December 9, 2022

Brandon Roberts
Executive Director, Office of Rulemaking, ARM-1
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Re: Final Report – Avionics System Harmonization Working Group (ASHWG) Ground Spoiler Alerting

Dear Mr. Roberts,

On behalf of the Aviation Rulemaking Advisory Committee (ARAC), I am pleased to submit the enclosed Recommendation Report from the Transport Aircraft and Engines (TAE) subcommittee's Avionics System Harmonization Working Group (ASHWG).

During the December 8, 2022, ARAC meeting at NASA's Ames Research Center in Mountain View, CA, Mr. Clark Badie, the working group chair, presented an overview of the report, the summary of the tasking, the four specific tasking questions that were asked of the working group, and the working group's recommendations.

ARAC members who attended the December 8 meeting, in-person and virtually, voted to accept the recommendation report. With that, I would welcome the agency's timely review, acceptance, and actions to implement a new rule to provide a "landing configuration alerting system" and advisory circular for aircraft that utilize ground spoilers as an aid to reduce landing and rollout distances.

I thank the chair and members of the ASHWG for their thorough and diligent work in response to the agency's tasking. With the global nature of the aviation industry, I would like to highlight the recommendation to harmonize with other civil aviation authorities. Doing so will further mitigate the risk of future runway overruns both here in the U.S. and abroad.

Lastly, I want to highlight and support the working group chair's request that the ASHWG be permitted to review the draft NPRM prior to publication in the Federal Register. Doing so will ensure alignment with the working group's recommendations and hopefully expedite the rulemaking process.

Sincerely,

David Oord
ARAC Chair

Enclosure: Final Report – ASHWG Ground Spoiler Alerting

Avionics Systems Harmonization Working Group (ASHWG)

Ground Spoiler Alerting

Prepared for the Aviation Rulemaking Advisory Committee (ARAC)
9-29-2022

Contents

1. EXECUTIVE SUMMARY

The FAA assigned the Aviation Rulemaking and Advisory Committee (ARAC) a new task for transport category airplane designs, to advise on the use of an alert when ground spoilers are not armed for landing (for new aircraft designs). This task cited 'a history of landing incidents and accidents where the automatic ground spoilers were not armed,' and a 'significant contribution to runway overruns.' The tasking statement specifically referenced the following incidents:

- April 26, 2011, Southwest Airlines Boeing 737-700 landing area overshoot incident at Chicago Midway International Airport.
- December 29, 2010, American Airlines Flight 2253 runway overrun incident at Jackson Hole Airport, Wyoming.

According to the NTSB reports, in the Southwest incident the ground spoilers were not armed for landing, and the probable cause of the American Airlines incident was the failure of the ground spoilers upon landing (no alert was provided to the flight crew).

This tasking was assigned by ARAC to the Avionics Systems Harmonization Working Group (ASHWG).

The Avionics Systems Harmonization Working Group (ASHWG) recognizes that ground spoiler alerting may be a good practice as one of many mitigations for potential runway excursions and is recommending a new rule (§25.704, Landing Configuration Alerting System) and advisory circular (AC 25.704) for aircraft that utilize ground spoilers as a means to reduce landing and rollout distances. Many current aircraft designs already include automation and alerting aligned with the intent of the proposed rule.

The ASHWG also strongly recommends that EASA CS 25.705 - Runway Overrun Awareness and Avoidance System (ROAAS) – be fully adopted/harmonized by the FAA.

Ground Spoiler alerting is recognized as one means to mitigate the effect of a runway overrun. However, after a review of other relevant accident/incident information and current industry practices, the ASHWG acknowledges that other circumstances and conditions unrelated to ground spoiler systems may result in a runway overrun, and designs to help mitigate runway overruns should utilize related regulations and guidance materials. The ASHWG recommends that the working group be tasked with broadening the proposed rule and advisory material to better understand runway overrun statistics and to truly capture the broad topic of landing configurations which will help develop improvements that can reduce the likelihood of runway overruns. For reference, FAA Advisory Circular AC 91-79A "Mitigating the Risks of a Runway Overrun Upon Landing," dated 2/20/2018, provides additional guidance for pilots and airplane operators to identify, understand, and mitigate risks with runway overruns during the landing phase of flight. It also identifies potential hazards associated with increased risk of a runway overrun.

