Initial Airworthiness Special Condition

AWO – CAT II in CS-23

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EASA European Union Aviation Safety Agency	**SC Consultation paper** **Special Condition**	Doc. No. : **SC-O23-div-08** Issue : 1 Date : 01 July 2021 Proposed ☐ Final ☒

SUBJECT	:	**AWO – CAT II in CS-23**
REQUIREMENTS incl. Amdt.	:	**CS-23.773, 23.1301, 23.1309, 23.1322, 23.1329, 23.1585 amdt 3.**
ASSOCIATED IM/MoC[1]	:	Yes☒ / No ☐
ADVISORY MATERIAL	:	**Flight Test Guide FAA AC 25-7D, AC 120-29A CAT I & II**

INTRODUCTORY NOTE:

The following Special Condition (SC) has been classified as important and as such shall be subject to public consultation in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) which states:

"*2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.*"

IDENTIFICATION OF ISSUE:

CAT II approach minima are commonly used by commercial and business aviation aircraft around the world that would typically hold a CS-25 aircraft Type Certificate (TC). The CS-AWO refers directly to CS-25. Therefore, the CS-AWO does not repeat certain requirements already covered by CS-25 and provides only the additional requirements deemed necessary to perform approaches down to 100ft Height above touchdown elevation (HAT).

At Low Visibility Operation (LVO) on an airport the capacity is drastically reduced to accommodate larger separations between aircraft. This in turn creates a high demand on ATC to provide a strictly organized traffic flow. In LVO, any flow perturbation has a strong impact on the airport capacity. As of today, only aircraft compliant to more stringent airworthiness requirements of CS-25 are participating to LVO. This means the flight deck compartment view under low visibility weather conditions must be adequate.

The purpose of this Special Condition is to provide the additional and adapted requirements deemed necessary for a safe CAT II operation with CS-23 aircraft when complying with CS-AWO Subpart 2 (CAT II).

The following topics are verified for certification basis adequacy and completeness:

1. Autopilot/Flight Director Architecture, Reliability and Performance
   (Fail safe, Failure modes, Flight path error, MUH).

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[1] In case of SC, the associated Interpretative Material and/or Means of Compliance may be published for awareness only and they are not subject to public consultation.

2. Auto Thrust Architecture, Reliability and Performance
3. Radar Altimeter Architecture, Reliability and Presentation
4. Indications and Alerting (Loc 1/3 dot deviation, Cautions, Warnings, Flags)
5. External View (Rain, Snow, and freezing fog Removal)
6. Human Factors (Min Flight Crew, Standard Operating Procedure, Flight deck adequacy)

Certification Basis Comparison CS-23 vs. CS-25 and CS-AWO

CS AWO Subpart 2 contains relevant requirements and the corresponding acceptable means of compliance to demonstrate that an aircraft can safely fly an ILS/MLS precision approach with published minima below 200ft down to 100ft above Touch Down Zone Elevation (TDZE) (or HAT). These requirements are additional to the CS-25 certification basis.

It is the EASA position that for a CS-23 aircraft the applicant may choose to use the equivalent CS-23 requirement providing it exists and is equivalent in nature to the CS-25 requirement within the scope of the related project.

Where CS-23 (at pre- amendment 5 issue) is missing or not adequate to support CAT II when compared to a CS-25 requirement, a special condition (SC) is added based on CS-25.

For the gap analysis of this identification of issue EASA CS-23 is considered at amdt. 3 and CS-25 is considered at amdt. 24;.

CS-AWO for CAT II requirements has been written for CS-25 aircraft. These aircraft already intrinsically fulfil these CS-25 requirements, what CS-23 aircraft do not. The objective of the table below is to identify CS-25 paragraphs that serve as a basis on which the CS-AWO requirements are build. In making a gap analysis with these specific CS-25 paragraphs, as identified in the right column of the table, EASA identified requirements that serve as a discussion basis to determine a new set of Part-23 Special Conditions for CAT II operations in addition to the compliance to the CS-AWO and its AMC.

