent sideslips and skids through control force changes.

2) Ensure that short periods of unattended operation do not result in any significant changes in yaw or bank angle.

3) Provide predictable roll and yaw response.

4) Provide acceptable level of pilot attention (workload) to attain and maintain a co-ordinated turn.

A suitable lateral-directional stability must allow to achieve the same goal. In the absence of positive lateral stability, the curve of lateral surface deflection against sideslip angle should be in a conventional sense and reasonably in harmony with rudder deflection during the sideslip.

II. Longitudinal stability and low energy awareness

1) General
The aeroplane's static longitudinal stability and energy awareness characteristics shall be evaluated by flight and simulator tests. Control laws that result in neutral static stability throughout most of the operational flight envelope may be accepted in principle subject to:

- adequate speed control without excessive pilot workload
- suitable longitudinal behaviour in turbulence
- acceptable high and low speed protection
- provision of adequate cues to the pilot of significant speed excursions beyond VMO/MMO, and of low energy situations.

2) Longitudinal stability
(a) Accurate speed control shall be achievable without excessive pilot workload in the full range of operating speeds including low speeds (scheduled speeds at take-off and landing with or without engine failed) and high speeds for each configuration including VMO/MMO.

(b) Since conventional relationships between stick forces and control surface displacements do not apply to a manoeuvre demand control system, longitudinal static stability characteristics shall be determined on the basis of the aeroplane's response to disturbances rather than on the basis of stick force versus speed gradients.

(c) Outside the normal flight envelope adequate high or low speed cues may be provided by a strong positive stability gradient. A force gradient of 1 lb for each 6 knots, applied through the side-stick shall be considered as providing this strong stability.

3) Low energy awareness

Although stability cues and protection systems may be adequate at high altitude, past experience has shown that additional attention is required at low altitude. Adequate cues shall be available to the pilot to ensure that the aircraft retains sufficient energy to recover from low power and/or low speed situations when close to the ground.

Such low energy cues may be provided by an appropriate warning with the following characteristics:

(a) it should be unique, unambiguous, and unmistakable.

(b) it should be active at appropriate altitudes and in appropriate configurations (i.e. at low altitude, in the approach and landing configurations).

(c) it should be sufficiently timely to allow recovery to a stabilized flight condition inside the normal flight envelope, while maintaining the desired flight path, and before the flight controls angle-of-attack protection function achieves a higher authority than that of the pilot.

(d) it should not be triggered during normal operation, including operation in moderate turbulence for recommended manoeuvres at recommended speeds.

(e) it should not be cancellable by the pilot other than by achieving a higher energy state.

(f) there should be an adequate hierarchy among the various warnings so that the pilot is not confused and led to take inappropriate recovery action if multiple warnings occur.

Global energy awareness and non-nuisance of low energy cues shall be evaluated by simulator and flight tests in the whole take-off and landing altitude range for which certification is requested, in all relevant combinations of weight, center of gravity position, configuration, airbrakes position, and available thrust, including reduced and derated take-off thrust operations and engine failure cases. A sufficient number of tests shall be conducted, allowing the level of energy awareness and the effects of energy management errors to be assessed.

– END –

C-13 (SC): Rudder Control Reversal Load Conditions	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.351
ADVISORY MATERIAL:	--

Special Condition (SC)

Rudder Control Reversal Load Conditions

The aeroplane must be designed for loads, considered as ultimate, resulting from the yaw manoeuvre conditions specified in paragraphs (a) through (e) of this SC from the highest airspeed for which it is possible to achieve maximum rudder deflection at zero sideslip or VMC, whichever is greater, to VC/Mc. These conditions are to be considered with the landing gear retracted and speed brakes (or spoilers when used as speed brakes) retracted. Flaps (or flaperons or any other aerodynamic devices when used as flaps) and slats extended configurations are also to be considered if they are used in en route conditions. Unbalanced aerodynamic moments about the centre of gravity must be reacted in a rational or conservative manner considering the aeroplane inertia forces. In computing the loads on the aeroplane, the yawing velocity may be assumed to be zero.

a) With the aeroplane in unaccelerated flight at zero yaw, it is assumed that the cockpit rudder control is displaced as specified in CS 25.351(a) and (b), with the exception that only 890 N (200 lbf) need be applied.

b) With the aeroplane yawed to the overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly displaced in the opposite direction to achieve the resulting rudder deflection, as limited by the control system or control surface stops, and as limited by the pilot force of 890N (200 lbf).

c) With the aeroplane yawed to the opposite overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly displaced in the opposite direction to achieve the resulting rudder deflection, as limited by the control system or control surface stops, and as limited by the pilot force of 890 N (200 lbf).

d) With the aeroplane yawed to the subsequent overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly displaced in the opposite direction to achieve the resulting rudder deflection, as limited by the control system or control surface stops, and as limited by the pilot force of 890 N (200 lbf).

e) With the aeroplane yawed to the opposite overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly returned to neutral.

ANNEX

Appendix 1 Means of Compliance to SC-C13

Appendix 1

Means of Compliance (MoC)

1. Purpose.

   This MoC describes acceptable means for showing compliance with the requirements of the above Special Condition (SC) on Rudder control reversal load conditions. These requirements specify structural design load conditions that apply to the airframe, and that occur as a result of multiple rudder pedal inputs.

2. Related CS 25 Regulations.

   a. CS 25.351, *Yaw manoeuvre conditions*.

   b. Special Condition C-13, Rudder control reversal load conditions.

3. Background.

   a. Requirements. CS 25.351, *Yaw manoeuvre conditions*, and SC C-13, *Rudder control reversal load conditions*, specify structural design load conditions that occur as a result of rudder pedal inputs. These conditions are intended to encompass all of the rudder manoeuvre loads expected to occur in service.

   b. Yaw manoeuvre conditions. The design load conditions specified in CS 25.351 are considered limit load conditions, and a 1.5 factor of safety is applied to obtain ultimate loads.

   c. Rudder control reversal load conditions. The design load conditions specified in this Special Condition are more severe than those in CS 25.351 and include rudder control reversals. These conditions are anticipated to occur very rarely, and so these are considered ultimate load conditions, and no additional safety factor is applied.

   d. Overswing sideslip angle definition: Maximum (peak) sideslip angle reached by the aeroplane with the cockpit rudder control displaced as specified in §4.b below.

4. Application of the requirements.

   a. General

   1) The aeroplane must be designed for the rudder control reversal load conditions specified in the Special Condition. These are considered ultimate load conditions and, therefore, no additional factor of safety is applied. However, any permanent deformation resulting from these ultimate load conditions must not prevent continued safe flight and landing.

   2) Design loads must be determined as specified in CS 25.321. The load conditions are considered from the maximum airspeed for which it is possible to achieve full rudder deflection at zero sideslip or VMC, whichever is greater, to VC/MC. A pilot force of 890 N (200 lbf) is assumed to be applied for all conditions. These conditions are to be considered with the landing gear retracted and speed brakes (or spoilers when used as speed brakes) retracted. Flaps (or

flaperons or any other aerodynamic devices when used as flaps) and slats-extended configurations are also to be considered if they are used in en route conditions.

3) System effects. System effects should be taken into account in the evaluation of this manoeuvre. For example, fly-by-wire aircraft should be analysed assuming the aeroplane is in the normal control law mode. Any system function used to demonstrate compliance with these requirements should meet the following criteria:

   (a) The system is normally operative during flight in accordance with the aeroplane flight manual procedures, although limited dispatch with the system inoperative could be allowed under applicable master minimum equipment list provisions provided MMEL requirements are still complied with, taking into account the rudder reversal pedal inputs as the next critical event under dispatch configuration; and

   (b) Appropriate crew procedures should be provided in the event of loss of function. If loss of system function would not be detected by the crew, the probability of loss of function (failure rate multiplied by maximum exposure period) should be less than 1/1000.

4) Failure conditions. Due to the very low probability of a full rudder pedal doublet event, failure scenarios do not need to be addressed in combination with the rudder control reversal load conditions specified in the Special condition.

b. SC requirements (a) through (e)

1) Conditions (a) through (e) of the Special Condition are intended as a full displacement pedal input followed by three pedal reversals and return to neutral. Speed should be kept reasonably constant throughout the manoeuvre using pitch control.

2) With the aeroplane in unaccelerated flight at zero yaw, it is assumed that the cockpit rudder control is suddenly displaced to achieve the resulting rudder deflection, as limited by the control system, control stops or pilot force of 890 N (200 lbf). In this context, “suddenly” means as fast as possible within human and system limitations. In the absence of a rational analysis, initial pedal displacement is achieved in no more than 0.2 seconds, and full rudder control reversal displacement is achieved in 0.4 seconds. Alternatively, the applicant may assume the rudder pedal is displaced instantaneously.

3) The resulting rudder displacement should take into account additional displacement caused by sideslip build-up, and the effects of flexibility should be considered when relevant.

4) As soon as the maximum overswing yaw angle is achieved, full opposite rudder pedal input is applied. The achieved rudder deflection may be limited by control laws, system architecture, or air loads, and may not be the same magnitude as the initial rudder deflection prior to the pedal reversal. For critically damped aircraft response, maximum overswing yaw angle may be assumed to occur when the sideslip angle is substantially stabilised.

5) Two additional reversals are performed as defined in (4). After the second reversal, as soon as the aeroplane yaws to the opposite overswing yaw angle, the cockpit rudder control is suddenly returned to neutral.

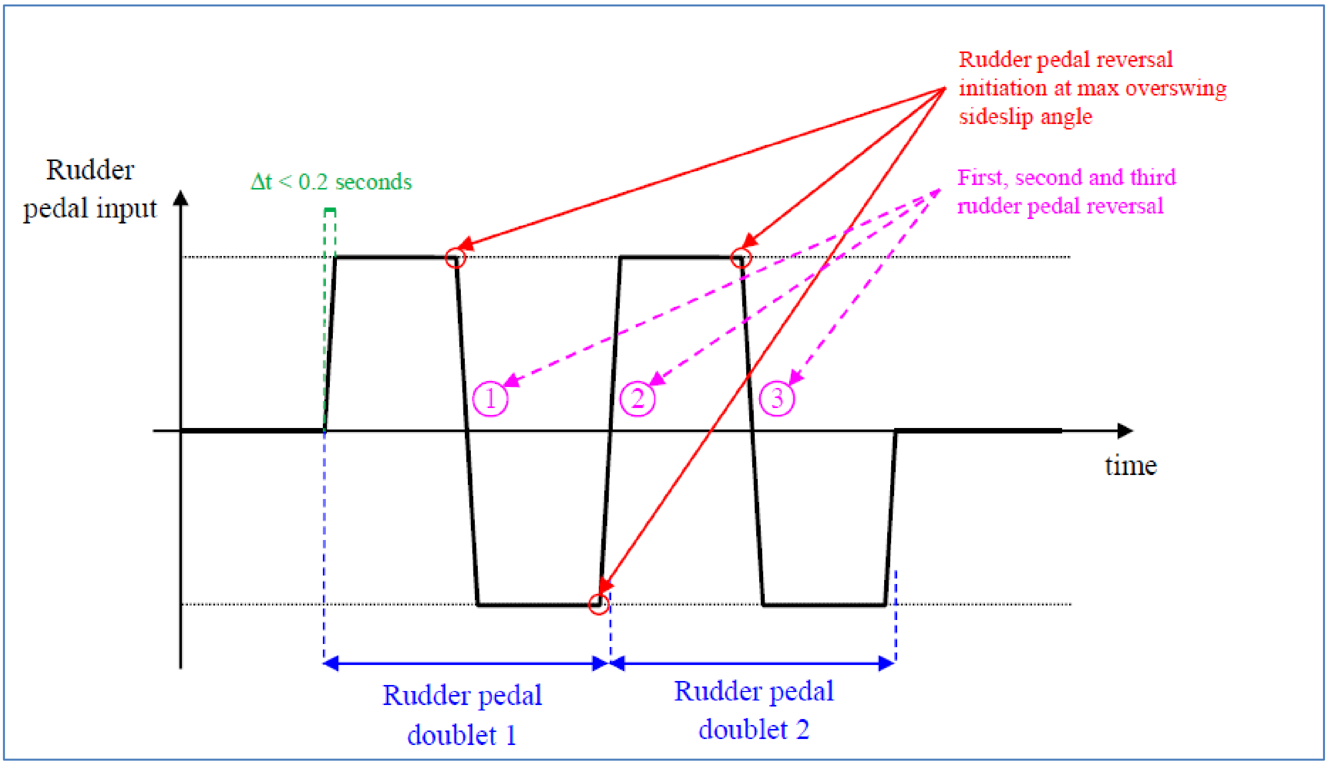


Fig. 1: Illustrative figure of the rudder pedal inputs

ANNEX

Appendix 1 **Interpretative Material to SC-F23.1309-03**

– END –

D-05 (SC): High Altitude Operations	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.831, CS 25.841, CS 25.903, CS 25.1309
ADVISORY MATERIAL:	AMC 20-128A, AMC 25.1309, INT/POL/25/16

Special Condition (SC)

Control Surface Awareness / Electronic Flight Control System

A - PRESSURE VESSEL INTEGRITY

For the damage tolerance evaluation, in addition to the damage sizes critical for residual strength, the damage sizes critical for depressurisation decay must be considered, taking also into account the (normal) unflawed pressurised cabin leakage rate. The resulting leakage rate must not result in the cabin altitude exceeding the cabin altitude time history shown in Figure 4.

B - VENTILATION

In lieu of the requirements of CS 25.831(a), the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort and fatigue and to provide reasonable passenger comfort during normal operating conditions and also in the event of any probable failure of any system which could adversely affect the cabin ventilating air. For normal operations, crew members and passengers must be provided with at least 0·55 lb/min of fresh air per person or the equivalent in filtered, recirculated air based on the volume and composition at the corresponding cabin pressure altitude of not more than 8000 ft.

The supply of fresh air in the event of the loss of one source, should not be less than 0·4 lb/min per person for any period exceeding five minutes. However, reductions below this flow rate may be accepted provided that the compartment environment can be maintained at a level which is not hazardous to the occupant (text of the AMC 25.831(a) of CS 25).

C - AIR CONDITIONNING

In addition to the requirements of CS 25.831, paragraphs (b) through (e), the cabin cooling system must be designed to meet the following conditions during flight above 15 000 ft mean sea level (MSL):

1) After any probable failure, the cabin temperature-time history may not exceed the values shown in Figure 1.

2) After any improbable failure, the cabin temperature-time history may not exceed the values shown in Figure 2.

Other temperatures standards could be accepted by the EASA if they provide an equivalent level of safety.

D - PRESSURISATION

In addition to the requirements of CS 25.841, the following apply:

1) The pressurisation system, which includes for this purpose bleed air, air conditioning and pressure control systems, must prevent the cabin altitude from exceeding the cabin altitude-time history shown in Figure 3 after each of the following :

   (a) Any probable double failure in the pressurisation system (CS 25.1309 may be applied).

   (b) Any single failure in the pressurisation system combined with the occurrence of a leak produced by a complete loss of a door seal element, or a fuselage leak through an opening having an effective area 2.0 times the effective area which produces the maximum permissible fuselage leak rate approved for normal operation, whichever produces a more severe leak.

2) The cabin altitude-time history may not exceed that shown in Figure 4 after each of the following :

   (a) The pressure vessel opening or duct failure resulting from probable damage (failure effect) while under maximum operating cabin pressure differential due to a tyre burst, loss of antennas or stall warning vanes, or any probable equipment failure (bleed air, pressure control, air conditioning, electrical source(s) ...) that affects pressurisation.

   (b) Complete loss of thrust from engines.

3) In showing compliance with paragraph D.1 and D.2 of this special condition, it may be assumed that an emergency descent is made by an approved emergency procedure. A 17-seconds crew recognition and reaction time must be applied between cabin altitude warning and the initiation of emergency descent.

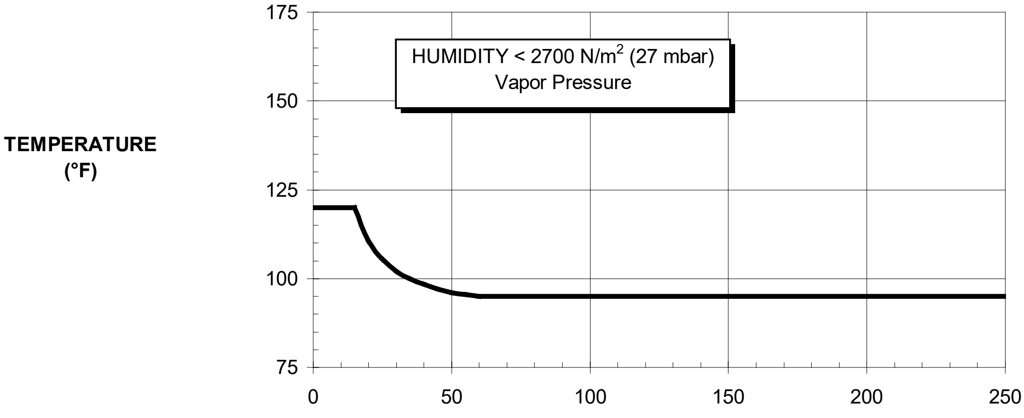
   For flight evaluation of the rapid descent, the test article must have the cabin volume representative of what is expected to be normal

4) Engine rotor failures must be assessed according to the requirements of JAR 25.903(d)(1).

   In considering paragraph 8.d(2) of AMJ 20-128A, consideration must be given to the practicability and feasibility of minimising the depressurisation effects, assessing each aircraft configuration on a case-by-case basis, and taking into account the practices in the industry for each configuration.

E - OXYGEN SUPPLY

AFM procedure must be introduced to require that when operating at flight altitudes above flight level 410, one pilot at the controls of the airplane shall at all times wear and use an oxygen mask secured, sealed, and supplying oxygen. If certification for operation above 41,000 feet without equipment donned is intended, the applicant must substantiate that if a rapid depressurization occurs, the crew can recognize it and don equipment quickly enough to prevent unacceptable levels of hypoxia.



TIME - TEMPERATURE RELATIONSHIP
FIGURE 1

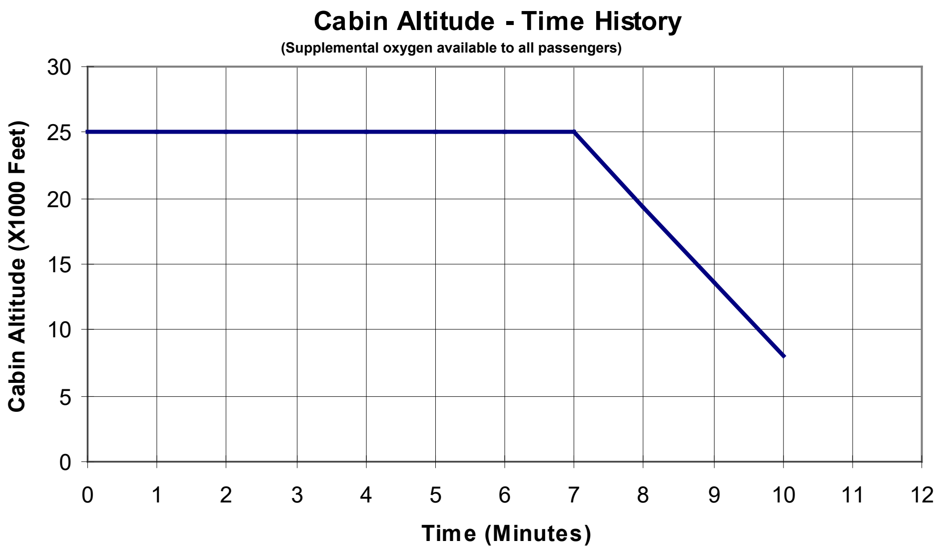


Figure 3

NOTE: For figure 3, time starts at the moment cabin altitude exceeds 8,000 feet during depressurization. If depressurization analysis shows that the cabin altitude limit of this curve is exceeded, the following alternate limitations apply: After depressurization, the maximum cabin altitude exceedence is limited to 30,000 feet. The maximum time the cabin altitude may exceed 25,000 feet is 2 minutes; time starting when the cabin altitude exceeds 25,000 feet and ending when it returns to 25,000 feet.

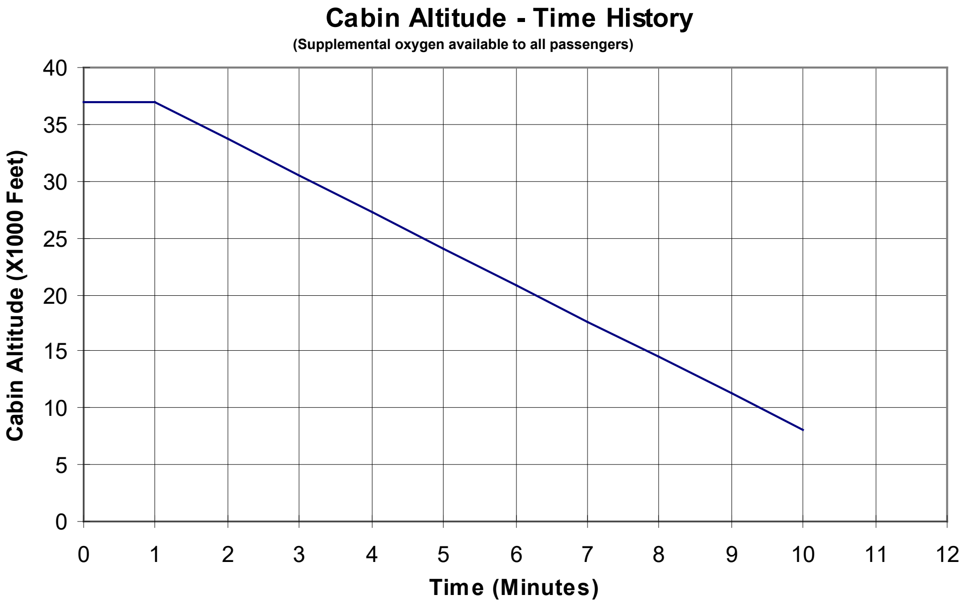


Figure 4

NOTE: For figure 4, time starts at the moment cabin altitude exceeds 8,000 feet during depressurization. If depressurization analysis shows that the cabin altitude limit of this curve is exceeded, the following alternate limitations apply: After depressurization, the maximum cabin altitude exceedence is limited to 40,000 feet. The maximum time the cabin altitude may exceed 25,000 feet is 2 minutes; time starting when the cabin altitude exceeds 25,000 feet and ending when it returns to 25,000 feet.