The new proposed rule 25.704 titled "Landing configuration alerting system" provides for growth as it can be expanded based on future recommendations addressing other specific mitigations. However, an alternative title "Ground Spoiler Alerting" specific to the proposed rule is recommended if the working group's recommendation to broadening the proposed rule

in the future (to include additional systems associated with the landing configuration) is not accepted.

The ASHWG also recommends that aircraft manufacturers continue to apply existing rules that govern the design assessment and certification process including §25.1309, §25.1302, and §25.1322, as these would be well suited to derive the requirements for the design of any system that may be used to mitigate the likelihood of a runway overrun.

2. BACKGROUND

There has been a history of landing incidents and accidents where the automatic ground spoilers were not armed, leading to a subsequent reduction in wheel-braking effectiveness as well as drag reduction. This has been a significant contribution to runway overruns. Two examples are the April 26, 2011, Southwest Airlines Boeing 737-700 landing area overshoot incident at Chicago Midway International Airport. and the December 29, 2010, American Airlines Flight 2253 runway overrun incident at Jackson Hole Airport, Wyoming.

3. WHAT IS THE TASK?

The Avionics Systems Harmonization Working Group was tasked to provide advice and recommendations to ARAC, through the TAE Subcommittee, in a report that addresses the following questions relative to new airplane designs. The report provides rationale for the responses.

1. Are the existing industry standards or guidance material sufficient, or do you recommend any new or revised industry standards or guidance material to provide acceptable automatic ground spoiler alerts for the flight crew in cases where the airplane is prepared to land (for example, when the airplane drops below an appropriate height above the runway), but the automatic ground spoilers are not armed? The recommendations should ensure there is enough flexibility to cope with potentially different aircraft designs.

2. Are the existing alerting standards in 14 CFR part 25 sufficient, or do you recommend changes to the existing alerting requirements?

3. After reviewing airworthiness, safety, cost, and other relevant factors including recent certification and fleet experience, are there any additional considerations that the FAA should take into account regarding avoidance of landing without ground spoilers armed?

4. Is coordination necessary with other harmonization working groups? If yes, coordinate with that working group and report on that coordination.

For purposes of this report, the terms speed brakes and ground spoilers serve a similar purpose to meet the same safety objective. Extending the speed brakes or ground spoilers after landing increases aerodynamic drag and reduces lift, which increases the load applied to the main gear tires and makes the wheel brakes more effective. A lack of speed brake or ground spoiler deployment results in severely degraded stopping ability.

4. WHO HAS WORKED THE TASK?

This task was worked by the Avionics Systems Harmonization Working Group (ASHWG). The ASHWG consists of individuals from industry, ALPA, NASA and regulatory (EASA, FAA, Transport Canada) organizations. Disciplines represented include general systems engineering, certification, flight test, and human factors.

5. ANY RELATION WITH OTHER TOPICS ?

No. However, this report is consistent with the recommendation RSV(A) 175/A/07 issued by the Command of Aeronautics Aeronautical Accident Investigation and Prevention Center (Final Report A-No 67/CENIPA/2009), and recommended as a reference by the Flight Test Harmonization Working Group (FTHWG). The report was issued as a result of an A320 runway overrun accident in Brazil, on 17 July 2007. The recommendation states "To monitor and evaluate, in coordination with the EASA, in terms of safety requirements and time for its implementation, the proposal for the modification of the logic of actuation of the systems responsible for the deceleration of the A320 aircraft, so that it considers the clear intention of the crew to make a landing and guarantees the effectiveness of the deceleration, even if the thrust levers are incorrectly positioned."

6. HISTORICAL INFORMATION

The ASHWG reviewed the reports from the two example references from the original tasking.