CS-AWO for CAT II	related CS-25 or CS-AWO
None	**CS-25.773(a)(b)(d)** Pilot compartment view
None	**CS-25.1585** AFM Operational Procedure
CS AWO.201 Safety Level	**CS-25.1309** Equipment, systems, Install.
CS AWO.202 Go around Rate	**CS-25.1329** Flight Guidance Systems
CS AWO.204 Control Flight Path	**CS-25.1329** Flight Guidance Systems
CS AWO.206 Control of Speed	**CS-25.1329** Flight Guidance Systems
CS AWO.207 Manual Control	**CS-25.1302** Sys used by Flight Crew
CS AWO.208 Oscillations and Deviations	**CS-25.1302** Sys used by Flight Crew
CS AWO.215 Decision height Recognition	**CS-25.1301** Function and Installation
CS AWO.216 Go Around	**CS-25.1302** Sys used by Flight Crew
CS AWO.221 Installed Equipment	**CS-25.1301** Function and Installation

	CS-25.1329 Flight Guidance Systems **CS-25.1322** Flight Crew Alerting
CS AWO.222 Min Equipment	**CS-25 1583** Operating Limitations
CS AWO.231 Flight path & speed control	**CS-25.1329** Flight Guidance Systems
CS AWO.233 Decision Height	**CS-25.1329** Flight Guidance Systems
CS AWO.236 Excessive deviation alert	**CS-25.1322** Flight Crew Alerting
CS AWO.243 Go Around Performance	**CS-25.1587** AFM Performance Information
CS AWO.251 Mode selection	**CS-25.1322** Flight Crew Alerting **CS.25.1329** Flight Guidance Systems
CS AWO.252 Presentation of information	**CS-25.1302** Sys used by Flight Crew **CS-25.1322** Flight Crew Alerting
CS AWO.253 Audible warning of autopilot disengagement	**CS AWO.153** Audible AP disengagement **CS-25.1309** Equipment, System, Install
CS AWO.262 Automatic Pilot	**CS.25.1329** Flight Guidance Systems **CS-25.1309** Equipment, System, Install
CS AWO.263 Flight Director Systems	**CS-25.1329** Flight Guidance Systems **CS-25.1309** Equipment, System, Install
CS AWO.268 Radio Altimeter	**CS-25. 1309** Equipment, System, Install
CS AWO.269 Excess-deviation alerts	**CS-25.1309** Equipment, System, Install
CS AWO.281 AFM	**CS25.1581** AFM GEN
NPA 2018-06(C) **CS-AWO.B.CATII.104** Flight Crew Workload (CS AWO.303 Minimum Flight Crew CAT III)	**CS-25.1523 & Appendix D** Min Flight Crew
CS AWO.352 Indications & Warnings	**CS AWO.361** Failure general CAT III **CS AWO.161** Failure general CAT I **CS AWO.172** ILS/MLS Gnd facility failure **CS AWO.268** Radio Altimeter reliability **CS AWO.269** Excess-dev alerts reliability **CS-25.1309** Equipment, System, Install **CS-25.1322** Flight Crew Alerting

Significant differences requiring supplementing requirements to CS-23:

EASA wants to highlight that the following discussions and determinations of supplemental requirements to CS-23 for CAT II operation with CS-23 aircraft are obviously additional to the direct compliance demonstration to CS-AWO and its AMC.

1. **CS-25.773 Pilot compartment with non-openable windows discussion**

   In CAT II at DH of 100 ft, the aircraft is about 580 m from the aiming point markings center. Instrumented runways for CAT II operation have normally the threshold at 400 m from the center of the aiming point center. This means that the aircraft is at about 180 m from the runway threshold at this moment with a RVR that can be as low as 300m. With the downward view masked by the aircrafts nose, being nearly on the runway, the approach lights are mostly not any more visible. This makes CAT II decision making and visual segment hand flying more difficult compared to CAT I due to

lesser visual cues and time to pilot's reaction. The lateral elements patterns recognition, THD lights or Touch Down (TD) zone lights, are essential for a safe attitude control in the visual segment.

EU 965/2012 CAT.P.MPA 305(e) states that the visual references for a CAT II continuation to land:

> (c) CAT II or OTS CAT II operations
>
> At DH, the visual references specified below should be distinctly visible and identifiable to the pilot:
>
> (1) a segment of at least three consecutive lights being the centreline of the approach lights, or touchdown zone lights, or runway centreline lights, or runway edge lights, or a combination of them;
>
> (2) this visual reference should include a lateral element of the ground pattern, such as an approach light crossbar or the landing threshold or a barrette of the touchdown zone light unless the operation is conducted utilising an approved HUDLS to touchdown.

CS-25 is significantly different and is not fully covered by the CS-23 equivalent. The organization of the rain removal, de/anti-icing and de/anti-fogging requirements and guidance are also slightly different between xx.773 and xx.775.