– END –

D-08 (SC): Control Surface Position Awareness/Electronic Flight Control System and Flight Control Jams	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.671, CS 25.672, CS 25.302
ADVISORY MATERIAL:	AMC 25.671 and 25.672, Aviation Rulemaking Advisory Committee (ARAC) Flight Control Harmonisation Working Group (FCHWG) Report 25.671 & 25.672 dated 17 May 2002

Special Condition (SC)

Control Surface Awareness / Electronic Flight Control System

In addition to current CS 25.671 paragraph, and to ESF D-01, the following conditions are applicable:

1) The flight control system shall be designed to continue to operate and must not hinder aircraft recovery from any attitude.
2) The system design must ensure that the flight crew is made suitably aware whenever the primary control means nears the limit of control authority.
3) If the design of the flight control system has multiple modes of operation, a means must be provided to indicate to the crew any mode that significantly changes or degrades the normal handling or operational characteristics of the airplane.

Appendix I

Interpretative Material - Control Surface Awareness / Electronic Flight Control System

Compliance to SC D-08.1. Abnormal attitude.

Compliance should be shown by evaluation of the closed loop flight control system. This evaluation is intended to ensure that there are no features or unique characteristics (including numerical singularities) which would restrict the pilot's ability to recover from any attitude. It is not the intent of this rule or guidance material to limit the use of envelope protection features or other systems that augment the control characteristics of the aircraft.

Compliance to SC D-08.2. Limit of control authority

SC D-08 requires suitable annunciation to be provided to the flight crew when a flight condition exists in which near-full control authority (not pilot-commanded) is being used. Suitability of such a display must take into account that some pilot-demanded manoeuvres (e.g., rapid roll) are necessarily associated with intended full performance, which may saturate the surface. Therefore, simple alerting systems, which would function in both intended and unexpected control-limiting situations, must be properly balanced between needed crew-awareness and nuisance alerting. Nuisance alerting should be minimised. The term suitable indicates an appropriate balance between nuisance and necessary operation.

Depending on the application, suitable annunciations may include cockpit control position, annunciator light, or surface position indicators. Furthermore, this requirement applies at limits of control authority, not necessarily at limits of any individual surface travel.

Compliance to SC D-08.3. Submodes of operation

Some systems, EFCS in particular, may have submodes of operation not restricted to being either on or off. The means provided to the crew to indicate the current submode of operation may be different from the classic "failure warning."

Appendix II

Interpretative Material - Flight Control Jams

a. Definition:

Jam. A failure or event such that a control surface, pilot control, or component is fixed in one position.

1) If the control surface or pilot control is fixed in position due to a physical interference, it is addressed under ESF D-01(c)(3). Causes may include corroded bearings, interference with a foreign or loose object, control system icing, seizure of an actuator, or a disconnect that results in a jam by creating an interference. Jams of this type must be assumed to occur and should be evaluated at positions up to and including the normally encountered positions defined below.

2) All other failures that result in a fixed control surface, pilot control, or component are addressed under ESF D-01 (c)(1) and ESF D-01 (c)(2), as appropriate. Depending on system architecture and the location of the failure, some jam failures may not always result in a fixed surface or pilot control; for example, a jammed valve could result in a surface runaway.

b. Determination of Control System Jam Positions – ESF D-01 (c)(3). The flight phases required by CS 25.671 and ESF D-01 can be encompassed by three flight phases: takeoff, in-flight (climb, cruise, normal turns, descent, and approach) and landing.

Takeoff is considered to be the time period between brake release and 35 ft. In-flight is considered to be from 35 ft following a takeoff to 50 ft prior to landing including climb, cruise, normal turns, descent, and approach.

ESF D-01 (c)(3) requires that the aeroplane be capable of landing with a flight control jam and that the aeroplane be evaluated for jams in the landing configuration. Jams that occur immediately before landing must be considered unless the jam is shown to be extremely improbable.

Only the aeroplane rigid body modes need to be considered when evaluating the aircraft response to manoeuvres and continued safe flight to landing.

It is assumed that if the jam is detected prior to V_1, the take-off will be rejected.

Although 1 in 1000 operational takeoffs is expected to include crosswinds up to 25 knots, the short exposure time associated with a control surface jam occurring between V_1 and VLOF allows usage of a less conservative crosswind magnitude when determining normally encountered lateral and directional control positions. Given that lateral and directional controls are continuously used to maintain runway centreline in a crosswind takeoff, and control inputs greater than that necessary at V_1 will occur at speeds below V_1, any jam in these control axes during a crosswind takeoff will normally be detected prior to V_1. Considering the control jam failure rate of approximately 10^{-6} to 10^{-7} per flight hour combined with the short exposure time between V_1 and VLOF, a reasonable crosswind level for determination of jammed lateral or directional control positions during take-off is 15 knots.

The jam positions to be considered in showing compliance include any position up to the maximum position determined by the following manoeuvres. The manoeuvres and conditions described here are only to provide the control surface deflection to evaluate continued safe flight and landing capability, and are not to represent flight test manoeuvres for such an evaluation.

1) Jammed Lateral Control Positions.

(i) Takeoff: The lateral control position for wings-level at V_1 in a steady crosswind of 15 knots (at a height of 10 meters above the takeoff surface). Variations in wind speed from a 10 meter height can be obtained using the following relationship:

$$V_{alt} = V_{10meters} * (H_{desired}/10.0)^{1/7}$$

Where:

$V_{10meters}$ = Wind speed at 10 meters AGL (knots)

V_{alt} = Wind speed at desired altitude (knots)

$H_{desired}$ = Desired altitude for which wind speed is sought (Meters AGL), but not lower than 1.5m (5 ft)

(ii) In-flight and landing: The lateral control position to sustain a 12 deg/sec steady roll rate from $1.23V_{SR1}$ ($1.3V_S$) to V_{MO}/M_{MO} or V_{fe}, as appropriate, but not greater than 50% of the control input.

Note: If the flight control system augments the pilot's input, then the maximum surface deflection to achieve the above manoeuvres should be considered.

2) Jammed Longitudinal Control Positions.

(i) Takeoff: Three longitudinal control positions should be considered:

(1) Any control position from that which the controls naturally assume without pilot input at the start of the takeoff roll to that which occurs at V_1 using the manufacturer's recommended procedures.

Note: It may not be necessary to consider this case if it can be demonstrated that the pilot is aware of the jam before reaching V_1 (for example, through a manufacturer's recommended AFM procedure).

(2) The longitudinal control position at V_1 based on the manufacturers recommended procedures including consideration for any runway condition for which the aircraft is approved to operate.

(3) Using the manufacturers recommended procedures, the peak longitudinal control position to achieve a steady aircraft pitch rate of the lesser of 5 deg/sec or the pitch rate necessary to achieve the speed used for all-engines-operating initial climb procedures (V_2+08) at 35 ft.

(ii) In-flight and landing: The maximum longitudinal control position is the greater of:

(1) The longitudinal control position required to achieve steady state normal accelerations from 0.8g to 1.3g at speeds from $1.23V_{SR1}$($1.3V_S$) to V_{MO}/M_{MO} or V_{fe}, as appropriate.

(2) The peak longitudinal control position commanded by the autopilot and/or stability augmentation system in response to atmospheric discrete vertical gust defined by 15 fps from sea level to 20,000 ft.

(3) Jammed Directional Control Positions.

(i) Takeoff: The directional control position for takeoff at V_1 in a steady crosswind of 15 knots (at a height of 10 meters above the takeoff surface). Variations in wind speed from a height of 10 meters can be obtained using the following relationship:

Where

$V_{alt} = V_{10meters} * (H_{desired}/10.0)^{1/7}$

$V_{10meters}$ = Wind speed at 10 meters AGL (knots)

V_{alt}= Wind speed at desired altitude (knots)

$H_{desired}$ = Desired altitude for which wind speed is sought (Meters AGL), but not lower than 1.5m (5 ft)

(ii) In-flight and landing: The directional control position is the greater of:

(1) The peak directional control position commanded by the autopilot and/or stability augmentation system in response to atmospheric discrete lateral gust defined by 15 fps from sea level to 20,000 ft.

(2) Maximum rudder angle required for lateral/directional trim from $1.23V_{SR1}(1.3V_S)$ to the maximum all engines operating airspeed in level flight with climb power, but not to exceed V_{MO}/M_{MO} or V_{fe} as appropriate. While more commonly a characteristic of propeller aircraft, this addresses any lateral/directional asymmetry that can occur in flight with symmetric power.

(4) Control Tabs, Trim Tabs, and Trimming Stabilisers. Any tabs installed on control surfaces are assumed jammed in the position associated with the normal deflection of the control surface on which they are installed.

Trim tabs and trimming stabilisers are assumed jammed in the positions associated with the manufacturer's recommended procedures for takeoff and that are normally used throughout the flight to trim the aircraft from $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate.

(5) Speed Brakes. Speed brakes are assumed jammed in any position for which they are approved to operate during flight at any speed from $1.23V_{SR1}$ $(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate. Asymmetric extension and retraction of the speed brakes should be considered. Roll spoiler jamming (asymmetric spoiler panel) is addressed under paragraph (1).

(6) High Lift Devices. Leading edge and trailing edge high lift devices are assumed to jam in any position for takeoff, climb, cruise, approach, and landing. Skew of high lift devices or asymmetric extension and retraction should be considered; CS 25.701 contains a requirement for flap mechanical interconnection unless the aircraft has safe flight characteristics with the asymmetric flap positions not shown to be extremely improbable.

(7) Load Alleviation Systems.

(i) Gust Load Alleviation Systems. At any airspeed between $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate, the control surfaces are assumed to jam in the maximum position commanded by the gust load alleviation system in response to a discrete atmospheric gust with the following reference velocities:

(1) 15 fps (EAS) from sea level to 20,000 ft (vertical gust),

(2) 15 fps (EAS) from sea level to 20,000 ft (lateral gust).

(ii) Manoeuvre Load Alleviation Systems. At any airspeed between $1.23V_{Sr1}(1.3V_{Smin})/V_{ref}$ to $V_{MO}/M_{MO}/V_{fe}$ the control surfaces are assumed to jam in the maximum position commanded by the manoeuvre load alleviation system during a pull-up manoeuvre to 1.3g or a pushover manoeuvre to 0.8g.

c. Structural Strength for Flight Control System Jams

(1) Jam Conditions per ESF D-01 (c)(3). It should be shown that the aircraft maintains structural integrity for continued safe flight and landing. Recognising that jams are infrequent occurrences and that margins have been taken in the definition of normally encountered positions of this interpretative material, criteria other than those specified in CS 25.302 Appendix K25.2(c) may be used for structural substantiation to show continued safe flight and landing.

This structural substantiation should be per section (2) as stated below.

(2) Structural Substantiation. The loads considered as ultimate should be derived from the following conditions at speeds up to the maximum speed allowed for the jammed position or for the failure condition:

(i) Balanced maneuver of the aeroplane between 0.25g and 1.75g with high lift devices fully retracted and in enroute configurations, and between 0.6g and 1.4g with high lift devices extended,

(ii) Vertical and lateral discrete gusts corresponding to 40% of the limit gust velocity specified at V_c in CS 25.341(a) with high lift devices fully retracted, and a 17 fps vertical and 17 fps head-on gust with high lift devices extended.

– END –

D-09 (SC): Pilot compartment view – Hydrophobic coatings in lieu of windshield wipers	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.771(a), CS 25.773(b), CS 25.1301, CS 25.1309, CS 25.1523, CS 25.1529
ADVISORY MATERIAL:	--

Special Condition (SC)

Pilot compartment view – Hydrophobic coatings in lieu of windshield wipers

1. CS 25.773(b)(1) is replaced by the following:

   "The airplane must have a means to maintain a clear portion of the windshield, during precipitation conditions, enough for both pilots to have a sufficiently extensive view along the ground or flight path in normal taxi and flight attitudes of the airplane. This means must be designed to function, without continuous attention on the part of the crew, in -"

2. CS 25.773(b)(1)(i) is replaced by the following:

   "Conditions from light misting precipitation to heavy rain at speeds from fully stopped in still air, to 1.5 VSR1 with lift and drag devices retracted; and"

3. All the reference in the regulation to CS 25.773 (b)(1) & (b)(1)(i) should be intended as amended above.

Appendix

Mean of Compliance

Method of showing compliance to CS 25.773(b) as amended by the special condition D-09

The method should address combinations of precipitation conditions, speeds, and airplane configurations that may result in areas on the windshield where airflow is stagnated or may otherwise interfere with maintaining the required clear vision area, and should establish the effectiveness of the hydrophobic coating to maintain the required area of clear vision in both rain and snow conditions.

Yet, the windshield hydrophobic coating proposed for the Falcon 5X may have a limited and variable effective life, and the failure of the coating may be latent. Dassault Aviation should consider this aspects in order to comply with CS 25.773(b)(4)(i), since CS 25.1309 cannot apply to the hydrophobic coating.

Dassault Aviation should describe how they propose to assure the continued airworthiness of the hydrophobic coating as required by CS 25.1529, even considering its latent failure. This information should include consideration of any factors that can cause long term degradation of the effectiveness of the coating such as aging, aerodynamic erosion, thermal effects, and exposure to water and expected airborne chemicals. Furthermore Dassault Aviation should identify any factors that could cause unacceptable degradation of the coating from a single exposure, such as hail, volcanic ash, or wind-blown sand, and describe how continued airworthiness will be assured following such exposure event. If the continuing airworthiness of the coating relies on an inspection/maintenance interval, Dassault Aviation should substantiate that such interval is appropriate in relation with the variable effective life of the coating. The analysis and the tests supporting the instruction for continuing airworthiness of the hydrophobic coating should consider the encountering of the above environmental conditions with a probability of 1.

The Dassault Falcon 5X pilot compartment view should be shown to comply with CS 25.773(b) as amended by this special condition with no more than 5% remaining of the substantiated service life or the proposed inspection interval of the windshield coating, as applicable.

In addition to the above considerations, it has been recently recognised that hydrophobic coatings may be particularly susceptible to degradation when the windscreen is handled in a way that would not normally pose a threat in case it rely on conventional means of precipitation removal. Dassault Aviation should describe the means they propose to avoid or mitigate this failure mechanism of the coating. Specific areas that must be addressed in the Instructions for Continued Airworthiness are:

- approved windscreen cleaning materials and procedure: type of rags, type of cleaners, waxes, etc.,
- appropriate warnings/placards near the windshields, if any,
- any information on the acceptability on the use of de-icing fluids.

Including appropriate information/limitation in both the Airplane Flight Manual and Aircraft Maintenance Manual can be found an acceptable way to mitigate this risk.

– END –

D-12 (SC): All Engines Failed Condition	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.671(d)
ADVISORY MATERIAL:	--

Special Condition (SC)

All Engines Failed Condition

Replace paragraph (d) of CS 25.671 as follows

CS 25.671 General

(d) The aeroplane must be designed so that, if all engines fail at any point of the flight and a suitable runway is available, then it is controllable:

(i) In flight;

(ii) On approach;

(iii) During the flare to a landing;

(iv) During the ground phase; and

(v) The aeroplane can be stopped.

Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

Appendix

Interpretative Material

Introduce new AMC 25.671(d) as follows:

AMC 25.671

Control Systems – General

…

AMC 25.671(d)
EVALUATION OF ALL ENGINES FAILED CONDITION – CS 25.671(d).

a. *Explanation.*

CS 25.671(d) states that, "The aeroplane must be designed so that it is controllable, an approach and flare to a landing is possible and, assuming a suitable runway is available, the aeroplane can be stopped, if all engines fail at any point in the flight. Compliance with the requirement may be shown by analysis where that method has been shown to be reliable."

The intent of CS 25.671(d) is to assure that in the event of failure of all engines and given the availability of an adequate runway, the aeroplane will be controllable, an approach and flare to a landing is possible and the aeroplane can be stopped. In this context, "flare to a landing" refers to the time until touchdown. Although the rule refers to "flare to a landing" with the implication of being on a runway, it is recognised that with all engines inoperative it may not be possible to reach an adequate runway or landing surface; in this case the aircraft must still be able to make a flare to landing attitude.

CS 25.671(d) effectively requires aeroplanes with fully powered or electronic flight control systems to have a source for emergency power, such as an air-driven generator, windmilling engines, batteries, or other power source capable of providing adequate power to the flight control system.

Analysis, simulation, or any combination thereof may be used to show compliance where the methods are shown to be reliable.

b. *Procedures.*

(1) The aeroplane should be evaluated to determine that it is possible, without requiring exceptional piloting skill or strength, to maintain control following the failure of all engines, including the time it takes for activating any backup systems. The aeroplane should also remain controllable during restart of the most critical engine, whilst following the AFM recommended engine restart procedures.

(2) The most critical flight phases, especially for aeroplanes with emergency power systems dependent on airspeed, are likely to be take-off and landing. Credit may be taken for hydraulic pressure/electrical power produced while the engines are spinning down and any residual hydraulic pressure is remaining in the system. Sufficient power must be available to complete a wings-level approach and flare to a landing.

Analyses or tests may be used to demonstrate the capability of the control systems to maintain adequate hydraulic pressure/electrical power during the time between the failure of the engines and the activation of any backup systems. If any of the backup systems rely on aerodynamic means to generate power, then a flight test demonstration should be performed to demonstrate that the backup system could supply adequate electrical and hydraulic power to the flight control systems. The flight test should be conducted at the minimum practical airspeed required to perform an approach and flare to a safe landing attitude.

(3) The manoeuvre capability following the failure of all engines should be sufficient to complete an approach and flare to a landing. Note that the aircraft weight could be extremely low (e.g., the engine failures could be due to fuel exhaustion). The maximum speeds for approach and landing may be limited by other Part-25 requirements (e.g., ditching, tire speeds, flap or landing gear speeds, etc.) or by an evaluation of the average pilot's ability to conduct a safe landing. At an operational weight determined for this case and for any other critical weights and positions of the centre of gravity identified by the applicant, at speeds down to the approach speeds appropriate to the aircraft configuration, the aircraft should be capable of:

(i) A steady 30° banked turn to the left or right;

(ii) A roll from a steady 30° banked turn through an angle of 60° so as to reverse the direction of the turn in not more than 11 seconds (in this manoeuvre the rudder may be used to the extent necessary to minimise side-slip, and the manoeuvre may be unchecked);

(iii) A push-over manoeuvre to 0.8 g, and a pull-up manoeuvre to 1.3 g;

(iv) A wings-level landing flare in a 90° crosswind of up to 10 knots (measured at 10 meters above the ground);

Note: If the loss of all engines has no effect on the control authority of the aircraft (e.g., manual controls), then the results of the basic handling qualities flight tests with all engines operating may be used to demonstrate the satisfactory handling qualities of the aeroplane with all engines failed.

(4) It should be possible to perform a flare to a safe landing attitude, in the most critical configuration, from a stabilised approach using the recommended approach speeds and the appropriate AFM procedures, without requiring exceptional piloting skill or strength. For transient manoeuvres, forces are allowed up to 1.5 times those specified in CS 25.143(c) for temporary application with two hands available for control.

(5) Finally, assuming that a suitable runway is available, it should be possible to control the aeroplane until it comes to a complete stop.

– END –

D-16 (SC): Use of Flaperons for Lift and Roll Control	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.701, 25.703, 25.671, 25.672 and 25.1309
ADVISORY MATERIAL:	--

Special Condition (SC)

Use of Flaperons for Lift and Roll Control

In addition to the current CS 25.701, the following conditions are applicable:

1. It must be demonstrated that an unsafe condition is not created by using the flaperons asymmetrically.

2. The degree of acceptable asymmetry (could be full asymmetry if shown to be safe) must be defined and justified for all flight phases with respect to structural loads, aircraft performance and handling.

3. Protection against excessive asymmetry (greater than established at point 2.) must be provided with a similar reliability as CS 25.701 requires for systems that are synchronised by a mechanical interconnection or approved equivalent means.

4. The flaperon control function is part of the flight control system and therefore compliance must be demonstrated to general system requirements and general flight control requirements. Therefore, the function must be demonstrated:

   - To comply with CS 25.671, 25.672 and CS 25.1309
   - To comply with CRI D-01 Flight Control System Failure Criteria with respect to significant latent failures

– END –

D-37 (SC): Personal injury criteria of dynamic testing of side facing sofas	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.785(b), 25.562
ADVISORY MATERIAL:	FAA PS-ANM-25-03-R1

Special Condition (SC)

Special Conditions for the installation of Side-Facing Seats

Personal injury criteria of dynamic testing of side facing sofas

1. Additional requirements applicable to tests or rational analysis conducted to show compliance with CS 25.562 and 25.785 for side-facing seats:
   a) The longitudinal test(s) conducted in accordance with CS 25.562(b)(2) to show compliance with the seat-strength requirements of CS 25.562(c)(7) and (8), and these special conditions must have an ES-2re anthropomorphic test dummy (ATD) (49 CFR part 572 subpart U) or equivalent, or a Hybrid-II ATD (49 CFR part 572, subpart B as specified in CS 25.562) or equivalent, occupying each seat position and including all items contactable by the occupant (e.g., armrest, interior wall, or furnishing) if those items are necessary to restrain the occupant. If included, the floor representation and contactable items must be located such that their relative position, with respect to the centre of the nearest seat place, is the same at the start of the test as before floor misalignment is applied. For example, if floor misalignment rotates the centreline of the seat place nearest the contactable item 8 degrees clockwise about the aircraft x-axis, then the item and floor representations must be rotated by 8 degrees clockwise also to maintain the same relative position to the seat place, as shown in Figure 1. Each ATD's relative position to the seat after application of floor misalignment must be the same as before misalignment is applied. To ensure proper loading of the seat by the occupants, the ATD pelvis must remain supported by the seat pan, and the restraint system must remain on the pelvis and shoulder of the ATD until rebound begins. No injury-criteria evaluation is necessary for tests conducted only to assess seat-strength requirements.
   b) The longitudinal test(s), conducted in accordance with CS 25.562(b)(2) to show compliance with the injury assessments required by CS 25.562(c) and these special conditions may be conducted separately from the test(s) to show structural integrity. In this case, structural-assessment tests must be conducted as specified in paragraph 1a, above, and the injury-assessment test must be conducted without yaw or floor misalignment. Injury assessments may be accomplished by testing with ES-2re ATD (49 CFR part 572 subpart U) or equivalent at all places. Alternatively, these assessments may be accomplished by multiple tests that use an ES-2re at the seat place being evaluated, and a Hybrid-II ATD (49 CFR part 572, subpart B, as specified in CS 25.562) or equivalent used in all seat places forward of the one being assessed, to evaluate occupant interaction. In this case, seat places aft of the one being assessed may be unoccupied. If a seat installation includes adjacent items that are contactable by the occupant, the injury potential of that contact must be assessed. To make this assessment, tests may be conducted that include the actual item, located and attached in a representative fashion. Alternatively, the injury potential may be assessed by a combination of tests with items having the same geometry as the actual item, but having stiffness characteristics that would create the worst case for injury (injuries due to both contact with the item and lack of support from the item).

c) If a seat is installed aft of structure (e.g., an interior wall or furnishing) that does not have a homogeneous surface contactable by the occupant, additional analysis and/or test(s) may be required to demonstrate that the injury criteria are met for the area which an occupant could contact. For example, different yaw angles could result in different injury considerations and may require additional analysis or separate test(s) to evaluate.

d) To accommodate a range of occupant heights (5th percentile female to 95th percentile male), the surface of items contactable by the occupant must be homogenous 7.3 inches (185 mm) above and 7.9 inches (200 mm) below the point (centre of area) that is contacted by the 50th percentile male size ATD's head during the longitudinal test(s) conducted in accordance with paragraphs a, b, and c, above. Otherwise, additional head injury criteria (HIC) assessment tests may be necessary. Any surface (inflatable or otherwise) that provides support for the occupant of any seat place must provide that support in a consistent manner regardless of occupant stature. For example, if an inflatable shoulder belt is used to mitigate injury risk, then it must be demonstrated by inspection to bear against the range of occupants in a similar manner before and after inflation. Likewise, the means of limiting lower-leg flail must be demonstrated by inspection to provide protection for the range of occupants in a similar manner.

e) For longitudinal test(s) conducted in accordance with CS 25.562(b)(2) and these special conditions, the ATDs must be positioned, clothed, and have lateral instrumentation configured as follows:

(1) ATD positioning:

Lower the ATD vertically into the seat while simultaneously (see Figure 2 for illustration):

a) Aligning the mid-sagittal plane (a vertical plane through the midline of the body; dividing the body into right and left halves) with approximately the middle of the seat place.

b) Applying a horizontal x-axis direction (in the ATD coordinate system) force of about 20 lb (89 N) to the torso at the intersection of the midsagittal plane and the bottom rib of the ES-2re or lower sternum of the Hybrid-II at the midsagittal plane, to compress the seat back cushion.

c) Keeping the upper legs nearly horizontal by supporting them just behind the knees.

