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Standard Practice for Production Approval of Unmanned Aircraft Systems (UAS)¹

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1. Scope

1.1 This practice provides unmanned aircraft systems (UAS) manufacturers with the requirements toward civil aviation authority (CAA) production approval that may be associated with a CAA airworthiness approval for UAS without people on board.

1.2 The Type Certification and Production Certificate (TC/PC) approval process is well-entrenched within the aviation industry. Internationally, these processes have good harmonization from country to country however those processes can be different depending on the country's aviation history, governmental organization, size of industry, safety culture, etc. The TC/PC process results in a highly robust product that has undergone compliance to the rigor that aviation regulations require. The TC/PC process is synonymous with the safety record of traditional manned aviation and the public will expect similar safety from the UAS industry.

1.2.1 ICAO State letter AN 11/61-22/70, dated 23 August 2022 proposed a new Annex 6—Operation of Aircraft, Part IV—International Operations—Remotely Piloted Aircraft Systems (UAS). The Standards and Recommended Practices (SARPs) in Annex 6, Part IV are applicable to the operation of RPAS certificated in accordance with Annex 8—Airworthiness of Aircraft (TC). The ICAO State letter and the foreword to Annex 6, Part IV identifies three categories of unmanned aircraft systems operations: Open, Specific and Certified. These three categories are summarized below:

1.2.1.1 The Open category poses the lowest operational risk. No authorization to operate from the CAA is required if operations are conducted within defined limitations such as VLOS only, specified distances from aerodromes, proximity of persons, maximum altitude, etc. The production of the UAS associated with Open category operations are typically not overseen by CAAs.

1.2.1.2 The Specific category addresses the medium operational risk. Within the Specific category, operational authorization is required from the governing CAA who may impose restrictions or limitations based on the type of operation, the

complexity of the UAS and the qualifications and experience of operating personnel. Operational approvals are based on analysis of a safety risk assessment and application of mitigation means to reduce risks to an acceptable level. Of significance to the Specific category is that the mitigated risk level is below that which warrants the full application of manned aviation principles, for example, below the TC/PC process. One methodology used to analyze safety risk is the JARUS Specific (category) Operational Risk Assessment (SORA). The SORA further divides the Specific category into Low, Medium, and High risk.

1.2.1.3 The Certified category deals with the highest operational risk. The safety risks within the Certified category have increased to an equivalent level as manned aviation and is typical regulated as such (for example, operator certification, UAS type certification, remote flight crew licensing, etc.).

1.2.2 In Fig. 1, the Open, Specific, and Certified categories are identified per the ICAO state letter. Further, the Specific category has been broken into Low, Medium, and High risks per the SORA. The terms “highest” and “lowest” are used to differentiate the Low risk and robustness associated with the Open category and the High risk and robustness associated with the Certified category. This practice addresses the production requirements for UA operating in the ICAO Specific category associated with Low, Medium, and High risk.

1.2.3 As the categories and associated risks increase in Fig. 1, so does the:

- (1) Number of requirements that need to be met for production authorization;
- (2) Robustness of the requirement outcomes;
- (3) Rigor required by the applicant to demonstrate compliance to the requirements;
- (4) Resulting quality of the product being made; and
- (5) Reliability of the product.

1.2.4 The TC/PC process remains the gold standard for safety and the corresponding acceptance of risk within the operation of the product. Note that the tiers proposed by this practice correspond to the Specific category's three levels of risk (low, medium, and high). There is a sizable difference in the robustness of the requirements and the production rigor (number or details, or both) from Tier 3 to Tier 2. There are fewer differences between Tier 2 and Tier 1. The diagram also shows the minimal differences between Tier 1 and the existing TC/PC process. In other words, Tier 1 has a high degree of