Anti/De-Fogging System and Reliability discussion:

CS-25.773(c) de-fogging function is mainly covered by CS-23.773(b). In CS-23, the reliability of the windshield internal de-fogging can make use of the "[..] unless fogging can be easily cleared by the pilot without interruption of normal pilot duties". This credit is not anymore acceptable for CAT II operation.

Rain removal System discussion (Heavy rain and Rain removal system necessity):

CS-23-773(a)(3)(i) states "design so that each pilot is protected [..] so that **moderate rain** conditions do not unduly impair the pilot's view of the flight path [..] while landing".

CS-25-773(b)(1) states "The aeroplane must have a means to maintain a clear portion of the windshield during precipitation conditions. Sufficient for both pilots to have a sufficiently extensive view along the flight path in normal flight attitudes of the aeroplane. This means must be designed to function, without continuous attention on the part of the crew, in [..] **heavy rain** at speeds up to 1.5 VSR1, with lift and drag devices retracted [..]".

AMC-25.773 states "Total loss of external visibility is considered **catastrophic**. A sufficient field of view must exist to allow the pilot to safely operate the aeroplane during all operations, including taxi. This field of view must remain clear in all operating conditions. Precipitation conditions such as outside ice, **heavy rain** must be considered.

AC 120-29A requires an equipment for rain removal where CS AWO does not. CS-25.773(b)(1)(i) requires a means to maintain a clear portion of the windshield during **heavy rain** precipitation condition. CS-23 does not provide a requirement for rain removal and addresses only **moderate rain** instead.

For CAT I operations the horizontal RVR is 550m, whereas in CAT II weather conditions the horizontal RVR can be as low as 300m. This lower visibility is driven by more moisture in the air leading to more demanding performance to provide a clear portion of the windshield. Therefore CS-23.773 is amended accordingly.

Concerning the rain requirements, CAT II operations predominantly take place in persistent meteorological conditions such as fog, mist or any combination of MIFG and or precipitation (DZ, RA-). Usually, rain clears the atmosphere and increases the visibility to above CAT II criteria. Should a microburst or thunderstorm produce rain that reduces the visibility to a CAT II standard, a landing would be very difficult if not impossible due to side effects such as wind-shears, flooded runway. Therefore, this special condition does not increase the requirement to heavy rain conditions and maintains the moderate rain level required in CS-23, however the AFM needs to indicate if flight testing has been done up to moderate rain conditions only.

Anti/De-Icing System discussion:

CS-25.773(b)(1)(ii) states the requirements for windshield de-icing system. The de-icing function is deemed sufficiently covered by the CS-23.775(f). It is noted that the appendix O for the icing envelope (supercooled large drop conditions) is excluded from this discussion.

De-Icing and Rain removal Reliability discussion:

CS-25.773(b)(2) states "No single failure of the systems used to provide the view required by subparagraph (b)(1) of this paragraph must cause the loss of that view by both pilots in the specified precipitation conditions".

CS-25.773(b)(4) states "that an openable window does not need to be provided if it is shown that an area of transparent surface will remain clear sufficient for one pilot to land the aeroplane safely in the event of – (i) Any system failure or combination of failures, which is not, extremely improbable in accordance with CS-25.1309 [..]".

AMC-25.773 states "Unless system failures leading to loss of a sufficient field of view for safe operation are shown to be **extremely improbable**, the following provides acceptable means to show compliance with CS-25.773(b)(4):

- Each main windshield should be equipped with an independent protection system. The systems should be designed so that no malfunction or failure of one system will adversely affect the other."

Design Eye Reference point discussion:

CS-23 does not require a Design Eye Reference Point (DERP). AC 23.1311-1C states "Part 23 rules do not require the applicant to establish a cockpit design eye reference point from which to measure viewing distances and angular displacement to various cockpit equipment".

CS-25.773(d) requires such DERP. In CAT II operation, it is essential that the pilot seats so that the visual acquisition of external references and the instruments scanning are optimal or not masked by glareshield or other cockpit frames.

2. CS-25.1302 Systems and equipment used by Flight Crew discussion

There is no such requirement in CS-23 addressing Human Factors performances.

CS AWO.252 (a) Presentation and Information to the crew requires that all indications must be designed to prevent crew errors.

CS AWO.252 (b) Presentation and Information to the crew requires that essential information and warnings permit a rapid recognition of malfunctions.

