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Navigating the FAA Regulatory Framework for Aircraft Repairs & Alterations

OPINION

The A&P of Tomorrow:

Preparing Aviation Maintenance Education for Advanced Air Mobility Aircraft

Generative Artificial Intelligence in Aviation Curriculum Development

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About the Council

ATEC was founded in 1961. Its mission is to promote and support aviation maintenance technical education.

The council actively engages with regulatory and legislative bodies to advocate on behalf of the community, and provides resources, continuing education, and networking opportunities for our members.

Our membership is made up of employers, vendors, and educational institutions with aviation technical programs. The vast majority of member schools are certificated by the FAA to provide aviation mechanic programs. Membership supports the following activities and initiatives—

- Advocating for sound regulatory policy, the development of clear and concise guidance, and consistent enforcement and application
- Participating on industry and agency committees to further aviation technical education and workforce development
- Fostering and supporting career pipeline partnerships between industry and educational institutions
- Facilitating networking opportunities through the annual conference, Washington fly-in, regional outreach meetings, and virtual webinars
- Enhancing aviation technical career awareness through support of ATEC's sister organization, Choose Aerospace

About the Journal

The *ATEC Journal* (ISSN 1068-5901) is a peer-reviewed, biannual electronic publication. The publication provides an opportunity for educators, administrators, students and industry personnel to share teaching techniques and research. Authors are encouraged to submit their articles for publication consideration, whether scholarly, research, application, or opinion, by using the submission form below. Papers supporting the council's regulatory and legislative agenda may be considered for presentation via online webinar and at the **annual conference**. Suggested topics include:

- Technical and soft-skills curriculum integration
- A history of legislative actions affecting aviation maintenance workforce development
- A study on implementing employer-education partnerships
- Funding implications stemming from Bureau of Labor Statistics occupational outlooks
- Highlighted innovations in the aviation maintenance industry
- A look at successful online teaching methods and subject matter in other technical fields
- Surveying currently used computer-based teaching across aviation maintenance training schools

Submission deadlines: Fall Issue Closing Date: October 1 • Spring Issue Closing Date: May 1

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The Fall 2026 edition of the Journal features three articles, ranging from FAA regulatory framework to cutting-edge technology.

Aviation maintenance instructors and practitioners understand the complexity of documents and regulations surrounding aircraft maintenance. Scott Fohrman, Narendra Gadwal, Ellis Brazeal, and Mark Barkey present us with a consolidated overview of the regulatory framework governing aircraft repairs and alterations in the U.S.

Whether your opinion of AI is favorable, unfavorable, or somewhere in between, few, if any, have remained untouched by AI's inescapable reach. Educators have witnessed the profound impact of AI in the classroom. Steven Locklear and Amy Rutledge share their exploratory findings of a proposed framework for Generative AI-assisted curriculum development.

When the future of aviation is considered, Advanced Air Mobility (AAM) is moving from concept to reality. In this piece, Collin McDonald shares timely insight on preparing aviation maintenance education for AAM.

I want to thank our Editorial Board for all their hard work in reviewing these articles in a short timeframe. We welcome Professor Steve Gossett to the Editorial Board. In addition to his industry experience, Professor Gossett has spent over 34 years in aviation maintenance education, has taught almost every subject in the Part 147 curriculum, and has co-authored an aviation maintenance textbook. Lastly, I am grateful for the excellent copyediting work of Sylvan Kines, a Literature PhD candidate at Auburn University.

I hope you enjoy this issue of the ATEC Journal.

Daniel Siao, PhD
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Committee Updates

ATEC committees are comprised of dedicated individuals representing both educational institutions and industry partners. A full list of committees & current participants is available at atec-amt.org/committees.



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The council welcomes new voices and actively encourages member representatives to get involved. If you're interested in contributing to the council's ongoing initiatives, please reach out to learn more about joining a committee.

01 CHOOSE AEROSPACE



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Choose Aerospace continues to expand its reach and strengthen the aviation maintenance talent pipeline, with more than 1,200 students enrolled in the curriculum this academic year. This growth is accompanied by continued momentum surrounding the ATEC General Aviation Maintenance Credential and efforts to strengthen pathways connecting students with FAA-certificated Part 147 schools and aviation maintenance employers.

The curriculum is also gaining traction in commercial workforce applications, including its use in registered apprenticeship programs, with opportunities for further expansion.

1,200+
students enrolled in the Choose Aerospace curriculum this academic year

Applications for the 2027 Choose Aerospace SKILLED Nation Scholarship Fund are open now through Jan. 31, offering $5,000 awards to students pursuing aviation maintenance careers. Recipients will be recognized at the ATEC Annual Conference in Wichita.

For more information, visit www.chooseaerospace.org.

02 ANNUAL CONFERENCE



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Planning is underway for the 2027 ATEC Annual Conference, scheduled for April 4-7 in Wichita, Kansas. Hosted by WSU Tech and presented by Bombardier, the event will bring together aviation maintenance educators, industry leaders, regulators, and workforce-development partners from across the country.

The annual conference will feature educational sessions covering FAA regulatory updates, innovative teaching strategies, emerging technologies, workforce development, career pathways, and industry partnerships shaping the future of aviation maintenance education.

Registration is now open. For more information about the upcoming conference and to register, visit www.atec-amt.org/events/2027-annual-conference.

03 REGULATORY



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The Regulatory Committee continues to advance initiatives aimed at modernizing mechanic testing, certification, and training. The Mechanic Airman Certification Standards Working Group continued refining its proposed revisions to the ACS and submitted a final recommendation last month.

Now that the recommendation is complete, the working group will begin recommended updates to the FAA mechanic handbooks that align with the proposed ACS.

Looking ahead, the committee is evaluating potential priorities for the next FAA reauthorization, including progressive certification, privileges associated with a General rating, and continued efforts to improve DME access and examiner capacity.

For more information about the committee's work, visit www.atec-amt.org/regulatory-priorities.

04 LEGISLATIVE



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The Legislative Committee continued its advocacy efforts during the 2026 ATEC Washington Fly-In, where members attended more than 80 congressional meetings focused on aviation maintenance education and workforce priorities.

Discussions highlighted the 23.2 percent increase in aviation maintenance graduates, the need for timely distribution of previously appropriated FAA workforce development grant funding, military transition initiatives, and opportunities to reduce constraints associated with workforce grant programs. The newly released *2026 Pipeline Report* provided supporting data for conversations with lawmakers and congressional staff.

Following the Fly-In, ATEC will continue engagement with congressional offices and federal agencies on these priorities while preparing for the next FAA reauthorization cycle. The committee is also working to strengthen advocacy materials and follow-up resources for continued congressional outreach.

For more information about the committee's work, visit www.atec-amt.org/legislative-priorities.

05 ATEC ACADEMY



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ATEC Academy continues to expand professional development opportunities for aviation maintenance instructors, with four cohorts planned for the coming year. The blended-learning program combines a two-day in-person session with three guided virtual sessions focused on part 147 instruction, student engagement, generational and technology gaps, and school-specific challenges.

Registration is now open for 2027 Academy cohorts, and ATEC is seeking mentors to support cohorts and institutions interested in hosting future sessions.

Additional information about all Academy opportunities is available at www.atec-amt.org/atec-academy.

EDUCATOR PROFESSIONAL DEVELOPMENT

ATEC ACADEMY

Struggling to find and keep instructors? Are you hiring instructors with extensive industry experience with little to no teaching experience?

Consider utilizing **ATEC Academy**. The Academy's three-month course equips new educators with essential teaching strategies, student engagement techniques, and assessment methods—ensuring they're prepared to excel in the classroom. Designed for aviation maintenance instructors and industry trainers, the program combines a two-day in-person session with virtual sessions and pairs all students with a seasoned instructor mentor. Recognizing the significant investments made by aviation maintenance programs in their instructor hiring practices, this immersive approach aims to improve student and instructor retention and persistence rates.

ATEC Academy will return in 2027, offering aviation maintenance educators opportunities to build effective teaching practices, engage students, and succeed in the classroom through a three-month professional development experience designed specifically for new and transitioning instructors. Registration is now open for each cohort.

January 11-12	April 8-9	June 8-9	September 28-29
Clearwater, FL	Wichita, KS	Tulsa, OK	Pittsburgh, PA

Register now at **atec-amt.org/events/atec-academy1**

Become an ATEC Academy Mentor

ATEC is seeking experienced aviation maintenance educators to serve as ATEC Academy mentors. Mentors share their expertise and provide guidance to new instructors throughout the Academy's three-month program, helping strengthen teaching practices and support the next generation of aviation maintenance educators. Mentors receive an honorarium, paid travel expenses, and professional recognition.