1. NTSB report DCA11IA047 (Boeing 737 Landing area overshoot) identified the probable cause as "The flight crew's delayed deployment of the speed brakes and thrust reversers, resulting in insufficient runway remaining to bring the airplane to a stop."

    - Contributing to the delay in deployment of these stopping devices was the flight crew's inadequate monitoring of the airplane's configuration after touchdown, likely as a result of being distracted by a perceived lack of wheel braking effectiveness.

    - Contributing to the incident was the flight crew's omission of the Before Landing checklist, which includes an item to verify speed brake arming before touchdown, as a result of workload and operational distractions during the approach phase of flight.

2. NTSB report AAR-12/01 PB2012-910401 (Boeing 757 Runway Overrun) identified the probable cause of this incident was "a manufacturing defect in a clutch mechanism that prevented the speed brakes from automatically deploying after touchdown and the captain's failure to monitor and extend the speed brakes manually."

    - Also causal was the failure of the thrust reversers to deploy when initially commanded. Contributing to the incident was the captain's failure to confirm speed brake extension before announcing their deployment and his distraction caused by the thrust reversers' failure to initially deploy after landing.

    - Safety issues identified in this incident were a lack of an alert to warn pilots when speed brakes did not automatically deploy during the landing roll along with safety issues related to inadequate and/or lack of pilot training. As a result of this investigation, three new safety recommendations were issued, and three existing safety recommendations were reiterated to the Federal Aviation Administration.

In addition to this history, the ASHWG reviewed other industry reports along with reports from working group members who represent major aircraft manufacturers. These references

reinforced a lack of ground spoiler deployment when required to deploy automatically as one cause of runway overruns. Based on those reviews, for aircraft not equipped with automatic arming of ground spoilers at landing, the working group agreed that a new requirement is needed to alert the crew before landing that the landing configuration is incorrect, and in particular to alert the flight crew when the speed brakes are not armed when required or fail to deploy upon landing (regardless of armed status).

Runway excursion issues are generally understood by the industry, and go well beyond a lack of ground spoilers deployment. This report acknowledges previous work done in this area, and points to AC 91-79A as one additional reference to hazards associated with runway overruns. The proposed rule has been written and includes the pretext "landing configuration" so that it can be updated in the future to consider additional design improvements which may help further mitigate runway overruns. Additional details including working group recommendations can be found in this report.

7. CONSENSUS

This report provides the ASHWG recommendations on the findings and results of the tasks explained above. There are no dissenting positions on the findings and the rationale for each position.

8. RECOMMENDATION

The ASHWG recommends a new rule to provide a "landing configuration alerting system" and advisory circular for aircraft that utilize ground spoilers as an aid to reduce landing and rollout distances.

The ASHWG strongly recommends that EASA CS 25.705 - Runway Overrun Awareness and Avoidance System (ROAAS) – be adopted by/harmonized with the FAA.

The new proposed rule provides for growth as the title "landing configuration alerting system" can be expanded based on future recommendations addressing specific mitigations. The response to task question #3 provides additional detail and rationale. However, an alternative title "Ground Spoiler Alerting" specific to the proposed rule is recommended if the working group's recommendation to broadening the proposed rule in the future (to include additional systems associated with the landing configuration) is not accepted.

Some aircraft systems which help reduce the likelihood of a runway overrun may not have a regulatory basis. In those instances, the ASHWG recommends that aircraft manufacturers apply existing rules that govern the design assessment and certification process (§25.1309, §25.1302, §25.1322). The ASHWG strongly recommends a follow-on tasking to update the proposed §25.704 and proposed AC 25.704 to truly capture the broad topic of landing configurations which would help mitigate the effect of a runway overrun.

The ASHWG also recommends adoption and harmonization of this new rule and AC by other civil aviation regulatory agencies.

9. WHO WOULD BE AFFECTED BY THE PROPOSED CHANGE?

Manufacturers of new aircraft designs which implement ground spoilers as a means to improve braking effectiveness. However, many later model aircraft have already implemented features related to ground spoiler automation and alerting, thus meeting the intent of the rule.

10. ECONOMICS

The economic impact will be very minimal as new aircraft designs are implementing these alerts. The benefit will be based on the potential reduction of accidents/incidents.