AMC AWO.252 states for installations involving more than one type of precision approach system the following should be taken into account "(iii) The ILS [..] system selected for the approach [..] should be indicated positively in the primary field of view at each pilot station.". Experience has shown that CS-23 equipment is not optimized to support such information for CAT II operations. They tend to provide only subtle indications with no clear approach mode labelling and with no automatic systems availability control.

A Human Factors special condition is added by SC-O23-div-08.01, if not already existing in the Certification Basis of the aircraft, for a good level of safety into CS-23 cockpit that wishes to operate in CAT II.

3. CS-25.1309 Systems, equipment and installations discussion

CS-25.1309 is written differently from CS-23.1309, however the main safety objectives are very similar with commuter (Class IV) aircraft category. Guidance ED-79A (ARP 4754A) has been developed for CS-25 modern and complex aircraft. ED-79(A) or ARP 4754(A) provide system safety analysis methods for the determination of functional DAL and item DAL. Their allocations follow engineering methods to grant IDAL reductions. However, some of the processes included are not necessary or appropriate for CS-23 airplanes.

If a CS-23 commuter is making usage of ED-79(A) or ARP-4754(A) and does not follow entirely the engineering methods proposed or is not appropriate for a CS-23 commuter, an alternate means of compliance will be necessary. This is normally not specific to the CAT II functionality but is rather linked to complex electronics systems like Fly by wire, stability augmentation, auto land, electronic backbones, UMS, IMA, etc.). EASA anticipates that AC 23.1309-1C and later, referring to ED 79 and ARP-4754 and later, is sufficient to address CAT II functionality. If CAT II specifically makes a new usage of this guidance then an AMOC CRI is needed.

Therefore, in this CAT II special condition, EASA proposes no System Safety Assessment (SSA) Special Conditions nor specific Means of Compliance (MoC) for it. The applicant must use the SSA CRI develop in its Type Certificate.

4. CS-25.1322 Flight Crew Alerting discussion

CS-25.1322 is significantly different and is not fully covered by the CS-23 equivalent. Since amendment 11 the CS-25.1322(c)(2) states for cautions and warnings to provide timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications.

In many existing aircraft designs the warning and/or caution alerts are presented only via one sensory means. While these designs are currently in-service on numerous aircraft, they do not meet the intent of CS-25.1322(c)(2); there is no assurance that visual methods alone can sufficiently attract the pilot's attention should he or she be focused elsewhere. This is a particular concern during certain phases of flight and situations that place higher demands on the flight crew's attentional resources, increasing the likelihood of cognitive tunnelling or perceptual blindness (25.1322(a)(2)). The addition of a second sensory channel is intended to mitigate these phenomena and enhance safety

Loss of CAT II capability below 200 feet requires immediate recognition and immediate action. Per 25.1322(b)(1), the loss of CAT II capability under those conditions is appropriately classified as a warning and must comply with 25.1322(c) through (f). In addition, CS AWO.253(a) states "Where the

approach flight path is controlled automatically, an audible warning must be given following disengagement of the automatic pilot or loss of the automatic approach mode." In essence the pilot must immediately determine to continue (if runway reference lights are visible) or initiate the missed approach procedure. An amber indication would imply that the decision could be delayed. Proximity to terrain and limited time to react necessitate a red warning with dual cues.

5. CS-25.1329 Flight Guidance System discussion

CS AWO.262 requires that the autopilot complies with CS-25.1329 and its AMC. Therefore, at the airworthiness certification level, the applicant must show compliance to CS-25.1329 and its associated AMC at least for the entire CAT II operation phase of flight.

However, the CAT II requires to delete an alternative design in CS-23.1329(a) that allows the override of the autopilot instead of a quick disconnect switch.

Considering all the above, the following Special Condition is proposed:

Appendix A

Special Condition SC-O23-div-08

AWO – CAT II in CS-23

SC-O23-div-08.01 - Applicability

This special condition is applicable to CS-23 commuter aircraft intended to be certified for CAT II operations in accordance with CS-AWO Subpart 2 complying with CS-23 amendment 3 or later.

The certification basis of the aircraft has to include the Special Condition SC-B23.div-01 'Human Factors', SC-F23.1309-02 (Protection from Effects of HIRF), and SC-F23.1309-03 (Protection from indirect Effects of Lightning Strike) or the certification basis is CS-23 amendment 4.