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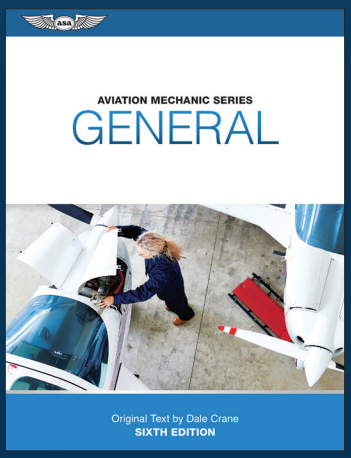







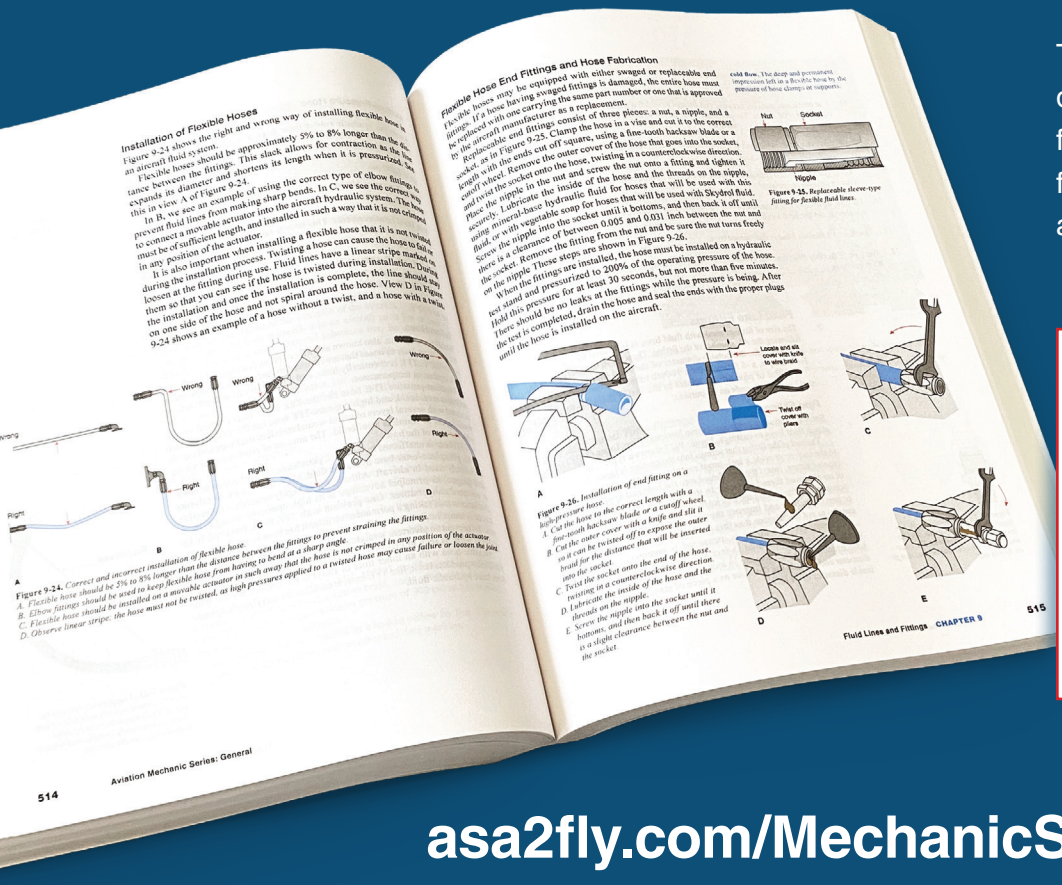

The Aviation Mechanic Series is designed for use in classrooms and for independent study. The textbooks feature color figures, study questions, and extensive glossaries and indexes.

INSTRUCTOR RESOURCES

Resources are available for instructors, including study questions with answer keys and images from each textbook for training presentations.

Inquire at **support@asa2fly.com**

asa2fly.com/MechanicSeries

Navigating the FAA Regulatory Framework for Aircraft Repairs and Alterations

Scott Fohrman is an aviation engineer and certificated aviation maintenance professional with more than 35 years of experience in aircraft maintenance, engineering, certification, and regulatory compliance. For the past two decades, he has specialized in aircraft certification, with particular emphasis on the engineering evaluation and approval of aircraft repairs and alterations. He holds a Master of Science in Aerospace Engineering and is an active aviation instructor and frequent presenter on aircraft maintenance, certification, and regulatory compliance.

C. Ellis Brazeal, III is a partner at Jones Walker LLP and co-leader of the firm's Aerospace and Aviation team. He advises clients on aerospace and aviation regulatory matters, commercial transactions, and mergers and acquisitions involving the civil, defense, and space industries. Dr. Brazeal is an adjunct professor at The University of Alabama, where he teaches Space Law in the College of Engineering and the School of Law. He is a frequent speaker on aerospace legal issues and serves in several leadership roles supporting the aerospace community.

Dr. Mark E. Barkey is Senior Associate Dean of the Styslinger College of Engineering at The University of Alabama and a professor of aerospace engineering and mechanics. He earned his B.S. in Engineering Mechanics from the University of Missouri–Rolla and his M.S. and Ph.D. in Theoretical and Applied Mechanics from the University of Illinois. His research focuses on structural testing, materials characterization, fatigue, and nonlinear finite element analysis, with projects supported by industry and government organizations, including NASA and major automotive manufacturers.

Narendra Kumar Gadwal is a PhD candidate in Aerospace Engineering and Mechanics at the University of Alabama, Tuscaloosa, AL, USA, where he also received his MS in the same field. He holds an MS in Materials Technology from the National Institute of Technology, Warangal, India. His research focuses on Damage Tolerance Analysis (DTA) and FEA stress analysis of aircraft structures, as well as mechanical structures. Fatigue, Fracture mechanics, and High-temperature alloy behavior for aerospace, nuclear, and energy applications, including additively manufactured Ti-6Al-4V, and Thermo-mechanical fatigue of steels. Previously, he was a Research Engineer at NIT Warangal, conducting creep, fatigue, and fracture testing of nickel-based superalloys (IN617 & IN625) for AUSC power plant qualification. He has authored multiple peer-reviewed publications.





Abstract

Aircraft repairs and alterations are governed by a regulatory framework that combines engineering considerations, maintenance practice, and regulatory compliance. While the Federal Aviation Regulations establish the legal requirements for performing and approving maintenance actions, the practical application of those requirements relies on a broad collection of Federal Aviation Administration (FAA) guidance materials, including Advisory Circulars (ACs), FAA Orders, policy documents, and regulatory interpretations. Because this information is distributed across numerous documents developed for different audiences and purposes, maintenance providers and the engineers who support them often encounter difficulty determining how these sources interact when evaluating a proposed repair or alteration. This paper provides a consolidated overview of the regulatory framework governing aircraft repairs and alterations within the United States FAA system. The discussion first examines the hierarchy of regulatory and guidance materials that form the foundation of FAA oversight. It then describes the regulatory criteria used to classify maintenance actions as major repairs, minor repairs, major alterations, minor alterations, or preventive maintenance. The article further examines the personnel certifications required to perform and approve maintenance actions and explains the distinction between FAA-approved technical data and data acceptable to the Administrator when substantiating repairs and alterations. The objective of this work is not to introduce new regulatory interpretations or guidance, but rather to assemble existing FAA regulatory and guidance materials into a single structured reference while identifying the original sources from which that information is derived. By clarifying how the principal regulations and guidance documents interact, this paper aims to provide maintenance providers and supporting engineers with a practical resource for navigating the regulatory aspects of aircraft repairs and alterations.

Keywords: *Aircraft maintenance regulation, Major and minor repairs, Aircraft alterations, FAA regulatory framework, Approved and Acceptable Technical Data, Airworthiness*

Introduction

Aviation is a heavily regulated industry. In many technical fields, the success of a design is determined primarily by whether it satisfies the governing laws of physics. In aviation, however, compliance with the laws of physics alone is insufficient. An aircraft design must satisfy not only the physical laws that govern flight but also the legal and regulatory framework under which the aircraft is operated.

This regulatory complexity is particularly evident in the requirements governing aircraft repairs and alterations. While aviation regulations governing aircraft operation and certification are often relatively prescriptive, allowing for comparatively clear determinations of whether a particular flight operation or design change is permitted, the regulatory environment surrounding aircraft repair and alterations is often less straightforward. Maintenance providers and engineers responsible for repairs and alterations must frequently navigate a regulatory structure that spans multiple overlapping regulations and fragmented guidance, requiring careful interpretation.

Complicating matters further, the terminology used within aviation regulations and guidance documents can be subtle and easily misunderstood. Similar phrases may carry very different regulatory meanings and consequences. For example, the terms *major alteration* and *major change* to *type design* appear closely related, yet they arise from different regulatory contexts and have distinctly different applications within the certification and maintenance processes. These subtle, yet important, differences can significantly affect how a repair or alteration must be evaluated and approved to meet regulatory compliance.

Although extensive guidance exists to assist mechanics and engineers, the relevant information is dispersed across a wide range of documents, including federal regulations, Advisory Circulars (AC), FAA Orders, legal interpretations, and administrative case law. These materials were developed for different purposes, at different times, and when considered individually, each specific document may appear incomplete or even contradictory. As a result, maintenance providers and engineers often find it difficult to determine which guidance is authoritative and how various sources should be applied in practice.