Once all lifting devices have been removed from the ATD:

d) Rock it slightly to settle it in the seat.

e) Separate the knees by about 4 inches (100 mm)

f) Set the ES-2re's head at approximately the midpoint of the available range of z-axis rotation (to align the head and torso midsagittal planes).

g) Position the ES-2re's arms at the joint's mechanical detent that puts them at approximately a 40 degree angle with respect to the torso. Position the Hybrid-II ATD hands on top of its upper legs.

h) Position the feet such that the centrelines of the lower legs are approximately parallel to a lateral vertical plane (in the aircraft coordinate system).

(2) ATD clothing:

Clothe each ATD in form-fitting, mid-calf-length (minimum) pants and shoes (size 11E) weighing about 2.5 lb (1.1 Kg) total. The colour of the clothing should be in contrast to the colour of the restraint system. The ES-2re jacket is sufficient for torso clothing, although a form-fitting shirt may be used in addition if desired.

(3) ES-2re ATD lateral instrumentation:

The rib-module linear slides are directional, i.e., deflection occurs in either a positive or negative ATD y-axis direction. The modules must be installed such that the moving end of the rib module is toward the front of the aircraft. The three abdominal-force sensors must be installed such that they are on the side of the ATD toward the front of the aircraft.

f) The combined horizontal/vertical test, required by CS 25.562(b)(1) and these special conditions, must be conducted with a Hybrid II ATD (49 CFR part 572 subpart B as specified in CS 25.562), or equivalent, occupying each seat position.

g) Restraint systems:

(1) If inflatable restraint systems are used, they must be active during all dynamic tests conducted to show compliance with CS 25.562.

(2) The design and installation of seat-belt buckles must prevent unbuckling due to applied inertial forces or impact of the hands/arms of the occupant during an emergency landing.

2. Additional performance measures applicable to tests and rational analysis conducted to show compliance with CS 25.562 and 25.785 for side-facing seats:

a. Body-to-body contact: Contact between the head, pelvis, torso, or shoulder area of one ATD with the adjacent-seated ATD's head, pelvis, torso, or shoulder area is not allowed. Contact during rebound is allowed.

b. Thoracic: The deflection of any of the ES-2re ATD upper, middle, and lower ribs must not exceed 1.73 inches (44 mm). Data must be processed as defined in Federal Motor Vehicle Safety Standards (FMVSS) 571.214.

c. Abdominal: The sum of the measured ES-2re ATD front, middle, and rear abdominal forces must not exceed 562 lbs (2,500 N). Data must be processed as defined in FMVSS 571.214.

d. Pelvic: The pubic symphysis force measured by the ES-2re ATD must not exceed 1,350 lbs (6,000 N). Data must be processed as defined in FMVSS 571.214.

e. Leg: Axial rotation of the upper-leg (femur) must be limited to 35 degrees in either direction from the nominal seated position.

f. Neck: As measured by the ES-2re ATD and filtered at CFC 600 as defined in SAE J211:

1) The upper-neck tension force at the occipital condyle (O.C.) location must be less than 405 lb (1,800 N).

2) The upper-neck compression force at the O.C. location must be less than 405 lb (1,800 N).

3) The upper-neck bending torque about the ATD x-axis at the O.C. location must be less than 1,018 in-lb (115 Nm).

4) The upper-neck resultant shear force at the O.C. location must be less than 186 lb (825 N).

g. Occupant (ES-2re ATD) retention: The pelvic restraint must remain on the ES-2re ATD's pelvis during the impact and rebound phases of the test. The upper-torso restraint straps (if present) must remain on the ATD's shoulder during the impact. Alternatively to this requirement, for instances where the pelvic restraint moves off the pelvis during the rebound phase of the test, a 250 lbs restraint tension load limit may be used to establish an alternative compliance, provided the following requirements are met:

1) A clear indication of when the restraint moves above the pelvis. Loose clothing can make it difficult to determine where the top of the pelvis is, and in turn make it hard to discern exactly when the restraint moved above it. This can be improved by marking the top of the pelvis clearly and by positioning the cameras so that the position of the restraint, relative to the top of the pelvis can be observed throughout the test.

2) Measurement of the restraint tension during the time when the restraint moves above the pelvis. The webbing transducer should be placed to measure the total tension in the forward restraint segment. If a split (combined body-centered and conventional) leading restraint is used, the tension should be measured in the common section so that it reflects the contribution of each segment. Since this placement typically produces contact between the ATD and the transducer, it is important to use a webbing transducer that is not sensitive to contact.

3) Useful video and pelvic restraint load data must be recorded until significant ATD rebound motion stops. Extra recording time is necessary because submarining usually occurs later in the test than other injury criteria maximums.

h. Occupant (ES-2re ATD) support:

1) Pelvis excursion: The load-bearing portion of the bottom of the ATD pelvis must not translate beyond the edges of its seat's bottom seat-cushion supporting structure.

2) Upper-torso support: The lateral flexion of the ATD torso must not exceed 40 degrees from the normal upright position during the impact.

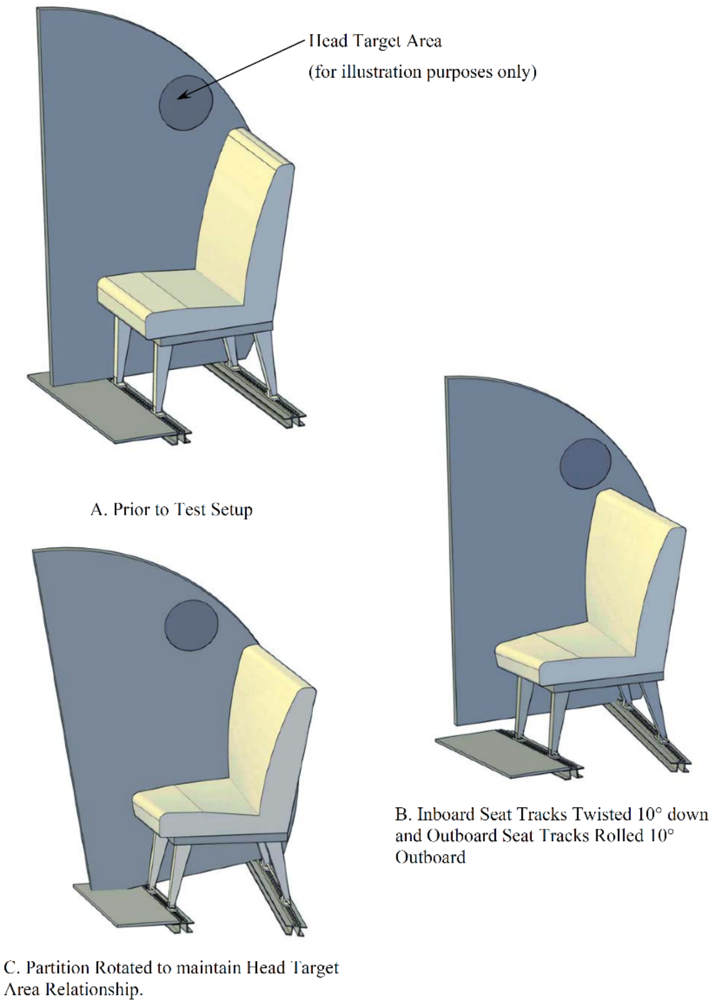


Figure 1

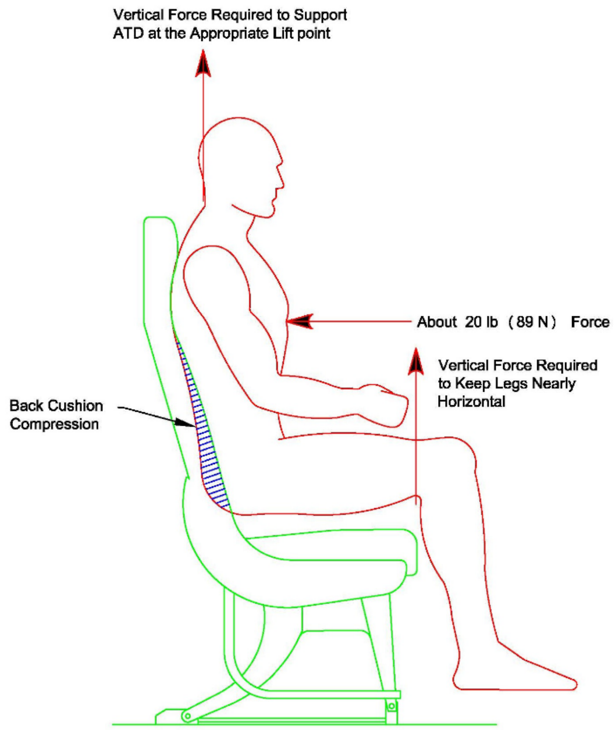


Figure 2

Special Condition (SC)

Special Conditions for side-facing seat place(s) equipped with inflatable passenger restraint

Personal injury criteria of dynamic testing of side facing sofas

1. For seats with automatically deploying safety systems, show that any automatically deploying safety system will deploy and provide protection under crash conditions where it is necessary to prevent serious injury. The means of protection must take into consideration a range of stature from a 2-year-old child to a 95th percentile male. The automatically deploying safety system must provide a consistent approach to energy absorption throughout that range of occupants. When the seat system includes an automatically deploying safety system, that system must be included in each of the certification tests as it would be installed in the airplane. In addition, the following situations must be considered:
   a. The seat occupant is holding an infant.
   b. The seat occupant is a pregnant woman.
2. All automatically deploying safety systems must provide adequate protection for each occupant regardless of the number of occupants of the seat assembly, considering that unoccupied seats may have active automatically deploying safety systems installed.
3. The design must prevent all automatically deploying safety systems from being either incorrectly buckled or incorrectly installed, such that the automatically deploying safety system would not properly deploy. Alternatively, it must be shown that such deployment is not hazardous to the occupant, and will provide the required injury protection.
4. It must be shown that all automatically deploying safety system are not susceptible to inadvertent deployment as a result of wear and tear, or inertial loads resulting from in-flight or ground manoeuvres (including gusts and hard landings), and other operating and environmental conditions (vibrations, moisture, etc.) likely to occur in service.
5. Deployment of any automatically deploying safety system must not introduce injury mechanisms to the seated occupant, or result in injuries that could impede rapid egress. This assessment should include an occupant whose belt is loosely fastened.
6. It must be shown that inadvertent deployment of any automatically deploying safety system, during the most critical part of the flight, will either meet the requirement of CS 25.1309(b) or not cause a hazard to the airplane or its occupants.
7. It must be shown that any automatically deploying safety system will not impede rapid egress of occupants 10 seconds after airbag deployment.
8. All automatically deploying safety system must be protected from lightning and high-intensity radiated fields (HIRF). The threats to the airplane specified in existing regulations regarding lightning, CS 25.1316, and HIRF, CS 25.1317, are incorporated by reference for the purpose of measuring lightning and HIRF protection.
9. All automatically deploying safety system must function properly after loss of normal aircraft electrical power, and after a transverse separation of the fuselage at the most critical location. A separation at the location of the automatically deploying safety system does not have to be considered.

10. It must be shown that automatically deploying safety systems will not release hazardous quantities of gas or particulate matter into the cabin.
11. All automatically deploying safety system installation must be protected from the effects of fire such that no hazard to occupants will result.
12. A means must be available for a crewmember to verify the integrity of all automatically deploying safety system prior to each flight, or it must be demonstrated to reliably operate between inspection intervals. The EASA considers that the loss of an automatically deploying safety system deployment function alone (i.e., independent of the conditional event that requires the automatically deploying safety system deployment) is a major-failure condition.
13. The inflatable material may not have an average burn rate of greater than 2.5 inches/minute when tested using the horizontal flammability test defined in part 25, Appendix F, part I, paragraph (b)(5).
14. Any automatically deploying safety system, once deployed, must not adversely affect the emergency-lighting system (i.e., block floor proximity lights to the extent that the lights no longer meet their intended function).

Note: The special conditions above are meant to apply to restraint mounted airbags for side facing seats, however they have been generalized to any automatically deploying safety system triggered by the airbag system. Some conditions, such as Special Condition 1, may not in part or fully, apply to non-inflatable systems, it is left to the design applicant to explain and justify this aspect.

Appendix

Means of Compliance with the special conditions on leg flail injury and on ATD submarining
Personal injury criteria of dynamic testing of side facing sofas

Leg Flail Injury Assessment

Special condition 2.e. of Appendix A contains the following requirement:

"Leg: Axial rotation of the upper-leg (femur) must be limited to 35 degrees in either direction from the nominal seated position."

It has been found problematic to comply with this requirement. During "threshold" testing, i.e. with the leg flail prevention device disabled and a correspondingly low deceleration chosen to substantiate the design for crash cases where the device will not be triggered, the 35 degrees limit has been exceeded. Also, in higher deceleration tests, with the leg flail prevention device functional, the 35 degrees limit has been exceed during rebound.

These issues have been investigated by the FAA and it has been concluded that a design may still be acceptable, even though it exhibits the above described exceedances, provided other limitations are respected.

EASA is in agreement with the FAA conclusions, and the alternative means of compliance.

Therefore, in lieu of direct compliance to paragraph 2.e. of Appendix A, the applicant may use the following means of compliance;

1. For g-levels up to the point where the leg flail airbag is designed to deploy, perform a severity comparison between the PMHS low–g research tests and the airbag threshold tests and demonstrate that the chosen airbag threshold is not injurious (e.g. the threshold test severity is less than the PMHS low-g research test that produced no injury).

2. For all g-levels, if the design of the leg flail limiting device does absorb some of the impact energy, returning only a portion to the legs (a qualitative assessment), then a rebound leg flail of greater than 35 degrees is acceptable.

NOTES:

a. For aspects such as the PMHS low-g research, refer to FAA Report DOT/FAA/AM-17/2 (Supplemental Injury Risk Considerations for Aircraft Side-Facing Seat Certification, dated January 2017).

b. The ES-2 ATD should be used.

ATD Submarining

Special condition 2.g of Appendix A contains the following requirement:

"Occupant (ES-2re ATD) retention: The pelvic restraint must remain on the ES-2re ATD's pelvis during the impact and rebound phases of the test. The upper-torso restraint straps (if present) must remain on the ATD's shoulder during the impact."

It has been found problematic to comply with this requirement. During testing with seats not having surrounding structure, after rebound the ATD ends up on its back. This typically results in the lap belt partially bearing on the ATD abdomen.

These issues have been investigated by the FAA and it has been concluded that a design may still be acceptable, even though testing exhibits the above described ATD behaviour, provided other limitations are respected. FAA provided an alternative means of compliance to the above quoted requirement. EASA is in agreement with the FAA conclusions, and the alternative means of compliance.

Therefore, in lieu of direct compliance to special condition 2.g. of Appendix A, the applicant may use the following means of compliance;

During testing a lap belt tension limit of 1112 N (250 lb) must not be exceeded. When obtaining the pelvic restraint performance using these criteria, three things are needed;

1. A clear indication of when the belt moves above the pelvis. Loose clothing can make it difficult to determine where the top of the pelvis is, and in turn make it hard to discern exactly when the belt moved above it. This can be improved by marking the top of the pelvis clearly and by positioning the cameras so that the position of the belt, relative to the top of the pelvis, can be observed throughout the test.
2. A measurement of the belt tension during the time when the belt moves above the pelvis. The webbing transducer should be placed to measure the total tension in the forward lap belt segment. If a split (combined body-centred and conventional) leading belt is used, the tension should be measured in the common section so that it reflects the contribution of each segment. Since this placement typically produces contact between the ATD and the transducer, it is important to use a webbing transducer that is not sensitive to contact.
3. Useful video and belt load data must be recorded until significant ATD rebound motion stops. Extra recording time is necessary because submarining usually occurs later in the test than other injury criteria maxima.

– END –

E-03 (SC): Water / Ice in Fuel System	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.951(c), CS 25J.951 (c)
ADVISORY MATERIAL:	--

Special Condition (SC)

Water / Ice in Fuel System

The applicant shall demonstrate that the aircraft/engine/APU fuel system is:

- either designed to prevent the accumulation of ice and release towards the aircraft/engine/APU supplying system,
- or be designed tolerant to the accumulation of ice and release towards the aircraft/engine/APU supplying system without significant adverse effect(s) on the powerplant systems

The applicant must establish the threat(s) (quantity of ice, temperature) that can be released.

Appendix

Interpretative Material

In finding compliance with SC E-03, the following guidelines should be considered:

1. All components of the fuel system should be taken into account, including pipes and fuel tank structure. The environmental effects of component immersion in fuel, exposure to the tank ullage space and surrounding ambient air temperatures should be assessed in consideration of ice accretion and release.
2. The assessment should be performed for the most critical temperature conditions. It should at least address temperatures close to the fuel freezing point as well as temperatures likely to favour ice accretion, typically in the -20°/-10°C range.
3. Cumulative ice accretion over several flights should be minimised by design. The effect of the water sumping program as well as ground operation below 0°C should be taken into account.

If testing is used to establish compliance, the applicant should ensure that consistent and repeatable results are achieved.

– END –

F-09 (SC): Flight Recorders including Data Link Recording	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1301, 25.1457, 25.1459
ADVISORY MATERIAL:	EUROCAE ED-112, ED-93

Special Condition (SC)

Flight Recorders including Data Link Recording

The flight recorder shall record:

a) Data link communications related to air traffic services (ATS Communications[1]) to and from the aeroplane.

b) All messages whereby the flight path of the aircraft is authorized, directed or controlled, and which are relayed over a digital data link rather than by voice communication.

c) The minimum recording duration shall be equal to the duration of the Cockpit Voice Recorder, and the recorded data shall be time correlated to the recorded cockpit audio.

d) To enable an aircraft operator to meet (EU) 965/2012 Regulation on Air Operations CAT.IDE.A.195(b), information shall be provided explaining how the recorded data can be converted back to the format of the original data link messages in order to determine an accurate sequence of events for the aircraft and the cockpit operation.

[1] ATS communications (ATSC) are defined by ICAO as communications related to air traffic services including air traffic control, aeronautical and meteorological information, position reporting and services related to safety and regularity of flight.

APPENDIX I

Interpretative Material

Data link communications mentioned in the Special Condition include:

- Controller/Pilot Data Link Communications (CPDLC),
- Character Orientated Air Traffic Service (ATS) Applications (ARINC 623 applications of DCL, OCL, and D-ATIS).
- Automatic Dependent Surveillance-Contract (ADS-C)
- ATS Facility Notification (AFN) or Context Management (CM)

Data-link communication in this context is limited to communications between the aircraft and the air traffic services via the air traffic network.

It also will include automatic dependent surveillance (ADS) information, when defined and implemented, to be used for air traffic surveillance purposes and unless the corresponding source data is already recorded on the FDR. In order to ensure harmonisation with FAA requirements, the data link communications should preferably be recorded on the Cockpit Voice Recorder.

In the context of this CRI, air traffic network means any network commissioned by an air traffic service provider.

In showing compliance with the above Special Condition, the data link recording process should be compliant with EUROCAE documents ED-93, “Minimum Aviation System Performance Specification for CNS/ATM Message Recording Systems” and ED-112 Part IV “Minimum Operational Performance Specification for crash protected airborne recorder system”, with the exception that table A-1 of this CRI supersedes table IV-B.1 of ED-112. The content of table A-1 of this CRI is fully compliant with the requirements of ICAO Annex 6, Part I, Chapter 6.3.4 and associated Appendix 8, Chapter 5 and (EU) 965/2012 Regulation on Air Operations CAT.IDE.A.195.

If data link communications are being recorded on the Cockpit Voice Recorder, the Erasure Function of the Cockpit Voice Recording System should only be applicable to the audio parts of the recorded files under the given preconditions. Data link recording files should not be erasable with this function.

Attachment 1 to Appendix I

Application Recording Table

The following table A-1 lists the appropriate data to be recorded:

Table A-1 symbol:

The following symbols are used in the table A-1 to denote:

C: Complete contents recorded.

M: Information that enables correlation to any associated records stored separately from the aeroplane

M* Applications that are to be recorded only as far as is practicable, given the architecture of the system.

