



Terms of Reference

for a rulemaking task

Loss of control or loss of flight path during go-around or other flight phases

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Applicability		Process map	
Affected regulations and decisions:	Part-26; CS-25; CS-26	Concept Paper:	No
Affected stakeholders:	Large aeroplane manufacturers/Type Certificate holders; operators and pilots of large aeroplanes	Rulemaking group:	Yes
Driver/origin:	Safety	RIA type:	Full
Reference:	SR FRAN-2013-025; FRAN-2013-026; FRAN-2013-042	Technical consultation during NPA drafting:	No
		Publication date of the NPA:	2016/Q4
		Duration of NPA consultation:	2 months
		Review group:	Yes
		Focussed consultation:	No
		Publication date of the Opinion:	2017/Q4
		Publication date of the Decision:	2017/Q4



1. Issue and reasoning for regulatory change

1.1. ASAGA¹ study and safety recommendations

A number of commercial air transport large aeroplane accidents or serious incidents have occurred either during/at the end of a go-around phase, or with the aeroplane close to the ground (but not in go-around mode) and with the pilots attempting to climb. Loss of control of the flight path or loss of control of the aeroplane has been observed in relation to inadequate flight crew awareness of the aeroplane's state, or in relation to inadequate management by the flight crew of the relationship between pitch attitude and thrust.

The above-mentioned occurrences have led the French Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) to conduct the ASAGA study in order to analyse this category of events (the so-called ASAGA-type events) and to identify the causal factors which contributed to such events and to suggest potential actions to prevent them from reoccurring.

The first phase of the BEA work was to conduct a statistical study, primarily of the data provided by the BEA and the International Civil Aviation Organization (ICAO). During the second phase of the study, significant events were selected and analysed. Subsequently, a survey was addressed to airline pilots, and Boeing 777 and Airbus A330 simulator sessions were performed.

A number of factors contributed to the ASAGA-type accidents and serious incidents, as well as to the difficulties experienced by flight crews performing go-arounds or climbs close to the ground, in operation or in the simulator. Among these factors, two key items linked to the design or ergonomics of the aeroplanes contribute significantly to the loss of control of the flight path:

- somatogravic illusions related to excessive thrust;
- non-detection of the position of nose-up trim by the flight crew.

This led the BEA to address the following safety recommendations to EASA in the domain of ergonomics and certification.

Limitations on available thrust

When full thrust is applied during a go-around, an excessive climb speed can be reached very quickly, thus making it difficult for flight crews to perform the actions related to the go-around procedure. Firstly, it can be incompatible with the time required to perform the go-around and, secondly, it can be a source of the somatogravic illusions that have led flight crews to make inappropriate nose-down inputs. Certain manufacturers have already implemented a system limiting the thrust. The main objective is to give flight crews sufficient time to limit excessive sensory illusions and excessive pitch attitudes.

Consequently, the BEA recommends that:

- EASA, in coordination with major non-European aviation authorities, amend the CS-25 provisions so that aircraft manufacturers add devices to limit thrust during a go-around and to adapt it to the flight conditions. [Recommendation FRAN-2013-025]
- EASA examine, according to type certificate, the possibility of retroactively extending this measure in the context of PART 26 / CS-26, to the most high performance aircraft that have already been certified. [Recommendation FRAN-2013-026]

¹ Study on Aeroplane State Awareness during Go-Around (ASAGA), published in August 2013. The report is available on the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) website at <http://www.bea.aero/etudes/asaga/asaga.php>.



Go-around and position of pitch trim

A go-around performed at low speed with an unusual nose-up trim position can lead to a stall and loss of control. Before the go-around, the speed drops and the aircraft systems compensate for this loss of speed by pitching up the stabiliser more and more.

Consequently, aircraft manufacturers should develop means to prevent this type of excessive trim from occurring and/or to prevent the aircraft stabiliser from being kept in an unusual attitude during a go-around. Flight crews pay less and less attention to the position of the trim during flight. They should thus be informed as early as possible of an excessive drop in speed so that they avoid applying full thrust with an unusual position of the pitch-up trim.