The purpose of this article is to provide a consolidated overview of the regulatory framework governing aircraft repairs and alterations. Although the concepts discussed have broad relevance to aviation maintenance internationally, the discussion presented here focuses specifically on the regulatory system established by the United States Federal Aviation Administration (FAA). By identifying the principal regulatory sources and explaining how each interacts, this paper seeks to offer maintenance providers and the engineers who support them with a practical reference for navigating the regulatory aspects of aircraft maintenance and modification. This work also provides a structured framework that may be applied in practice when evaluating proposed repairs and alterations. Rather than presenting an exhaustive legal analysis, the intent is to clarify the structure of the available guidance and to illustrate how these materials are typically applied when developing and approving aircraft repairs and alterations in compliance with regulations.

Overview of the FAA Regulatory Structure: Regulations, Orders, Advisory Circulars, Legal Interpretations, and Administrative Case Law

The first step in understanding the regulatory framework governing aircraft repairs and alterations is to understand the different types of regulatory and guidance documents that make up the FAA system. These materials serve different purposes, apply to different audiences, and carry different levels of authority within the regulatory structure. Together they form the framework through which aircraft maintenance, modification, and continued airworthiness are regulated in the United States. At a broad level, this structure begins with the legally binding regulations contained in the Code of Federal Regulations (C.F.R.), followed by FAA policy documents (Orders), public guidance materials (ACs), and formal legal interpretations that clarify how those regulations are applied in practice. In practical terms, the regulations establish the legal requirements; FAA Orders guide how those requirements are interpreted by FAA personnel; ACs describe commonly accepted methods of regulatory compliance; and legal interpretations clarify how specific regulatory provisions should be understood when questions arise.

The most fundamental source of regulatory authority

within the United States aviation system is the C.F.R. (FAA, 2024). Aviation regulations are codified primarily within Title 14 of the C.F.R., which establish the legally binding requirements governing the design, operation, maintenance, and continued airworthiness of aircraft. Historically, these rules were referred to as the Federal Air Regulations (FARs), a term that remains in common informal aviation usage (FAA, 2015). Compliance with these regulations is mandatory under federal law (General Requirements, 2024). The most current versions of these regulations are available through the DRS and the Electronic Code of Federal Regulations (eCFR).

Although the regulations establish the legal requirements for aviation activities, their application can require interpretation. This is particularly true in areas such as aircraft repairs and alterations, where regulatory language may allow more than one technically reasonable interpretation. To promote consistency in how regulations are applied during oversight activities, the FAA publishes internal policy documents known as FAA Orders.

FAA Orders provide direction to FAA employees, including inspectors, engineers, and certification specialists, regarding how specific regulations are to be interpreted and applied during the performance of their duties. These documents therefore play a significant role in shaping how regulations are implemented in practice. It is important to note, however, that FAA Orders are binding only for FAA personnel and designees. Maintenance providers, engineers, and aircraft operators are legally required to comply with the regulations themselves, but they are not directly bound by the internal policies in FAA Orders. Nevertheless, because FAA inspectors rely on these documents when evaluating whether maintenance actions, repairs, or alterations comply with the regulations, FAA Orders often provide valuable insight into how the agency is likely to interpret a given regulatory requirement in practice. Current FAA Orders are available through the DRS.

In addition to internal policy documents, the FAA publishes ACs to assist the aviation community in understanding and complying with regulatory requirements. Advisory Circulars provide guidance describing methods, procedures, and practices that the FAA considers acceptable for demonstrating compliance with specific regulations. In many cases, ACs outline established approaches for performing maintenance, and designing repairs and alterations that will be accepted as regulatorily compliant.

Advisory Circulars are advisory in nature and are not themselves regulatory requirements. Compliance with the procedures described in an AC is not mandatory. However, if a method described in an AC is followed, it is accepted by the FAA as an acceptable means of complying with the applicable regulation. Alternative methods of compliance may also be used, provided they can be shown to meet the regulatory requirements (FAA, 2015). Advisory Circulars are publicly available through the DRS.

The FAA also publishes legal interpretations addressing questions regarding the meaning or application of specific regulations. Legal interpretations are issued by FAA attorneys in response to questions submitted by members of the public or by FAA personnel seeking clarification of regulatory requirements. These interpretations explain how the FAA understands and applies particular regulatory provisions and therefore provide valuable insight into how the agency may evaluate an activity (FAA Office of the Chief Counsel, 2016).

Legal interpretations are particularly useful in situations where the regulatory language may allow for multiple interpretations. By clarifying how the FAA views the regulation, these documents can help maintenance providers, engineers, and aircraft operators determine whether a proposed action is likely to be considered compliant. Although the FAA is not currently issuing new legal interpretations as frequently as in the past, thousands of previously issued interpretations remain available through the DRS and continue to provide useful regulatory guidance.

Related to FAA legal interpretations are judicial decisions and administrative case law that address the application of specific FAA regulations and associated guidance. These decisions include rulings from federal courts and administrative decisions issued by bodies such as the National Transportation Safety Board (NTSB) in enforcement proceedings. Collectively, these sources provide insight into how regulatory provisions have been interpreted and applied in practice.

Case law and administrative precedent are useful in clarifying how broadly worded regulatory standards, such as those governing airworthiness or maintenance, are

applied in specific factual contexts. By examining how courts and administrative bodies have evaluated compliance in prior cases, maintenance providers and engineers can better understand how similar actions may be viewed under the regulations.

It is important to note, however, that while judicial decisions and binding administrative rulings establish precedent within their respective jurisdictions, they do not replace the underlying regulations. Rather, they serve to interpret and clarify those regulations and are most appropriately used as supplemental guidance when evaluating regulatory compliance.

Understanding the roles of these different forms of regulatory and guidance material is essential when evaluating the legality of a proposed aircraft repair or alteration. The relationship between these documents and their respective roles within the regulatory structure is summarized in Table 1. In practice, determining whether a maintenance action complies with FAA requirements often involves consulting several of these sources simultaneously, including the applicable regulations, relevant FAA policy documents, and available guidance materials. The following sections examine how this regulatory framework is applied when evaluating aircraft repairs and alterations and determining whether a proposed maintenance action satisfies the requirements of Title 14 C.F.R.

Classification of a Repair or Alteration as Major, Minor, or Preventative Maintenance

With an understanding of the regulatory and guidance structure described above, the next step in evaluating a proposed maintenance action is determining whether the work constitutes a major repair, minor repair, major alteration, or minor alteration. This classification is foundational because it determines several critical aspects of the maintenance process, including the level of certification required to perform the work, the form of the maintenance record entry required, and the type of technical justification necessary to demonstrate compliance with the applicable regulations. The discussion that follows outlines the regulatory definitions used to make this determination and explains how these definitions are typically interpreted and applied in practice.

Table 1: Primary Sources of FAA Regulatory and Guidance Material

Document Type	Authority Level	Primary Audience	Typical Purpose
Code of Federal Regulations (14 CFR)	Legally binding regulation	All participants in the aviation system	Establishes mandatory legal requirements governing aircraft design, operation, maintenance, and continued airworthiness
FAA Orders	Internal FAA policy	FAA inspectors, engineers, and certification personnel	Provides direction to FAA personnel on how regulations should be interpreted and applied during oversight and certification activities
Advisory Circulars (ACs)	Non-regulatory guidance	Aviation industry (mechanics, engineers, operators)	Describes methods and procedures that the FAA considers acceptable for demonstrating compliance with regulations
FAA Legal Interpretations	Formal legal clarification	Public and FAA personnel	Explains how specific regulatory provisions are interpreted when questions arise regarding regulatory compliance
Judicial decisions and Administrative case law	Legal Precedent	Public and FAA personnel	Explains how specific regulatory provisions are interpreted by the Courts


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Under Title 14 C.F.R., the responsibility for making the classification determination rests with the person who returns the aircraft to service. This is demonstrated by Title 14 C.F.R. § 43.9(d) and indirectly in many enforcement cases involving falsification of aircraft records (*Administrator v. Nyerges*, 2009; Content, Form, and Disposition, 2024). The definitions and general criteria used to distinguish between major and minor repairs or alterations are provided in Title 14 C.F.R. § 1.1 and Appendix A to Part 43 (Definitions, 2024; Major Alterations, Major Repairs, and Preventive Maintenance, 2024). Correctly applying these definitions is therefore an essential responsibility for maintenance providers and the engineers who support them.

In practice, however, making this determination can be challenging. While the FAA provides definitions and examples intended to guide this decision, the regulations cannot realistically provide an exhaustive list covering every possible repair or alteration on every type of aircraft. Aircraft designs vary widely in size, complexity, and operating environment, and the same maintenance action may present different levels of risk depending on the specific aircraft and system involved. For example, a modification that may be considered minor on a small general aviation aircraft could constitute a major alteration if performed on a large airliner. As a result, the regulatory framework intentionally allows for a degree of professional judgment when determining the classification of a repair or alteration.

The regulatory definitions that form the basis for this determination are contained in Title 14 C.F.R. § 1.1 (Definitions, 2024), which defines both major alterations and major repairs. The regulation states:

> *Major alteration* means an alteration not listed in the aircraft, aircraft engine, or propeller specifications—
>
> (1) That might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness; or
>
> (2) That is not done according to accepted practices or cannot be done by elementary operations.
>
> *Major repair* means a repair:
>
> (1) That, if improperly done, might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness; or
>
> (2) That is not done according to accepted practices or cannot be done by elementary operations.