Table A-1: Definition of "Data Link Point to Point Communications" Application

Item No.	Application Type	Application Description	Required Recording Content
1	Data link Initiation	This includes any applications used to logon to, or initiate data link service. In FANS-1/A and ATN, these are ATS Facilities Notification (AFN) and Context Management (CM) respectively.	C
2	Controller/Pilot Communication	This includes any application used to exchange requests, clearances, instructions and reports between the flight crew and controllers on the ground. In FANS-1/A and ATN, this includes the CPDLC application. It also includes applications used for the exchange of oceanic (OCL) and departure clearances (DCL) as well as data link delivery of taxi clearances.	C
3	Addressed Surveillance	This includes any surveillance application in which the ground sets up contracts for delivery of surveillance data. In FANS-1/A and ATN, this includes the Automatic Dependent Surveillance (ADS-C) application. Where parametric data is reported within the message it shall be recorded unless data from the same source is recorded on the FDR.	C
4	Flight Information	This includes any application used for delivery of flight information data to specific aeroplanes. This includes D-ATIS, D-OTIS, text weather services, NOTAM delivery.	C
5	Aircraft Broadcast Surveillance	This includes Elementary and Enhanced Surveillance Systems, as well as ADS-B output data. Where parametric data sent by the aeroplane, is reported within the message it shall be recorded unless data from the same source is recorded on the FDR.	M*

Item No.	Application Type	Application Description	Required Recording Content
6	AOC data	This includes any application transmitting or receiving data used for AOC purposes (in accordance with ICAO definition of AOC)	M*

APPENDIX II

ACRONYMS

ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
AFN	ATS Facilities Notification
AOC	Aeronautical Operational Control
ATS	Air Traffic Service
ATSC	Air Traffic Service Communications
C of A	Certificate of Airworthiness
CM	Context Management
CPDLC	Controller / Pilot Data Link Communications
CS	Certification Specification
CVR	Cockpit Voice Recorder
D-ATIS	Digital – Automatic Terminal Information Services
DCL	Departure Clearance
DL	Data Link
DLIC	Data Link Initiation Capability
ED	EUROCAE Document
ETSO	European Technical Standard Order
FDR	Flight Data Recorder
ICAO	International Civil Aviation Organization
MASPS	Minimum Aviation System Performance Specification
OCL	Oceanic Clearances
SC	Special Condition

– END –

F-39 (SC): Security Protection of Aircraft Systems and Networks	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1309
ADVISORY MATERIAL:	EUROCAE ED-202

Special Condition (SC)

Security Protection of Aircraft Systems and Networks

a) The applicant shall ensure security protection of the systems and networks of the aircraft from any remote or local access by unauthorized sources if corruption of these systems and networks (including hardware, software, data) by an inadvertent or intentional attack would impair safety, and

b) The applicant shall ensure that the security threats to the aircraft, including those possibly caused by maintenance activity or by any unprotected connecting equipment/devices inside or outside the A/C, are identified, assessed and risk mitigation strategies are implemented to protect the aircraft systems from all adverse impacts on safety, and

c) Appropriate procedures shall be established to ensure that the approved security protection of the aircraft's systems and networks is maintained following future changes to the Type Certificated design.

APPENDIX I

Interpretative Material

Aircraft systems and networks covered by CS 25.1309 should be assessed against potential failure caused by information security threats in order to evaluate their vulnerabilities to these threats. To do so an acceptable means is to perform a Particular Risk Analysis, called in the rest of this AMC "Network Security Assessment", that is described in section I.

As a result of this assessment, either the aircraft systems have no known vulnerabilities, or the vulnerabilities cannot be exploited by any security threat to create a Hazard of a Failure Condition that has an effect deemed unacceptable against CS 25.1309.

When vulnerabilities exist and protection mechani5X are needed to fulfil this requirement, validation and verifications of these security protection mechanisms, as described in section II, should demonstrate that the implemented mechanisms provide the expected protection against information security threats.

When required, Instruction for Continued Airworthiness as described in section III should be developed to maintain the security efficiency after the entry into service of the Aircraft.

I . AIRCRAFT SYSTEMS AND NETWORK SECURITY ASSESSMENT

As recommended in ED-79A/ARP-4754A and ED-135/ARP-4761, a Particular Risk Analysis is required when risks, as those events or influences which are outside the system(s) and item(s) concerned, but which may violate failure independence claims, may be encountered. Having identified the appropriate risks with respect to the design under consideration, each risk should be the subject of a specific study to examine and document the simultaneous or cascading effect(s) of each risk. The objective is to ensure that any safety related effects are either eliminated or the risk is shown to be acceptable.

In this context, the applicant should develop an analysis similar to the Particular Risk Analysis and dedicated to Aircraft Systems and Network Information Security, hereafter referred to as the Network Security Assessment. It should include:

1. identification and detailed definition or the information security threats, risks and vulnerabilities
2. identification of the impacted assets
3. review of the consequences on safety of the information security threat on the affected items

   Note*: the following documentation should be used as input, when appropriate: FHA, FMEA or PSSA*

4. review of the potential effect of the information security threats on the aircraft safety
5. Determination if the consequences are acceptable.
   a) If yes, preparation of justification for certification
   b) If no,
      i. implementation, description and justification of a protection mechanism(s),
      ii. Identification of the vulnerabilities associated with incorrect operation or loss of the protection mechanisms
6. Definition of the Security Level for all implemented protection mechanism. This security level determination should encompass:
   c) the effectiveness of the protection mechanism,
   d) the likelihood of the information security thread to occur and,
   e) the acceptability of the risk, depending on its effect to the safety.

When a system and network security rule violation may, as a result of this assessment, generate an unsafe condition, this violation should be reported timely to the crew or maintenance operators. Guidance can be found in AMC 25.1309 § 9(5) Crew and Maintenance Actions (i), (ii) and (iii).

The applicant should gain the agreement of the EASA for those assigned protection levels and their network security protection plan(s).

Guidance for performing security risk assessments for airworthiness on Aircraft Systems and Network, and for Security Level determination can be found in document EUROCAE ED-202/ RTCA DO-326.

This Network Security Assessment should be performed for any design change which may have an effect on the Aircraft Systems and Network Security.

II VALIDATION AND VERIFICATION OF THE AIRCRAFT SYSTEMS AND NETWORK SECURITY PROTECTION

When vulnerabilities have been identified during the Network Security Assessment, and when these vulnerabilities require the implementation of protection mechanisms, security verifications should demonstrate that Aircraft safety is not lowered by information security threats.

These security verifications should:

a) establish the correct functioning of security technical features, and

b) verify the absence of unintended functionality, and

c) verify the absence of new vulnerabilities introduced by the protection mechanism.

These verifications should be performed as much as possible by security testing. Security testing addresses the aircraft system from the perspective of a potential adversary, using network access or other vulnerabilities identified in the Network Security Assessment, potentially including:

a) Network access;

b) Logical remote access where enabled; and

c) Forged data (such as malware, coherently corrupted data tables, configuration files).

In case that these verifications cannot be established through functional testing, they may be done by combinations of analysis, (security oriented) robustness testing, inspection and review.

III. INSTRUCTION AND INFORMATION FOR CONTINUED AIRWORTHINESS

The applicant should identify the network security assets and protection mechanism to be addressed by the ICA of the aircraft (for example: physical and operational security, auditing and monitoring of the security efficiency, key management procedures that are used as assumptions in the security assurance process) and develop the appropriate procedure to maintain the security efficiency after the aircraft enters commercial service.

When an in-service occurrence is reported, the applicant should consider the possibility to be originated by a system and network security rule violation and should take any required corrective action accordingly. When a system and network security rule violation has generated an unsafe condition, then information about occurrence, investigation results and recovery actions will be reported to the Agency in accordance with Part 21A.3.

The Applicant should also assess the impact of new threats not foreseen during previous Network Security Assessment, on the aircraft systems and networks. In case the assessment would identify an unacceptable hazard of Failure Condition, the Applicant should notify the Operators of the need to update the protection means.

APPENDIX II

Definitions and glossary

Definitions:
See also ED-202 for a complete set of definition.

Terms	Definitions
Asset	Systems or Functions which have a safety effect and their level of protection depends of the safety effect for the safety.
Security	Safeguarding civil aviation against acts of unlawful interference, which consist in this context of threats to the integrity and availability of aircraft systems and data, including operational software, over networks and network interfaces but excluding consideration for or mitigation of physical threats that does not involve propagation of data or information over a network or manipulation of data by a computer system.
Security Effectiveness	Property of system demonstrating that security features are sufficient against security objectives (which includes considered threat sources).
Threat	Any potential violation of security that could cause direct or indirect damages to an asset
Vulnerability	A flaw or weakness in system security procedures, design, implementation, or internal controls that could be exercised (accidentally triggered or intentionally exploited) and result in a security breach or a violation of the system's security policy.

Glossary:

Abbrev	**Meaning**
AMC	Acceptable Means of Compliance
CRI	Certification Review Item
CS	Certification Specification
EASA	European Aviation Safety Agency
ED	EUROCAE Document
IM	Interpretative Material
RTCA	Radio Technical Commission for Aeronautics
SC	Special Condition
STC	Supplemental Type Certification
TC	Type Certification

– END –

F-43 (SC): Non-rechargeable Lithium Battery Installations	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.601, 25.863, 25.869, 25.1301, 25.1309, 25.1353(c), 25.1529, 25.1360 (b)
ADVISORY MATERIAL:	--

Special Condition (SC)

Non-rechargeable Lithium Battery Installations

In lieu of the requirements of CS 25.1353(c) (1) through (c)(4), non-rechargeable Lithium batteries and battery installations must comply with the following special conditions:

4. Be designed so that safe cell temperatures and pressures are maintained under all foreseeable operating conditions to preclude fire and explosion.
5. Be designed to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.
6. Not emit explosive or toxic gases in normal operation, or as a result of its failure, that may accumulate in hazardous quantities within the airplane.
7. Must meet the requirements of CS 25.863(a) through (d).
8. Not damage surrounding structure or adjacent systems, equipment or electrical wiring of the airplane from corrosive fluids or gases that may escape and that may cause a major or more severe failure condition.
9. Have provisions to prevent any hazardous effect on airplane structure or essential systems caused by the maximum amount of heat it can generate due to any failure of it or its individual cells.
10. Have a means to detect its failure and alert the flight crew in case its failure affects safe operation of the aircraft.
11. Have a means for the flight crew or maintenance personnel to determine the battery charge state if its function is required for safe operation of the airplane.

Note 1: A battery system consists of the battery and any protective, monitoring and alerting circuitry or hardware inside or outside of the battery. It also includes vents (where necessary) and packaging. For the purpose of this special condition, a battery and battery system are referred to as a battery.

Note 2: These special conditions apply to all non-rechargeable lithium battery installations in lieu of 25.1353(c)(1) through (c)(4). Section 25.1353(c)(1) through (c)(4) will remain in effect for other battery installations.

Note 3: For the purpose of SCs 7 and 8, “safe operation of the airplane” is defined as continued safe flight and landing following failures or other non-normal conditions. The following are examples of devices with batteries that are not required for continued safe flight and landing of the airplane: emergency locator transmitters, underwater locator beacons, seat belt air bag initiators and flashlights. A backup flight instrument with a non-rechargeable lithium battery is an example that would be required for safe operation of the airplane.

APPENDIX

Means of Compliance

Minimum Operational Performance Standards (MOPS) for Non–Rechargeable Lithium Batteries DO-227A and a risk assessment at A/C level (limited to Special Conditions 3, 4, 5 & 6) are an acceptable MoC to the Special Conditions 1 to 6 contained in this CRI.

For Very Small Non-rechargeable Lithium Batteries (equal or less than 2 Watt-hour of energy), an acceptable MoC with this Special Conditions is showing these batteries compliant with Underwriters Laboratories (UL) 1642.

– END –

F-46 (SC): Airframe Ice Protection System performance above CS 25 Appendix C	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1419, CS 25.1093(b), CS 25 Appendix C
ADVISORY MATERIAL:	--

Special Condition (SC)

Aeroplane Ice Protection System operation above the maximum altitudes of CS-25 Appendix C icing envelopes

If an ice protection system (IPS) is optimised/modulated, or even inhibited, above the maximum altitude of Appendix C icing envelopes, the applicant shall demonstrate that the aeroplane can safely operate in icing conditions encountered at any altitudes of the operational flight envelope, or an AFM limitation shall be introduced to prohibit operations in icing conditions at altitudes beyond a certified icing envelope.

Annex

Acceptable Means of Compliance to SC to demonstrate safe operation above the maximum altitudes of the Appendix C icing envelopes with an optimised/modulated IPS.

The associated Means of Compliance is published for awareness only and is not subject to public consultation.

An aeroplane IPS is considered optimised/modulated wherever a bleed 'optimization' logic is implemented at engine or aeroplane level. When an aeroplane is operated with such IPS logic, it could not be able to demonstrate safe operation in icing conditions within its entire flight envelope. In such a case the applicant should define the certified icing envelope where the aircraft operation in icing condition is unrestricted.

The applicant should follow one of the following 3 options:

12. The applicant demonstrates safe operation in icing conditions at all altitudes up to its operational ceiling; then the certified icing envelope is the aeroplane flight envelope, and no AFM limitation is required.

13. The applicant does not demonstrate safe operation in icing conditions at altitudes above the maximum altitude of the Appendix C icing envelopes; then the certified icing envelopes are those indicated in the CS-25 Appendix C only; and an AFM limitation is introduced to prevent aeroplane operation in icing conditions above the maximum altitude of Appendix C icing envelopes.

14. The applicant demonstrates safe operation in icing conditions up to a certain altitude between the maximum altitude of Appendix C icing envelopes and its operational ceiling; then the certified icing envelope is the Appendix C icing envelopes extended up to the demonstrated altitude; and an AFM limitation is introduced to prevent aeroplane operation in icing conditions at altitudes above the demonstrated altitude and up to its ceiling.

With regard to the Case 2 – limitation to Appendix C icing envelopes -, considering the difference in term of maximum altitude in the CM and IM icing envelopes, 2 ways forward are envisaged:

- If a limitation is proposed at 22000 feet, no further demonstration is required from the applicant;
- If a limitation is proposed between 22000 and 30000 feet, the capability to safely operate in CM icing conditions has to be demonstrated up to the proposed altitude limit accordingly.

With regard to the case 3, CM and IM icing conditions should be assessed above their respective maximum altitude envelopes and up to the altitude limit for flight in icing conditions selected by the applicant.

An applicant may demonstrate safe flight operation of an aeroplane with an optimised IPS design above the altitude of Appendix C icing envelopes through two compliance strategies, i.e.:

a) based on comparative analysis with previously certified IPS designs with safe flight-in-icing in-service experience, or

b) based on direct demonstration.

Below some guidance material for options a) and b)

Compliance Strategy/Option a): Comparative Analysis

For new aeroplane design having comparable handling qualities and performance in both dry air and Appendix C icing conditions to previous certified product, the applicant may demonstrate compliance with the Special Condition by means of a comparative analysis between the proposed “optimised” IPS above the altitude of Appendix C icing envelopes and a previously approved design, supported by safe flight-in-icing in-service history in the entire certified aeroplane operating envelope.

The analysis should demonstrate that the new IPS provides comparable performance as the reference one within the respective aeroplane operational envelopes. The applicant might claim that although the IPS thermal flow is optimised above Appendix C altitudes, it still provides sufficient ice protection and remains comparable to former IPS design in a reference fleet.

Both aeroplane operational envelopes and the kind of operation of the IPS should be comparable.

Compliance Strategy/Option a): Direct Demonstration

Applicants may seek for direct demonstration to validate that the aeroplane, while operated with an optimised/modulated or even inhibited IPS above the Appendix C icing envelopes altitude, is still safe. For the evaluation of safe operation, the applicant should assess the degradation of aeroplane performance and handling qualities created by the potential ice accretion on aeroplane unprotected and protected parts. Furthermore, the applicant should assess the effect of sudden release of the ice accretions on the engines and essential equipment.

The applicant should propose and substantiate the icing conditions and scenarios that should be considered. In the absence of any proposal, the following icing conditions and operational scenarios may be considered.

Atmospheric icing Conditions.

In the lack of empirical data to precisely characterise the icing atmosphere standard over 22,000 feet for CM conditions and over 30,000 feet for IM conditions, the following conservative assumptions are taken:

- The CM icing conditions at 22,000 feet are extended up to the maximum operating aeroplane altitude, by assuming the liquid water content for the coldest temperature shown in CS-25 Appendix C, Figure 1 reducing linearly to 0 g/m^3 at -40 °C and the absence of liquid phase below that temperature.
- The IM icing conditions at 30,000 feet are extended up to the maximum operating aeroplane altitude, by assuming the liquid water content for the coldest temperature shown in CS 25 Appendix C, Figure 4 and the absence of liquid phase below -40°C.

Operational scenario to compute the relevant airframe ice accretion.

The basic assumption is that the aeroplane may be flying within the Appendix C conditions and may already have some ice accretion on unprotected areas and/or runback ice beyond protected areas.

To show that the aeroplane can safely operate in CM icing conditions at altitudes above 22,000 feet and in IM icing conditions at altitudes above 30,000 feet, the applicant should consider the following operational scenarios to define the appropriate “en-route” ice shapes accordingly:

1. Operations in icing conditions above 22,000 feet in CM icing conditions

a) The critical ice accretion that would be already on the aeroplane after a climb through a single 17.4 nm CM cloud within the Appendix C, i.e., below 22,000 ft.

b) The critical ice accretion from step a) plus an exposure to one CM cloud in cruise at altitudes between 22,000 feet and the maximum aeroplane cruise operating altitude. The applicant will define the cloud distance as per figure 3 of Appendix C and leading to the maximum runback ice accretion behind the ice protected area(s) (if any). 310 nm should be selected if the IPS is inhibited on purpose without any aeroplane operational restriction, in order to maximise the ice accretion mass.

2. Operations in icing conditions above 30,000 feet in IM icing conditions

a) The critical ice accretion that would be already on the aeroplane after a climb through a single 2.6 nm IM cloud within the Appendix C, i.e., below 30,000 ft.

b) The critical ice accretion from step a) plus an exposure to one IM cloud in cruise at altitudes between 30,000 feet and the maximum cruise operating altitude. The applicant will define the cloud distance as per figure 6 of Appendix C and leading to the maximum runback ice accretion behind the ice protected area(s) (if any). 5.21 nm should be selected if the IPS is inhibited on purpose without any aeroplane operational restriction.

– END –

F-48 (SC): Installation of a therapeutic oxygen system	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1445, 25.1447(c)(1)
ADVISORY MATERIAL:	AMC 25.1447(c)(1)

Special Condition (SC)

Installation of a therapeutic oxygen system

1. When oxygen is supplied to passengers for both supplemental and therapeutic purposes, the distribution system must be designed for either:
   (a) A source of supplemental supply and a separate source for therapeutic purposes; or
   (b) A common source of supply with means to separately reserve the minimum supplemental supply required for the passengers.
2. If any therapeutic oxygen system can be used by the occupants during the flight, means shall be provided to warn the occupant to use the supplemental oxygen mask in case of depressurisation instead of the mask connected to the therapeutic oxygen system.

Appendix

Acceptable Means of Compliance (AMC)

In showing compliance to SC F-48 (1)-(b) for designs with a common source of oxygen, the “means” to separately reserve the minimum supplemental supply required for the passengers should include physical means (i.e., isolation valve) and may include monitoring procedures by the operator based on the minimum supplemental supply for the planned route, occupant count and segment of flight.

In showing compliance to SC F-48 §2 the following may be considered:

- If Cabin Crew is required, procedures for use of therapeutic and supplemental oxygen shall be included in the Cabin Crew Operating Manual (CCOM).

Or

- Pre-flight briefing must be provided to the passengers on the use of therapeutic oxygen and emergency supplemental oxygen and
- Clear indications (e.g. oxygen mask drop-down) must be provided to the passengers when emergency supplemental oxygen shall be used.

– END –

F-55 (SC): Rechargeable Lithium Battery Installations	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.601, 25.863, 25.1353
ADVISORY MATERIAL:	--

Special Condition (SC)

Rechargeable Lithium Battery Installations

In lieu of the requirements of CS 25.1353(c) the following applies:

(a) Lithium batteries and battery installations must be designed and installed as follows:

(1) Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition, or during any failure of the charging or battery monitoring system not shown to be extremely remote. The Li battery installation must be designed to preclude explosion in the event of those failures.

(2) Li batteries must be designed to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.

(3) No explosive or toxic gasses emitted by any Li battery in normal operation or as the result of any failure of the battery charging or monitoring system, or battery installation not shown to be extremely remote, may accumulate in hazardous quantities within the aeroplane.

(4) Li battery installations must meet the requirements of CS 25.863(a) through (d).

(5) No corrosive fluids or gasses that may escape from any Li battery may damage surrounding aeroplane structures or adjacent essential equipment.

(6) Each Li battery installation must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

(7) Li battery installations must have a system to control the charging rate of the battery automatically so as to prevent battery overheating or overcharging, and,

i. A battery temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over-temperature condition or,

ii. A battery failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure.

(8) Any Li battery installation whose function is required for safe operation of the aeroplane, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers, whenever the capacity and SOC of the batteries have fallen below levels considered acceptable for dispatch of the aeroplane.

(9) The Instructions for Continued Airworthiness must contain maintenance procedures for Lithium-ion batteries in spares storage to prevent the replacement of batteries whose function is required for safe operation of the aeroplane, with batteries that have experienced degraded charge retention ability or other damage due to prolonged storage at low SOC.

(b) Compliance with the requirements of this Special Condition must be shown by test or, with the concurrence of EASA, by analysis.

Minimum Operational Performance Standards (MOPS) for Rechargeable Lithium Batteries DO-311A is an acceptable means of compliance with these requirements.

Alternative Means of Compliance can be proposed by the applicant to show compliance with the SC's included in this CRI and agreed by EASA in a case by case basis

– END –

G-03 (SC): Performance Requirements for Operations on Contaminated Runways and Landing Distance Assessment at Time of Arrival	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1591
ADVISORY MATERIAL:	AMC 25.1581, AMC 25.1591, FAA AC25-32, F6X CRI B-07, NPA 2016-11

Special Condition (SC)

Performance Information for Landing Distance Assessment

Referring to **NPA 2016-11**, the **CS 25.1591** is modified as below to restrict applicability to **take-off performance** information only. The text of the amendment is arranged to show deleted, new or amended text as shown below:

- deleted text is marked with ~~strike through~~;
- new or amended text is highlighted in grey;
- an ellipsis '(…)' indicates that the rest of the text is unchanged.