Note: If this SC has not been addressed during initial certification, it must be addressed to allow the application of this special conditions within the scope of CAT II operations.

SC-O23-div-08.02 - Front windshield protection:

CS-23.773 is replaced by the following:

(a) Both pilot compartment must be –

(1) Arranged with sufficiently extensive clear and undistorted view to enable the pilot to safely taxi, take-off, approach, land and perform any manoeuvres within the operating limitations of the aeroplane.

(2) Free from glare and reflections that could interfere with the pilot's vision. Compliance must be shown in all operations for which certification is requested.

(b) The aeroplane 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 flight path in normal flight attitudes of the aeroplane. This means must be designed to function, without continuous attention on the part of the crew, in moderate rain considering speeds up to the maximum applicable approach speed for CAT II operation (at the worst case condition, Maximum Landing Mass, for the fastest configuration including system failure cases authorized for CAT II operation) +5kts.

(c) Each pilot compartment must have a means to either remove or prevent the formation of fog or frost on an area of the internal portion of the windshield and side windows sufficiently large to provide the view specified in sub-paragraph (a) (1). Compliance must be shown under all expected external and internal ambient operating conditions. It must be shown that the windshield and side windows can be easily cleared without interruption of normal pilot duties and without any pilot manual removal actions.

(d) No single failure of the systems used to provide the view required by subparagraph (b) of this paragraph must cause the loss of that view by both pilots in the specified precipitation conditions.

(e) Openable windows do not need to be provided if it is shown that an area of transparence surface will remain clear sufficient for one pilot to land the aeroplane safely in the event of any system failure or combination of failures, which is not, extremely improbable in accordance with CS-23.1309.

(f) Fixed Design Eye Reference Point (DERP) or other guides must be installed at each pilot station to enable the pilots to position themselves in their seats for an optimum combination of outside visibility and instrument scan. T*he visual acquisition of external references and the instruments scanning must be optimal and not masked by glare shield or other cockpit frames.*

If lighted markers or guides are used, they must comply with the requirements specified in CS-25.1381.

(g) The means to maintain the clear portion of the windshield during precipitations should be an active rain removal means (e.g. windshield wipers, windshield bleed air). If a passive rain removal means is used (e.g. coating and/or windshield physical/geometrical properties) to achieve the acceptable forward visibility in precipitation conditions, then SC-O23-div-08.03 has to complied with.

SC-O23-div-08.03 – Passive Rain Removal:

SC-O23-div-O8.02 (b) is replaced by the following:

(b) The aeroplane 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 aeroplane. This means must be designed to function, without continuous attention on the part of the crew*, in conditions from light misting to* moderate rain *from fully stopped in still air* up to up to the maximum applicable approach speed for CAT II operation (at the worst case condition, Maximum Landing Mass, for the fastest configuration including system failure cases authorized for CAT II operation) +5kts.

SC-O23-div-08.04 Flight Crew Alerting

In addition to CS-23.1322 during CAT II operations the following must be complied with:

(a) Flight crew alerts must:

(1) provide the flight crew with the information needed to:

(i) identify non-normal operation or aeroplane system conditions, and

(ii) determine the appropriate actions, if any;

(2) be readily and easily detectable and intelligible by the flight crew under all foreseeable operating conditions, including conditions where multiple alerts are provided;

(3) be removed when the alerting condition no longer exists.

(b) Warning and Caution alerts must:

(1) be prioritised within each category, when necessary;

(2) provide timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications;

(3) permit each occurrence of the attention-getting cues required by subparagraph (b)(2) to be acknowledged and suppressed, unless they are required to be continuous.

SC-O23-div-08.05 - Flight Guidance System:

Sub-paragraph CS-23.1329 (a)(2) is deleted and replaced by:
The autopilot must not create an unsafe condition when the flight crew applies an override force to the flight controls.

Sub-paragraph CS-23.1329(h) is deleted and replaced by:
The flight guidance system functions, controls, indications, and alerts must be designed to minimise flight crew errors and confusion concerning the behaviour and operation of the flight guidance system. Means must be provided to indicate the current mode of operation, including any armed modes, transitions, and reversions. Selector switch position is not an acceptable means of indication. The controls and indications must be grouped and presented in a logical and consistent manner. The indications must be visible to each pilot under all expected lighting conditions.