Together, these regulatory requirements establish alternative grounds for classifying work as major: its potential appreciable effects on the listed airworthiness characteristics, or its departure from accepted practices or need for more than elementary operations.

In addition to the general criteria contained in Title 14 C.F.R. § 1.1, Appendix A to Part 43 also contains lists of specific repairs and alterations that are considered major (Major Alterations, Major Repairs, and Preventive Maintenance, 2024). Appendix A(a) provides examples of major alterations, and Appendix A(b) provides examples of major repairs. These lists include examples involving structural repairs, control system modifications, and powerplant installations, and are intended to assist maintenance providers in applying the regulatory definitions. However, they are not intended to represent an exhaustive catalog of all possible major repairs or alterations (FAA Office of the Chief Counsel, 2009).

A key element in the regulatory definitions of both major repairs and major alterations is the phrase "might appreciably affect" the weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness of the aircraft. This language is intentionally broad and is intended to capture maintenance actions that could have a meaningful impact on the continued airworthiness of the aircraft if designed or installed improperly.

Importantly, the phrase "might appreciably affect" does not require that a repair or alteration change the performance or characteristics of the aircraft. Rather, the regulatory concern is whether the work has the potential to significantly influence one or more of the listed airworthiness characteristics (*Kornitzky Group, LLC v. Elwell*, 2019).

For example, work involving primary structural components, flight control systems, powerplant installations, or other critical systems may be considered major because a

failure of these components could appreciably affect the airworthiness of the aircraft. In contrast, work involving nonstructural components or systems with limited safety impact may often be classified as minor, provided the work can be accomplished using accepted practices and elementary operations.

It is also important to understand how "weight and balance" is intended to be interpreted in the context of Title 14 C.F.R. § 1.1. These terms refer to changes that may affect the aircraft's approved operating limitations, such as the maximum allowable weight or the approved center of gravity (CG) envelope (Major Alterations, Major Repairs, and Preventive Maintenance, 2024). "Weight and balance" in this context is not intended to imply that every alteration which adds weight to the aircraft or shifts the empty weight center of gravity (EWCG) necessarily constitutes a major alteration. Many routine alterations and equipment installations change the aircraft's empty weight or EWCG without affecting the aircraft's approved weight limitations or allowable CG range, and such changes alone do not necessarily indicate that the alteration is major.

However, the addition of weight may constitute a major alteration or repair, depending on how and where that weight is installed. For example, the addition of weight in areas that may appreciably affect flutter or flight characteristics, such as wingtips or tail surfaces, may appreciably affect airworthiness and therefore require classification as a major repair or alteration (FAA, 2014). Accordingly, the addition of weight does not, by itself, necessitate classification as a major repair or alteration; rather, the classification depends on how and where that weight is installed and whether it might appreciably affect airworthiness characteristics.

Because the regulatory definitions intentionally rely on professional judgment, the FAA has developed several guidance tools intended to assist maintenance providers and inspectors in applying these criteria in practice. One such resource is the decision flowcharts contained in AC 43-210A (FAA, 2016), which provide a structured method for evaluating whether a repair or alteration should be classified as major or minor. These decision flowcharts guide the installer through a series of questions related to the potential effect of the work on aircraft airworthiness characteristics and the methods used to accomplish the work. For reference, the major/minor determination flowcharts from AC 43-210A are reproduced in Figure 1 and Figure 2. Advisory Circular 43-210A and other ACs are publicly available through the DRS website.

In addition to publicly available ACs, the FAA has developed internal policy documents that provide further insight into how repairs and alterations are evaluated in practice. One such document is FAA Order 8300.16, Major Repair and Alteration Data Approval, which includes the Major Repair and Alteration Data Approval (MRADA) Job Aid (FAA, 2014). This job aid is intended primarily for use by FAA inspectors and engineering personnel to determine the appropriate level of approval and coordination required when evaluating data supporting a major repair or alteration. The document identifies categories of alterations and indicates if coordination with FAA engineering offices or approval through a Supplemental Type Certificate (STC) is required. FAA Order 8300.16 and the associated MRADA Job Aid are also available through the DRS website.

Although the MRADA Job Aid is not itself a regulatory document and does not determine whether a repair or alteration is major or minor, it provides useful insight into how the FAA evaluates proposed alterations in practice. Because the job aid addresses approval paths for major repairs and alterations, alterations identified within it are generally understood to fall within the scope of major alterations as defined by Title 14 C.F.R. § 1.1 and Appendix A to Part 43.

Repairs or alterations that do not meet the criteria for classification as major are considered minor repairs or minor alterations (Definitions, 2024). These actions involve maintenance tasks that do not appreciably affect the airworthiness characteristics of the aircraft and can be accomplished using accepted practices and standard maintenance procedures. Minor repairs and alterations normally require less extensive technical substantiation and documentation than major actions, although they must still be performed in accordance with the applicable regulations and accepted maintenance practices.

A third category of maintenance actions identified within Appendix A to Part 43 is preventive maintenance (Major Alterations, Major Repairs, and Preventive Maintenance,

2024). Appendix A(c) provides a list of maintenance tasks that are considered preventive maintenance and identifies relatively simple maintenance operations that do not involve complex assembly procedures. These tasks represent a limited subset of maintenance activities that the regulations treat separately from both major and minor repairs or alterations.

Ultimately, the classification of a repair or alteration as major, minor, or preventive maintenance establishes the regulatory framework under which the work must be performed. This determination influences not only the level of technical substantiation required to demonstrate compliance with the applicable regulations, but also the qualifications and certifications required of the individual performing or approving the work. In practice, once a maintenance action has been properly classified, the next step is determining who is authorized to perform the work

Figure 1: Process of Determining the Classification of a Repair or Alteration from FAA AC 43-210A (Federal Aviation Administration, 2016)

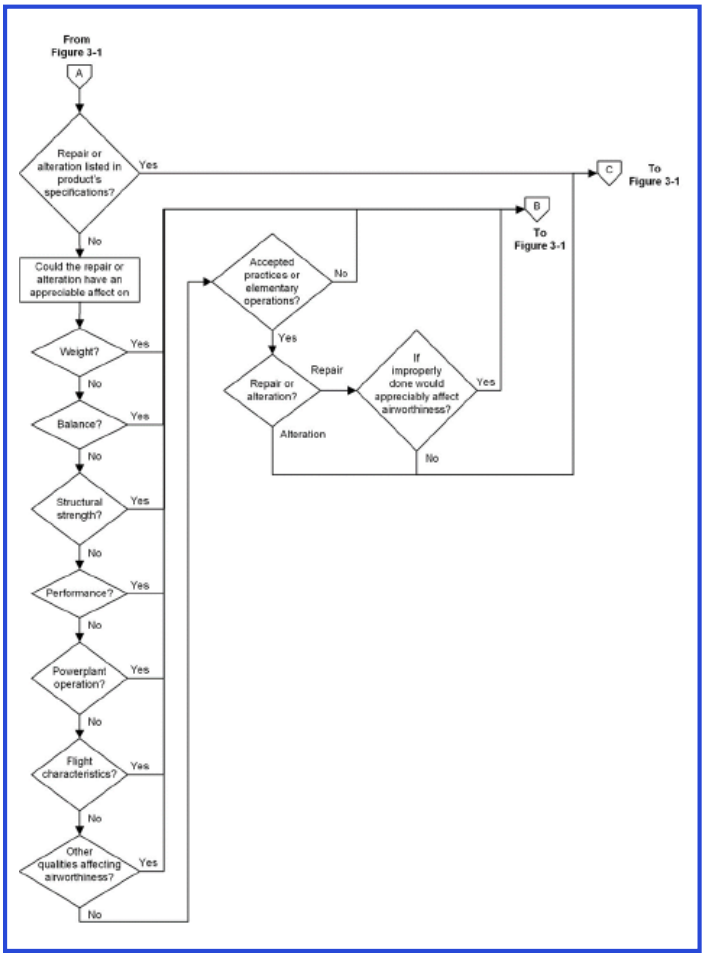
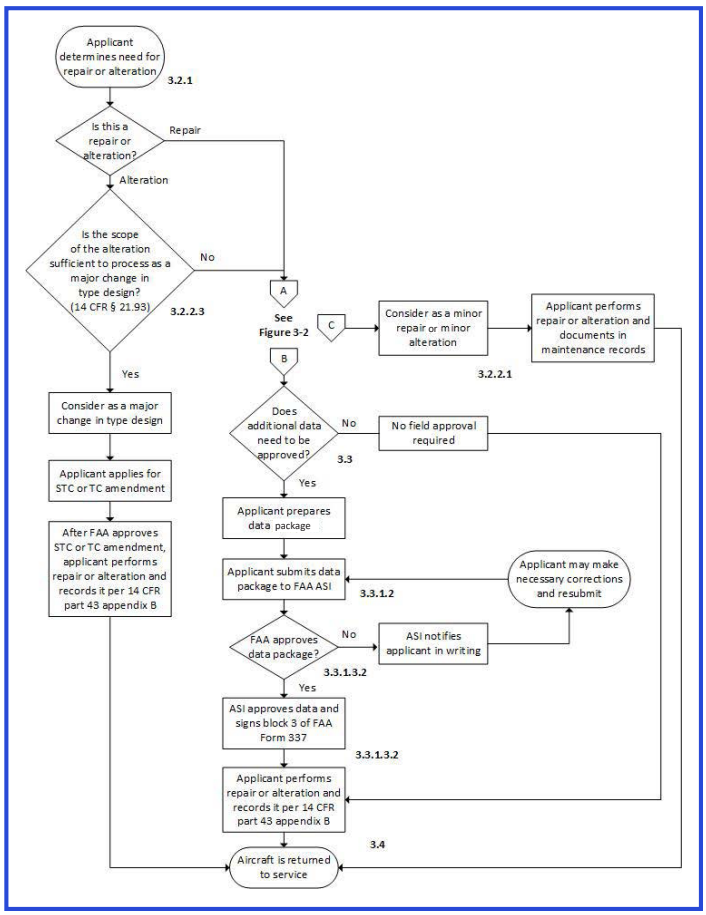