A new specification **CS 25.1592** is introduced for landing performance information:

CS 25.1591 - Take-off Performance Information for Operations with Slippery Wet and Contaminated Runway Surface Conditions

- Supplementary take-off performance information applicable to aeroplanes operated on slippery wet, or runways contaminated with standing water, slush, snow or ice may be furnished at the discretion of the applicant. If supplied, this information must include the expected performance of the aeroplane during take-off ~~and landing~~ on hard-surfaced runways covered by these contaminants. If information on any one or more of the above ~~contaminated~~ surfaces is not supplied, the AFM must contain a statement prohibiting take-off ~~operation(s)~~ on ~~the~~ surfaces failing the minimum friction criteria, or those contaminated surface(s) for which information is not supplied. Additional information covering operation on contaminated surfaces other than the above may be provided at the discretion of the applicant.
- Performance information furnished by the applicant must be contained in the AFM. ~~The information may be used to assist operators in producing operational data and instructions for use by their flight crews when operating with contaminated runway surface conditions.~~ The information may be established by calculation or by testing.
- The AFM must clearly indicate the conditions and the extent of applicability for each contaminant used in establishing the contaminated runway performance information. It must also state that actual conditions that are different from those used for establishing the contaminated runway performance information may lead to different performance.

CS 25.1592 (NPA 2016-11) - Performance Information for Landing Distance Assessment

- At the option of the applicant, supplementary landing performance Information may be furnished for landing on wet slippery and contaminated runways for use by operators to support dispatch of a flight; If information for any one or more of these surfaces is not supplied, the AFM must contain a statement prohibiting landing on runways failing the minimum friction criteria, or landing on those contaminated runways for which information is not supplied. Additional information covering operation on contaminated surfaces other than the above may be provided at the discretion of the applicant.
- Landing distances must be furnished for landing performance assessment at time of arrival on dry, wet, wet slippery and contaminated runways.
- Performance information furnished by the applicant must be contained in the aeroplane flight manual (AFM). The information may be established by calculation or by testing.
- The data to be used for landing performance assessment at time of arrival consists of the horizontal distance from the point at which the main gear of the aeroplane is 50 ft above the landing surface to the point where the aeroplane comes to a complete stop. The data must allow computation of the landing distance based on Runway Condition (see Appendix B), winds, temperatures, average runway slope, pressure altitude, icing condition, planned final-approach speed, aeroplane mass and configuration, and deceleration devices. The applicant may optionally provide information for runway surface conditions and braking actions.

Appendix B

Means of Compliance

Referring to **NPA 2016-11**, the **AMC 25.1581** and **AMC 25.1591** are modified as below to take into account the introduction of the proposed regulatory changes. The text of the amendment is arranged to show deleted, new or amended text as shown below:

a) deleted text is marked with ~~strike through~~;

b) new or amended text is highlighted in grey;

c) an ellipsis '(…)' indicates that the rest of the text is unchanged.

A new MOC **25.1592** is introduced for CS 25.1592 (NPA 2016-11) - Performance Information for Landing Distance Assessment:

AMC 25.1581 (NPA 2016-11) - Aeroplane Flight Manual

(…)

6 AEROPLANE FLIGHT MANUAL CONTENTS

(…)

6. d. Performance Section

(…)

(18) Landing Distance

The landing distance from a height of 50 ft must be presented either directly or with the factors required by the operating regulations, together with associated conditions and weights up to the maximum take-off weight. For all landplanes, landing distance data must be presented for smooth, dry, hard-surfaced runways for standard day temperatures. With concurrence by the Agency, additional data may be presented for other temperatures and runway slopes within the operational limits of the aeroplane, or for operations on other than smooth, hard-surfaced runways. For all weather operations, additional landing performance data may be required.

The unfactored landing distances for dry and wet runway are minimum distances based on certification test procedures and are normalised to a runway surface with no slope at standard day temperature and landing speeds.

The AFM should state the following conditions for which the landing distances are valid:

1. Runway slope
2. Temperature
3. Landing Configuration
4. Thrust setting

The landing distances at time of arrival (LDTA) reflect the performance expected to be achieved in operational conditions. The AFM should present LDTA for

5. All Runway Condition Codes from 1 to 6,

6. Certified landing configurations,
7. Final Approach speeds VAPP including recommended speed increments,
8. With and without reverse thrust credit,
9. Within the certified flight envelope for
   - Runway slope
   - Outside air temperature

The AFM should state that a safety margin should be applied to account for operating practices and expected operational variability.

The introduction of the SC 25.1592 and the concept of landing distance at time of arrival in the operating regulation leads to a larger variety of landing distance data being provided in the AFM. The intended use of each part of the landing distance information should be properly explained in the AFM.

The AFM should emphasize to apply a safety margin particularly for such landing distances which have least conservatism in their method of derivation, for example, distances determined from a maximum performance manoeuvre with data (e.g. flight path angle and touchdown sink rate) normalised to specified conditions such that the landing distance achieved in operational conditions may be greater.

(…)

AMC 25.1591 (NPA 2016-11)

The derivation and methodology of performance information for use when taking-off ~~and landing~~ with slippery wet and contaminated runway surface conditions.

1.0 Purpose

This AMC provides information, guidelines, recommendations and acceptable means of compliance for use by applicants in the production of performance information for aeroplanes when ~~operated on~~ taking off from runways that are slippery wet or contaminated by standing water, slush, snow, and ice ~~or other contaminants~~.

2.0 Technical Limitations of Data

(…)

~~It has been recently determined that the assumption to use wet runway surface field length performance data for operations on runway surfaces contaminated with dry snow (depths below 10 mm) and wet snow (depths below 5 mm) may be inappropriate. Flight test evidence together with estimations have indicated some measure of relatively low gear displacement drag and a measurable reduction in surface friction in comparison to the assumptions associated with wet runway field performance data. As a consequence it has been agreed that additional work is required to further develop the associated methodology. As an interim measure it has been concluded that it is reasonable to consider these surfaces by recommending that they be addressed by using the data for the lowest depth of the contaminant provided.~~ It is recognised that the observation and reporting of the type and depth of contaminants (water, slush, dry snow and wet snow) is limited in terms of the accuracy and timeliness with which it can be made and relayed to the flight crew. Furthermore, shallow depths of contaminants do not generally reduce wheel braking friction below that of a wet runway, except in unfavourable circumstances for which lower than expected runway condition codes (RWYCCs) are reported (see AMC 25.1592). In line with International Civil Aviation Organization (ICAO) and Federal Aviation Authority (FAA) standards, a depth of more than 3 mm for contaminant accountability in take-off performance assessments is considered as a reasonable lower threshold. Below this depth of loose contaminant, or in case of a thin layer of frost, the runway is considered to be wet, for which AMC 25.1591 does not apply.

(…)

4.0 Definitions

~~These definitions may be different to those used by other sources but are considered appropriate for producing acceptable performance data, suitable for use in aeroplane operations.~~ The following definitions are a subset of the runway surface condition descriptors for which a representative take-off performance model may be derived using the methods contained in this AMC.

4.1 Frost

Ice crystals formed from airborne moisture on a surface whose temperature is below freezing. Frost differs from ice in that frost crystals grow independently and, therefore, have a more granular texture.

Note 1: below freezing refers to air temperature equal to or lower than the freezing point of water (0 °C).

Note 2:— under certain conditions, frost can cause the surface to become very slippery, which is then reported appropriately as ‘reduced braking action’.

4.1a Standing Water

Water of a depth greater than 3mm. ~~A surface condition where there is a layer of water of 3mm or less is considered wet for which AMC 25.1591 is not applicable.~~

Note: a surface condition where there is a layer of water of 3 mm or less is considered wet, for which AMC 25.1591 is not applicable.

4.2 Slush

~~Partly melted snow or ice with a high water content, from which water can readily flow, with an assumed specific gravity of 0.85. Slush is normally a transient condition found only at temperatures close to 0°C.~~ Snow that is so water-saturated that water will drain from it when a handful is picked up or will splatter if stepped on forcefully.

4.3 Wet Snow

~~Snow that will stick together when compressed, but will not readily allow water to flow from it when squeezed, with an assumed specific gravity of 0.5.~~ Snow that contains enough water to be able to make a well-compacted, solid snowball, without squeezing out water.

4.4 Dry Snow

~~Fresh snow that can be blown, or, if compacted by hand, will fall apart upon release (also commonly referred to as loose snow), with an assumed specific gravity of 0.2. The assumption with respect to specific gravity is not applicable to snow which has been subjected to the natural ageing process.~~ Snow from which a snowball cannot readily be made.

4.5 Compacted Snow

~~Snow which has been compressed into a solid mass such that the aeroplane wheels, at representative operating pressures and loadings, will run on the surface without causing significant rutting.~~ Snow that has been compacted into a solid mass such that aeroplane tires, at operating pressures and loadings, will run on the surface without significant further compaction or rutting of the surface.

4.6 Ice

Water ~~which~~ that has frozen or compacted snow that has transitioned into ice ~~on the runway surface, including the condition where compacted snow transitions to a polished ice surface~~, in cold and dry conditions.

Note: this definition excludes wet ice that has a film of water on top of it or contains melting ice, which provides minimal braking friction and uncertain lateral control.

4.7 Slippery Wet

A wet runway where the surface friction characteristics of a significant portion of the runway have been determined to be degraded.

4.~~7~~8 Specially Prepared Winter Runway

A runway, with a dry frozen surface of compacted snow and/or ice which has been treated with sand or grit or has been mechanically or chemically treated to improve runway friction. The runway friction is ~~measured~~ monitored and reported on a regular basis in accordance with national procedures.

4.~~8~~9 Specific Gravity

The density of the contaminant divided by the density of water.

5.0 Contaminant Properties to be Considered

5.1 Range of Contaminants

(…)

Contaminant Type	***Range of Depths to be Considered - mm***	***Specific Gravity Assumed for Calculation***	***Is Drag Increased?***	***Is Braking Friction Reduced below Dry Runway Value?***	***Analysis Paragraphs Relevant***
Standing Water, Flooded runway	More than 3- up to 15 (see Note 1)	1.0	Yes	Yes	7.1, 7.3, 7.4
Slush	More than 3- up to 15 (see Note 1)	0.85	Yes	Yes	7.1, 7.3, 7.4
Wet Snow (see Note 2)	~~Below~~ More than 3 up to 5 (see Note 1)		No	Yes	7.3, 7.4
Wet Snow (see Note 3)	More than 5- up to 30	0.5	Yes	Yes	7.1, 7.3, 7.4
Dry Snow (see Note 2)	~~Below~~ More than 3 up to 10 (see Note 1)		No	Yes	7.3, 7.4
Dry Snow	More than 10- up to 130	0.2	Yes	Yes	7.2, 7.3, 7.4
Compacted Snow At or Below outside air temperature (OAT) -15°C	0 (see Note 4)		No	Yes	7.3, 7.4
Compacted Snow Above outside air temperature (OAT) -15°C	0 (see Note 4)		No	Yes	7.3, 7.4
Dry Snow over Compacted Snow (see Note 3)	More than 10- up to 130	0.2	Yes	Yes	7.2, 7.3, 7.4
Wet Snow over Compacted Snow	More than 5- up to 30	0.5	Yes	Yes	7.1, 7.3, 7.4
Ice (Cold & Dry)	0 (see Note 4)		No	Yes	7.3, 7.4

Contaminant Type	***Range of Depths to be Considered - mm***	***Specific Gravity Assumed for Calculation***	***Is Drag Increased?***	***Is Braking Friction Reduced below Dry Runway Value?***	***Analysis Paragraphs Relevant***
Slippery Wet	0 (see Note 4)		No	Yes	7.3, 7.4
Specially Prepared Winter Runway (see Note 5)	0 (see Note 4)		No	Yes	7.3.4, 7.4

Table 1

Note 1: Runways with water depths or slush or snow depths of 3 mm or less are considered wet, for which AMC 25.1591 is not applicable.

Note 2: Contaminant drag may be ignored.

Note 3: For conservatism the same landing gear displacement and impingement drag methodology is used for wet snow as for slush.

Note 4: Where depths are given as zero it is assumed that the aeroplane is rolling on the surface of the contaminant.

Note 5: No default model is proposed for specially prepared winter runways in this AMC. Such surfaces are specific and treatment may be of variable effectiveness. The procedures and methods should be approved by the competent authority of the state of operator.

(…)

6.0 Derivation of Performance Information

6.1 General Conditions

Take-off ~~and landing~~ performance information for contaminated runways should be determined in accordance with the assumptions given in paragraph 7.0.

(…)

(…)

~~6.3 Landing on a Contaminated Runway~~

~~6.3.1 Airborne distance~~

~~Assumptions regarding the airborne distance for landing on a contaminated runway are addressed in paragraph 7.4.2.~~

6.3.2 Ground Distance

Except as modified by the effects of contaminant as derived below, performance assumptions for ground distance determination remain unchanged from those used for a dry runway. These assumptions include:

- Touchdown time delays.
- Stopping means other than wheel brakes (but see paragraph 7.4.3).

7.0 Effects of Contaminant

7.1 Contaminant Drag –Standing Water, Slush, Wet Snow

General advice and acceptable calculation methods are given for estimating the drag force due to fluid contaminants on runways:

Total drag due to fluid contaminant	=	Drag due to fluid displacement by tyres	+	Drag due to airframe impingement of fluid spray from tyres

The essence of these simple calculation methods is the provision of appropriate values of drag coefficients below, at, and above tyre aquaplaning speed, V_P (see paragraph 7.1.1):

1. Paragraphs 7.1.2.a and 7.1.2.b give tyre displacement drag coefficient values for speeds below V_P.
2. Paragraph 7.1.3.b.2 gives tyre equivalent displacement drag coefficient values to represent the skin friction component of impingement drag for speeds below V_P.
3. Paragraph 7.1.4 gives the variation with speed, at and above V_P, of drag coefficients representing both fluid displacement and impingement.

The applicant may account for contaminant drag for computation of the deceleration segment of the accelerate-stop distance. However, if the actual contaminant depth is less than the reported value, then, using the reported value to determine contaminant drag will result in a higher drag level than the one that actually exists, leading to a conservative take-off distance and take-off run, but a potentially optimistic accelerate-stop distance. It is assumed that these effects will offset each other; however, the applicant may consider:

4. either using 100 % of the reported contaminant depth when determining the acceleration portion, and 50 % when considering the deceleration portion; or
5. using 50 % of the reported contaminant depth when determining both the acceleration and the stop portion of the accelerate-stop distance. This should result in a conservative computation without being unduly penalising. The applicant should check to ensure that using drag for half of the contaminant depth for the accelerate-stop computation is conservative for the applicant’s aeroplane configuration.

7.1.1 Aquaplaning Speed

An aeroplane will aquaplane at high speed on a surface that is contaminated by standing water, slush or wet snow. For the purposes of estimating the effect of aquaplaning on contaminant drag, the aquaplaning speed, V_P, is given by -

$$V_P = 9\sqrt{P}$$

where V_P is the ground speed in knots and P is the tyre pressure in lb/in^2.

For the purpose of estimating the effect of aquaplaning on wheel-to-ground friction, the aquaplaning speed V_P given above should be factored with a coefficient of 0.85.

Predictions (Reference 5) indicate that the effect of running a wheel over a low density liquid contaminant containing air, such as slush, is to compress it such that it essentially acts as high density contaminant. This means that there is essentially no increase in aquaplaning speed to be expected with such a lower density contaminant.

For this reason, the aquaplaning speed given here is not a function of the density of the contaminant.

(See References 1, 5 and 10)

(…)

7.1.4 Effect of Speed on Displacement and Impingement Drag Coefficients at and above Aquaplaning Speed V_P

The drag above V_P reduces to zero at lift off and one acceptable method is to reduce C_D as shown in the curve in Figure 1. This relationship applies to both displacement and spray impingement drag coefficients.

(…)

7.3.1 Default Values

To enable aeroplane performance to be calculated conservatively in the absence of any direct test evidence, default wheel braking coefficient values as defined in Table 2 may be used. These ~~friction~~ values represent the maximum effective braking coefficient of a~~n~~ fully modulating anti-skid controlled braked wheel/tyre. For quasi-modulating systems, multiply the listed braking coefficient by 0.625. For on-off systems, multiply the listed braking coefficient by 0.375. For the classification of anti-skid systems, please refer to AMC 25.109(c)(2). Aeroplanes without anti-skid systems will need to be addressed separately on a case-by-case basis.

Contaminant	**Default Wheel Braking Coefficient μ**
Standing Water and Slush	$= -0.0632\left(\frac{V}{100}\right)^3 + 0.2683\left(\frac{V}{100}\right)^2 - 0.4321\left(\frac{V}{100}\right) + 0.3485$ where V is ground speed in knots. Note: For V greater than 85 % of the aquaplaning speed V_P, use μ = 0.05 constant. At the option of the applicant, the Wheel Braking Coefficient as defined for RWYCC 2 in AMC 25.1592 may be applied.
Wet Snow ~~below 5mm~~ above 3 mm depth	0.16~~7~~
~~Wet Snow~~	~~0.17~~
Dry Snow ~~below 10mm~~ above 3 mm depth	0.16~~7~~
~~Dry Snow~~	~~0.17~~
Wet Snow over Compacted Snow	0.16
Dry Snow over Compacted Snow	0.16
Compacted Snow below outside air temperature (OAT) -15 °C	0.20
Compacted Snow Above outside air temperature (OAT) -15 °C	0.16
Ice ~~(Cold & Dry)~~	0.07~~5~~
Slippery When Wet	0.16

Note: Braking Force = load on braked wheel x Default Friction Value μ

Table 2

Note: For a specially prepared winter runway surface no default friction value can be given due to the diversity of conditions that will apply.

(See reference 10)

(…)

7.3.3 Use of Ground Friction Measurement Devices

Ideally it would be preferable to relate aeroplane braking performance to a friction index measured by a ground friction device that would be reported as part of a Surface Condition Report. However, t There is not, at present, a correlation between aircraft stopping capability and mmon friction index for all ground friction measuring devices. Hence it is not practicable at the present time to determine aeroplane performance on the basis of an internationally accepted friction index measured by ground friction devices. Notwithstanding this lack of correlation a common index, the applicant may optionally choose to present take-off and landing performance data as a function of an aeroplane braking coefficient or wheel braking coefficient constant with ground speed for runways contaminated with wet snow, dry snow, compacted snow or ice. The responsibility for relating this data to a friction index measured by a ground friction device will fall on the operator and the operating competent authority of the state of operator.

7.3.4 Specially Prepared Winter Runway Surface

At the option of the applicant, take-off performance data may be provided for specially prepared winter runway surfaces. This may include icy surfaces that have been treated with sand or gravel in such a way that a significant improvement of friction may be demonstrated. It is suggested that a reasonable margin should be applied to the observed braking action in performance computations for such surfaces, and that wheel braking coefficients not greater than 0.20 should be assumed for fully modulating anti-skid systems. For other anti-skid system types, this coefficient must be factored as described in 7.3.1. Appropriate procedures and methods should be approved by the competent authority of the state of aerodrome in compliance with ADR.OPS.B.36.

7.4 Additional Considerations

(…)

7.4.2 Landing Air Distance

For contaminated surfaces, the airborne distance should be calculated by assuming that 7 seconds elapse between passing through the 50 ft screen height and touching down on the runway. In the absence of flight test data to substantiate a lower value, the touchdown speed should be assumed to be 93% of the threshold speed.

7.4.23 Reverse Thrust

Performance information may include credit for reverse thrust where available and controllable, as described in AMC 25.109.

8.0 Presentation of Supplementary Performance Information

(…)

8.3 Take-off and Landing Data

This should be presented either as separate data appropriate to a defined runway contaminant or as incremental data based on the AFM normal dry or wet runway information. Information

~~relating to the use of speeds higher than VREF on landing, that is speeds up to the maximum recommended approach speed additive to VREF, and the associated distances should also be included~~

The landing distance must be presented either directly or with the factors required by the operating regulations, with clear explanation where appropriate.

Where data is provided for a range of contaminant depths, for example greater than 3, 6, 9, 12, 15mm, then the AFM should clearly indicate how to define data for contaminant depths within the range of contaminant depths provided.

The AFM should provide:

(1) the performance data for operations on contaminated runways;
~~(2)~~ definitions of runway surface conditions~~;~~

The AFM should state that operations are prohibited on runways with contaminant depths greater than those for which data is provided. Instructions for use of the data should be provided in the appropriate documentation.

Where the AFM presents data using V_{STOP} and V_{GO}, it must be stated in the AFM that use of this concept is acceptable only where operation under this standard is permitted.

9 References

Reference sources containing worked methods for the processes outlined in 7.1 to 7.3.3 are identified below:

- ESDU Data Item 83042, December 1983, with Amendment A, May 1998. 'Estimation of Spray Patterns Generated from the Side of Aircraft Tyres Running in Water or Slush'.
- ESDU Data Item 98001, May 1998. 'Estimation of Airframe Skin -Friction Drag due to Impingement of Tyre Spray'.
- ESDU Data Item 90035*, November 1990, with Amendment A, October 1992. "Frictional and Retarding Forces on Aircraft Tyres. Part V: Estimation of Fluid Drag Forces".
- ESDU Memorandum No.97*, July 1998. "The Order of Magnitude of Drag due to Forward Spray from Aircraft Tyres".
- ESDU Memorandum No. 96, ~~February 1998~~ re-issued May 2011, "Operations on Surfaces Covered with Slush".
- ESDU Memorandum No. 95, ~~March 1997~~ re-issued October 2013, "Impact Forces Resulting From Wheel Generated Spray: Re-Assessment Of Existing Data".
- NASA Report TP-2718 "Measurement of Flow Rate and Trajectory of Aircraft Tire-Generated Water Spray".
- Van Es, G.W.H., "Method for Predicting the Rolling Resistance of Aircraft Tires in Dry Snow". AIAA Journal of Aircraft, Volume 36, No.5, September-October 1999.
- Van Es, G.W.H., "Rolling Resistance of Aircraft Tires in Dry Snow", National Aerospace Laboratory NLR, Technical Report TR-98165, Amsterdam, 1998.

- ESDU Data Item 72008*, May 1972. 'Frictional and retarding forces on aircraft tyres. Part III: planning.
- FAA AC 25-31, ‘Takeoff Performance Data for Operations on Contaminated Runways’, 22 December 2016.
- ICAO Doc 10064, ‘Aeroplane Performance Manual’.