In the event of an excessive nose-up pitch position that is uncontrolled, few pilots know the upset recovery procedure which consists of reducing the thrust and/or modifying the trim position.

Consequently, the BEA recommends that:

- EASA, in cooperation with the major non-European certification authorities, make mandatory the implementation of means to make crews aware of a low speed value and, where necessary, prevent an unusual nose-up trim position from occurring or being maintained.

[Recommendation FRAN-2013-042]

1.2. Current regulatory frame for the certification of large aeroplanes

Go-around thrust: Certification Specifications for Large Aeroplanes (CS-25) contain requirements for minimum climb gradient performances (CS 25.119 for all-engine-operating; CS 25.121 and Appendix Q for one-engine-operative) and controllability/manoeuvrability (CS 25.143). Therefore, certification flight tests focus on aeroplane configurations aiming at demonstrating the minimum performance and controllability/manoeuvrability requirements.

There is neither a requirement to limit the thrust during go-around so as to keep the vertical speed or climb gradient below a certain limit, nor a requirement to demonstrate aeroplane controllability in configurations where a high pitch-up effect can be expected when applying full thrust (e.g. aircraft low weight, rearward position of the centre of gravity, low speed, horizontal stabiliser trim in extreme pitch-up position).

Unusual nose-up pitch trim prevention at low speed: CS-25 does not specifically require a means to prevent unusual nose-up trim at low speed.

Low-speed protection for Flight Guidance Systems is addressed in CS 25.1329(h) and the related AMC No 1 to CS 25.1329; however, there is no specific guidance in the AMC about the consideration of the pitch trim position.

1.3. Existing systems developed by manufacturers

Thrust/power management systems

Despite the fact that there is currently no rule requiring a means to adjust the thrust or power during go-around, manufacturers proactively worked on this issue and developed systems able to limit the thrust or power. The principle of these systems is to set the thrust or power in order to achieve a vertical speed target. However, the maximum thrust or power can still be commanded by the pilots at any time. Such systems have been certified on several types of large aeroplanes.

Pitch-up trim monitoring

Some aeroplanes are equipped with automatic pitch trim function. However, no alerting function has been put in place to alert to an unusual pitch-up trim position (such as in relation to low speed).



Note: On some aeroplanes, an alert is generated when the autotrim function is disengaged to inform the pilots that they have to trim the aircraft manually. This is a means to attract pilots' attention when the trim is in an unusual pitch-up position at the time of disengagement of the autotrim function. Nevertheless, accidents and incidents have happened during which the pilots did not take action to put the trim back into a suitable position and, therefore, experienced a very high pitch and vertical speed as a result of the combined effect with the go-around full thrust.

High-angle-of-attack protection

Some aeroplanes are equipped with a function which protects against stalling by preventing the angle of attack from exceeding a certain limit. The function is available under normal flight control law but may be lost under degraded flight control law.

1.4. Safety risk

The application of excessive engine thrust/power during go-around, possibly combined with a pitch-up trim configuration, can lead to a loss of control of the flight path or stall of the aeroplane if the pilots do not react on time to reduce the thrust and adjust the position of the trim. As this kind of manoeuvre typically occurs close to the ground surface, there is a high risk of catastrophic consequences from the impact with the ground surface or constructions. The risk is higher for twin-engined aeroplanes, as demonstrated by the review of accidents and incidents; this is because twin-engined aeroplanes have a higher amount of thrust/power in all-engine-operating configuration in order to comply with the performance certification specifications applicable to the one-engine-inoperative configuration.

Furthermore, the risk of reaching a loss-of-control situation because of unusual pitch-up trim position combined with high-thrust application also exists in other flight phases like during a transition from descent to climb, or in cruise after an abnormal event leading to stall or close-to-stall speed situation requiring a recovery action by the pilots.