Figure 2: Process of Determining the Classification of a Repair or Alteration from FAA AC 43-210A Continued (Federal Aviation Administration, 2016).



and what type of supporting data is required to justify the repair or alteration. The following section therefore examines the regulatory requirements governing maintenance authorization and the distinction between FAA-approved and FAA-accepted technical data used to substantiate aircraft repairs and alterations.

The primary regulatory and guidance documents commonly used when determining whether a repair or alteration should be classified as major, minor, or preventive maintenance are summarized in Table 2.

Table 2: Summary of Guidance Documents Commonly Used to Classify Major and Minor Repairs and Alterations and Preventative Maintenance

Guidance Type	Regulatory Reference / Source	Purpose / Use
Regulatory Definitions	**14 CFR §1.1** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	Provides the regulatory definitions of major repair and major alteration, including the criteria involving work that "might appreciably affect" aircraft airworthiness characteristics.
Regulatory Lists of Maintenance Actions	**14 CFR Part 43 Appendix A** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	Identifies examples of repairs and alterations considered major and defines the tasks classified as preventive maintenance. Often used as an initial reference when classifying maintenance actions.
FAA Advisory Guidance	**Advisory Circular 43-210** — FAA Dynamic Regulatory System (DRS)	Provides decision flowcharts and explanatory guidance used to determine whether a repair or alteration should be classified as major or minor.
FAA Internal Engineering Guidance	**FAA Order 8300.16** – Major Repair and Alteration Data Approval (MRADA Job Aid) — FAA Dynamic Regulatory System (DRS)	Provides internal FAA guidance used by inspectors and engineers to determine appropriate data approval pathways and coordination requirements for major repairs and alterations.

Personnel Authorized to Perform Repairs and Alterations

After the major/minor classification of a proposed action has been determined, the next step is identifying the categories of certificated personnel authorized to perform or approve the work. Title 14 C.F.R. Part 43 establishes several maintenance credentials, each with specific privileges and limitations governing the types of maintenance activities that may be performed and the level of responsibility assumed when determining that an aircraft is airworthy (Maintenance, Preventive Maintenance, Rebuilding, and Alteration, 2024). The certification of maintenance personnel is established primarily in Title 14 C.F.R. Part 65 (Certification: Airmen Other Than Flight Crewmembers, 2024), while the privileges and limitations associated with performing maintenance are defined in Title 14 C.F.R. Part 43 (Maintenance, Preventive Maintenance, Rebuilding, and Alteration, 2024). Understanding these maintenance authorizations is important because the regulatory classification of a repair or alteration directly affects which individuals may perform or approve the work. The principal categories of maintenance personnel recognized by the regulations are described below.

The most common credential for performing aircraft maintenance is the Airframe and Powerplant (A&P) mechanic certificate. This certificate is defined in Title 14 C.F.R. § 65 Subpart D, and its privileges are defined in § 65.81 (General Privileges and Limitations, 2024; Mechanics, 2024). An individual holding this certificate has demonstrated both practical skills and technical knowledge of aircraft maintenance. Typically, this qualification is obtained through completion of an FAA-approved aviation maintenance technician school school (AMTS) consisting of approximately 18–24 months of training or through documented practical experience performing aircraft maintenance (Aviation Maintenance Technician Schools, 2024; Mechanics, 2024). Applicants must pass three written knowledge examinations covering general maintenance, airframe systems, and powerplant systems, followed by an oral and practical examination administered by an FAA Designated Mechanic Examiner (DME) (Knowledge Requirements, 2024; Mechanics, 2024).

Although several other maintenance credentials exist, including various repairman certificates and specialized authorizations associated with particular aircraft or organizations, the A&P certificate remains the primary credential used throughout the aviation maintenance industry.

Unlike many other aviation certificates, the mechanic certificate itself does not expire and does not require periodic renewal, although there is a recent experience requirement assessed over the preceding 24 months (Recent Experience Requirements, 2024).

A further level of certification is available to seasoned mechanics in the form of an Inspection Authorization (IA). Inspection Authorization privileges are established in Title 14 C.F.R. Part § 65.95 (Inspection Authorization Privileges and Limitations, 2024). This authorization allows a mechanic to perform certain inspection and approval functions that carry a higher level of regulatory responsibility. To qualify for an IA, an individual must have held an A&P certificate for at least three years and must have been actively engaged in aircraft maintenance for two of those years (Inspection Authorization, 2024). Applicants must also pass a written examination demonstrating familiarity with applicable regulations, inspection procedures, and maintenance documentation requirements. The IA endorsement must be renewed every two years through a combination of recent maintenance activity or completion of approved training (Inspection Authorization: Renewal, 2024).

In addition to certificated mechanics, the regulations also permit limited categories of maintenance to be performed by individuals who do not hold a mechanic certificate. The most notable example is preventive maintenance, which may be performed by a pilot holding at least a private pilot certificate issued under Title 14 C.F.R. Part 61 on an aircraft that the pilot owns or operates, subject to the limitations established in Title 14 C.F.R. Part 43 (Certification: Pilots, Flight Instructors, and Ground Instructors, 2024; Maintenance, Preventive Maintenance, Rebuilding, and Alteration, 2024).

These differing levels of maintenance certification and authorization are summarized in Table 3.

Table 3: Summary of Differing Levels of Maintenance Certification and Authorization for Performance of Major and Minor Repairs and Alterations and Preventative Maintenance

Maintenance Personnel	Regulatory Reference / Source	Purpose / Use
Pilot	**14 CFR §43.3(g)** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	Authorizes pilots holding at least a private pilot certificate to perform preventive maintenance on aircraft they own or operate, subject to the limitations of Part 43.
Airframe & Powerplant Mechanic (A&P)	**14 CFR §65.71–§65.77** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	Establishes the requirements for obtaining an Airframe and Powerplant (A&P) mechanic certificate. Applicants must document appropriate practical experience or complete an FAA-approved aviation maintenance technician school program (typically about 2,000 hours of instruction). Candidates must then pass three FAA knowledge examinations (general, airframe, and powerplant) followed by an oral and practical examination administered by a designated mechanic examiner.
Inspection Authorization (IA)	**14 CFR §65.91–§65.93** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	Establishes the eligibility requirements for obtaining an Inspection Authorization. Applicants must have held an A&P certificate for at least three years and must have been actively engaged in aircraft maintenance for at least two years prior to application. Candidates must pass a written examination demonstrating knowledge of inspection procedures and applicable maintenance regulations. Inspection Authorizations must be renewed every two years through evidence of continued maintenance activity or completion of approved training.

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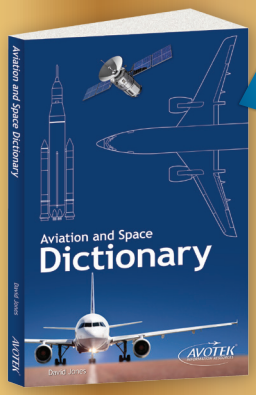

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Personnel and Data Requirements for Repairs and Alterations

The determination whether a proposed maintenance action constitutes a major repair, minor repair, major alteration, minor alteration, or preventive maintenance establishes the regulatory framework under which the work must be performed. Throughout this article, these regulatory categories are collectively referred to as the maintenance classification of the proposed action. The assigned maintenance classification determines several important aspects of the maintenance process, including who may perform the work, the level of technical data required to perform it, and how the work must be documented in the aircraft's maintenance records.

Major repairs and major alterations represent maintenance actions with the greatest potential to affect the airworthiness of an aircraft and therefore require the highest level of regulatory oversight. These actions must be performed by appropriately certificated maintenance personnel, typically an A&P mechanic, in accordance with the provisions of Title 14 C.F.R. § 43.3 (Persons Authorized to Perform Maintenance, Preventive Maintenance, Rebuilding, and Alterations, 2024). Following completion of the work, the repair or alteration must be approved for return to service by an A&P mechanic holding an IA, or by another entity such as a Part 145 repair station authorized under Title 14 C.F.R. § 43.7 (Inspection Authorization Privileges and Limitations, 2024; Persons Authorized to Approve Aircraft, 2024).