For existing aircraft (e.g. retrofit), the changed product rule § 21.101 Designation of applicable regulations, and potentially § 21.19 Changes requiring a new type certificate for more substantial changes is the forum for decision of applicability. For practical reasons, on existing airplanes where integration of new alerts into the flight deck would be very challenging, incorporating ground spoiler alerts into existing designs should consider the guidance contained in AC/AMC 25.1322-1, paragraph 14.

11. DOES THE HWG WANT TO REVIEW THE DRAFT NPRM PRIOR TO PUBLICATION IN THE FEDERAL REGISTER?

Yes.

QUESTION 1: ARE THE EXISTING INDUSTRY STANDARDS OR GUIDANCE MATERIAL SUFFICIENT, OR DO YOU RECOMMEND ANY NEW OR REVISED INDUSTRY STANDARDS OR GUIDANCE MATERIAL TO PROVIDE ACCEPTABLE AUTOMATIC GROUND SPOILER ALERTS FOR THE FLIGHTCREW IN CASES WHERE THE AIRPLANE IS PREPARED TO LAND (FOR EXAMPLE, WHEN THE AIRPLANE DROPS BELOW AN APPROPRIATE HEIGHT ABOVE THE RUNWAY), BUT THE AUTOMATIC GROUND SPOILERS ARE NOT ARMED? THE RECOMMENDATIONS SHOULD ENSURE THERE IS ENOUGH FLEXIBILITY TO COPE WITH POTENTIALLY DIFFERENT AIRCRAFT DESIGNS.?

Although existing industry standards, regulations and associated advisory material including §25.1309/AC 25.1309-1A (System design and analysis), §25.1302/AC 25.1302-1 (Equipment used by the flight crew) are helpful in a system design, there is no current standard nor guidance material that specifically requires a ground spoilers alert. Therefore, the ASHWG recommends the inclusion of the "landing configuration alerting system" to be in accordance with the working group's findings from the NTSB recommendations, and to provide for future growth of improvements that may mitigate runway overruns.

However, an alternative title "Ground Spoiler Alerting" specific to the proposed rule is recommended if the working group's recommendation to broadening the proposed rule in the future (to include additional systems associated with the landing configuration) is not accepted.

The ASHWG strongly recommends a follow-on tasking to update the proposed §25.704 and proposed AC 25.704 to truly capture the broad topic of landing configurations which would help mitigate the effect of a runway overrun.

For future improvements which meet the same safety objective, but do not have a current basis of airworthiness (for example, future improvements to reduce unstable approaches), the ASHWG recommends that aircraft manufacturers continue to apply existing rules that govern the design assessment and certification process including §25.1309, §25.1302, and §25.1322.

The ASHWG strongly recommends that EASA CS 25.705, Runway Overrun Awareness and Avoidance System (ROAAS), and AMC 25.705 be fully adopted by / harmonized with the FAA.

The proposed new rule §25.704 "Landing Configuration Alerting System," proposed new AC 25.704, and the recently released EASA CS 25.705, and AMC 25.705 are included at the end of this report.

QUESTION 2: ARE THE EXISTING ALERTING STANDARDS IN 14 CFR PART 25 SUFFICIENT, OR DO YOU RECOMMEND CHANGES TO THE EXISTING ALERTING REQUIREMENTS?

There are no proposed changes to existing alerting standards based on the recommendation to include a new §25.704 and harmonize with CS 25.705.

The intended function of a landing alert must be specified (i.e. timely alerting when spoilers are not armed or do not deploy as designed) without introducing nuisance alerts or distractions. Once the intended function of the alert is specified, the existing §25.1322 standard along with AC 25.1322-1 provides adequate requirements and guidance regarding development, evaluation, and determination of compliance of any specific alert, and does not need to be modified.

As a reminder, the purpose of flight crew alerts is to attract the attention of the flight crew, to inform them of specific non-normal airplane system conditions or certain non-normal operational events that require their awareness, and, in modern alerting systems, to advise them of possible actions to address these conditions.

