

AE, CVE and DAE in Design Assurance System

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Abstract. To civil aircraft applicant, the establishment of design assurance system (DAS) is not only a satisfaction to regulations, but also a embodiment of its design and airworthiness ability. It is important for applicant to establish an efficient and high-quality team to ensure the good functioning of the DAS. Based on the practical experience of a civil aircraft main manufacturer, the main airworthiness roles (AE, CVE and DAE) of the DAS are introduced. Through the introduction of their responsibility, qualification and positioning, it provides a reference for the civil aviation DAS and airworthiness team construction.

Keywords-component: civil aviation; DAS; AE; CVE; DAE

1. Introduction

According to Article 21.13 of CCAR-21-R4[1], the person who has shown or is showing that the DAS meets the requirements of Chapter 14 is qualified to apply for type certification (TC), that is, the necessity of DAS for TC applicant is required from the regulation level. Article 21.487 of CCAR-21-R4 also stipulates the rights of design institution that has established a DAS accepted by CAAC: In addition to applying for certificates such as TC, the approved or recognized DAS also has the right to confirm that the design change is classified as "major change" or "minor change", and to approve minor change and maintenance program.

Generally, in order to ensure the good operation of its own DAS, the applicant must be equipped with sufficient human resources and office conditions to perform the duties mentioned in Chapter 14 of CCAR-21-R4, such as ensuring that its design complies with applicable airworthiness regulations and environmental protection requirements, independent verification of compliance statements and related documents, and the right of Article 21.487.

2. Airworthiness Engineer (AE)

AE usually refers to the technical personnel who has obtained qualification from the airworthiness functional department and is in charge of airworthiness technology research, providing professional advise for the design process, managing and organizing compliance work.

AE is the basic member of the airworthiness team and participates in airworthiness work at all stages of the aircraft development process, including before and after TC. In addition to the professional airworthiness work, AE also needs to assume the responsibility of organization and management, especially as a bridge between airworthiness authority and design departments to coordinate the airworthiness related work.

2.1 Responsibility of AE

The work of AE usually includes at least the following:

- Study airworthiness regulations, environmental protection requirements, airworthiness related industrial standards, etc., and clarify compliance methods and criteria;
- Establish contact with CAAC, coordinate airworthiness review, organize and attend airworthiness review meetings;
- Participate in the planning, formulation and implementation of the airworthiness certification, manage the airworthiness work in the compliance demonstration process, and support the handling of various airworthiness certificates;

- Prepare or participate in the preparation of professional/system level compliance plan (CP) according to the division of labor;
- Prepare compliance guide;
- Jointly determine the manufacturing compliance inspection items with CAAC/DAS and cooperate with the inspection, and jointly carry out partial compliance verification test, analysis, calculation and inspection with design team to generate compliance evidence;
- Check compliance evidence and prepare compliance statement;
- Prepare TCDS, compliance check list (CCL) and other documents;
- Evaluate and manage the compliance activities of suppliers and compliance verification test units;
- Assist in the construction and maintenance of DAS;
- Prepare relevant materials for airworthiness review of major nodes (project approval review, TC application, first TCB, preliminary design review (PDR), critical design review (CDR), detailed design review (DDR), first flight, TIA, final TCB, etc.) .

2.2 Qualification of AE

AE shall obtain the post qualification of airworthiness functional department before engaging in airworthiness work.

3. Compliance Verification Engineer (CVE)

CVE generally refers to the professional and technical personnel who is qualified and authorized by the DAS to perform independent verification of airworthiness compliance.

Usually, CVE should have a deeper professional degree than AE. CVE checks the airworthiness compliance of documents before DAE/CAAC, which can better support the compliance verification work and improve the quality and efficiency of document approval. It should be noted that the CVE shall maintain the relative independence of the professional design team during the verification work and ensure that it is not affected by other factors such as the project schedule.

3.1 Responsibility of CVE

The work of CVE usually includes at least the following:

- Provide consultation on airworthiness requirements to design department;
- Independently verify airworthiness compliance documents;
- Check the airworthiness compliance of the node approval conditions at each stage of aircraft development.