In the context of aircraft maintenance, approving an aircraft for return to service effectively constitutes a determination that the aircraft is airworthy. Although the Federal Aviation Regulations do not provide a single formal definition of the term "airworthy," the concept is derived from the airworthiness definition contained in Title 14 C.F.R. § 3.5 (Statements About Products, Parts, Appliances and Materials, 2024), which states that an aircraft is airworthy when it conforms to its approved type design and is in a condition for safe operation. FAA legal interpretations have consistently applied this language as a two-part standard for determining airworthiness: an aircraft must (1) conform to its approved type design, including any properly approved repairs or alterations, and (2) be in a condition for safe operation (FAA Office of the Chief Counsel, 2008). When a certificated mechanic or inspector approves a repair or alteration for return to service under the provisions of Part 43, that individual is therefore attesting that the aircraft continues to meet both elements of this airworthiness standard.

In addition to the restrictions on who may perform the work and approve the aircraft for return to service, major repairs and alterations must be supported by FAA-approved technical data (*Administrator v. Nyerges*, 2009; FAA, 2016). The completed repair or alteration must also be documented on FAA Form 337, Major Repair and Alteration (FAA, n.d.), which provides a permanent record describing the work performed and the data used to substantiate the work performed. A copy of this form becomes part of the aircraft's permanent maintenance records and must be retained in accordance with Title 14 C.F.R. § 91.417 (Maintenance Records, 2024).

Minor repairs and minor alterations may generally be performed by an FAA-certificated A&P mechanic, as authorized under Title 14 C.F.R. § 43.3 (Persons Authorized to Perform Maintenance, Preventive Maintenance, Rebuilding, and Alterations, 2024). Unlike major repairs and alterations, these actions do not require FAA-approved technical data. Instead, they may be accomplished using acceptable data and methods, such as manufacturer maintenance manuals, advisory circular guidance, or other recognized maintenance practices, consistent with the requirements of Title 14 C.F.R. § 43.13(a) (Performance Rules [General], 2024). The distinction between approved and acceptable data is important and will be discussed in greater detail in a subsequent section.

Minor repairs and minor alterations are documented through maintenance record entries in the aircraft logbooks in accordance with Title 14 C.F.R. § 43.9 (Content, Form, and Disposition, 2024). Unlike records of major repairs and alterations, which must be retained as part of the aircraft's permanent maintenance records, records of routine maintenance tasks, including minor repairs and alterations, need only be retained for one year or until the work is superseded by subsequent maintenance, as specified in Title 14 C.F.R. § 91.417 (Maintenance Records, 2024). Although most aircraft owners choose to retain these records indefinitely for historical and resale purposes, the regulations do not require permanent retention.

Preventive maintenance represents a distinct regulatory category defined in Appendix A(c) to Title 14 C.F.R. Part 43 (Major Alterations, Major Repairs, and Preventive Maintenance, 2024). These tasks may be performed by a pilot holding at least a private pilot certificate on an aircraft that the pilot owns or operates, provided the aircraft is not operated under Title 14 C.F.R. Parts 121, 129, or 135 (Certification: Pilots, Flight Instructors, and Ground Instructors, 2024; Persons Authorized to Perform Maintenance, Preventive Maintenance, Rebuilding, and Alterations, 2024). Appendix A(c) contains a specific list of maintenance actions considered to present a low risk to airworthiness when performed in accordance with accepted practices, including tasks such as replacing safety wire, servicing landing gear wheel bearings, or changing engine oil. FAA legal interpretations have emphasized that pilots may perform the tasks listed in Appendix A(c); however, this list should not be treated as all inclusive (FAA Office of the Chief Counsel, 2009).

Preventive maintenance tasks are recorded in the aircraft logbooks in the same manner as minor repairs and alterations. The individual performing the work must make a maintenance record entry describing the work performed and identifying the person who performed it (Content, Form, and Disposition, 2024; FAA Office of the Chief Counsel, 2016). As with other routine maintenance records, these entries must be retained for at least one year or until superseded by subsequent work (Maintenance Records, 2024).

Taken together, these requirements illustrate how the FAA maintenance framework establishes a graduated system of responsibility and oversight. Maintenance actions with greater potential to affect aircraft airworthiness require personnel with higher levels of certification and technical data subject to greater levels of FAA review and approval. Conversely, simpler maintenance tasks with limited safety implications may be performed by individuals with lower levels of certification and are subject to correspondingly reduced documentation and oversight requirements. These relationships between maintenance classification, personnel authorization, data requirements, and documentation are summarized in Table 4. Because the level of technical substantiation required for a maintenance action depends heavily on whether the data used to accomplish that action must be FAA-approved or merely FAA-acceptable, understanding the distinction between these two categories of technical data is essential. The following section therefore examines the regulatory meaning of approved and acceptable data and explains how these terms are applied when developing and substantiating aircraft repairs and alterations.

Distinction Between FAA Approved and FAA Acceptable Technical Data

The classification of a repair or alteration as major or minor largely determines the level of technical substantiation required to support the work. This determination governs whether the repair or alteration must be supported by FAA-approved technical substantiation or whether the work may be accomplished using technical data acceptable to the Administrator (*Administrator v. Nyerges*, 2009; FAA, 2016).

In the context of aircraft maintenance, technical substantiation refers to the technical data, instructions, and supporting information used to demonstrate and accomplish a repair or alteration while maintaining the aircraft's approved airworthiness standards (FAA, 2016). These materials may include manufacturer maintenance manuals, engineering drawings, service instructions, or other technical documentation describing how the work is to be performed.

The Federal Aviation Regulations do not provide a single comprehensive definition of the terms approved data and acceptable data. Although Title 14 C.F.R. § 1.1 defines the term approved in terms of FAA approval, approval under delegated authority, or approval under specified bilateral agreements (Definitions, 2024), the regulations do not specifically define what constitutes approved technical data. Likewise, the concept of data acceptable to the Administrator appears throughout the maintenance regulations but is not explicitly defined in the regulatory text. Instead, the distinction between approved and acceptable data emerges from how the regulations address the performance of maintenance and the approval of repairs and alterations (FAA, 2016).

Repairs and alterations classified as major generally require the use of FAA-approved technical data (*Administra-*

Table 4: Personnel Authorization, Data Requirements, and Recordkeeping for Major Repairs, Minor Repairs, and Preventive Maintenance

Maintenance Category	Regulatory Reference / Source	Who May Perform the Work and Data Required	Record and Retention Requirement
Major Repair /Major Alteration	**14 CFR §43.3, §43.7, §43.9, §43.11, and 65.95** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	FAA-certificated **Airframe & Powerplant (A&P) mechanic** performing the work and approved for return to service by a mechanic holding **Inspection Authorization (IA)** or other authorized approval authority. Work must be performed using **FAA-approved data.**	**FAA Form 337** documenting the repair or alteration and the approved data used. The form becomes part of the aircraft's permanent maintenance records and must be retained for the **life of the aircraft** in accordance with 14 CFR §91.417.
Minor Repair /Minor Alteration	**14 CFR §43.3 and §43.9** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	FAA-certificated **Airframe & Powerplant (A&P) mechanic**. Work must be performed using **FAA-acceptable data** such as manufacturer maintenance manuals, service instructions, or recognized industry practices.	**Maintenance record entry** in the aircraft logbook describing the work performed and identifying the person performing the work. Records must be retained for **one year or until superseded by subsequent work** in accordance with 14 CFR §91.417.
Preventive Maintenance	**14 CFR §43.3(g) and Part 43 Appendix A(c)** — Electronic Code of Federal Regulations (eCFR) or FAA Dynamic Regulatory System (DRS)	**Pilot holding at least a private pilot certificate** performing preventive maintenance on an aircraft they own or operate, subject to the limitations of Part 43. Work must be limited to the tasks listed in **Appendix A(c)** and accomplished using **appropriate maintenance instructions or accepted practices**.	**Maintenance record entry** in the aircraft logbook describing the work performed and identifying the person performing the work. Records must be retained for **one year or until superseded by subsequent work** in accordance with 14 CFR §91.417.

tor v. Nyerges, 2009; FAA, 2016). Approved data consists of technical information that has been specifically reviewed and formally approved by the FAA, or by an individual or organization authorized to act on behalf of the FAA, as demonstrating compliance with the applicable airworthiness requirements (FAA, 2016). Examples of approved data include engineering drawings or analyses approved by FAA engineering personnel, data approved through the FAA field approval process and documented on FAA Form 337 (FAA, n.d.) and design data approved through a STC (FAA, 2016). In many cases, approved data may also be generated and approved by FAA-authorized representatives such as Designated Engineering Representatives (DERs) or Major Repair, Alteration, and Airworthiness (MRA) Organization Designation Authorization (ODA) holders acting within the scope of their delegated authority (FAA, 2016). Additional guidance concerning the approval of technical data for major repairs and alterations is provided in FAA Order 8300.16, Major Repair and Alteration Data Approval, which contains the MRADA Job Aid used by FAA inspectors and engineers when evaluating the approval of data supporting major repairs and alterations (FAA, 2014).

