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- Safety Assessment (SA) -
Part Two: Talking About AC 25.1309-1A (I/V)

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In this flash, we will present our comments about the initial part of the methodology suggested by the FAA, in the AC 25.1309-1A, to show the compliance of a design with five of the six requirements of § 25.1309: (a), (b), (c), (d) and (e). The requirement (e) refers to the requirements (a) and (b). The requirement (f) is assessed according to § 25.1709. Therefore, it is not included in the mentioned AC.

Like the all Parts of the 14 CFR, Part 25 establishes requirements, but normally does not provide guidance to show the compliance of a design with these requirements. For this reason, FAA has developed a group of publications for helping the applicant to show this compliance. They are the so-called Advisory Circulars, better known by its acronym AC.

FAA decided to issue this kind of document because the requirements were interpreted in different ways by the applicants, making complicated the certification process.

AC 25.1309-1A (from now on simply referred to as AC 25.1309 or, where applicable, just by AC) is therefore a means acceptable by the authority for verification of compliance of equipment, systems and installation design (E/S/I) with the requirements of § 25.1309.

The AC is not a mandatory document. It is only a help from the authority to the applicant for developing his work of verification of conformity with the requirements, in a manner acceptable by the authority.

But this characteristic of the AC of not be a mandatory document has its controversial points because there are guidelines in the AC that must be followed, what makes them a kind of requirements. As we will see later, the AC defines the severity of a failure condition and the probability of a failure condition, establishing a ranking for the Severity and ranges for the probability with well defined limits. The applicant has to follow this. Therefore, it is a requirement.

Despite the freedom for the applicant, to the use any other methodology, it is suggested that he follows the AC, thus avoiding possible controversies with the authority. If even using the means of AC, it is possible to arise polemics with the authority, one can imagine that the use of different means can raise the level of these controversies.

The AC is applicable to the original applicant seeking issuance of a Type Certificate (TC), an Amended Type Certificate (ATC), a Supplemental Type Certificate (STC), or a Parts Manufacturer Approval (PMA) for the initial approval of the new type design or a change in the approved type design.

Of course, the application of the AC depends on the applicability of § 25.1309. Consequently, the AC applies to aircraft systems and their associated components, as well as the installation of these items. So, the following systems are included: hydraulic, pneumatic, electrical/electronic, mechanical and propulsion (engines and propellers).

But there are a few exceptions that need to be highlighted, to prevent that the applicant follows wrong procedures. This is the case of a type certification, in which equipment and systems approved as parts of an engine or propeller with type-certificate are excluded.

The applicant has to exclude too the flight structures (wings, fuselage, wings, control

surfaces, mechanical flight control cables, levers, engine cradles and structural elements of the landing gear), whose requirements are specified in the Subparts B, C and D of part 25.

Moreover, the AC also does not apply to the performance and flight characteristics. For example, it does not apply to airplane's inherent stall characteristics or their evaluation, but does apply to a stall warning system used to enable compliance with § 25.207

But what are the basic points that we must consider in SA, according the AC 25.1309? The answer is: "failure", "failure condition", "severity of a failure condition" and "probability of the failure that leads to a failure condition". Let us try to explain each one.

Failure[1] is an occurrence or event that affects the operation of an item such that it can no longer function as intended (this includes both loss of function and malfunction). But errors are not considered failures, although can cause failures.

Failure condition is the effect on either the airplane or its occupants, or both, either direct or consequential, which is caused or contributed to by one or more failures or errors considering the flight phase and relevant adverse operational or environmental conditions or external events (temperature variations, icing, lightning, runway conditions, conditions of communication and navigation, etc.).

The term **Severity** refers to the potential level of gravity (seriousness) of a failure condition, within a graduation established. The FAR 25.1309 does not discuss this term. It is discussed in the AC, which details the severity levels. As we said, although the AC should not establishes requirements (because it is a suggestion), such scale is a requirement because the condition failure has to be included in one of those levels. Therefore the applicant has to adopt such scale.

As we said in the MSC 06, the severity scale was ranked from the less severe to the most severe failure condition:

- Minor ;
- Major;
- Severe Major or Hazardous; and
- Catastrophic.

The severity defined by applicant for each failure condition can generate a long discussion with the authority, due the subjectivity in interpreting the graduation used for a given failure condition. At this point, the applicant's analyst experience is important. We recommend that always be formed a team with experts from all engineering areas and the staff of flight test.

The failure condition M**inor** refers to a condition that does not bring great concern for the safety, i.e. does not affect the safe flight and landing and does not require actions normally outside the ability of the crew, to circumvent it. Occupants may or may not perceive it, but without physical or mental discomfort. May be that the maximum that can happen is a change of routine established in the flight plan.

E.g.: Loss of function of fuel level indication. Nothing happens with the flight and may be that none of the passengers notices the problem. The crew's work is to calculate the fuel available, based on the total initial fuel, the distance travelled and the distance to be travelled, ensuring, on the basis of this calculation, the normal continuity of the flight.

On **Major** severity, the failure condition can reduce the margins of safety of the aircraft and/or its functional capacity. There is an additional workload for the crew out of your routine. Occupants may feel some discomfort.

E.g.: Loss of primary indication function of attitude on roll and pitch. The crew must pass to secondary items or other means to control the attitude. This increases their workload. Passengers may notice the change and then feel some discomfort.

On **Severe Major** (Hazardous) severity, there is a great reduction of margins of safety of the aircraft and/or of its functional capacity. The crew has a great difficulty to overcome the effects of the adverse conditions and can arise a greater discomfort for the occupants and possible injuries.

E.g.: Loss of deceleration function with wheel braking. If the pilot does not have this loss

[1] Note that there is some confusion between the terms failure and fault. Following some international entities, failure is an event and fault is a state. After a failure, the item goes into fault. The maintenance personnel uses these terms exactly with this meaning

indicated in the cockpit, he will only realize this condition, when attempting the braking on the ground. Then comes the overload of trying to use as much as possible the reverse and spoilers, but the crew cannot get your intent, and the aircraft can exit the runway, with unforeseeable consequences. The discomfort to passengers is notorious. Probably, there will be some panic and injuries.

At the other end of the ranking we have the **catastrophic** failure condition. This condition prevents the secure flight and landing.

E.g.: Total loss of the function of attitude indication on roll and pitch. If the flight is in the IFR condition, the crew will not have the information needed to maintain the correct attitude and they could exceed the limits of attitude, resulting in loss of aircraft control, what could lead it to the precipitation, with loss of the aircraft and lives.

We will continue talking about AC 25.1309-1A, in MSC 08.

See you.

References

(1) FAA: CFR 14 Part 25 § 1309, Equipment, Systems, and Installations, Amdt. 25-123, USA, 8/11/2007.

(2) FAA: AC 23.1309-1E, System Safety Analysis and Assessment for Part 23, USA, 11/17/2011.

(3) FAA: AC 25.1309-1A, System Design and Analysis, USA, 06/21/1988.