



General Failure Regulations §25.901(c) & §25.1309(b) Q&A Session

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§25.901(c) & §25.1309(b) Presentation Objectives

- ✍ Answer specific questions submitted by DER's**
- ✍ Present Related "Hot Topics"**
- ✍ Open Q&A Session (as time permits)**

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§25.901(c) & §25.1309(b) Question #1

Q – Does the “no single fault” clause of §25.901 apply only to Catastrophic Failures (consistent with the “no single fault” clause of AC 25.1309) or does it also include Hazardous failures ?

A –All “Catastrophic” and most, but not all, “Hazardous” failure condition have traditionally been considered to “Jeopardize”.

There is no unique regulatory definition of “Jeopardize”. Hence, the dictionary definition: “to expose to loss or injury”; is the literal legal intent. Further, the intent of §25.901(c) is clearly linked by preamble to a previous version of §25.1309(b) which read:

"The equipment, systems and installations must be designed to prevent hazards to the airplane if they malfunction or fail."

In practice, any condition substantially more severe than a “single engine safe shutdown” may be considered to “Jeopardize”.

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§25.901(c) & §25.1309(b) Related “Hot Topic”

“NO SINGLE FAILURE”

Recent ARAC Harmonization Working Group Recommendations would add a prohibition against single catastrophic failures to the §25.1309(b) rule itself. “Extremely Remote” single failures would be allowed to be hazardous.

These same requirements would be applicable to Powerplant Installations if/when the remaining Subpart E&F harmonization issues are successfully resolved and §25.901(c) amended as proposed by ARAC.

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§25.901(c) & §25.1309(b) Related “Hot Topic”

“NO SINGLE FAILURE”

One remaining Subpart E&F disharmony is the configurations and missions to which the failsafe standards are applied.

- ⌘ Traditionally, all §25.901(c) requirements are applied to all foreseeable flights. Hence the infamous “latent plus one” compliance criteria.
- ⌘ The “no single failure” requirement of §25.1309(b) has traditionally been applied to the “as built” airplane while the requirements associated with “combinations of failures” have been applied to a “typical flight of mean duration”.

Several years ago the FAA proposed a hybrid approach to ARAC for their consideration. No satisfactory resolution has yet been reached, but a new round of discussions is forthcoming.

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§25.901(c) & §25.1309(b) Question #2

Q – Why do the terms “Probable” and “Extremely Remote” seem to have different meanings when used in association with §25.901(c) & §25.1309(b)?

A – These terms are used in a more traditional sense in §25.901(c) to reference conditions that are and are not ‘foreseen’ to occur. Subsequently, the initial AC25.1309 gave these terms different more prescriptive meanings. In AC25.1309 terms, these §25.901(c) terms should be thought of as “not extremely improbable” and “extremely improbable” respectively.

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§25.901(c) & §25.1309(b) Related “Hot Topic ”

PROBABILITY TERMS

Numerous Probability Terms are undefined and/or used in dissimilar ways throughout the FAR’s.

Years ago the FAA initiated a rulemaking project to add probability terms to FAR Part 1 and standardize their use throughout the FAR’s, but this project has never been completed.

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§25.901(c) & §25.1309(b) Question #3

Q – When showing “extremely improbable” under §25.1309, is it permissible to take account of the combination of failures and circumstances (conditions, exposure times, etc.) ?

A – Yes, as delineated more completely in draft AC25.1309-1B, it is permissible to take warranted account of both conditional probabilities and average exposure times, but only when computing the average probability per flight hour of failure conditions resulting from multiple independent failures.

Any anticipated combination of operating and/or environmental conditions approved for the airplane must be assumed to occur when establishing:

- ✍ The effects of any single failure; and
- ✍ Failure Condition Hazard Classifications and the associated Design Assurance Levels.

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§25.901(c) & §25.1309(b) Question #3 (Continued)

Q – When showing “extremely improbable” under §25.1309, is it permissible to take account of the combination of failures and circumstances (conditions, exposure times, etc.) ?