Maintenance actions classified as minor repairs or minor alterations may be performed using data acceptable to the Administrator. Under Title 14 C.F.R. § 43.13(a), maintenance must be performed using methods, techniques, and practices acceptable to the Administrator (Performance Rules [General], 2024). This provision establishes the regulatory basis for the use of acceptable data when

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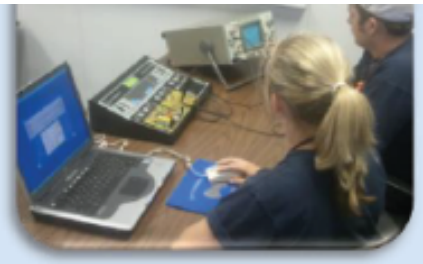

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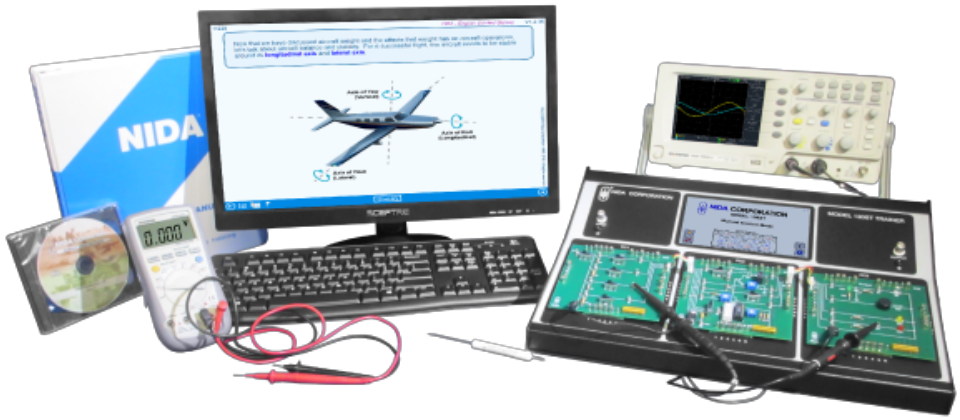

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performing maintenance tasks that do not require formal engineering approval. Acceptable data commonly include aircraft manufacturer maintenance manuals, service instructions, advisory circular guidance, and other maintenance practices recognized by the Administrator describing accepted methods of performing maintenance (Performance Rules [General], 2024). Examples of these sources are also reflected in FAA training guidance such as the FAA Mechanic Airmen Certification Standards which require mechanics to identify and apply appropriate sources of acceptable maintenance data when performing maintenance tasks.

One commonly referenced source of acceptable maintenance practices is AC 43.13-1B (FAA, 1998), which provides guidance on a wide range of commonly used inspection and repair techniques. A companion document, AC 43.13-2B, provides similar guidance for many types of aircraft alterations (FAA, 2008). These ACs generally represent technical data acceptable to the Administrator; however, the FAA specifies in the introduction to AC 43.13-1B that certain repairs described in the document may also be used as approved data when specific conditions are met (FAA, 1998). In particular, the guidance may be used as approved data for repairs to non-pressurized areas of civil aircraft, provided that no conflicting or more specific repair instructions are contained in the applicable aircraft manufacturer's maintenance or structural repair documentation (FAA, 1998). Guidance contained in AC 43.13-2B may likewise be accepted or approved by the FAA when used to support specific alteration approvals (FAA, 2008).

In practical terms, the distinction between approved and acceptable data reflects the level of regulatory oversight required to ensure continued airworthiness. Repairs and alterations that may appreciably affect aircraft airworthiness require formal engineering review and approval of the supporting technical data, whereas maintenance actions with more limited airworthiness impact may generally be accomplished using accepted maintenance practices described in manufacturer documentation or advisory circular guidance (FAA, 2016; Performance Rules [General], 2024). As discussed in the previous section, several FAA guidance documents support this regulatory framework, including AC 43-210A, AC 43.13-1B, and FAA Order 8300.16, which together help maintenance providers, engineers, and inspectors interpret the technical data requirements associated with repairs and alterations (FAA, 1998, 2014, 2016).

Although the distinction between approved and acceptable data is conceptually straightforward, determining whether specific documentation qualifies as approved data can sometimes require careful evaluation. Certain forms of manufacturer documentation, for example, may constitute FAA-approved data if they are incorporated into the aircraft's approved type design or explicitly approved by the FAA (FAA, 2014, 2016). In other cases, similar documentation may represent only acceptable maintenance guidance. Maintenance providers and engineers must therefore evaluate both the classification of the maintenance action and the regulatory status of the technical data used to accomplish it. Examples of commonly encountered sources of FAA-approved and FAA-acceptable technical data are summarized in Table 5.

Conclusion

Aircraft repairs and alterations exist at the intersection of aircraft maintenance practice, engineering evaluation, and regulatory compliance. While the technical aspects of performing maintenance are governed by sound aircraft maintenance practice, supported where necessary by engineering evaluation, those actions must also conform to a regulatory framework that determines how the work may be performed, what level of technical substantiation is required, and who is authorized to approve the aircraft for return to service. Because the relevant regulatory and guidance materials are distributed across numerous sources, including federal regulations, FAA Orders, ACs, and regulatory interpretations or related guidance—understanding how these materials interact can be challenging for maintenance providers and the engineers who support them.

This article has presented an overview of the regulatory structure governing aircraft repairs and alterations within the United States FAA system. The discussion examined the hierarchy of regulatory and guidance materials that define the FAA oversight framework; the criteria used to classify maintenance actions as major or minor, the categories of personnel authorized to perform and approve maintenance actions, and the distinction between FAA-ap-

Table 5: Examples of FAA-Approved and FAA-Acceptable Technical Data Used in Aircraft Maintenance

Source of Technical Data	Typical Classification	Typical Use	Where Found / Regulatory Basis
Aircraft Type Certificate Data Sheet (TCDS)	FAA-Approved Data	Defines the approved configuration and limitations of a certificated aircraft, engine, or propeller	14 CFR §§21.41 and 21.43; FAA Type Certificate documentation
Supplemental Type Certificate (STC)	FAA-Approved Data	Approved alterations to the aircraft type design	14 CFR §21.111; STC approval documentation
FAA Field Approval (FAA Form 337)	FAA-Approved Data	Approval of specific major repairs or alterations not covered by existing approved data	14 CFR Part 43 Appendix B; documented on FAA Form 337
DER or ODA Approved Engineering Data	FAA-Approved Data	Engineering analyses or drawings approved by authorized FAA representatives	14 CFR Part 183 (DER delegation) and ODA approvals
Manufacturer Structural Repair Manual (SRM) when part of approved type design	FAA-Approved Data	Structural repairs developed and approved by the aircraft manufacturer	14 CFR §21.31 (approved type design data)
Aircraft Maintenance Manual (AMM) or Instructions for Continued Airworthiness (ICA)	Acceptable Data (may be approved when incorporated in type design)	Routine maintenance procedures and minor repair instructions	14 CFR §§21.50 and 43.13
Service Bulletins / Service Instructions	Acceptable Data (may become approved when incorporated into approved data)	Maintenance or modification guidance issued by manufacturers	Referenced under 14 CFR §43.13(a)
Advisory Circular 43.13-1B	Acceptable Data (may serve as approved data under specific conditions)	Standard inspection and repair methods for many common aircraft repairs	May be used as approved data for certain repairs to non-pressurized aircraft ≤12,500 lbs when no conflicting manufacturer data exists
Advisory Circular 43.13-2B	Acceptable Data (may be accepted or approved when supporting alteration approvals)	Standard practices and methods for many common aircraft alterations	FAA advisory circular guidance
Other maintenance practices recognized by the Administrator	Acceptable Data	Industry-recognized maintenance techniques	14 CFR §43.13(a)

Note: The classification shown reflects typical regulatory usage. In some circumstances, data normally considered acceptable may be approved by the FAA when specifically authorized as part of a repair or alteration approval.

proved and FAA-acceptable technical data used to substantiate repairs and alterations.

The primary objective of this work has not been to introduce new regulatory interpretations or guidance beyond those established by the FAA, but rather to consolidate existing regulatory and guidance material into a single, structured reference. The information necessary to evaluate aircraft repairs and alterations is contained within FAA regulations and associated guidance materials, including FAA Orders, ACs, and regulatory interpretations or related guidance. However, these materials are dispersed across numerous documents that were developed for different audiences and purposes. By assembling the most relevant elements of those documents into a single narrative while identifying the original regulatory sources, this paper aims to provide maintenance providers and supporting engineers with a clearer pathway for navigating the regulatory aspects of aircraft repairs and alterations.

Equally important, the discussion presented here is intended to serve as a gateway to the underlying regulatory material. By identifying the principal sources of authority and explaining how they relate to one another, readers are better positioned to consult the original regulations, FAA Orders, and ACs when more detailed guidance is required. In this regard, the article serves as both a summary of the regulatory framework and a guide directing readers to the relevant source documents.

In practice, the framework described herein may be applied as a structured approach when evaluating proposed repairs and alterations during maintenance planning or engineering support activities, thereby supporting more consistent and defensible regulatory compliance decisions.

