



AEROSPACE RECOMMENDED PRACTICE

ARP7042™

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Recommended Practice: Development Planning for Design of Additive Manufactured Components in an Aircraft System

RATIONALE

This SAE Aerospace Recommended Practice (ARP) is intended to provide an airframe manufacturer or system supplier guidance for planning to use additive manufacturing (AM) in developing an aircraft development program and is intended as a comprehensive plan pertaining to the development of the AM components in the aircraft system.

FORWARD

The development of an aircraft system using AM for a modern high-performance air vehicle is an engineering, manufacturing and program management process which covers many years in calendar time and also crosses over many disciplines and abilities. The process is subordinate to and dependent upon the plan for development of the air vehicle itself. A good documented development plan allows the design team to perform the task more effectively. Aircraft system (engines, skins/airframe structure, avionics, interiors, hydraulic/electric systems, and maintenance repair and overhaul (MRO) repairs) development for additively manufactured components/repairs shall be in accordance with specific sections herein use ARP4754 and AIR7352 (derived from the AIA-AM guidance document) as guidelines.

The total plan is one which might be prepared by a contractor to describe a development program for a specific aircraft and be submitted for approval before initiation of the actual work. The plan should be revised and updated at intervals during the development program as influencing factors dictate. A milestone chart using a commercially available software package should be a part of the plan and should show the interrelationship between phases of the development and various functions involved in work to be performed. Design reviews should be identified and scheduled. The progressive design verification process to demonstrate compliance with requirements must be clearly delineated.

Some of the steps covered are mandatory, and others are elective or dependent upon customer requirements or desires. Economics is a very significant factor and for each analysis or test performed, more confidence and assurance of success is gained—but at a price. Some of the steps are performed as a matter of “good engineering practice” and without special recognition. Others are unique to a particular aircraft system and all together comprise a complete development.

For the purpose of this document, the “airframer” is defined as the designer of the airplane and the “system supplier” is defined as the integrator contracted by the airframer for the system development. The development has been divided into six functional/chronological phases although each phase overlaps and affects the others. These general divisions are:

- Preliminary design
- Design integration
- Component development
- Subsystem development

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Documents
Document Sharing Hub

- On-air vehicle development
- Post delivery development

Discussion of these six major development phases is given in the following pages.

1. SCOPE

1.1 Form

This SAE Aerospace Recommended Practice (ARP) outlines a development, design/repair, and industrial guidance for systems using additive manufacturing (AM) to respond to aircraft requirement specifications. These recommendations reflect procedures that have been effective for designing/repairing metallic alloy components.

1.2 Intent

This ARP intends to provide a roadmap in developing, designing, and industrializing AM components for aircraft requirement specifications and repairs.

1.3 Application

This ARP should be applied to additively manufactured part designs and repairs for aircraft system, propulsion, and structural applications. Each application may have unique design and certification performance needs (and examples are given in this document for guidance) and requirements for compliance to meet the airplane requirements specification and airworthiness safety compliance. A thorough review of the air framer and the regulatory airworthiness requirements is essential for each application.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR7352 Additively Manufactured Component Substantiation

ARP4754 Guidelines for Development of Civil Aircraft and Systems

3. PRELIMINARY DESIGN DEVELOPMENT

The preliminary design stage of an aircraft (and all of the structures and systems that comprise the vehicle) is a process in which the designer strives for the optimum overall airplane configuration to best meet the designated air vehicle requirements. Adequate attention must be given to the system and integration into the airplane at this time to prevent compromises that may eventually result in increased maintenance costs, excess weight, and expensive rework. At the conclusion of the preliminary design phase, the preliminary design review (PDR) should be held.