The following additional requirements must be fulfilled:
Following disengagement of the autopilot, a warning (visual and aural) must be provided to each pilot and be timely and distinct from all other cockpit warnings.

Following disengagement of the autothrust function, a caution must be provided to each pilot.

SC-O23-div-08.06 – Operating procedures

CS-23.1585 (a) is amended by the following additional point:

(6) The maximum demonstrated precipitation rate (in terms of moderate or heavy rain) pertinent to CAT II operations.

Appendix B

Associated Interpretative Material and Means of Compliance to Special Condition AWO – CAT II in CS-23

Means of Compliance

MOC to SC-O23-div-08.03 – Passive Rain Removal

Performance of the passive rain removal means:

The method should address combinations of precipitation conditions, speeds, time exposure 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 passive rain removal means to maintain the required area of clear vision.

The definition of the precipitation rate is provided in table 1.

Note: The definition of the median droplet volume diameter should be considered in the method to show compliance when it involves artificial or simulated raining conditions.

-	Misting conditions :	(*) (MVD 0.1 mm)
-	Light :	from 0.25 (MVD 0.2 mm) to 4.5 mm/hour (MVD 1.0 mm)
-	Moderate :	from 4.5 (MVD 1.0 mm) to 12.5 mm/hour (MVD 1.5 mm)
-	Heavy :	from 12.5 (MVD 1.5 mm) to 50 mm/hour (MVD 2.1 mm)

(*): Mist conditions resulting from a suspension of water droplets in the air at high relative humidity (at least 80%) and reducing the visibility between 1.000 and 5.000 m.

Table 1: Precipitation rate(mm/hour) & median droplet volume diameter (mm)

The performance of the passive rain removal should be demonstrated for rain conditions, but it should also be confirmed that the implementation of the passive rain removal capability do not create any distortion, glare or reflection that may interfere with pilot's vision during day and night, with or without precipitation conditions such as rain, icing conditions and snow.

The following paragraph only applies for passive rain removal based on windshield hydrophobic coating implementation:

Coating durability and reliability:

Yet, the windshield hydrophobic coating may have a limited and variable effective life, and the failure of the coating may be latent. These aspects should be considered in order to comply with CS 23.603, and SC-O23-div-08.03 (b), since CS 23.1309 cannot apply to the hydrophobic coating.

It should be described how the continued airworthiness of the hydrophobic coating is assured as required by CS 23.1529, 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, salt spray, sand, dust, UV, ozone and expected airborne chemicals.

Furthermore any factors that could cause unacceptable degradation of the coating from a single exposure, such as hail, volcanic ash, or wind-blown sand, should be identified and it should be described how continued airworthiness will be assured following such exposure event. If the continuing airworthiness of the coating relies on an inspection/maintenance interval, it should be substantiated 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 one.

The pilot compartment view should be shown to comply with SC-O23-div-08.03 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 relies on conventional means of precipitation removal. The means proposed to avoid or mitigate this failure mechanism of the coating should be described. 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.

MOC to SC-O23-div-08.04 Flight Crew Alerting:

For the area specific to CAT II operations:

Prevention of crew errors and the rapid recognition of malfunctions request to provide a separate approach mode annunciator in the primary field of view in a position consistent with the other approach modes used. This annunciator can only be in active state when all equipment supporting this selected approach status are met (LOCs, GSs, DMEs, Radar Altimeters, FDs 1/2, APs 1/2, Channel comparators, etc..). The colour philosophy must be consistent with the existing avionics colour philosophy.

Loss of approach capability during an approach requires immediate recognition and immediate action from the pilot. Therefore the loss of CAT II capability below 200 feet is classified as a warning.

In addition, CS-AWO 253(a) states, in part, “Where the approach flight path is controlled automatically, an audible warning must be given following disengagement of the automatic pilot or loss of the automatic approach mode.” In the case of CAT II without automatic downgrade to CAT I, it means that the pilot must

immediately determine to continue (if he or she can see the runway) or initiate the missed approach procedure. An amber indication implies that the decision can be delayed. Proximity to terrain and limited time to react indicate that a warning alert is appropriate.

MOC to SC-O23-div-08.05 Flight Guidance System:

For the area specific to CAT II operations:

Quick Disengagement Control.

The purpose of the "Quick Disengagement Control" is to ensure the capability for each pilot to manually disengage the autopilot quickly with a minimum of pilot hand/limb movement. The "Quick Disengagement Control" must be located on each control wheel or equivalent and should be within easy reach of one or more fingers/thumb of the pilot's hand when the hand is in a position for normal use on the control wheel or equivalent.