A – For a condition to be “extremely improbable” it must not be anticipated to occur on any airplane during any flight. When the anticipated variability and/or uncertainty associated with a given contributing condition is significant, a conservative simplifying assumption such as setting the associated conditional probability to one or utilizing the maximum exposure time may be necessary to support a conclusive finding of compliance.

The most notable example of this concept is the assumption that no single failure or error is in and of itself “extremely improbable”.

This is intended to compensate for statistically inadequate or diverse relevant experience and/or the impracticality of assuring any continuous minimum component integrity.

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§25.901(c) & §25.1309(b) Related Hot Topic

“Acceptance of Conditional Probabilities in Safety Analyses”

Single Failures

- ✍ Due primarily to the impracticality of assuring continuous minimum component integrity, single failures are assumed to occur under any anticipated operating and/or environmental conditions approved for the airplane. That is, their probability of occurring during any given flight is taken to be “one”.
- ✍ Nevertheless, that doesn’t mean that associated failure conditions can’t be found to be “extremely improbable”. If the conditions necessary for a single failure to result in a catastrophe are in and of themselves not anticipated to occur (i.e. they are “extremely improbable”), then the associated catastrophic single failure condition is also clearly not anticipated to occur.

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§25.901(c) & §25.1309(b) Related Hot Topic

“Acceptance of Conditional Probabilities in Safety Analyses”

Multiple Failures

- ✍ As delineated in Section 11.g. of draft AC25.1309-1B, a probability of one should usually be used for encountering a discrete condition for which the airplane is designed, such as instrument meteorological conditions or Category III weather operations.
- ✍ However, Appendix 4 of the draft AC proposes allowable probabilities that may be assigned to various operational and environmental conditions for use in computing the average probability per flight hour of failure conditions resulting from multiple independent failures. The FAA endorses the Appendix 4 concept but not necessarily all the proposed values.
- ✍ In any case, if conditional probabilities are not well validated or are substantially non-random, it may be necessary to set them equal to some conservative value (usually “one”) to support a conclusive finding.

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§25.901(c) & §25.1309(b) Question #4

Q – What is the hazard classification of runway departures/excursions ? Does it depend on the speed or extent of the departure ?

A – Hazard classifications are based on the worst anticipated outcome.

The relevant variables such as airplane and airport configurations, environmental conditions, and departure scenarios are usually very diverse and often not deterministic.

Consequently, for the purposes of type certification, any anticipated runway lateral departure or overrun of the stopway should normally be classified as “Catastrophic”.

Any exception must be clearly warranted and effectively validated for all approved operating conditions.

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§25.901(c) & §25.1309(b) Related Hot Topic

“CRITICALITY OF RUNWAY DEPARTURE”

A study performed in association with NTSB Recommendation A98-70 indicates that:

- ✍ Past “practice” has been anything but “standardized”;
- ✍ Actual outcomes are a function of numerous variables including airplane and airport configurations, environmental conditions, and departure scenarios.
- ✍ Service history indicates that around 5-8% of runway departure events lead to catastrophic consequence. To date the key element has been departure speed.
- ✍ Development of a less conservative, comprehensive and effective policy guidance based on all the relevant variables was undertaken and has proven problematic due primarily to the diversity and non-deterministic nature of the pertinent conditions adjacent to runways worldwide.
- ✍ Even those runways meeting Part 139/Annex 8 standards can present conditions, especially when the soil is saturated with water, which are potentially catastrophic for aircraft with limited ground clearance and/or without ruggedized landing gear.

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Funchal, Madeira Island



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Telluride, Colorado



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Recent Avweb News Story

“STOP OR ELSE - -

AIRPORT REMOVES LAND MINES:

Not that you would want to, but it’s now a tiny bit safer to overrun the south end of the runway at Taiwan’s Shangyi Airport. More than 4,000 land mines and undetonated bombs have been removed from the site, a job that took six months’ effort. Should make those landings a little bit less stressful.”

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QUESTIONS ?



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