* *This document has been withdrawn by ESDU and is no longer available.*

AMC 25.1592 (NPA 2016-11)

The Derivation and Methodology of Performance Information for Landing on Slippery Wet and Contaminated Runways for use by operators to support dispatch of a flight. and on all Runway Conditions for Landing Performance Assessment at Time of Arrival

1.0 Purpose

This AMC provides information, guidelines, recommendations and acceptable means of compliance for use by applicants in the production of landing performance information. This information is for use by operators:

(3) To support dispatch of a flight when planning to land on runways that are slippery wet or contaminated by standing water, slush, snow, ice or other contaminants; and

(4) For landing performance assessment at the time of arrival, whatever the runway surface condition is.

2.0 Applicability of Data

Appropriate landing performance data are required for dispatch and to perform time-of-arrival landing performance assessments. Because of differences in the variables to be taken into account and of the various ways that those data are to be used, the landing performance data for time-of-arrival landing performance assessments may be different to the landing performance data developed in accordance with CS 25.125 and provided in the aeroplane flight manual (AFM) in accordance with CS 25.1587(b).

DRY AND WET RUNWAYS: This MOC CRI includes the methods for derivation of landing distance on dry and wet runways intended to be used for landing performance assessment at the time of arrival only. For preflight landing performance assessment, when planning to land on a dry or wet runway surface, the landing distance established in compliance with CS 25.125 should be used.

SLIPPERY WET AND CONTAMINATED RUNWAYS: The data derived in accordance with the method(s) in this MOC is appropriate for the landing performance assessment at time of arrival and for dispatch, when planning to land on a runway surface that is slippery wet–or contaminated provided that paragraphs CS 25.125(c)(3) and (g) are also accounted for.

Aeroplane performance data for contaminated runway conditions produced in accordance with Appendix A of this CRI should include recommendations for operational use of the data. Where possible, this operational guidance should be provided by the applicant or its production co-ordinated with the applicant to ensure that the information is valid for use.

Operators are expected to make careful and conservative judgments in selecting the appropriate performance data to use for operations on slippery wet and contaminated runways. Particular attention should be paid to the presence of any contaminant in the critical high speed portion of the runway.

In considering the maximum depth of runway contaminants it may be necessary to take account of the maximum depth for which the engine air intakes have been shown to be free of ingesting hazardous quantities of water in accordance with CS 25.1091(d)(2).

3.0 Standard Assumptions

The data for time-of-arrival landing performance assessments should represent expected landing performance of a trained flight crew of average skill following normal flight procedures. It should take into account runway surface conditions/runway condition codes, winds, temperatures, average runway slope, pressure altitude, icing condition, final-approach speed, aeroplane weight and configuration, and deceleration devices used.

Like the landing distances defined in CS 25.125, the landing distances to be used for time-of-arrival landing performance assessments are defined as the horizontal distance from the point at which the main gear of the aeroplane is 50 ft above the landing surface to the position where the aeroplane is brought to a stop. See Figure 1 below.

4.0 Definitions

In addition to those terms defined in the AMC 25.1591 as modified by the MoC at Appendix B, the following runway conditions should be considered:

Runway Condition Code (RWYCC)

A number used in the runway condition report (RCR) that describes the effect of the runway surface condition(s) on aeroplane deceleration performance and lateral control. See Section 6.2 of this AMC for the classification of runway conditions.

Note: the purpose of RWYCC is to enable an operational aeroplane performance calculation by the flight crew. Procedures for the determination of the runway condition code are described in ICAO Doc 9981 'PANS — Aerodromes'.

5.0 Assumptions for Landing Distances

Landing performance data should be provided in terms of RWYCCs within the approved operational envelope for landing. Data should be provided for codes 6 through 1. At the option of the applicant, additional data for fluid contaminants (dry snow, wet snow, slush and standing water) may be provided for the range of depths given in Table 2 of Section 7.0 of this MOC.

Landing performance data is not presented for code 0 (zero) because this is not a performance category but rather a condition in which flight operations should cease on the runway until the aerodrome has taken an action to improve the braking action.

The effect of each of the parameters affecting landing distance should be provided, by taking into account the following:

(5) approved landing configurations, including Category III landing guidance, where approved;
(6) approved deceleration devices (e.g. wheel brakes, speed brakes/spoilers, and thrust reversers);
(7) pressure altitudes within the approved landing operating envelope;
(8) weights up to the maximum take-off weight (MTOW);
(9) expected airspeeds at the runway threshold, including speeds up to the maximum recommended final-approach speed, considering possible speed additives for winds and icing conditions;
(10) temperatures within the approved landing operating envelope;
(11) operational correction factors for winds within the established operational limits of the aeroplane, for not more than 50 % of nominal wind components along the take-off path opposite to the direction of landing, and not less than 150 % of nominal wind components along the take-off path in the direction of landing;
(12) runway slopes within the approved landing operating envelope; and
(13) icing conditions, if CS 25.125 (a)(2) applies.

6.0 Derivation of Landing Distance

The landing distance consists of three segments:

(14) an airborne segment,
(15) a transition segment,
(16) a final stopping configuration (full braking) segment

as shown in Figure 1 below.

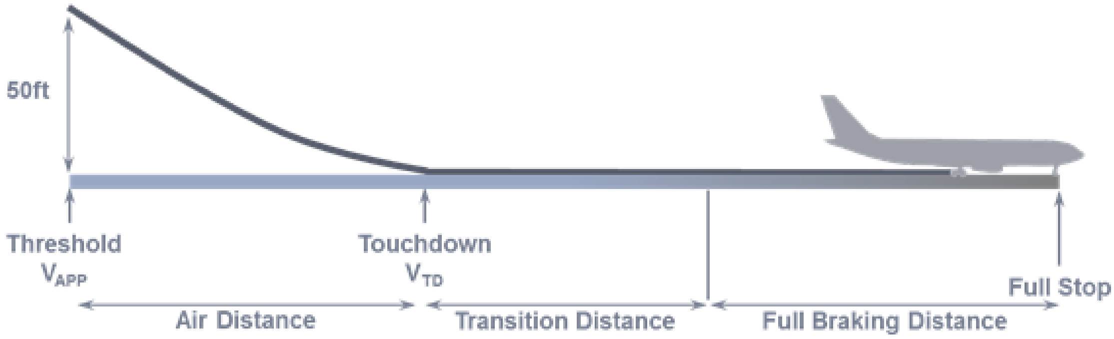


Figure 1 — Landing distance segments

The landing distance for dispatch landing performance assessment, when planning to land on a dry or wet runway surface, is the landing distance developed in compliance with CS 25.125.

The landing distance for dispatch landing performance assessment, when planning to land on a contaminated or slippery wet runway surface is derived in accordance with the method(s) contained in sections 6 and 7 of this AMC.

The landing distance for time-of-arrival landing performance assessment may be determined analytically from the landing performance model developed to show compliance with CS 25.125 modified as described in the following sections.

Changes in the aeroplane's configuration, speed, power, and thrust used to determine the landing distance for time-of-arrival landing performance assessments should be made using procedures established for operation in service. These procedures should:

(17) be able to be consistently executed in service by crews of average skill;
(18) use methods or devices that are safe and reliable; and
(19) include allowance for any time delays that may reasonably be expected in service (see Section 6.2. below).

6.1 Air Distance

6.1.1 Default distance allowance

The intent of the information in this paragraph is to establish a distance allowance for the airborne phase that is appropriate to most aeroplanes and types of approaches.

As shown in Figure 1 above, the air distance is the distance from a height of 50 ft above the landing surface to the point of main gear touchdown. This definition of the air distance is unchanged compared to that used for compliance with CS 25.125. However, the air distance determined under CS 25.125 may not be appropriate for use when making operational landing performance assessments. The air distances determined under CS 25.125 may be shorter than the distance that the average pilot is likely to achieve in normal operations.

The air distance used for any individual landing at any specific runway is a function of the following parameters:

(20) runway approach guidance;
(21) runway slope;
(22) use of any aeroplane features or equipment (e.g. heads-up guidance, autoflight systems, etc.);
(23) pilot technique; and
(24) the inherent flare characteristics of the specific aeroplane.

Unless the air distance used for compliance with CS 25.125 is representative of an average pilot flying in normal operations (see flight test demonstration below), the air distance used for operational landing performance assessments should be determined analytically as the distance traversed over a time period of 7 sec at a speed of 98 % of the recommended speed over the landing threshold. The recommended speed over threshold can also be referred to as the final-approach speed (VAPP). The above distance represents a flare time of 7 sec and a touchdown speed (VTD) of 96 % of the VAPP. The VAPP should be consistent with the procedures recommended by the applicant, including any speed additives, such as those that may be used for winds or icing. The effect of higher speeds, to account for variations that occur in operations or are caused by the operating procedures of individual operators, should also be provided.

If the air distance is determined directly from flight test data instead of using the analytical method provided above, the flight test data should meet the following criteria:

(25) procedures should be used that are consistent with the applicant's recommended procedures for operations in service; these procedures should address the recommended final-approach airspeed, flare initiation height, thrust/power reduction height and technique, and target pitch attitudes;
(26) at a height of 50 ft above the runway surface, the aeroplane should be at an airspeed not slower than the recommended final-approach airspeed; and
(27) the touchdown rate of descent should be in the range of 1–4 ft per sec.

If the air distance is based on a time of 7 sec at a speed of 98 % of the recommended speed over the runway threshold, this air distance is considered valid for downhill runway slopes up to 2 % in magnitude (no credit should be taken for an uphill runway slope).

6.1.2 Steep approach landing

The distance allowance described in paragraph 6.1.1. may not be appropriate in case of steep approach. This paragraph provides information for steep approach using a glide path greater than or equal to 4.5°.

Air distances achieved with steep approaches are determined directly from flight test following requirements from CS 25 Appendix Q. Those demonstrated air distances may be used for landing distance assessment at dispatch and at time of arrival, in lieu of air distance requirements of paragraph 6.1.1.

6.2 Transition Distance

As shown in Figure 1 above, the transition distance is the distance travelled from the point of main gear touchdown to the point where all deceleration devices used for determining the landing distance are operating. If the air distance is based on a time of 7 sec at a speed of 98 % of the recommended speed over the runway threshold, the speed at the start of the transition segment should be 96 % of the recommended speed over the runway threshold.

The transition distance should be based on the recommended procedures for use of the approved means of deceleration, both in terms of sequencing and of any cues for initiation. Reasonably expected time delays should also be taken into account.

For procedures that call for initiation of deceleration devices beginning at nose gear touchdown, the minimum time for each pilot action taken to deploy or activate a deceleration means should be the demonstrated time, but not less than one second.

For procedures that call for initiation of deceleration devices beginning prior to nose gear touchdown, the minimum time for each pilot action taken to deploy or activate a deceleration means should be the demonstrated time plus one second.

For deceleration means that are automatically deployed or activated (e.g. auto-speedbrakes or autobrakes), the demonstrated time may be used with no added delay time.

The distance of the transition segment, and the speed at the start of the final stopping configuration segment should include the expected evolution of the braking force achieved over the transition distance. The evolution of the braking force should take into account any differences that may occur for different RWYCCs, such as the aeroplane transition to the full braking configuration (see Table 1 below for the wheel braking coefficient of the full braking configuration of each runway surface condition and reported RWYCC).

RWYCC	Runway surface condition description	Wheel braking coefficient
6	**DRY**	90 % of certified value used to comply with CS 25.125[1]
5	**FROST**[4] **WET** (The runway surface is covered by any visible dampness or water up to and including 3 mm deep. **SLUSH** (up to and including 3 mm depth) **DRY SNOW** (up to and including 3 mm depth) **WET SNOW** (up to and including 3 mm depth)	Per method defined in CS 25.109(c)
4	**COMPACTED SNOW** (Outside air temperature minus 15 degrees Celsius and below)	0.20[2]
3	**WET** ("Slippery wet" runway) **DRY SNOW** (more than 3 mm depth) **WET SNOW** (more than 3 mm depth) **DRY SNOW ON TOP OF COMPACTED SNOW** (Any depth) **WET SNOW ON TOP OF COMPACTED SNOW** (Any depth) **COMPACTED SNOW** (Outside air temperature above minus 15 degrees Celsius)	0.16[2]
2	**STANDING WATER** (more than 3 mm depth) **SLUSH** (more than 3 mm depth)	(1) For speeds below 85 % of the hydroplaning speed[3], 50 % of the wheel braking coefficient determined in accordance with CS 25.109(c), but not greater than 0.16[2] (2) For speeds at 85 % of the hydroplaning speed[3] and above, 0.05[2]
1	**ICE**	0.07[2]
0	**WET ICE** **WATER ON TOP OF COMPACTED SNOW** **DRY SNOW OR WET SNOW ON TOP OF ICE**	Not applicable (no operations in RWYCC = 0 conditions)

Table 1 — Correlation between wheel braking coefficient and RWYCC

1 100 % of the wheel braking coefficient used to comply with CS 25.125 may be used if the testing from which that braking coefficient was derived was conducted on portions of runways containing operationally representative amounts of rubber contamination and paint stripes.

2 These wheel braking coefficients assume a fully modulating anti-skid system. For quasi-modulating systems, multiply the listed braking coefficient by 0.625. For on-off systems, multiply the listed braking coefficient by 0.375. For the classification of anti-skid systems, please refer to AMC 25.109(c)(2). Aeroplanes without anti-skid systems will need to be addressed separately on a case-by-case basis.

3 The hydroplaning speed, VP, may be estimated by the equation VP = 9$\sqrt{P}$, where VP is the ground speed in kt and P is the tire pressure in lb/in2. For the purpose of estimating the effect of aquaplaning on wheel-to-ground friction, the aquaplaning speed VP given above should be factored with a coefficient of 0.85.

4 Heavy frost that has noticeable depth may have friction qualities similar to ice and downgrading the runway condition code accordingly should be considered. If driving a vehicle over the frost does not result in tire tracks down to bare pavement, the frost should be considered to have sufficient depth to consider a downgrade of the runway condition code.

6.3 Final Stopping Configuration Distance (Full Braking Distance)

As shown in Figure 1 above, the final stopping configuration (full braking) segment begins at the end of the transition segment, which is the point where all deceleration devices used in determining the landing distance are operating. It ends at the nose gear position when the aeroplane comes to a stop.

The calculation of the final stopping configuration distance should be based on the braking coefficient associated with the runway surface condition or Runway Condition Code (RWYCC), including the effect of hydroplaning, if applicable. Means other than wheel brakes may be used to determine the landing distances, if that means is in compliance with CS 25.109(e) & CS 25.109(f) except that for time-of-arrival landing distances the effects of available reverse thrust may be included for dry runway landing distances. Credit may be taken for the use of reverse thrust, if their design fulfils the criteria of AMC25.109(f), excepting the demonstration requirements under paragraph 6 of that AMC. Thrust reverser use may reduce directional controllability in combinations of crosswinds and low friction conditions. Recommendations or guidelines associated with crosswind landings, including maximum recommended crosswinds, should be provided to operators for the RWYCCs for which landing distance data are provided. A suitable simulation may be used to develop these guidelines for operation on contaminated runways. See following Section 7 for information about taking into account contaminant drag from loose contaminants.

6.4 Landing Distance Data to consider for Dispatch.

For dispatch computation, performance data for landing on a contaminated surface may include credit for reverse thrust in compliance with CS 25.125 (c)(3) and CS 25.125(g), the latter of which requires account to be taken of the one-engine-inoperative configuration. It is assumed that the engine fails during the landing flare. Should as a consequence the availability of a deceleration device be adversely affected then in compliance with 25.125(g), a comparison must be made between:

(3) The normal landing distance without engine failure using the available deceleration means factored by 1.15; and

(4) The unfactored landing distance assuming an engine failure in the flare and loss of availability of any related deceleration means.

The scheduled landing distance is the longer of (1) and (2) above, and be clarified as the minimum landing distance to be considered which already embodies an operational factor of 1.15.

6.5 Time-Of-Arrival Landing Distances.

For time of arrival landing distances, CS 25.125(g) does not need to be applied.

7.0 Contaminant Drag — Standing Water, Slush, Wet Snow

Loose contaminants result in additional contaminant drag due to the combination of the displacement of the contaminant by the aeroplane tires and impingement of the contaminant spray on the airframe. This contaminant drag provides an additional force helping to decelerate the aeroplane, which reduces the distance needed to stop the aeroplane. Because contaminant drag increases with contaminant depth, the deeper the contaminant is, the shorter the stopping distance will be. However, the actual contaminant depth is likely to be less than the reported depth for the following reasons:

(28) contaminant depths are reported in runway surface condition reports using specific depth increments;

(29) the procedure for reporting contaminant depths is to report the highest depth of the contaminant along the reported portion of the runway surface; contaminant depths, however, are unlikely to be uniform over the runway surface (or reported portion of the runway surface), so it is likely that there will be areas of lesser contaminant depth; and

(30) in a stable weather environment (that is, no replenishment of the contaminant on the runway), the contaminant depth is likely to decrease as successive aeroplanes traverse through this environment and displace the contaminant.

(31) Contaminated conditions are reported from 25% coverage in one third. Total coverage of the runway with significant depths of contaminant may thus be less than 10% of the entire runway surface.

If the actual contaminant depth is less than the reported value, using the reported value to determine the contaminant drag will result in a higher drag level than the one that actually exists, leading to an optimistic stopping distance prediction. Therefore, it is recommended not to include the effect of contaminant drag in the calculation of landing distances for time-of-arrival landing performance assessments. If the effect of contaminant drag is included, it should be limited to no more than the drag resulting from 50 % of the reported depth.

If the effect of contaminant depth is included in the landing distance data, then data should be provided for the reportable contaminant depths up to the maximum contaminant depth for each contaminant for which landing operations are permitted. In considering the maximum depth of runway contaminants, it may be necessary to take account of the maximum depth for which the engine air intakes have been shown to be free of ingesting hazardous quantities of water in accordance with CS 25.1091(d)(2).

If the effect of contaminant depth is included in the landing distance data, then data should be provided for the specific gravities shown in Table 2 below.

Loose contaminant	***Specific gravity***
Standing Water	1.0
Slush	0.85
Dry Snow	0.2
Wet Snow	0.5

Table 2 — Specific gravity of loose contaminants

For the method of determining the contaminant drag, refer to AMC 25.1591 as modified by this CRI.

8.0 Presentation of Supplementary Performance Information

8.1 General

Performance information for dry, wet, slippery wet and contaminated runways, derived in accordance with Sections 5.0–7.0 of this MOC, should be accompanied by appropriate statements such as the following:

(32) operation on runways contaminated with water, slush, snow, ice or other contaminants implies uncertainties with regard to runway friction and contaminant drag and, therefore, to the achievable performance and control of the aeroplane during landing since the actual conditions may not completely match the assumptions on which the performance information is based; where possible, every effort should be made to ensure that the runway surface is cleared of any significant contamination;

(33) the performance information assumes any runway contaminant to be of uniform depth and density; and

(34) the provision of performance information for contaminated runways should not be taken as implying that ground handling characteristics on these surfaces will be as good as those that may be achieved on dry or wet runways, in particular following engine failure, in crosswinds or when using reverse thrust.

8.2 Procedures

In addition to performance information appropriate to operating on contaminated runways, the AFM should also include recommended procedures associated with this performance information if such procedures are specific to the aeroplane. Changes in other procedures to adapt them for operation of the aeroplane on a contaminated surface should also be presented, e.g. reference to crosswinds.

8.3 Landing Data

This should be presented either as separate data appropriate to a defined runway contaminant or as incremental data based on the normal dry or wet runway information in the AFM. Information relating to the use of speeds higher than the VREF on landing, that is, speeds up to the maximum recommended approach speed additive to the VREF, as well as the associated distances, should also be included. The landing distance should be presented either directly or with the factors required by the applicable operating regulation, with a clear explanation, where appropriate.

Where data is provided for a range of contaminant depths, e.g. greater than 3, 6, 9, 12, 15 mm, then the AFM should clearly indicate how to define data for contaminant depths within the range of the contaminant depths provided.

When for at least one runway condition the landing distances to be used at time of dispatch are defined by the unfactored distance established with one engine assumed to be failing in the flare, all landing distances at time of dispatch should be presented in the AFM as factored distances. This should be clearly stated to avoid double application of operational factors.

The AFM should provide:

1. definitions of runway surface conditions;
2. the performance data for operations on contaminated runways;
3. Landing distances on contaminated runways and data with no reverse thrust credit to cover operational restrictions on reverser use and to provide flight crew awareness as to the importance of reverser selection on contaminated runways;
4. the procedures and assumptions used to develop the performance data;
5. The appropriate statements per Section 8.1 of this AMC.

Instructions for use of the data should be provided in the appropriate operational documentation.

9.0 References

a) FAA AC 25-32, 'Landing Performance Data for Time-of-Arrival Landing Performance Assessments', 22 December 2015.

Appendix C

Interpretative Material G-03

Landing performance penalties resulting from system failures

The F6X CRI B-07 was released to provide guidance with respect to the scheduling of data for landing in abnormal configurations or following the loss of normal services. At time of its release, the only available landing data were furnished in the AFM section 5. Therefore landing performance penalties were directly applied to the before mentioned AFM landing data.

With the introduction of the SC for CS 25.1592 an additional set of landing performance data (LDTA) will be provided in a dedicated Annex to the AFM. In principle, as the LDTA will be approved by EASA, the landing performance penalties can be directly applied to such distances, however Dassault Aviation should clarify how it intends to manage the application of landing performance penalties for:

- aircraft not operated under the provisions of IR AIR OPS CAT.OP.MPA.303 where LDTA data are not mandatory
- aircraft registered in Third Countries where LDTA data are considered advisory.

EASA still considers the F6X CRI B-07 an adequate guidance for scheduling of data for landing distance in abnormal configuration or following the loss of normal services.

– END –

MCSD-01 (SC): OSD Maintenance Certifying Staff (MCSD) Certification Basis	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	Annex I to EC Regulation EU 748/2012 (Part 21) Part 21A.15, 16A, 16B, 17A, 17B, 20
ADVISORY MATERIAL:	CM-MCSD-001, GM to Part 21.A.15(d), AMC 21.A.20(b)

Special Condition (SC)

OSD Maintenance Certifying Staff (MCSD) Certification Basis

1. Type Rating Determination

Dassault Aviation shall propose the maintenance type rating for the Falcon 5X.

At the conclusion of the evaluation, the type rating(s) will be included in the Type Certificate Data Sheet (TCDS).The type rating(s) determined should address the models/variants specified in the TCDS.

The following criteria should be evaluated to require a different maintenance type rating separate from the existing type ratings:

a) the aircraft is subject to a different aircraft type certificate; or
b) the aircraft is subject to a major significant modification for installation of another type of engine; or
c) the aircraft is subject to a STC for installation of another type of engine; or
d) The aircraft is subject to a major design modification demanding for the MCS:
    I. Significant additional knowledge, or
    II. Significant additional/different ability and skills.
e) such a recommendation is made by the Applicant or the Agency.