QUESTON 3: AFTER REVIEWING AIRWORTHINESS, SAFETY, COST, AND OTHER RELEVANT FACTORS INCLUDING RECENT CERTIFICATION AND FLEET EXPERIENCE, ARE THERE ANY ADDITIONAL CONSIDERATIONS THAT THE FAA SHOULD TAKE INTO ACCOUNT REGARDING AVOIDANCE OF LANDING WITHOUT GROUND SPOILERS ARMED?

No. Regarding ground spoilers the proposed rule and AC will be sufficient.

However, the underlying safety objective is the mitigation of runway overruns, for which there are many potential causes.

After examining the conditions that influence a safe landing, current mitigations and tools, and the human factor considerations including workload surrounding the approach and landing maneuver, flight crew alerting for other inappropriate landing configurations could help mitigate runway overrun risks. As with other tools and mitigations, a configuration alert may fill a limited need that will increase flight crew awareness and corresponding actions.

The importance of identifying a more complete set of hazards associated with runway overruns is stressed in order to develop risk mitigation strategies and tools for runway overruns. For reference, a list of identified hazards was developed in AC 91-79A CHG 2 and is provided below:

- Unstabilized approach;
- High airport elevation or high-Density Altitude (DA), resulting in increased groundspeed;
- Effect of excess airspeed over the runway threshold;
- Airplane landing weight;
- Landing beyond the touchdown point;
- Downhill runway slope;
- Excessive height over the runway threshold;
- Delayed use of deceleration devices;
- Landing with a tailwind; and
- A wet or contaminated runway.

In regard to the list above, the ASHWG believes that pilots should be informed concerning the risk of a runway excursion during landing by providing alerting, in flight and on ground, when the aircraft is at risk of not being able to stop within the available distance to the end of the runway. Standards and guidance have already been implemented by EASA in a rule requiring the Runway Overrun Awareness and Avoidance System (ROAAS). This system is now required by EASA (reference: CS25.705) and the ASHWG strongly recommends that the FAA adopt this rule at the earliest opportunity.

Understanding the wide range of conditions which may contribute to runway overruns led to the working group's understanding that other mitigations and/or tools may be necessary to reduce or mitigate inappropriate configurations beyond alerting. Even in the above list, inappropriate configurations are not listed as a hazard, however, the correct configuration is a necessary requirement for a safe landing, especially in high workload situations. The ASHWG strongly recommends a follow-on tasking to update the proposed §25.704 and

proposed AC 25.704 to truly capture the broad topic of landing configurations which would help mitigate the effect of a runway overrun.

The proposed rule and AC were written with this in mind, and to be able to be updated in the future.

QUESTION 4: IS COORDINATION NECESSARY WITH OTHER HARMONIZATION WORKING GROUPS? IF YES, COORDINATE WITH THAT WORKING GROUP AND REPORT ON THAT COORDINATION.

Yes, the recommendations from this report are consistent with the Flight Test Harmonization Working Group Task 9: Wet Runway Stopping Performance Final Report, March 16, 2018. This report provided recommendations for Ground Spoiler not armed warning regulation / guidance as well as a requirement for ROPs/RSAT/Smart Landing type systems for CFR 25

The ASHWG provided an advance review copy of this report to the FTHWG for acknowledgement and comment. Their feedback has been incorporated into this final report.

PROPOSED NEW RULE §25.704, LANDING CONFIGURATION ALERTING SYSTEM

§ 25.704 Landing configuration alerting system

A landing configuration alerting system must be installed that meets the following requirements:

(a) The alert(s) required in the following paragraphs must be presented to allow sufficient time for the flight crew to take corrective action.

(b) For aircraft designs with automatic ground spoiler deployment at landing:

(1) If the ground spoilers are required to be manually armed prior to landing but are not armed, an alert must be activated prior to landing

(2) An alert must be provided if the ground spoilers fail to automatically deploy upon landing.