The "Quick Disengagement Control" should meet the following criteria:

(a) Be accessible and operable from a normal hands-on position without requiring a shift in hand position or grip on the control wheel or equivalent;

(b) Be operable with one hand on the control wheel or equivalent and the other hand on the thrust levers;

(c) Be easily located by the pilot without having to first locate the control visually;

(d) Be designed so that any action to operate the "Quick Disengagement Control" should not cause an unintended input to the control wheel or equivalent; and

(e) Be designed to minimize inadvertent operation and interference with other nearby control wheel (or equivalent) switches/devices (e.g. radio control, trim).

System Safety Assessment.

Dependent upon the functionality provided in a specific FGS, the failure conditions could potentially impact the following:

- the control of the aeroplane in the pitch, roll and directional axes,
- the control of thrust,
- the integrity and availability of guidance provided to the flight crew,
- the structural integrity of the aeroplane,
- the ability of the flight crew to cope with adverse operating conditions,
- the flight crew's performance and workload,
- the safety of the occupants of the aeroplane.

The type of the FGS Failure Conditions will depend, to a large extent, upon the architecture, design philosophy and implementation of the system. Types of Failure Conditions can include:

- Loss of function – where a control or display element no longer provides control or guidance
- Malfunction – where a control or display element performs in an inappropriate manner which can include the following sub-types:

a) Hardover – the control or display goes to full displacement in a brief period of time – the resultant effect on the flight path and occupants of the aeroplane are the primary concern.

b) Slowover - the control or display moves away from the correct control or display value over a relatively long period of time – the potential delay in recognizing the situation and the effect on the flight path are the primary concern.

c) Oscillatory - the control or display is replaced or augmented by an oscillatory element – there may be implications on structural integrity and occupant well-being.

Failure Condition Mitigation

The propagation of potential Failure Conditions to their full effect may be nullified or mitigated by a number of methods. These methods could include, but are not limited to, the following:

- failure detection and monitoring,
- fault isolation and reconfiguration,
- redundancy,
- authority limiting, and
- flight crew action to intervene.

Flight Test requested.

A. Autopilot Override and Pitch Trim behavior

The autopilot should disengage when the flight crew applies a significant override force to the controls. The applicant should interpret “significant” as a force that is consistent with an intention to overpower the autopilot by either or both pilots. The autopilot should not disengage for minor application of force to the controls (e.g. a pilot gently bumping the control column while entering or exiting a pilot seat during cruise).

If the autopilot is designed such that it does not automatically disengage due to a pilot override, verify that no unsafe conditions are generated due to the override. The evaluation should be repeated with progressively increasing rate of force application to assess FGS behavior.

The pilot should then apply an input to the pitch cockpit controller (i.e., control column or sidestick) below that which would cause the autopilot to disengage and verify that the automatic pitch trim system does not generate unsafe conditions.

If the system design is such that the autopilot does not have an automatic disengagement on override feature, the pilot should initiate an intentional override for an extended period of time. The autopilot should then be disengaged, with the Quick Disconnect Button, and any transient response assessed. The effectiveness and timeliness of any Alerts used to mitigate the effects of the override condition should be assessed during this evaluation.

B. Fault Recognition and Pilot Action during approaches with vertical path reference

The Safety Assessment process may identify a vulnerability to the following types of Failure Condition:

- hardover
- slowover
- oscillatory

The various types of effect will cause differing response in the aeroplane and resultant motion and other cues to the flight crew to alert them to the condition. The flight crew attention may be gained by additional alerting provided by systems on the aeroplane. The recognition is then followed by appropriate action including recovery. The assessment of the acceptability of the Failure Condition and the validation of the Safety Assessment assumptions are complete when a stable state is reached as determined by the test pilot.

Figure 1 provides a depiction of the deviation profile method. The first step is to identify the deviation profile from the worst-case malfunction. The next step is to 'slide' the deviation profile down the glidepath, until it is tangential to the 1:29 line or the runway. The Failure Condition contribution to the Minimum Use Height may be determined from the geometry of the aircraft wheel height determined by the deviation profile, relative to the 1:29 line intersecting a point 4.5 m (15 ft) above the threshold. The method of determination may be graphical or by calculation.