2. Minimum Syllabus Content

The Applicant shall provide the minimum syllabus content specified for the type. The minimum syllabus content should be clearly identified and allocated to one of the four “box” categories indicated in GM No 3 to 21.A.15(d) (see fig. 1) in order to classify its mandatory or non-mandatory status. The contents should address both theoretical and practical elements.

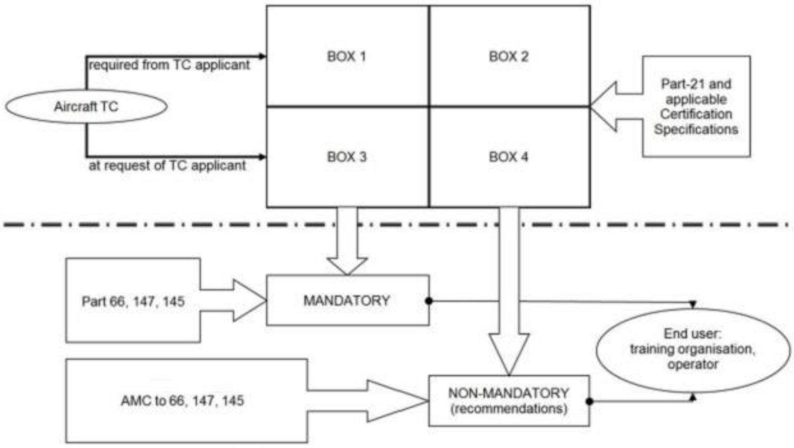


Figure 1

BOX 1 (MANDATORY DATA FOR THE END USER)

- Type Rating Determination (see paragraph 1.).
- The base aircraft (Falcon 5X) configuration relevant to Maintenance Certifying Staff involvement (MCSi) to be addressed in accordance with the certificated type design. This configuration should:
  - be detailed to the ATA system – subsystem level;
  - include the identification of the relevant maintenance activity for the ATA-sub ATA: inspection, functional/operational test, lubrication, removal/installation, troubleshooting, servicing/ground handling, MMEL,.. and
  - contain the Level of the Technical Ability (LTA) required for the maintenance certifying staff.

  The certificated a/c configuration detailed in Box1 should cover the complete base aircraft (Falcon F5X) configuration relevant to maintenance certifying staff activity and should leave the certificated configuration options (i.e. options at system, subsystem or equipment/appliance level in addition to/in place of the base configuration) to be addressed in Boxes 3 and 4.
- Maintenance Area of Specific Emphasis (MASE) – any element considered by the applicant as having a degree of novelty, specificity or uniqueness relevant to the maintenance of his product. This could be a technical or operational feature that maintenance personnel need to be aware of and take into consideration. Refer to Annex I for further practical guidance on MASE.
- Student PRereQuisites (PRQ) could be in BOX1 if the TCH considers that there is no alternate means to comply with. Otherwise the Student prerequisites can be in BOX 2.

BOX 2 (NON-MANDATORY DATA FOR THE END USER)

- Student PRereQuisites (PRQ) (knowledge, experience, qualification) for the particular a/c type training (e.g. previous exposure to and type of a/c maintenance experience; a/c type maintenance related elements for composite repair and bonding and appropriate knowledge, experience, and awareness in accordance with AMC 20-29, SAE AIR 5719)

BOX3 (MANDATORY DATA FOR THE END USER)

- All elements which should be considered in addressing minimum syllabus difference between Falcon 5X and other models or variant under the same Type Rating endorsement. Those elements should be identified using the same criteria utilised for Box 1.
- Logical Training Sequence (LTS) (i.e. time wise order) of imparting training elements from minimum syllabus if any (e.g. ATA29 training on hydraulic system(s) configuration should precede ATA27 training on flight controls actuation). If the TCH does not mandate any entire or partial Logical Training Sequence, the end user (training provider) will organise the training sequencing in accordance with the PART 66 requirements.
- Logical Training Sequence is in BOX3 if the TCH considers that there is no alternate means to comply with, otherwise the Logical Training Sequence is in BOX 4.
- Optional systems.

BOX4 (NON-MANDATORY DATA FOR THE END USER)

- All and any elements identified by applying the Box2 type of content rationale and which should be considered in addressing a difference training between types or models under the same type .
- Course outline, which may include footprints, all learning objectives, examination elements… or full developed course on request when available.
- Potential use of specific Maintenance Simulation Training Devices (MSTD) to be used in imparting some of the type training minimum syllabus elements;
- Type rating training course instructional duration (i.e. consolidated per the whole course and/or segregated per elements of the minimum syllabus);
- Note: in the absence of any recommendation about the overall course length, the figures as mentioned in Part-66, Appendix III, 3.1 will apply.
- Outlines of any other supplemental courses e.g. for engine run-up, advanced T/S, special complex composite repairs, specific basic knowledge training needed.
- Logical Training Sequence if not in Box 3.
- Any other additional elements (i.e. in addition to and beyond the Box1, Box2 and Box3 content) which are recommended by the TCH to the OSD-MCSD user.

An example of the Minimum requirement for MCS Type Rating Syllabus template can be found in Annex II.

Annex I

In order to identify the MASE, consideration should be given to, as applicable, but not limited to:

(1) Criticality and safety impact of the task on the aircraft and personnel – of the System/ Sub System/ Component/ Structure/Procedure (e.g. new technologies, material, function, maintenance staff integrity)

(2) Difficulty - depending on how difficult it is to perform the tasks/procedures (e.g. if it is necessary to use a complex tool; special coordination between people; complex maintenance instructions; specific interpretation skills)

(3) Unusual Design - Relating to special features derived from new or unusual design related to system or subsystem (e.g. not covered by Part-66 Appendices I and III)

(4) Frequency - Depending on the frequency with which the maintenance task or procedure will be performed or the item be replaced.

(5) Note: "Frequency" does not necessarily mean that carrying out the task often make it complex or requires any special competence. However when a type of task normally carried out at "C" check is requested to be every "A" check for any good safety reasons, further attention should be given as to whether the task can be considered as MASE and why.

(6) Human Factor - Relating to the human factor issues associated to the system, subsystem, components and/or tasks. (e.g. accessibility during maintenance, effect of volume, weight…; special attention)

(7) In Service Experience - Relating to the feedback originating from operators and occurrence reporting and ADs.

(8) Master Minimum Equipment List/Configuration Deviation List - Consider if this item is a part of Master Minimum Equipment List or not.

(9) Special tools/equipment and tests.

In addition, in order to identify the MASE, a systematic and structured approach is recommended. The applicant may propose different methods to capture the MASE and demonstrate compliance with this special condition. For instance, following CS 25 requirements may be used as reference in order to address those areas of maintenance interests, such as:

- CS 25.509 (Towing procedures and limitations)
- CS 25.571 (Structural inspection procedures)
- CS 25.603 (Maintenance procedures for composite materials)
- CS 25.689(f) (Cable systems inspections procedures)
- CS 25.611 (Accessibility provisions)
- CS 25.901(b) (Engine installation instructions)
- CS 25.981(d) (CDCCL inspections and procedures)
- CS 25.1301 (Labelling/identification/operating limitations)
- CS 25.1309 (Certification Maintenance Requirements)

- CS 25.1529 (Instructions for the Continued Airworthiness)
  - CS-25 H.3(a) (Aircraft Maintenance Manual)
  - CS-25 H.3(b)(1) (Scheduling Maintenance Instructions)
  - CS-25 H.3(b)(2) (Troubleshooting Instructions)
  - CS-25 H.3(b)(3) (Removal and Installation Instructions)
  - CS-25 H.3(b)(4) (Systems testing Instructions, ground checks, weighing,...)
  - CS-25 H.3(c) (Structural accesses Instructions)
  - CS-25 H.3(d) (Special Inspection Instructions)
  - CS-25 H.3(e) (Protective Treatments Instructions)
  - CS-25 H.3(f) (Structural fasteners Instructions)
  - CS-25 H.3(g) (Special Tools Instructions)
  - CS-25 H.4 (Airworthiness Limitation Section)
  - CS-25 H.5 (EWIS ICA)
- CS 25.1711 (EWIS components labelling Instructions)
- CS 25.1719 (EWIS Accessibility Provisions Instructions)
- CS 25.1729 (EWIS ICA)
- CS-25 M (Fuel Tank FRM maintenance Instructions)

Annex II

Content of the 4 Boxes illustrated with a Minimum Requirement for MCS Type Rating Syllabus possible template.

ATA-Sub	TITLE	B1/B2/C MCS involvement							Level of technical ability			MASE	DESIGN SPECIFICITY	SPECIFIC TASKS
		INSP	FOT	LUB	R/I	TS	SGH	MMEL/CDL	B1	B2	C			
XX-XX	ABCDFE	B1	B1		B1	B1	B1	B1/C	3	1	1			
XX-YY	UVWXYZ		B1/B2		B1/B2	B1/B2		B1/B2/C	3	3	1			

ABBREVIATIONS:

- **INSP:** Inspection
- **FOT:** Functional/Operational test
- **LUB:** Lubrication /Greasing
- **R/I:** Removal/Installation
- **TS:** Trouble-Shooting
- **SGH:** Servicing and ground Handling (including energisation, power ON/OFF, preservation/depreservation)
- **MMEL/CDL:** Master minimum equipment list / Configurationdeviation list

LEVEL OF TECHNICAL ABILITY (LTA1/2/3) related to MCS (B1/B2/C)

LTA 1:

- Basic knowledge of the aircraft airframe, system general layout and characteristics of the power plant as outlined in the System Description Section of the AMM
- Knowledge of safety precautions related to the airframe, its system and power plant
- Knowledge of maintenance practice important to the aircraft
- Basic knowledge of the aircraft relevant documentation ICA,AFM, MMEL/CDL
- Basic knowledge of special tooling and test equipment used with the aircraft

LTA 2: In addition to the LTA 1 the MCS must:

- Understand the theoretical fundamentals
- Apply knowledge in a practical manner using detailed procedures
- Know the safety precautions to be observed when working on or near the aircraft, powerplant and systems
- Know systems and aircraft handling particularly access, power available and source
- Know the locations of the principal components
- Know the normal functioning of each major system, including terminology and nomenclature
- Perform the procedures for servicing associated with the aircraft for the following systems: Fuel, Power Plants, Hydraulic s, Landing gear, Water/Waste, and oxygen
- Use with proficiency crew report and on board reporting systems(minor troubleshooting) and determine aircraft airworthiness per the MMEL/CDL
- Use, interpret and apply appropriate documentation including instruction for continued airworthiness, maintenance manual, illustrated part catalogue, etc)

LTA 3: In addition to the LTA1 and LTA2 the MCS must:

- Have a theoretical knowledge of the aircraft system and structures and interrelationships with other systems
- Interpret results from various sources and measurements and apply corrective action when appropriate.
- Perform system, power plant, component and functional test as specified in the AMM
- Use , interpret and apply appropriate documentation including Structure Repair Manual and Trouble Shouting Manual
- Correlate information for the purpose of making decisions in respect of fault diagnosis and rectification to maintenance manual level

– END –

Deviations (DEV)

D-38 (DEV): Wheel Flange Debris and Fuel Tank Protection (DEV-F25.734-01)	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.734, CS 25.963(e)(1)
ADVISORY MATERIAL:	AMC 25.734, AMC 25.963(e)

Deviation (DEV)

Wheel Flange Debris and Fuel Tank Protection

1. APPLICABILITY

CS-25 Large Aeroplanes

1.1 AFFECTED CS

The following paragraphs of CS-25 are affected because compliance cannot be demonstrated for a small area of the fuselage fuel tank:

- CS 25.734 “Protection against wheel and tyre failures”

  The safe operation of the aeroplane must be preserved in case of damaging effects on systems or structures from:
  - *…*
  - *wheel flange debris.*

- CS 25.963 “Fuel tanks: general”

  (…)
  (e) Fuel tanks must comply with the following criteria in order to avoid hazardous fuel leak:

  (1) Fuel tanks located in an area where experience or analysis indicates a strike is likely, must be shown by analysis supported by test, or by test to address penetration and deformation by tyre and wheel fragments, small debris from uncontained engine failure or APU failure, or other likely debris (such as runway debris).

  (…)

1.2 Pre-Conditions for Application of the Deviation

Not Applicable

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 Regulation (EU) 2018/1139 are affected by the actual design:

Paragraph 1.3.3:

"The aircraft systems and equipment, considered separately and in relation to each other, must be designed such that any catastrophic failure condition does not result from a single failure not shown to be extremely improbable and an inverse relationship must exist between the probability of a failure condition and the severity of its effect on the aircraft and its occupants"

and

paragraph 1.3.5:

"Design precautions must be taken to minimise the hazards to the aircraft and occupants from reasonably probable threats, including information security threats, both inside and external to the aircraft, including protecting against the possibility of a significant failure in, or disruption of, any non-installed equipment."

3. MITIGATING FACTORS

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

- It must be demonstrated that only few percent of trajectories of wheel debris impacting the fuel tanks can create a hazardous fuel leak. This may take into account the fact that some of these trajectories are protected by system layout before the debris impact the tanks.
- A zonal analysis must demonstrate that, even in case of fuel leakage, the risk of hazard to the aircraft (and consequently the occupants) is limited taking into account the potential ignition source(s).
- The Deviation has been exceptionally granted with a limited number of flight cycles or calendar time (whichever comes first).

Note: Full CS 25.734 and CS 25.963(e)(1) compliance on the concerned fuel tanks will be restored with a dedicated design change. The design change will be implemented through retrofit on any individual aircraft delivered with a design that is compliant with this deviation only. Therefore, a plan for implementation of the design change and retrofit is to be defined to limit the exposure. This should be determined through an analysis to be agreed by EASA. In-service experience from similar designs wheels from same manufacturer, production and operational constraints can be used to support the analytical considerations.

– END –

F-59 (DEV): Flight Crew Alerting (DEV-F25.1322-01)	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1322
ADVISORY MATERIAL:	AMC 25.1322

Deviation (DEV)

Flight Crew Alerting

1. APPLICABILITY

CS-25 large aeroplanes

1.3 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) …

1.4 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.

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

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 5	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)
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 1 - System Status Flags: Cases and Mitigations

ID	Approach Type	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 Removal of the SVS (including the synthetic runway) on PFD to emphasizes the visual cues indicating the loss of ILS data in case of manual CAT1 approach (or manual LOC, B/C or LOC/DME)
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	
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 2 - Approach Flags: Cases

Appendix

Detailed Scenarios and Non-Compliances

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

Table 3 details the scenarios linked to System Status Flags, while Table 4 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: • 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: • 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: • 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)

ID	Flight Phase	Abnormal condition	Non-Compliance (description)	Non-Compliance (req. para)
4	Take-Off	**Loss** of RA (radioaltitude) ALT (altitude) HDG (Heading) VS (vertical speed) LOC (Localizer)	For this scenario the design is not compliant since: • 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 a amber visual indication as imposed by CS25.1322(e)(1)(ii).	CS25.1322(b)(2) CS25.1322(e)(1)(ii)
5		**Loss** of LOC (Localizer)	For this scenario the design is not compliant since: • 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 (radioaltitude) ALT (altitude) HDG (Heading) VS (vertical speed)	For this scenario the design is not compliant since: • 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 a 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 (radioaltitude) VS (vertical speed)	For this scenario the design is not compliant since: • 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 a amber visual indication as imposed by CS25.1322(e)(1)(ii).	CS25.1322(b)(2) CS25.1322 (e)(1)(ii)

Table 3 – System Status Flags: Cases and Non-Compliances

ID	Approach Type	Abnormal condition	Non Compliance (description)	Non Compliance (requirement)
8	Non precision approaches: LOC B/C (Back Course) LOC/DME	**Loss** of ILS beam[3] 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[3] 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: • 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 4 – Approach Flags: Cases and Non-Compliances

– END –

[3] The loss of ILS beam is not due to an airborne system failure.

Equivalent Safety Findings (ESF)

D-01 (ESF): Flight Control System Failure Criteria	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.671(c), CS 25.1309
ADVISORY MATERIAL:	FCHWG §25.671 ARAC recommendation

Equivalent Safety Finding (ESF)

Flight Control System Failure Criteria

Replace paragraph CS 25.671(c) by the following:

"(c) The airplane must be shown by analysis, test, or both, to be capable of continued safe flight and landing after any of the following failures, including jamming, in the flight control system and surfaces (including trim, lift, drag, and feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable failures must have only minor effects and must be capable of being readily counteracted by the pilot.

(6) Any single failure, excluding failures of the type defined in (c)(3).

(7) Any combination of failures not shown to be extremely improbable. Furthermore, in the presence of any single failure in the flight control system, any additional failure states that could prevent continued safe flight and landing shall have a combined probability of less than 1 in 1000. This paragraph excludes failures of the type defined in (c)(3)."

Additional criteria:

1) Double failures, with either one or both latent, that can lead to a Catastrophic Failure Condition shall be avoided in system design.
2) Latent failures contributing to Hazardous or Catastrophic repercussions should be avoided in system design.
3) The use of periodic maintenance or flight crew checks to detect significant latent failures when they occur is undesirable and should not be used in lieu of practical and reliable failure monitoring and indications, as per AMC 25.1309 9.c.6.
4) It is recognised that, on occasion, there may be no possibility to comply with the above criteria 1) and 2). In such cases:
   a) The deviation shall be recorded and justified in the PSSA/SSA and reviewed during the design review process for acceptance,
   b) Acceptance should be based on both previous experience and sound engineering judgement and shall assess:
      i) the failure rates and service history of each component,
      ii) the inspection type and interval for any component whose failure would be latent, and
      iii) any possible common cause of cascading failure modes.

c) The integrity of the evident part of the significant failure condition shall meet a minimum standard:

i) For Catastrophic failure combinations comprising only one evident failure, the probability per FH of each evident failure should be <= 10-6/Fh and the sum of the probabilities of these evident failures should be <= 10-5/Fh.

ii) For Hazardous failure combinations comprising only one evident failure, the probability per FH of the evident part should be <= 10-4/Fh.

d) In addition, a Specific Risk calculation should be considered in accepting the presence of a latent failure. For each combination composed of one active failure and latent failures and leading to a Catastrophic Failure Condition:

i) the probability of the latent part of the combination (e.g. "Sum of the products of the failure rates multiplied by the exposure time" of any latent failure) must be equal or less than 1x10-3 (=1/1000) on average.

e) The periodic maintenance checks, which may result from the compliance to this Specific Risk criterion (d), will be considered as CMR candidates, in addition to the CMR Candidates already selected for compliance to CS 25.1309.

(8) Any failure or event that results in a jam of a flight control surface or pilot control that is fixed in position due to a physical interference. The jam must be evaluated as follows:

(i) The jam must be considered at any normally encountered position.

(ii) The causal failure or failures must be assumed to occur anywhere within the normal flight envelope except during the time immediately before landing where recovery may not be achievable when considering time delays in initiating recovery.

(iii) In the presence of a jam considered under this sub-paragraph, any additional failure states that could prevent continued safe flight and landing shall have a combined probability of less than 1 in 1000.

(9) Any runaway of a flight control to an adverse position if such runaway could be due to a single failure, or due to a combination of failures that is not extremely improbable."

– END –

D-11 (ESF): Pack Off Operations	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.831(a)
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Pack Off Operations

Following compensating factors must be demonstrated to achieve an Equivalent Level of Safety to CS 25.831(a):

1. There must be a means to annunciate to the flight crew that the pressurisation system (conditioned air supply) is OFF.
2. It must be demonstrated that the ventilation system continues to provide an acceptable environment in the passenger cabin and flight-crew cockpit for the period when the air conditioning system is not operating. The degradation of crewmember air quality shall not reach the level that would cause undue discomfort and fatigue to the point that it could affect the performance of their duties.
3. Furthermore, equipment environment shall be evaluated during those short periods to ensure equipment reliability and performances are not impaired. This evaluation should cover the extremes of ambient hot air temperatures in which the aeroplane is expected to operate.
4. In addition, it shall be demonstrated that no unsafe condition due to packs-off operation will result, should a fire occur. The following criteria will be considered:
   (a) Cockpit Smoke Penetration and Evacuation regarding any cargo or electronic compartment fire and Cabin Smoke Penetration regarding cargo compartment fire will not be impaired by packs off operation.
   (b) During limited duration packs-off operation time the smoke detection systems are effective and the A/C packs can be turned on and returned to the approved packs-on configuration to exclude any hazardous quantities of smoke.
5. Finally, the air conditioning packs-off operation is intended to be a short duration operation. Therefore, the maximum period of operation in this configuration will be defined by the applicant and specified in the AFM, along with any related operating procedures necessary to maintain compliance with the regulatory issues discussed above.

– END –

D-28 (ESF): Servicing Doors (ESF-D25.783-01)	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.783(h)(2)
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Servicing Doors

The refuelling door and the aft toilet servicing door located on body fairing outside the pressurised compartments may detach from the body fairing in case of opening in flight. It is difficult to demonstrate that servicing doors remain attached to the aircraft if they open in flight and if they are connected to a composite fairing. For connections to metallic fuselage parts, it is generally achievable to remain attached to the aircraft. Therefore, this Equivalent Safety Finding is limited to servicing doors attached to composite body fairings.

To compensate the non compliance with CS 25.783(h)(2), for servicing doors attached to composite body fairings the following factors are considered adequate.

Compensating Factors:

The following compensating factors provide an Equivalent Safety Level to CS 25.783(h)(2) by ensuring that the service doors are closed and latched at departure, so they cannot open and consequently detach during flight:

- In case of an open door there is an amber warning message for the cockpit crew at the park and during taxi phases.
- In case of an unlatched door on ground, the doors remains in open position due to gravity and hinges at the bottom. In addition, red paint is applied on the side faces of the doors to enhance contrast. This design ensures that an open door is clearly visible on ground during the pre-flight walk.
- Both doors latching system consist of secured latches with a “lock” device; two actions are needed to unlatch.
- The doors have three respectively four latches. It will be demonstrated that with one latch open, the door remains attached to the aircraft considering aerodynamic loads.