In addition, if the compliance verification test needs to be witnessed by CVE, CVE shall also cooperate as required.

3.2 Qualification of CVE

In general, a CVE shall have the following qualifications and be selected, trained, assessed and authorized by the DAS before performing the duties of CVE:

- Bachelor degree or above related to the applied specialty;
- Have at least 5 years of airworthiness or equivalent work experience(e.g. relevant research experience during master/doctor);
- Relatively comprehensive grasp of the technical knowledge and background of the application;
- Familiar with airworthiness regulations, standards and operation requirements;
- Experience in airworthiness compliance review/verification is preferred.

4. Designated Airworthiness Engineer (DAE)

DAE usually refers to the personnel who is qualified and authorized by the DAS to perform the right stipulated in CCAR21.487.

As the person with the approval authority of the DAS, DAE shall be fully responsible for the airworthiness compliance and quality of the approved content, and further confirm the verification content of CVE. Similar to CVE, DAE shall also maintain the independence of the approval work when performing CCAR21.487 rights, and ensure that the approval work is not affected by other factors such as project progress. The professional and accurate approval of DAE ensures the high-quality operation of DAS and can also gain more trust from CAAC.

4.1 Responsibility of DAE

The work of DAE usually includes at least the following:

- Confirm that the design change is classified as "major change" or "minor change";
- Approve minor design change within the authorized scope of the DAS, and relevant CP, design data, configuration difference evaluation report and compliance data;
- Approve authorized maintenance plan of DAS;
- Approve CP, configuration difference evaluation report and compliance data of the authorized project by CAAC before TC.

In addition, DAE shall also participate in the compliance verification test witness as required.

4.2 Qualification of DAE

In general, a DAE shall have the following qualifications and be selected, trained, assessed and authorized by DAS before performing the duties of DAE.

- Bachelor degree or above related to the applied specialty;
- Have more than 3 years of CVE or equivalent work experience, such as CAAC (including DER), FAA ODA, EASA DOA review work experience, or more than 10 years of work experience in the technical professional field;
- Fully grasp the technical knowledge and background of the application specialty;
- Proficient in airworthiness regulations, standards and operation requirements;
- Experience in airworthiness compliance review/verification is preferred.

5. Das Personnel Structure and Setup (Ae / Cve / Dae)

5.1 Personnel Structure

The personnel structure of DAS is shown in Figure 1.

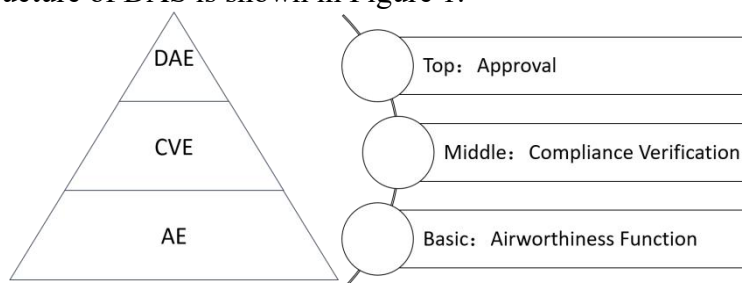


Figure 1. Personnel structure of DAS.

Basic level: As the cornerstone of the DAS, AE is usually composed of full-time personnel of airworthiness functional department, who is responsible for organizing and coordinating the overall airworthiness process of relevant disciplines and performs corresponding airworthiness functions. AE plays a fundamental role in the work of DAS, and is the most solid force for daily airworthiness

work and DAS operation. They can well coordinate and communicate the opinions of professional design department, CVE and DAE, and greatly improve the efficiency of verification and approval.

Middle level: CVE is the backbone of the DAS, who can be composed of full-time airworthiness personnel (i.e. AE) and professional designer with rich experience. The main responsibility of CVE is to carry out independent verification of airworthiness compliance, and check the contents that need to be approved by DAE in advance. Compared with AE, CVE is more experienced. The setting of CVE greatly reduces the workload of DAE, and their early check of document compliance and quality also promotes the improvement of approval efficiency.