PROPOSED NEW AC 25.704, LANDING CONFIGURATION ALERTING SYSTEM

AC 25.704 Landing Configuration Alerting Systems

1. PURPOSE. This AC provides guidance for the certification of landing configuration alerting systems installed in large airplanes. Like all AC material, this AC is not mandatory and does not constitute a requirement. It is issued to provide guidance and to outline a method of compliance with the rules.

2. RELATED REGULATIONS

25.1301	Equipment function and installation
25.1302	Installed Systems and Equipment for Use by the Flightcrew
25.1322	Flightcrew alerting
25.1309	Equipment, systems, and installations
25.1523	Minimum Flightcrew
25.771	Pilot compartment
25.671	General
25.729	Retracting Mechanism

3. RELATED MATERIAL.

AC 25.1302-1	Installed Systems and Equipment for Use by the Flightcrew
AC 25.1322-1	Flightcrew alerting
AC 25.1309-1A	Equipment, systems, and installations
AC 25.1523-1	Minimum Flightcrew
AC 25-7D	Flight Test Guide for Certification of Transport Category Airplanes
AC 25-11B	Electronic Flight Displays
AC 91-79A	Mitigating the Risks of a Runway Overrun Upon Landing
AC 25-23	Airworthiness Criteria for the Installation Approval of a Terrain Awareness and Warning System (TAWS) for Part 25 Airplanes

Policy Statement ANM-01-03(A)-Final Factors to consider when reviewing an applicant's proposed human factors methods of compliance for flight deck certification

Policy Statement ANM-25-11, Guidance for Hazard Classifications of Failure Conditions that Lead to Runway Excursions

EASA CS 25.705 / AMC 25.705 - Runway Overrun Awareness and Avoidance System (ROAAS)

4. *BACKGROUND.*

A number of airplane accidents and incidents have occurred because the airplane was not properly configured for landing, and the flight crew was not aware, which then resulted in a runway overrun. Investigations of these accidents and incidents have indicated a need for regulation and guidance material for design and approval of a landing configuration alerting system, specifically to generate flight crew awareness of incorrect ground spoiler operation (lack of an armed state when required, or failure to correctly deploy on landing).

5. *DISCUSSION.*

This does not replace any existing rules or guidance material for other configurations used during the approach and landing phase, including:

- §25.729 (e).2, which includes the requirement to provide an 'aural warning that functions continuously, or is periodically repeated, if a landing is attempted when the landing gear is not locked down';

- AC 25-23, which provides guidance for a 'too low flaps' alert; and,

- § 25.699 (a) Lift and drag device indicator, which does not explicitly require an alert but states "an indication of unsymmetrical operation or other malfunction in the lift or drag device systems must be provided when such indication is necessary to enable the pilots to prevent or counteract an unsafe flight or ground condition, considering the effects on flight characteristics and performance."

For purposes of §25.704 and this AC, the terms speed brakes and ground spoilers serve a similar purpose to meet the same safety objective: Extending the speed brakes or ground spoilers after landing increases aerodynamic drag and reduces lift, which increases the load applied to the main gear tires and makes the wheel brakes more effective. A lack of speed brakes or ground spoilers deployment may result in severely degraded stopping ability.

Certain aircraft designs may require a manual crew action prior to or during approach to prepare (or arm) the speed brakes/ground spoilers for automatic deployment at landing.

For such aircraft designs, a pre-landing checklist usually includes an item to arm the speed brakes/ground spoilers. However, there may be circumstances where the flight crew does not perform all or part of that checklist, and therefore is insufficient to meet the safety objective.

If this crew action is not performed, then the non-deployment of speed brakes/ground spoilers may contribute to a runway overrun, due to an increase in the stopping distance during landing or may result in a bounced or hard landing.

In those conditions, unusually low aircraft deceleration despite maximum pedal braking may not be immediately evident to the crew and may delay or prevent expected flight crew actions, and other mitigations (e.g. automatic deployment of ground spoilers only upon thrust reverser selection) may be employed.

§25.704 requires specific alerting to inform the flight crew when the speed brakes/ground spoilers are not armed prior to landing, for aircraft designs that are required to do so, and in a manner to provide sufficient time for the flight crew to take corrective action (e.g. arm the speed brakes/ground spoilers, continue the landing based on expected landing performance, utilize other stopping devices, or perform a go-around).