– END –

D-30 (ESF): Combined aircraft pressurization outflow and positive pressure differential relief valves	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.841(b) (1), CS 25.843(b) (1), CS 25.1309
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Combined aircraft pressurization outflow and positive pressure differential relief valves

An equivalent safety finding shall be used for the DA F5X Type Certification by showing compliance to CS 25.841(b)(1) and 25.843(b)(1) by the following:

1. The SSA of the cabin pressure control system will demonstrate that an uncontrollable over-pressure by the pressure relief function will be extremely improbable by taking into account the latent failure of the pneumatic relief valve or alternatively without taking credit at all of the independent mechanical (pneumatic) relief valve.
2. Either the independent mechanical (pneumatic) relief valve (SFV) or the protection function embedded in the OFV will be adequate to automatically limit the positive pressure differential at the maximum rate of flow delivered by the pressure sources.
3. Dassault Aviation will develop appropriate test to cover the intent of CS 25.843(b)(1)
4. Dassault Aviation must show that the risk of common cause failures and of development

   errors has been adequately mitigated, and that the proposed design is equivalently safe or safer, with respect of such risks, to a conventional design.

– END –

E-05 (ESF): Fuel Tank Expansion	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.969
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Fuel Tank Expansion

Statement of Issue:

The EASA requirement CS 25.969, applicable to the DA Falcon 5X states the following:

*"**CS 25.969 Fuel tank expansion space***

Each fuel tank must have an expansion space of not less than 2% of the tank capacity. It must be impossible to fill the expansion space inadvertently with the aeroplane in the normal ground attitude. For pressure fuelling systems, compliance with this paragraph may be shown with the means provided to comply with CS 25.979(b)."

In the Falcon 5X airplane, the wing and main fuel tanks are individual tanks that, according to 25.969, should each one have an expansion space of at least 2 %. As fuel tank expansion space is provisioned per group of tanks and not per tank, the design is therefore not strictly compliant with 25.969 since some of the individual tanks may not have an expansion space of not less than 2% of the tank capacity.

Equivalent Safety Finding on CS 25.969: Fuel tank expansion space

Applicable to Dassault Aviation Falcon 5X

Applicant Proposal:

Through the current DA Falcon 5X architecture, it is proposed to comply with the requirement

25.969 by considering that individual fuel tanks are grouped and that each group of fuel tanks functions as an individual fuel tank.

Safety Equivalency Demonstration:

From the hypothesis established through the Applicant proposal, the fuel tank expansion space of not less than 2 % requirement will be applied to each group of fuel tanks capacity in order to substantiate the prevention of fuel tanks overpressure and fuel spillage on ground.

– END –

E-09 (ESF): Ignition Switches	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1145
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Ignition Switches

CS25.1145 (a) and (b) requires dedicated control switches for the engine ignition system in the flight deck. In the cases when a design includes integrated automatic starting and ignition control system fully controlled by the Engine Electronic Control Unit (in order to control automatically ground starts, in-flight starter assisted and windmill restarts, and is capable of being deactivated for the purpose of dry and wet motoring of the engines on ground), direct compliance with the provisions of CS25.1145 (a) and (b) is not possible and the applicant shall demonstrate adequate control of the engine ignition system in the absence of dedicated control switches on the flight deck as required by CS 25.1145 (a) and (b), providing an Equivalent Level of Safety in lieu of direct compliance with CS 25.1145(a)(b).

Acceptable compensating factors are based on the following considerations:

- More efficient than manual operation
  - The ignition is fully controlled and monitored during start sequence on ground (conditions and faults are detected).
  - The ignition is fully controlled and monitored during relight or restart sequence in flight (conditions and faults are detected).
  - Ignition function is turned off after engine reached predefined conditions.
- Crew workload decrease
  - Removal of ignition control switches enhances safety by simplifying flight deck design and crew procedures. In addition, pilots will not be required to manually select ignition configurations for critical ground and in-flight phases (encounter of severe flight environmental conditions, operation on contaminated runways).
  - As there is no ignition switches there is no risk of inadvertent operation of ignition by the crew. The EEC controls the ignition stop as well as the ignition start.
- The system design and logic ensure that there is no dormant failure.

– END –

E-10 (ESF): Powerplant Instruments Colour Markings	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1549
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Powerplant Instruments Colour Markings

Paragraph CS 25.1549: 'Powerplant instruments' requests that : 'for each powerplant instrument either a placard or colour markings or an acceptable combination must be provided to convey information on the maximum and (where applicable) minimum operating limits'. Besides, the colour coding to be used is defined in sub-paragraphs CS 25.1549 (a) to (d).

In the cases where the design proposed by the Applicant for the powerplant instruments is not fully compliant with the sub-paragraphs of CS 25.1549 (a) to (d), EASA considers that an equivalent level of safety to CS 25.1549(b) is assured considering the following compensating factors:

- Pointer and digital readout are green when in normal operating range, thus indicating safe operation.
- A white arc associated to pointer and digital readout is more readable than a green arc.

– END –

E-12 (ESF): Nacelle behind fire Wall: TRAS compartment, absence of fire detection system	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1203(a), CS 25.1182(a)
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Nacelle behind fire Wall: TRAS compartment, absence of fire detection system

In the cases where the TRAS compartment does not have a fire detection system installed and is considered as a “nacelle area immediately behind firewalls”, direct compliance to the CS25.1182(a) and CS25.1203(a) requirements cannot be demonstrated. Therefore, it is necessary to substantiate that the design of TRAS compartment provides a safety level equivalent to the CS25.1182(a) and CS25.1203(a) requirements.

The following compensating factors provide an equivalent level of safety to that of direct compliance to CS 25.1182 (a) and CS25.1203 (a) requirements:

- Number of hydraulic fittings, location and routing has been optimized to minimize the risks of leakage;
- Limited flammable fluids quantities in the compartment in case of leakage, thanks to hydraulic fluid isolation means (T/R isolation valves closed when T/R inoperative);
- specifically sized drain and sufficient ventilation flow to prevent flammable fluid or vapours accumulation and therefore to reduce the quantity of fluid available for fire consumption;
- Low propensity of ignition of the hydraulic fluid thanks to limited exposure to high temperatures: no nominal ignition sources in the compartment such as hot air lines.
- Low propensity of ignition due to electrical wires and components: wires are shielded to prevent any short circuit. The wires for switches monitoring carry low amperage current and other wires are only powered when the T/R doors are actuated: low current levels since only the proximity sensors of the Primary Lock Unit and deploy/stow switches are powered during flight;
- Use of fireproof hydraulic pipes, fittings and flexible hoses in the TRAS compartment for hydraulic TRAS lines.

– END –

E-20 (ESF): Thrust Reverser Testing	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.934, CS-E 890
ADVISORY MATERIAL:	--

Equivalent Safety Finding

Thrust Reverser Testing

CS 25.934 requires that the “*thrust reversers installed on turbo-jet engines must meet the requirements of CS-E 890*” which deals with thrust reverser testing.

CS-E 890 (b) requests that "*The thrust reverser shall be fitted to the Engine for the whole of the Endurance Test of CS-E 740 and a representative control system shall be used*".

However, the engine manufacturer does not intend to install the thrust reverser unit during their Engine type certification 150h Endurance test requested by CS-E 890 and opts to use use slave C-ducts.

In these case, whether or not the thrust reverser is supplied by the engine manufacturer, the aircraft manufacturer shall present an Equivalent Safety Finding to demonstrate compliance with CS 25.934 regarding the thrust reverser test. An acceptable alternative means of compliance are:

- A production representative thrust reverser to be tested on a production representative engine during the 225 cycles bench test ensuring direct compliance to CS-E 890(c)(1) through (4), to CS-E 890(e)(1) and (e)(2)
- Following the 225 cycles, the T/R shall be subjected to a complete strip inspection, in compliance with CS-E 890(f). During the test, all nacelle component downstream of the pylon necessary to actuate the T/R will be included (EEC, hydraulic actuators, LCV, etc). This test will ensure compatibility of the thrust reverser with the engine with regard to aerodynamic, thermodynamic, mechanical stiffness and dynamic response
- The Thrust Reverser integration with the engine shall be addressed through an analysis to demonstrate that endurance is not sizing for the T/R and will be addressed through T/R 225 cycles bench test.

– END –

F-14 (ESF): Landing Light Switch	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1383(b)
ADVISORY MATERIAL:	--

Equivalent Safety Finding

Landing Light Switch

CS 25.1383(b) requires separate switches for each landing light but allows that one switch is used for the lights of a multiple light installation at one location. There was no evolution since the creation of FAR 25 in 1965, which itself was derived from identical CAR 4b text.

CS25.1383 (b) requires separate switches for each landing light (except when one switch is used for the lights of a multiple light installation at one location). The public ELOS memo CP-101-S-23 issued by FAA for Airbus A380-800 program on September 16th, 2005 provides explanations on the original aim of this requirement: CS25.1383 (b) requirement was defined for propeller engine aircraft type design. On such aircraft, the side landing light beam reflection on the propeller can disturb pilot view of the runway during high crosswind approach and landing. The separate switches enable the pilots to switch off one side light independently to the other side one.

The Falcon SMS is a swept wing jet aircraft with engines mounted on the rear section of the fuselage and landing lights located in the fuselage body fairing close to the wing leading edge root. Consequently, the concern that was at the origin of the CS 25.1383(b) requirement does not apply to the Falcon SMS design. There is no risk at all of landing light reflection that may cause the need of a selectable switch for one or either landing light. Therefore, he absence of crew vision disturbance due to the landing lights and the simplification of the flight deck design provides an equivalent level of safety for requirement CS 25.1383(b).

– END –

F-29 (ESF): Use of IRS for DFDR vertical acceleration	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1459(a)(2)
ADVISORY MATERIAL:	ED-112

Equivalent Safety Finding

Use of IRS for DFDR vertical acceleration

Falcon 6X design does not directly comply with CS 25.1459(a)(2) requirement. For EASA to be in position to accept an Equivalent Level of Safety, Dassault Aviation will have to demonstrate that

- the IRS acceleration data, as sent to the Flight Data Recorder, represent the data as measured by a dedicated accelerometer at the CG position as specified in CS 25.1459(a)(2),
- the IRS data, as sent to the Flight Data Recorder, is appropriate to record high peak accelerations that could occur in crash conditions with comparable accuracy and dynamic characteristics as provided by dedicated acceleration sensors compliant with ED-112.
- The potential effect of any failure mode of the IRS on the characteristics of the recorded acceleration data are identified and properly recorded.

Dassault Aviation may comply with this by means of analysis, laboratory and/or flight tests. All compliance data will have to be delivered to EASA for agreement.

After compliance has been shown, EASA will accept the use of the IRS acceleration data in lieu of a dedicated sensor for Flight Data Recorder on the basis of equivalent safety.

– END –

F-50 (ESF): Minimum mass flow of passenger supplemental oxygen	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1443(c)
ADVISORY MATERIAL:	--

Equivalent Safety Finding

Minimum mass flow of passenger supplemental oxygen

In lieu of the airworthiness requirements of CS 25.1443(c) and associated standards of ETSO C64a and related SAE AS 8025 document, the following compliance method is considered acceptable:

For passengers and cabin crew members, it shall be shown, that the passenger oxygen system provides an equivalent level of protection from hypoxia as detailed below:

(1) Between 10,000 ft and 18,500 ft cabin pressure altitude, the supplemental oxygen system for the passenger and cabin crew shall provide a blood oxygenation level that is equivalent with the blood oxygenation level reached at 10,000 ft cabin pressure altitude when breathing standard air. Breathing standard air at 10,000 ft cabin pressure altitude provides a mean tracheal oxygen partial pressure of 100 mmHg as required by CS 25.1443(c).

(2) Between 18,500 ft and 40,000 ft cabin pressure altitude, the supplemental oxygen system for the passenger and cabin crew shall provide a blood oxygenation level that is equivalent with the blood oxygenation level reached at 14,000 ft cabin pressure altitude when breathing standard air. Breathing standard air at 14,000 ft cabin pressure altitude provides a mean tracheal oxygen partial pressure of 83.8 mmHg as required by CS 25.1443(c).

(3) During an actual decompression event and sudden exposure to high cabin pressure altitudes, it is likely that cabin occupants may begin to experience symptoms of hypoxia with decreasing SaO2 levels for many reasons, such as delays in donning their supplemental oxygen masks. In order to provide an equivalent level of protection, the reduced flow oxygen system should allow the user to recover from lowered SaO2 levels at a rate equal to or better than they would, using an oxygen system where the oxygen flow was determined by using traditional test methods and assuming delivery of a homogeneous gas mixture to comply with CS 25.1443(c). This could be accomplished by ensuring that a high flow rate of oxygen is available when the oxygen mask is first donned such that the users SaO2 levels would fully recover to baseline values before using a lower flow of oxygen intended to sustain the user at the baseline value. As an alternative, comparative data should be provided to demonstrate that the time to return from lowered SaO2 levels to baseline or greater values using a reduced oxygen flow is either unchanged or medically insignificant compared to the use of systems where the minimum flow rate was determined assuming a homogeneous gas mixture is delivered to the user.

Appendix

Interpretative Material

TEST SET UP

(a) The blood oxygenation level in human bodies is characterised by the stabilised arterial blood oxygen saturation level (SaO2). The purpose of the test is to demonstrate that the supple-mental oxygen dispensing equipment ensures test subjects SaO2 levels, which are sufficient or at least as high as the applicable baseline SaO2:

(1) 10,000 feet baseline: At 10,000 ft cabin pressure altitude, the “10,000 ft baseline” SaO2 of test subjects will be measured while breathing standard air. In the next step, the cabin pres-sure will be reduced in steps up to 18,500 ft cabin pressure altitude while the test subjects are breathing supplemental oxygen at a flow rate that matches the “10,000 ft base-line” SaO2 level.

(2) 14,000 feet baseline: At 14,000 ft cabin pressure altitude, the “14,000 ft baseline” SaO2 of test subjects will be measured while breathing standard air. In the next step, the cabin pres-sure will be reduced in steps up to 40,000 ft cabin pressure altitude while the test subjects are breathing supplemental oxygen at a flow rate that matches the “14,000 ft base-line” SaO2 level.

(b) The cabin altitude depending oxygen flow rates will be recorded and later used to specify the cabin altitude depending oxygen flow performance of the supplemental oxygen dispensing equipment. The test results from the 10,000 feet baseline will be used for the cabin pressure altitude range of 10,000 to 18,500 ft, whereas the 14,000 feet baseline will be used for the cabin pressure altitude range of 18,500 to 40,000 ft.

(c) The testing shall be accomplished in accordance with established industry practices. The evaluation of the passenger oxygen system performance must include an agreed number of masks and randomly selected novice human subjects. If new and novel test methods are used statistical means must be provided to justify the quantity of test subjects.

(d) The test subjects shall be exposed to the full range of altitudes for which the system will be certified to. A series of exposures at increments of at maximum 7,500 feet pressure altitude is acceptable for compliance demonstration. Existing data might also be used such as data from previous qualification tests or compliance findings, provided that the applicant can sufficiently justify the validity of those data.

(e) To address the increased breathing rate of a panicking person, the equipment must deliver in the above mentioned paragraph “a1” and “a2” the specified oxygen flow rate under the CS 25.1443(c) specified tidal volume and breathing rate, which may be demonstrated by tests using a breathing machine (breathing machine performance as specified in SAE ARP 1109B).

(f) For a subset of the test runs, the altitude chamber may be simulated on ground by using hypoxic gas mixtures.

– END –

F-60 (ESF): Degraded flight instrument external probe heating system (ESF-F25.1326-01)	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS 25.1326(b)(2)
ADVISORY MATERIAL:	AMC 25.1326

Equivalent Safety Finding (ESF)

ADS degraded flight instrument external probe heating system

1. APPLICABILITY

This ESF is applicable to CS-25 Large Aeroplanes.

1.1 AFFECTED CS

CS 25.1326(b)(2) at Amdt 21. Flight instrument external probes heating systems alert

2. COMPENSATING FACTORS

Dassault Aviation Falcon 6X ADSP and TAT probe heating system, although not literally compliant with CS 25.1326(b)(2) for certain failure modes leading to degraded anti-icing performance, may be installed and safely operated within the aircraft flight envelope provided that the below compensating factors are complied with.

3. For ADSP

1. The failure of one ADSP heater having an effect on operational capability or safety shall be detected, based on the following logics:
   - If the degraded heating leads to small bias below the DFCS monitoring threshold, there is no effect on operational capability or safety and the aircraft will pursue the flight safely and so as per AMC 25.1326, there is no need to provide alert to the crew.
   - If the degraded heating leads to bias higher than the DFCS monitoring threshold (erroneous data), the DFCS monitoring system allows to detect the erroneous ADS data and trigger a root cause for dispatch purpose and possibly a caution CAS message “ADS x: FAIL”.
2. The DFCS shall embed sufficient monitoring capabilities that enable 2 ADS erroneous data not to have higher than hazardous consequences and may trigger a caution CAS message “ADS x+y: FAIL” (e.g., subsequent failures) or a warning CAS message “ADS: ALL UNRELIABLE” (e.g., simultaneous failures).
3. In case of 3 or more ADS erroneous data there shall be sufficient monitoring capabilities that may trigger a warning CAS message “ADS: ALL UNRELIABLE”.
4. the Instructions for Continued Airworthiness (ICA) shall include:
   - maintenance tasks checking the probe heating system following the generic ADS fault messages triggered to avoid latent failures remaining in the system.
   - a scheduled maintenance task (through a Certification Maintenance Requirement (CMR)) aimed at checking the ADSP heater in order to detect potential latent failures modes

degrading the anti-icing/de-icing capability. The CMR interval shall adequately compensate the duration of operation with the latent failure(s).

Notes: With those CAS messages, pilots would be aware of a failure of the ADS but would not be informed of the origin of the failure.

The AFM procedures associated to CAS message “ADS x(+y): FAIL” and “ADS x(+y): PROBE HEAT FAIL” require the same pilot actions: reversion to the valid ADS/IRS source or disregard of ADS driven parameters in SFD, as applicable.

The AFM procedure associated to CAS “ADS: ALL UNRELIABLE” does not require different pilot action whether it is an ADS failure or an ADSP heater failure that drives this CAS message.

4. For TAT Probes

1. The failure of one TAT heater – leading to 2 erroneous temperature data - having an effect on operational capability or safety shall be detected. The crew is aware of erroneous TAT thanks to the caution CAS message “ADS: TAT MISCOMPARE”.
2. In case of 3 or more erroneous temperature data, there shall be sufficient monitoring capabilities that may trigger a caution CAS message “ADS: TAT MISCOMPARE” leading the crew to leave icing conditions which is considered as major.
3. the Instructions for Continued Airworthiness (ICA) shall include:
   - maintenance tasks checking the probe heating system following the generic TAT fault messages triggered to avoid latent failures remaining in the system
   - a scheduled maintenance task (through a Certification Maintenance Requirement (CMR)) aimed at checking the TAT heater in order to detect potential latent failures modes degrading the anti-icing/de-icing capability. The CMR interval shall adequately compensate the duration of operation with the latent failure(s).

Note: In case of triggering of the CAS message “ADS: TAT MISCOMPARE”, the procedure differs from “ADS x+y: TAT HEAT FAIL” and the pilot is required to avoid or leave the icing conditions and increase speed and landing distance.

– END –

F-61 (ESF): Terrain Information Display and Synthetic Vision System (ESF-ACNS.E.TAWS.030-01)	
APPLICABILITY:	Falcon 6X
REQUIREMENTS:	CS ACNS.E.TAWS.030 (b)(3), (b)(4), (e)
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Terrain Information Display and Synthetic Vision System

1. APPLICABILITY

This ESF is applicable to all aeroplanes equipped both with a Terrain Awareness and Warning System (TAWS) and with displays presenting a Synthetic Vision System (SVS) on Primary Flight Display (PFD).

1.1 AFFECTED CS

CS ACNS.E.TAWS.030 (b)(3), (b)(4), (e) at Amdt. 1	Terrain information display

2. SCOPE

In lieu of direct compliance with CS ACNS.E.TAWS.030 (b)(3), (b)(4), and (e), and provided that the below compensating factors are complied with, the PFD may display SVS using colour codes based on absolute terrain elevation.

3. COMPENSATING FACTORS

a. In addition to SVS , a separate window must display in the maximum field of view a two-dimensional terrain view that complies with CS ACNS.E.TAWS.030 (b)(3) and (b)(4) during Forward Looking Terrain Avoidance (FLTA) alerts or upon crew activation, ensuring that the flight crew is aware of the relative elevation of the surrounding terrain that could become a threat as well as of the areas that generate an alert when present.

b. The Flight Path Vector (FPV) must be displayed on the SVS, which anticipate the future position of the aeroplane, giving an indication of potential collision when overlapping the synthetic terrain and, conversely, showing that the short term flight path remains above any threatening terrain.

– END –

ESF-F25.1303-01 (ESF): Indication removal from Primary Flight Displays during ground phases	
APPLICABILITY:	Falcon 6X and 7X
REQUIREMENTS:	JAR 25.1303(b)(1)(2)(3)(4)(5) amendment 15
ADVISORY MATERIAL:	--

Equivalent Safety Finding (ESF)

Indication removal from Primary Flight Displays during ground phases

1. Applicability

This ESF applies to large aeroplanes embedding avionic functions/ features (like airport moving map) on the PFD which may negatively impact the readability of essential information while on the ground. The proposed ESF is limited to ground phases until line up on the Take Off runway and after landing below 80kts."

1.1 Affected Certification Specifications

JAR 25.1303(b)(1)(2)(3)(4)(5) amendment 15

2. Compensating Factors

In lieu of direct compliance to JAR 25.1303(b) and provided that the below compensating factors are complied with, some indications can be removed from primary flight displays during ground phases.

The applicant is expected to demonstrate that the usability, functionality and safety is equivalent to a full-time display of those indications. For this purpose, the applicant must show that:

- Each crew member does not need to use the indication when it is removed on the ground or can rely on an alternate information that is more relevant for this specific case (e.g. ground speed in place of indicated air speed),
- The removed indication is automatically displayed in ground phases when it is required (e.g. from line up on the take-off runway),
- The display of the removed indication can be manually selected by the flight crew without interfering with the display of other required information,
- If the indication is failed while removed (e.g. failure of the bank and pitch information when not displayed), the corresponding alerting is as efficient as when the indication is available,
- Mitigations have been put in place to compensate for the reduced exposure of flight crew to failures that may not be detected by the systems (e.g. frozen heading and airspeed on both sides),
- If the removed indication fails to be displayed when required or is erroneously removed during other flight phases (e.g. in cruise), the failure effect and compounding effects meet all applicable certification specifications,
- Appropriate procedures when needed to ensure Continued Safe Flight and Landing and to recover the removed information are introduced in the Aeroplane Flight Manual.

– END –

Acronyms and Abbreviations

TCDS	Type Certificate Data Sheet
SC	Special Condition
DEV	Deviation
ESF	Equivalent Safety Finding

– END –