2. Objectives

The overall objective is to mitigate the safety risk for large aeroplanes of loss of control of the flight path or loss of control of the aircraft during go-around phases, or other flight phases executed from a low-speed configuration.

The first objective is to ensure that the thrust available after selecting the go-around mode is set to a reasonable value, such that the aeroplane's performance parameters (e.g. forward and vertical speeds, pitch attitude) are not excessive to the point that the control of the flight path may be a very demanding or hazardous task. The thrust setting should be such that the aeroplane's performance still complies with the performance requirements of CS-25 Subpart B, and the pilot can still easily select the full thrust, if needed.

The second objective is to prevent an excessive nose-up pitch trim condition when transitioning from a low-speed phase of flight and when a high level of thrust is applied. This may be achieved by different means, such as by increasing the flight crew awareness of the low-speed/excessive nose-up trim condition, or by incorporating active systems preventing an unusual configuration (low-speed/excessive nose-up trim condition) from developing.

These objectives should be considered firstly for upgrading the Certification Specifications for Large Aeroplanes (CS-25), and also for mandating additional requirements for already certified aeroplanes (Part-26/CS-26). Furthermore, account should be taken of the accident and incident history to limit the Part-26/CS-26 rule to a certain category of large aeroplanes (i.e. the ones for which a higher risk has been evidenced by their involvement in the majority of events).



3. Activities

- Prepare new CS-25 provisions (Certification Specifications and Acceptable Means of Compliance/Guidance Material) meeting the two objectives above. The new specifications should provide performance-based objectives and should take into account the existing designs (for go-around thrust adaptation) and their Certification Specifications (EASA Certification Review Item/FAA Issue Paper). A *light* Regulatory Impact Assessment (RIA) will be prepared to support the proposal.
- In addition to the new CS-25 provisions, prepare options for a new Part-26/CS-26 rule which will mandate similar specifications for already certified large aeroplanes. A *full* RIA will be developed for the comparison of the different options and for an option selection to be made. These options should consider a restriction of the rule applicability to the aeroplanes at higher risk (high-performance large aeroplanes) and also production cut-in versus full retrofit.

4. Deliverables

- Notice of Proposed Amendment (NPA) proposing an amendment to CS-25 and an amendment to Part-26/CS-26, including the RIAs as identified in Chapter 3 above.
- Comment-Response Document (CRD) providing responses to the comments received on the NPA;
- Executive Director Decision amending CS-25;
- Agency Opinion proposing an amendment to Part-26², together with a draft Executive Director Decision proposing an amendment to CS-26³;
- Executive Director Decision amending CS-26 to be published together with the European Commission regulation amending Part-26.

5. Profile and contribution of the rulemaking group

- Participation of manufacturers: The rulemaking group should comprise several (ideally, at least three) members representing large aeroplane manufacturers, European and non-European manufacturers. The required expertise shall be in the domain of aeroplane performance & handling qualities, flight crew alerting system, flight control systems, and power plant systems.
- Participation of foreign aviation authorities: For the sake of harmonisation, FAA and TCCA participation is recommended.

² Annex I to Commission Regulation (EU) 2015/640 of 23 April 2015 on Additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012.

³ Annex to ED Decision 2015/013/R dated 8 May 2015 – Certification Specifications and Guidance Material for Additional airworthiness specifications for operations.



6. Annex I: Reference documents

6.1. Affected regulations

- Part-26: Annex I to Commission Regulation (EU) 2015/640 of 23 April 2015 on Additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012

6.2. Affected decisions

- CS-25: Decision No. 2003/2/RM of the Executive Director of the Agency of 17 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for large aeroplanes
- CS-26: Annex to ED Decision 2015/013/R dated 8 May 2015 – Certification Specifications and Guidance Material for Additional airworthiness specifications for operations

6.3. Reference documents

- Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA), France: Study on Aeroplane State Awareness during Go-Around (ASAGA), published in August 2013. The report is available on the BEA website at <http://www.bea.aero/etudes/asaga/asaga.php>