Even when the speed brakes/ground spoilers are confirmed armed prior to landing, there may be failure conditions which prevent their timely deployment (for example, mechanical faults which result in a failure of the ground spoilers to deploy). An alert in case of non-

deployment of speed brakes/ground spoilers at landing should be provided to trigger appropriate crew reaction.

Certain designs may not need crew manual action of arming speed brakes/ground spoilers prior to landing, or may be dependent on other systems to automatically deploy speed brakes/ground spoilers (for example, a linkage to thrust reversers). However, those designs should also consider an alert for circumstances where the automated systems are not operating correctly, which could also result in failure to deploy speed brakes/ground spoilers.

6. LANDING CONFIGURATION ALERTING SYSTEM DESIGN CONSIDERATIONS

In accordance with § 25.1301, the landing configuration alerting system must be designed appropriate to its intended function and must function properly when installed.

- The intended function of a landing alert is to attract attention and inform the flight crew when the aircraft is not in a required landing configuration, with adequate time to elicit intervention with corrective action by a qualified flight crew, to continue safe flight, or landing.

- The intended function of a ground spoiler alert is to attract attention and inform the flight crew when the ground spoilers have not been armed, or are not operating as expected, with adequate time to elicit intervention with corrective action by a qualified flight crew to continue safe flight or landing.

The landing configuration alerting system must be designed in accordance with the requirements found in § 25.1322 (amendment 131 or later version). This includes considerations such as alert category, timely cueing, message nomenclature, false and nuisance alerts, alert components (e.g. aural, visual, tactile), and prioritization with other alerts, including windshear alerts or stall warning if applicable. (ACs 25.1322-1 and 25-11B).

Per §25.1322(c)(3) it may be permissible to acknowledge and suppress the attention-getting cues associated with the alert, unless it is required to be continuous (as determined by the applicant).

The alert may also specify the general problem (configuration), or the exact problem (speed brakes not armed, speed brakes failed).

The applicant must show that the landing configuration alerting will meet the requirements in § 25.1302 for installed systems and equipment for use by a qualified flight crew. This should include the requirements related to accessible and usable information consistent with the urgency of the flight crew tasks along with flight crew awareness of the effects on the airplane or systems resulting from flight crew actions.

The proposed section § 25.704(a) requires a timely alert in that it should be presented early enough that a qualified flight crew can respond appropriately. This is to facilitate a safe landing (and rollout) or perform a go-around without requiring exceptional skill, alertness or workload. In determining if the alert is timely, attention should be given to whether the design includes allowances for any time delays associated with the flight crew's recognition

time and correct accomplishment of corrective actions that may be reasonably expected in service. (ACs 25.1302-1, 25.1322-1, and 25.1523-1)

Design considerations of the alert must account for effects on flight crew workload in accordance with § 25.1523, Appendix D to Part 25 (AC 25.1523-1).

The reliance on speed brakes should be analyzed in accordance with AC 25.1309, to identify the failure conditions, their potential consequences (hazard levels), the expected mitigations, and any assumptions regarding flight crew response.

Analysis should consider all the sensors, transducers and the elements they depend on, as well as any landing configuration alerting system components and the actual visual and aural alert elements.

The analysis should consider that there may be non-normal airplane conditions which would result in an unsafe condition if the speed brakes are automatically deployed. The applicant should define those conditions and incorporate procedures which explicitly state when to not arm the speed brakes.

At the current time, FAA Policy Statement PS-ANM-25-11, Dated 11/13/2013, titled "Guidance for Hazard Classifications of Failure Conditions that Lead to Runway Excursions," provides guidance for acceptable methods of establishing the hazard classifications of airplane system failure conditions leading to runway excursions during takeoff or landing.