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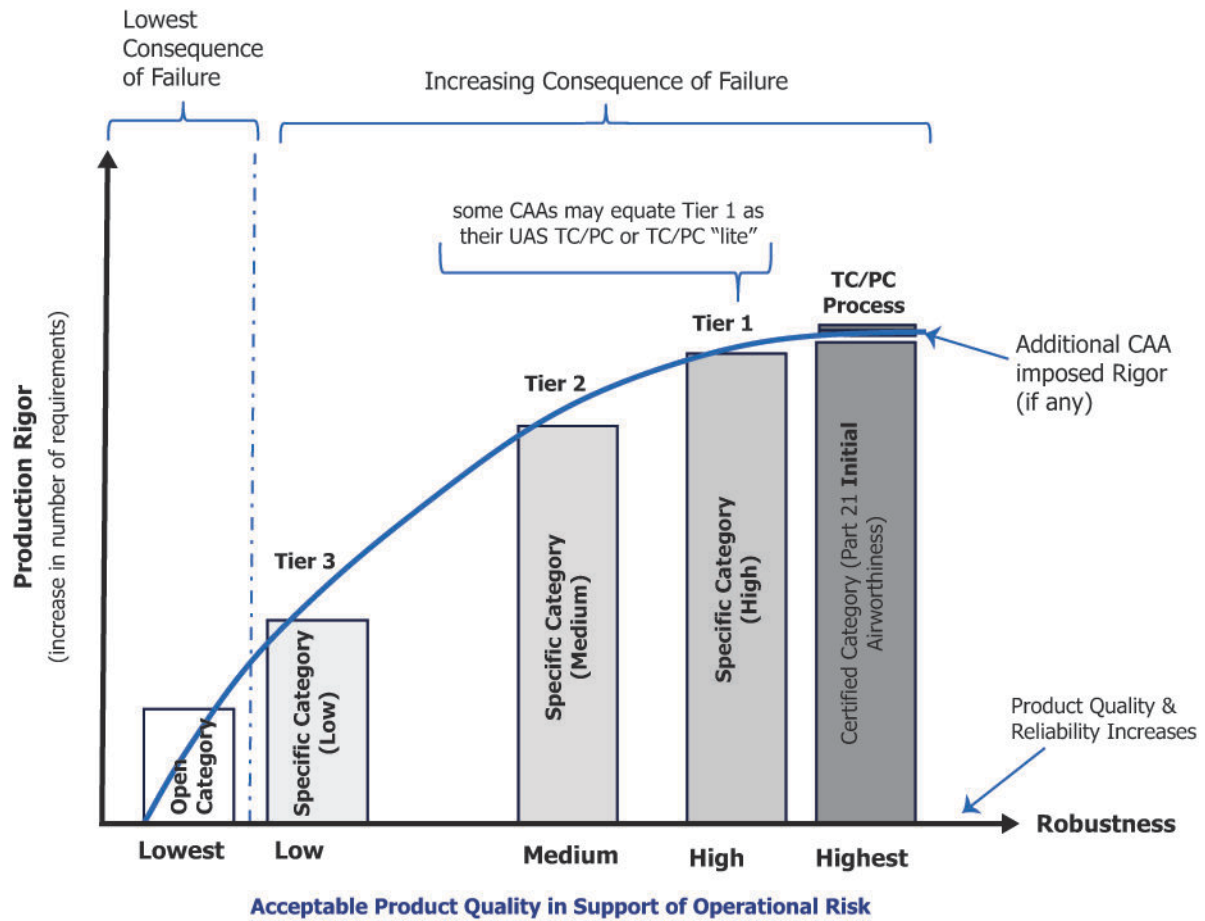


FIG. 1 Relationship Between Operational Risk and Production Requirements

commonality with most CAA TC/PC requirements; however, the details of some requirements may vary or have unique domestic adaptations particular to the governing CAA, or both, that may necessitate additional requirements not captured by the scope of this practice.

1.3 In this practice, a scalable risk-based assessment similar to the Joint Authorities for Rulemaking of Unmanned Systems Specific Operations Risk Assessment (JARUS SORA) for determining CAA Tiers 1–3–based production approval is used.