NOTE: The Minimum Use Height is based on the recovery point because:

i) It is assumed that in service the pilot will be "Hands off" until the autopilot is disengaged at the Minimum Use Height in normal operation.

ii) ii) The test technique assumes a worst case based on the pilot being "Hands off" from the point of malfunction initiation to the point of recovery.

iii) iii) A failure occurring later in the approach than the point of initiation of the worst case malfunction described above is therefore assumed to be recovered earlier and in consequence to be less severe.

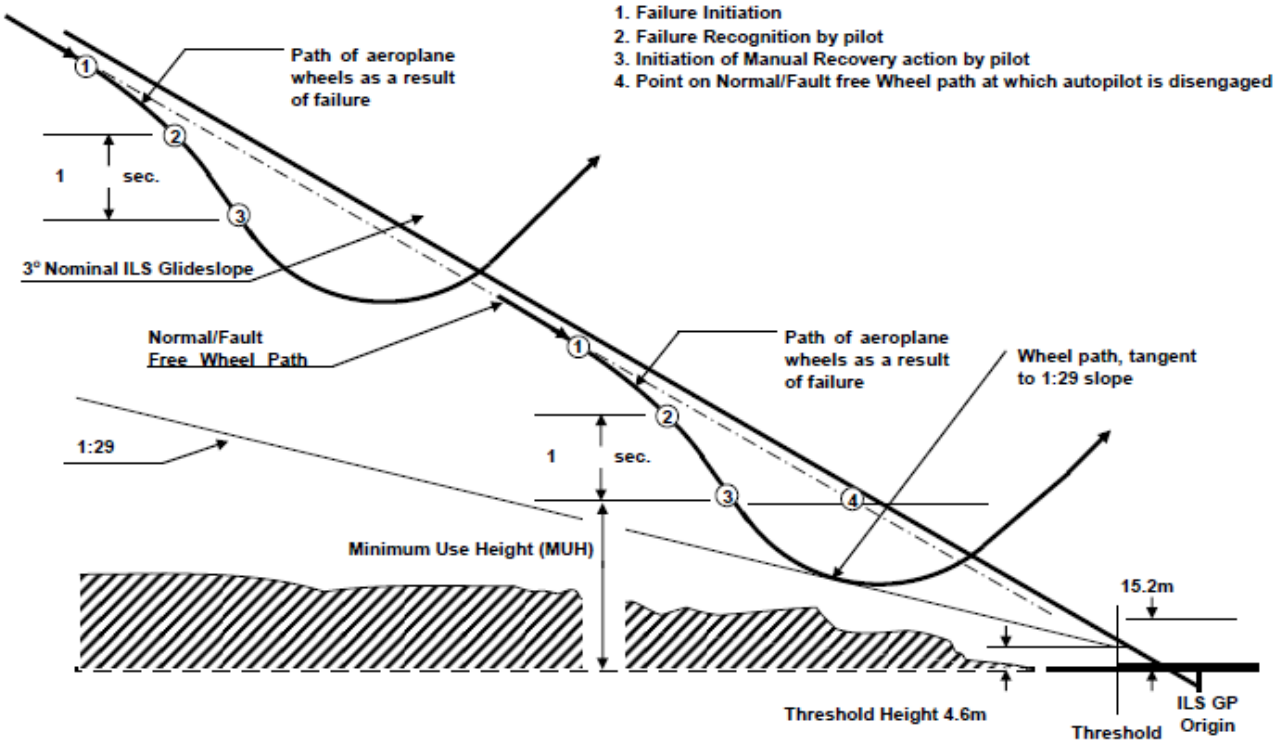

Figure FT-1: Deviation Profile Method

Interpretative Material

IM to SC- SC-O23-div-08.02 (d) Front windshield protection

Often Single pilot aircraft have a prioritization of the essential system to the left seat. Therefore, a CAT II visual segment and the landing phase might not be flyable from the right seat in case of windshield protection failure. Depending on the ice and rain protection architecture, it must be determined if a limitation is necessary when the landing cannot be conducted from one pilot station following a system failure.

MOC to CS-23.1523: Minimum Flight Crew:

The following Workload factors is in addition considered significant when analysing and demonstrating workload for the minimum flight crew determination:

Incapacitation of a flight crewmember (Pilot Flying or Pilot Monitoring) during CAT II approach. The applicant must determine if the aircraft can still be landed with an abnormal procedure or if a go around with an eventual diversion is effectively necessary. Standard and Abnormal operational procedure are necessary.