Top level: DAE is the top-level personnel who assume the role of "approval" in the DAS. Such personnel can also be composed of experienced full-time airworthiness personnel (i.e. AE) and professional designer. However, compared with CVE, DAE has stronger professional ability, longer working years and higher qualification requirements, which is determined by the tasks undertaken by DAE in the DAS. As the personnel in the DAS who exercise the rights of Article 21.487 on behalf of the company, the work effect of DAE will directly reflect the quality of the DAS and affect the trust of CAAC.

5.2 Personnel Settings

In a civil aircraft main manufacturer, the personnel settings of AE, CVE and DAE are shown in Figure 2.

Basically, AE and CVE have more personnel settings than DAE. According to the needs of each discipline, the ratio of AE and CVE may fluctuate slightly, but the ratio of CVE to DAE is basically maintained at 2:1. Of course, the personnel ratio can be adjusted according to the actual work needs.

The comparison of the verification workload and the number of CVE personnel in each specialty is shown in Figure 3.

Basically, the workload and personnel number of structural strength (SS), electrical and electronic (EE), mechanical system (MS), power plant (PP) and general performance (GP) are more, while the workload and personnel number of software and hardware (SH), continuous airworthiness (CA), design assurance (DA) and other discipline are less, and the number of personnel and workload basically match.

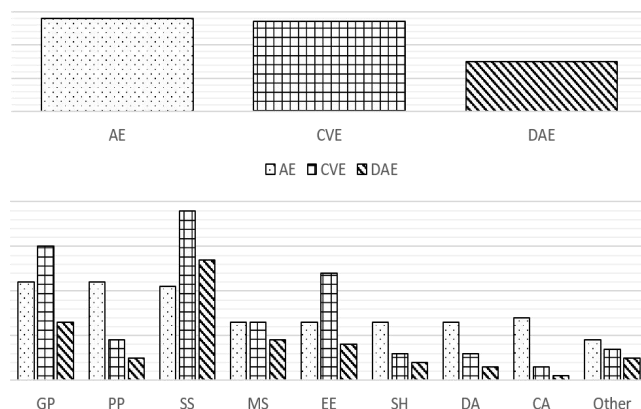


Figure 2. Personnel settings of AE/CVE/DAE.

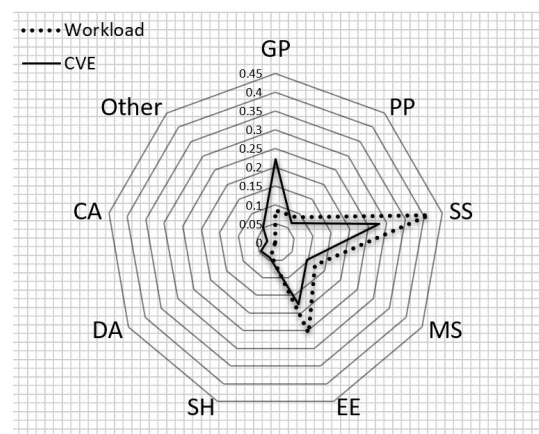


Figure 3. Verification workload and CVE personnel number in each specialty.

6. Conclusion

The establishment of the DAS of the main manufacturer of civil aircraft is not only a compliance with the regulations, but also a reflection of its self-airworthiness and design ability. Good operation, reasonable personnel allocation and efficient work of DAS can greatly improve the efficiency of review, increase the trust of airworthiness authority, and improve the ability of applicant.

At present, the appointment mechanism tends to institutional appointment rather than individual appointment, and the CAAC is seeking opinions widely on this. Therefore, the development and construction of DAS should attract more attention.

The DAS construction experience of the civil aircraft manufacturer mentioned in this paper, can provide some reference for the system construction of this industry. No matter main manufacturer or supplier, there is still a lot of room for growth in airworthiness team construction, which requires continuous exploration and innovation in combination with practical work experience and suggestions of the airworthiness authority.

References

- [1] CAAC, Certification Regulations for Civil Aviation Products and Parts (CCAR-21-R4), 2017.