1.3.1 As an example, the European Union Aviation Safety Agency (EASA) framework incorporating the SORA operational safety objectives (OSO) #2 was used to guide the UAS manufacturer's level of production robustness based upon integrity and assurance (reference [Appendix X1](#)). Tier 1 is the highest production robustness that should enable broad access to operations when combined with airworthiness/type certification. Tier 2 is the medium robustness that should enable UAS manufacturers to lower risk Specific and Open operations. Tier 3 is the lowest robustness limiting UAS manufacturers to more restrictive operations with even lower risk. The assessed operational risk is commensurate with the manufacturer's production rigor. For example, UAS intended for higher risk operations necessitate greater production rigor, quality standards, and oversight (reference [Annex A1](#)).

1.4 In this practice, a roadmap is provided for small, medium, and large manufacturers to pursue production approval through a governing CAA. This standard roadmap also allows companies to progress their organization from the initial Tier 3 requirements to advanced Tier 1.

1.5 This practice has been purposefully designed within the broader context of the ASTM F38 library. Although the original source materials for the content presented here were intended to function as standalone documents, the ASTM working group has consciously removed any redundant information in favor of adopting a referential "single-source-of-truth" approach. Consequently, when applying this standard, it is essential to consider and integrate all relevant ASTM F38 standards to ensure its comprehensive and accurate implementation.

1.6 When intending to utilize the information provided in this practice as a means of compliance for production approval, it is crucial to consult with the respective governing authority (for example, CAA) regarding its acceptable use and application. To find out which authorities have accepted this standard (in whole or in part) as an acceptable means of compliance to their regulatory requirements (hereinafter "the Rules"), please refer to the ASTM F38 webpage (www.ASTM.org/COMMITTEE/F38.htm).

1.7 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.8 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

F2910 Specification for Design and Construction of a Small Unmanned Aircraft System (sUAS)

F3060 Terminology for Aircraft

F3298 Specification for Design, Construction, and Verification of Lightweight Unmanned Aircraft Systems (UAS)

F3322 Specification for Small Unmanned Aircraft System (sUAS) Parachutes

F3341/F3341M Terminology for Unmanned Aircraft Systems

F3365 Practice for Compliance Audits to ASTM Standards on Unmanned Aircraft Systems

F3478 Practice for Development of a Durability and Reliability Flight Demonstration Program for Low-Risk Unmanned Aircraft Systems (UAS) under FAA Oversight

2.2 EU Standards:³

2019R0945 Unmanned Aircraft Systems and on Third-Country Operators of Unmanned Aircraft Systems

2019R0947 Rules and Procedures for the Operation of Unmanned Aircraft

2.3 ISO Standards:⁴

ISO 9001 Quality Management Systems—Requirements

2.4 SAE Standards:⁵

AS9100 Quality Systems—Aerospace—Model for Quality Assurance in Design, Development, Production, Installation and Servicing

AS9145 Aerospace Series—Requirements for Advanced Product Quality Planning and Production Part Approval Process

AS13004 Process Failure Mode and Effects Analysis (PFMEA) and Control Plans

3. Terminology

3.1 *Unique and Common Terminology*—Terminology used in multiple standards is defined in Terminology **F3341/**

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from the European Union, Publications Office of the European Union, EUR-Lex & Legal Information Unit, L-2985 Luxembourg, Luxembourg, <https://eur-lex.europa.eu>.

⁴ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

⁵ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

F3341M, UAS Terminology Standard, and Terminology **F3060**, Aircraft Terminology Standard. Terminology that is unique to this specification is defined in this section.

3.2 Definitions:

3.2.1 *article, n*—subcomponent, part, process, or other element that is part of or associated with an unmanned aircraft (UA).

3.2.2 *audit (compliance audit), n*—systematic, documented, and objective review of an audited entity to evaluate its compliance status relative to audit criteria. **F3341/F3341M**

3.2.3 *civil aviation authority, CAA, n*—government regulatory agency that governs aircraft, airmen, and operations. **F3341/F3341M**

3.2.4 *manufacturer, n*—entity responsible for assembly and integration of components and subsystems to create a safe operating unmanned aircraft system (UAS).

3.2.5 *shall versus should versus may, v*—use of the word “shall” implies that a procedure or statement is mandatory and shall be followed to comply with this practice; “should” implies recommended; and “may” implies optional at the discretion of the supplier, manufacturer, or operator. **F3341/F3341M**

3.2.6 *small unmanned aircraft system, sUAS, n*—composed of an sUAS and all required on-board subsystems, payload, control station, safety devices, other required off-board subsystems, any required launch and recovery equipment, and command and control. **F3341/F3341M**

3.3 Definitions of Terms Specific to This Standard:

3.3.1 *product, n*—as used in this practice, this implies to unmanned aircraft (UA).