When manual tests or checks are required to show compliance with § 25.1309, by detecting the presence of and limiting the exposure time to a latent failure that would render the alert inoperative, they should be adequate, simple and straight forward in function and interval to allow a quick and proper check by the flight crew and maintenance personnel. Flight crew checks may be specified in the approved Airplane Flight Manual (AFM) and, depending on the complexity of the landing configuration alerting system and the airplane, maintenance tasks may be conventional Maintenance Review Board (MRB) designed tasks or listed as Certification Check Requirements (CCR) where appropriate, as defined in AC 25.1309, and determined as part of the approval process between the manufacturer and the certification office.

7. EVALUATION USING ANALYSIS, SIMULATION, AND/OR FLIGHT TEST.

Specified tests/checks established in accordance with this AC should be demonstrated as part of the approval process and should show that the landing configuration alerting system, including each input as well as the alerting logic, is verified as required to meet the intended function. It should also be demonstrated that the alert self-cancels when required to do so, for example by correcting the aircraft configuration.

AC 25.1322-1 contains guidance on how to evaluate flight crew alerts. In addition, AC 25.1302-1 provides recommendations for the design and evaluation of controls, displays, system behavior, and system integration that are all part of human factors considerations.

A timeline analysis as described in AC 25.1523-1 along with simulation and flight test are recognized means for determining if the applicant's design is timely enough for the flight crew to continue safe flight or landing in response to the alert. There should be adequate time for the qualified flight crew to successfully accomplish all corrective actions as described in the alert's intended function. Successful accomplishment of corrective actions should not require exceptional flight crew skill, alertness or workload.

In determining adequate time for the qualified flight crew actions, all sources of time delays should be considered. This includes delays associated with the flight crew recognition and identification of the alert, their corrective actions and the airplane's response delays including systems delays.

Whether or not a separate timeline analysis has been conducted, simulation and flight test are essential to help establish and validate if the qualified flight crew can adequately perform all tasks resulting from the alert and continue safe flight or landing.

The applicant should describe how relevant human factors elements will be addressed (such as flight crew response times, workload, corrective actions, and minimizing of flight crew errors) and other assumptions that must be made about crew behavior as part of the evaluations discussed in this section. These elements should be reviewed to ensure that no assumptions are being made that will require the crew to respond in a manner beyond their expected capabilities.

During simulation or flight testing it should be shown that the landing configuration alerting system does not issue nuisance alerts or interfere with other systems. Specific testing should be conducted to ensure that the landing configuration alerting system works satisfactorily for all sensor inputs to the system.

REFERENCE CS 25.705/AMC 25.705

Reference: CS 25.705 Runway overrun awareness and alerting systems (See AMC 25.705)
A runway overrun awareness and alerting system (ROAAS) must be installed. The ROAAS shall reduce the risk of a longitudinal runway excursion during landing by providing alert, in flight and on ground, to the flight crew when the aeroplane is at risk of not being able to stop within the available distance to the end of the runway.
(a) During approach (from a given height above the selected runway) and landing, the ROAAS shall perform real-time energy-based calculations of the predicted landing stopping point, compare that point with the location of the end of the runway, and provide the flight crew with:
(1) in-flight, timely, and unambiguous predictive alert(s) of a runway overrun risk, and
(2) on-ground, timely, and unambiguous predictive alert(s) of a runway overrun risk. At the option of the applicant, the ROAAS may also provide an automated means of deceleration control that prevents or minimises runway overrun during landing.
(b) The ROAAS shall at least accommodate dry and wet runway conditions for normal landing configurations.

Reference: AMC 25.705
Runway overrun awareness and alerting systems 1. When demonstrating compliance with CS 25.705, the applicant should take account of EUROCAE Document ED-250, 'Minimum Operational Performance Standard for a Runway Overrun Awareness and Alerting System', dated December 2017.
2. When demonstrating compliance with CS 25.1581 and CS 25.1585, the applicant should include in the aeroplane flight manual the following elements:
(1) A description of the runway overrun awareness and alerting system (ROAAS) operational domain, including all conditions for which the ROAAS is expected to perform its intended function,
(2) Any operational limitations applicable to the ROAAS, and
(3) Operational procedures to be used by the flight crew when ROAAS alerts are triggered.