- Installation of Avionics Equipment: The Eye of the Certifier -

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MSC 21 – 10 OUT 2012

This MSC applies to applicants for Supplemental Type Certification (CST), held at the Civil or Military Authorities, who have not much experience with this certification process. The goal is to give them an idea of the characteristics and behavior of certifiers operating in this type of process.

We will be dealing with certification in the areas of electrical and electronics (avionics), but much of what we will present applies also to other areas (pneumatic, hydraulic, etc.).

First of all, we make clear that any certification process comprises a theoretical part, documental, and a practical part.

The documental part passes by presentation by the applicant of various documents, highlighting the Certification Plane (CP), with its Certification Basis (BC) and Means of Compliance - MOC - in the area civil - or Matrix of Compliance of requirements (MCR) - in the military area, test proposals, test reports, analytical demonstrations, drawings, technical specifications, photos, manuals, and so on.

The certifier that deals with this set of documents has sufficient technical knowledge of the matters dealt with therein, enough for not miss the important details.

He knows, for example, that the analysis of reports of Reliability, Availability, Safety (Safety) and others is not a task for beginners.

Even though the authors of these analyses are engineers with experience in these areas, he must keep in mind that the certifier sometimes does not accept one or another item of their analysis reports. He has technical basis for this rejection, but the applicant also need to be aware that the certifier is always available to discuss with the applicant the reason for his non-compliance with one or another item from the analysis.

Besides having a conceptual basis of the matters discussed in the analysis, he has the knowledge to discuss details of the calculations presented in these analyses.

But the difficulties do not end there, ie only in the theoretical part. The certifier knows that the other part of the process, ie, the practice must be followed carefully.

As first step, He only accepts installation of equipment which has a minimum condition for installation, such as equipment with TSO Approval ("TSO Approval - TSOA") generally already available in the market but that are compatible with the characteristics of the environment of the aircraft in which it will be installed.

When the equipment does not have a TSOA, or even having, no presents characteristics suitable for the installation on the aircraft, in terms of tests conducted under the auspices of the respective TSO, he will have to be subjected to the necessary tests to check whether it has the necessary characteristics .

If the equipment has to be developed for use in military aircraft missions, they must pass first through a component certification process.

The more complicated part of this practical process are the tests of electromagnetic interference (EMI) and environmental testing.

The bench tests of electromagnetic interference are provided in MIL-STD-461 (Ref. 1) and are of rare complexity. There are several combinations for these tests.

With regard to the environmental testing, MIL-STD-810 allows a good deal of tailoring. But these adjustments must be made with acceptable criteria by the certifier. It is known that at least four tests must be performed: temperature, altitude, vibration and humidity. But the applicant may propose adjustments to these tests. The certifier may or may not accept the proposed adjustments. The non-acceptance is always discussed with the applicant.

In possession of the equipment suitable for installation, the applicant takes all steps for the certification of this installation

The certifier must feel convinced that these EMI tests, placed in the applicant's proposal, are sufficient for that type of equipment. A practical way to accept the proposed combinations is by checking the existence of similar equipment with TSO approval. It is enough to analyze the tests prescribed in this TSO and compare them with those proposed by the applicant.

But the above procedure is valid only if the applicant can demonstrate that there is the mentioned similarity .

De posse do equipamento apto para a instalação, o requerente toma todas as providências teóricas para a certificação dessa instalação.

When the applicant presents his installation project, the certifier want to know the basis used for the design of this installation. The applicant must keep in mind that the certifier feels much more comfortable if is presented to him a design based on the manufacturer's installation manual for installation of the equipment, since that if the applicant has used this manual, there is a good chance of no problems arise afterwards.

But the certifier also knows that the installation manual is written for a typical installation, where one imagines an aircraft with certain geometry and dimensions, knowing that not always an installation can follows exactly what is written in the installation manual.

This is typical for the installation of antennas, although not concentrate only there. In this case, the certifier can and should ask the installer about any deviations (and sometimes are many) design, relative to what is prescribed in the manufacturer's installation manual.

Once installation is complete, move on to functional tests, in rigs, simulators and in the aircraft (ground and flight). The tests in the aircraft are conclusive ones , since the equipment will be operating in its environment.

A pretty consistent procedure that can be adopted by the applicant, in aircraft ground tests and accompanied with relative ease by the certifier, is that suggested in Advisory Circular 23.1309-1D (Ref. 2), aimed at verifying compliance with the requirements (1), (2) and (3) as provided in 14 CFR Part 23 § 1309.

These procedures apply to any installation and aircraft permitting ascertaining the adverse effects of the operation of the equipment with other equipment installed in the aircraft, and the adverse effects on the new equipment installed for testing. These tests are called Electromagnetic Compatibility Tests, which fall into the practical activities of Safety Assessment (Safety Assessment) that are addressed in the aforementioned AC.

The details of these tests with some comments will be subject to another MSC.

But the work of the certifier is not only that. He also inspects the physical installation of the equipment. He does not accept, for example, folds on wiring smaller than 90 degrees, especially in output connector of the equipment, which may occur when the product enters forced into the space that was available on the aircraft.

In military combat aircraft, is not admitted to pass in the same wiring cables of critical redundant systems such as buses provided in MIL-STD-1553B, ARINC 429, etc. These cables must be installed on opposite sides. Reason? Vulnerability. Hardly the two cables would be targeted simultaneously in combat.

And so on. We could go on showing other aspects of the certifier's performance , but the idea was just to show some characteristics of this professional, in one process of supplemental type certification.

We know that experience in previous projects, installation and maintenance is very important for a certifier, but we think that is more important that they have a basic training in certification and then remain in a process of continued training, trying to remain in the state of the art of the essential knowledge for the activity. We have observed that, in some way, this is happening.

See you

References:

1) DoD. MIL-STD-461 - Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment. USA: DoD, 2007.

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