3.3.1.1 *Discussion*—This definition includes the following: aircraft, engine, and propeller.

3.4 Acronyms:

3.4.1 *EASA*—European Union Aviation Safety Agency

3.4.2 *OSO*—operational safety objectives

3.4.3 *PAH*—production approval holder

3.4.4 *PC*—production certificate

3.4.5 *PFMEA*—process failure mode effects and analysis

3.4.6 *PRS*—parachute recovery system

3.4.7 *QC*—quality control

3.4.8 *QMS*—quality management system

3.4.9 *UA*—unmanned aircraft

3.4.10 *UAS*—unmanned aircraft system

4. Significance and Use

4.1 This practice is applicable to UAS manufacturers seeking a governing CAA production approval for UAS products or articles manufactured by themselves. Article suppliers are otherwise indicated.

4.2 This practice serves to standardize quality and production best practices for production approval.

4.3 In this practice, best practices for UAS manufacturers seeking production approval are provided. This practice may support additional requirements brought by the governing CAA.

4.4 Through establishing best practices in quality, production, and compliance to governing CAA specific requirements, the UAS manufacturer can apply for CAA production approval as illustrated in Fig. 2.

4.5 Illustrated in Fig. 3 is the relationship between tier level production approval and UAS manufacturers' production rigor.

5. Current Production Approval Methodology

5.1 Type certification (TC) is the first step for a UAS manufacturer to demonstrate their design complies with applicable airworthiness requirements. Production under TC requires "each" manufactured product to be inspected by the CAA. If CAA approval is given, a specific aircraft will obtain an airworthiness certificate by the CAA. This certificate only applies to the inspected aircraft, not any aircraft produced afterwards, even if all the same components and suppliers are used. Additional produced aircraft will require CAA inspection once again. This process can take a long time before the next aircraft is inspected and approved through issuance of an airworthiness certificate. This may or may not produce an undue burden on governing CAA agencies. Fig. 4 shows the approval process when the manufacturer is not a production approval holder (PAH).

5.2 For manned aircraft, the CAAs have defined the criteria for manufacturers to become a production approval holder (PAH) and obtain a production certificate (PC) for the aircraft they produce.

5.3 For unmanned aircraft systems (UAS) without people, the current PAH and PC criteria are not commensurate with the risk associated with the UA. In the subsequent sections, the standards for associating production rigor with the level of operational risk are described.

6. New Standard Productional Approval Methodology

6.1 This practice may be used in concert with a TC/airworthiness process described by the governing CAA.

6.2 This practice should be used to determine the level of rigor inherent to a UAS manufacturing process based on operational risk for the UAS and support compliance with applicable requirements from a governing CAA.

6.3 UAS manufacturers shall establish industry best quality system practices based on the applicable manufacturing tier.

6.4 The UAS manufacturer shall establish industry best production practices to assure a repeatable and reliable manufacturing process commensurate with the applicable manufacturing tier.

6.5 The UAS manufacturer should show compliance to this practice and any special requirements from the governing CAA, or a national or international third-party approved by the governing CAA.

6.6 Sections 7 – 10 are applicable to all UAS manufacturers.

6.7 Tier 1 and 2 manufacturers shall meet all the requirements within their applicable tier.

6.8 In Fig. 5, the production approval process in the new standard practice for production approval is depicted.



FIG. 2 Best Practices for Production Approval

Tier Level Production Approval

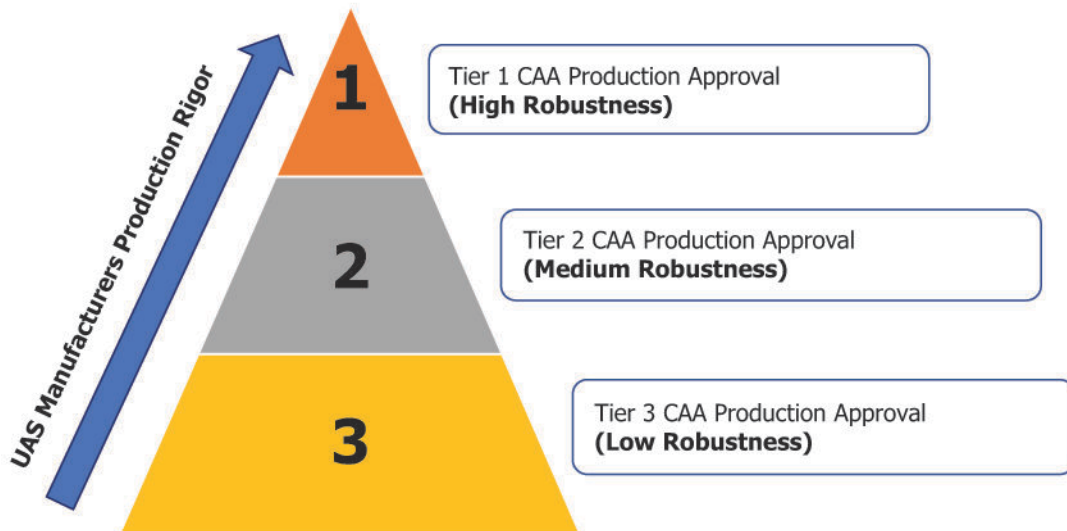


FIG. 3 Relationship Between Tier Level Production Approval and UAS Manufacturers' Production Rigor

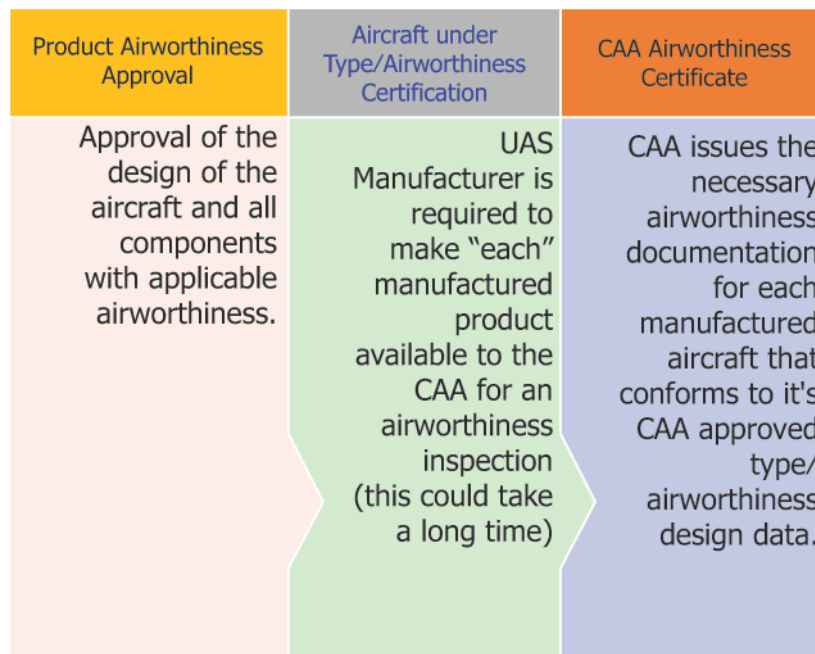


FIG. 4 Current Production Approval Process

7. Organizational Structure and Responsibilities

7.1 The manufacturer shall create an organizational structure and designate responsibilities for managing aspects of production quality.

8. Design Records

8.1 The manufacturer is responsible for maintaining design records and drawings in a controlled system. Drawings shall include product part number, revision number, date released, dimensions and other geometric tolerances, physical and mechanical properties, visual features, electrical requirements,

performance requirements, and any other specific requirement deemed necessary to consistently produce.

8.2 Records should be maintained for a period of five years following the end of production or as required by the governing CAA.

8.3 Practices for maintaining records should be kept in accordance with industry standards, best practices, or in a manner acceptable to the governing CAA. For example, digital or cloud-based storage are a few examples of industry best practices.