Taken together, the regulatory concepts discussed in this paper illustrate how the FAA maintenance framework establishes a graduated system of oversight. The classification of a maintenance action determines the personnel authorized to perform the work, the level of technical data required to substantiate it, and the documentation necessary to record the repair or alteration. Understanding how these elements interact allows maintenance providers and supporting engineers to more effectively navigate the regulatory process and ensure that proposed repairs and alterations satisfy both the technical and regulatory requirements necessary to maintain aircraft airworthiness.

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The A&P of Tomorrow: Preparing Aviation Maintenance Education for Advanced Air Mobility Aircraft



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Advanced Air Mobility (AAM) aircraft is moving from an idea on an engineer's whiteboard toward a real part of aviation. The Federal Aviation Administration (FAA) describes AAM aircraft as typically highly automated, electrically powered, and capable of vertical takeoff and landing (eVTOL; FAA, 2026). Examples of this platform include the Archer Aviation eVTOL aircraft, anticipated to be used at the 2028 Olympics; Joby Aircraft's 5-passenger manned AAM aircraft; and BETA Technologies, which recently received a Special Airworthiness Certificate to expand flight operations (FAA, n.d.; GAN, 2026; Snowden, 2025). With more than just one single company or developer pursuing this platform, there is evidence that it will become a reality in our skies quite soon. These are not simply "new aircraft" but unique platforms that should raise an important question for aviation maintenance educators: Are today's aviation maintenance technician school (AMTS) graduates being prepared to maintain the next generation of aircraft?

These vehicles are unique in several respects, but the major one for the aircraft mechanic would be the lack of traditional systems typically covered in AMTS curricula. Many of these vehicles are primarily electric and computer-managed, leading to a significant need for coding and software troubleshooting skills. As an aircraft system going through the certification process, these tasks will need to be addressed to build competent aircraft mechanics in this field. The Airframe and Powerplant (A&P) mechanic remains the foundation of aviation maintenance. The concern is that the systems at the core of AAM aircraft are shifting the technical focus toward electrical power, electronics, computing, software, data networks, and automated flight controls. Most AMTS are not preparing students for such advanced concepts.

The industry has already identified this issue. A Government Accountability Office (GAO) review of AAM found that traditional maintenance technicians will need new skills in automation and electric propulsion and that developing those skills will require investment in new standards and curricula. More recently, the U.S. Department of Transportation's (DOT) 2025 AAM Comprehensive Plan called for identifying competency gaps in existing workforce-development programs and determining whether emerging aviation technologies require new training or education (DOT, 2025; GAO, 2022).

Addressing the potential gap between training and emerging technologies is not entirely new. When the FAA began the process of modernizing how AMTS manages its instructional material, they explicitly recognized that aircraft technology was increasingly emphasizing electricity, electronics, and advanced materials. The FAA's current guidance for aviation maintenance and avionics technicians states that future avionics work will require strong technical backgrounds in computer hardware, software, databases, integration, and networking (FAA, 2015; FAA, 2026; GAO, 2022).

The Bureau of Labor Statistics (BLS) describes A&P mechanics as certified generalists, while avionics technicians specialize in electronic systems (BLS, 2026). The distinction between the traditional A&P and the avionics technician is important. Consider the maintenance technician troubleshooting an AAM aircraft propulsion system. The problem may not be a visibly failed component. It could involve battery-management data, inverter behavior, motor-controller faults, communication between distributed computers, sensor disagreement, or a software-defined fault that requires interpreting system data before a component is replaced. The technician still needs traditional mechanical skills—but those skills are now part of a larger diagnostic system. The A&P will need the ability to troubleshoot using electronic fault-identification methods and a level of competence in understanding system logic and flow. The AMTS instruction should

integrate these needs without compromising the foundational ability to perform physical maintenance.

Aviation maintenance technician schools do not need to turn every A&P student into an avionics engineer or a software developer. They should, however, strengthen the technicians' foundation in electrical and electronic troubleshooting, digital communication, data interpretation, high-voltage safety, computer-based diagnostics, and the interaction between software and hardware. Students should also learn to troubleshoot systems they cannot physically "see" by using wiring diagrams, fault data, maintenance documentation, test equipment, and system logic (FAA, 2026).

There is already movement in this direction. Many AMTS have introduced an Advanced Air Mobility Maintenance Technician certificate program that focuses on batteries, motors, propellers, and supporting subsystems, also exposing experienced traditional technicians to AAM aircraft technologies. This should not be thought of as a new or separate mechanic certificate but training to prepare the current A&P mechanic for this next-generation platform.

The current consideration for AMTS is not whether every A&P program should immediately create an AAM specialization. They should begin preparing the next generation of technicians for a maintenance environment that is becoming increasingly electric, digital, automated, and software dependent.

Advanced air mobility aircraft may ultimately develop differently than its advocates predict. But the technological trend is already here. Aviation maintenance technician schools do not need to wait until large AAM aircraft fleets arrive at maintenance facilities; the time to strengthen the bridge between mechanical maintenance and modern electronics is now.

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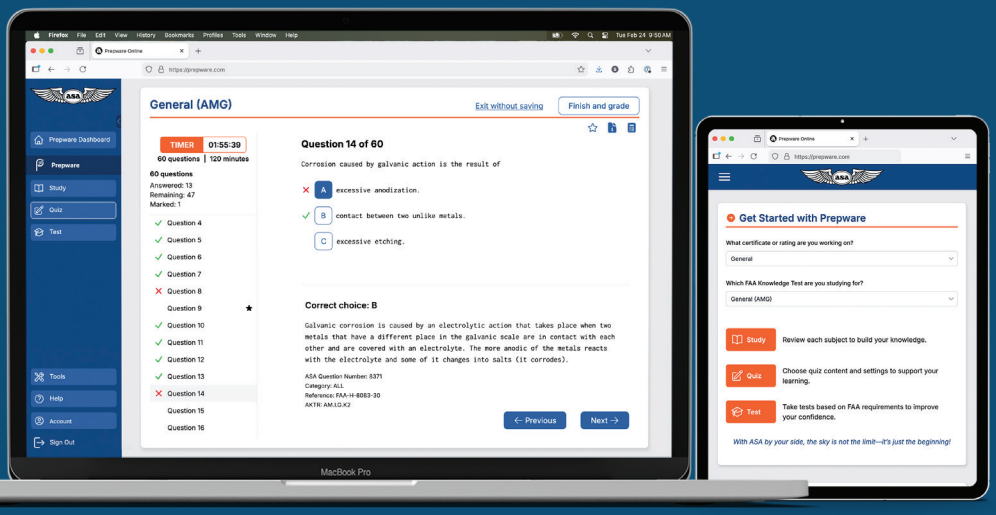

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Generative Artificial Intelligence in Aviation Curriculum Development

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Abstract

Generative artificial intelligence (GenAI) is available for instructional development, but it raises questions regarding accuracy, prompting, instructor oversight, and appropriate application. This exploratory investigation examined the use of GenAI during the development and revision of an aviation electronics curriculum module of instruction and used those experiences to inform a GenAI-assisted curriculum-development framework. An experienced aviation maintenance instructor without formal GenAI training used ChatGPT to develop approximately four weeks of lectures, laboratory activities, reviews, and assessment materials. The process was iterative: outputs were evaluated, corrected, and prompts refined, decomposed, or manually revised as needed. GenAI helped organize information, develop concepts, generate instructional materials, develop projects, and generate initial assessment items. However, outputs sometimes contained technical errors, omissions, inappropriate emphasis, or unsuitable instructional material. Instructor verification and repeated revision remained necessary. This exploratory process contributed to developing the proposed Framework for GenAI-Assisted Curriculum Development. The framework has not yet been empirically evaluated for efficacy or effectiveness and is intended as a foundation for subsequent research.

GenAI is becoming a standard tool across many aspects of daily life and professional practice (Grewal et al., 2024; Zakarneh et al., 2024). By responding to user prompts, GenAI systems can rapidly generate instructional materials, explanations, examples, assessments, and other educational resources, making them increasingly attractive for curriculum development (Al Naqbi et al., 2024; Harris, 2025; Noroozi et al., 2024). Additionally, GenAI can help instructors refresh their understanding of material they have not reviewed recently and support preparation for lectures, laboratories, and other instructional activities (Noroozi et al., 2024; Viet, 2025). This speed is particularly valuable in technical fields, where instructors must continually revise the curriculum to address evolving technologies, industry practices, and regulatory requirements (Federal Aviation Administration [FAA], 2026; Wang & Li, 2026).

While GenAI can generate instructional content efficiently, concerns remain about its accuracy, appropriateness, and instructional effectiveness. Researchers have identified issues such as factual errors, hallucinations, misinformation, bias, unsupported claims, oversimplified explanations, poorly aligned assessments, and realistic-looking images or diagrams that inaccurately represent actual systems or processes (Cazzamatta & Sarısakaloğlu, 2025; García-López & Trujillo-Liñán, 2025; Mak et al., 2025; Viet, 2025). These inaccuracies can mislead learners and create misconceptions that are difficult to correct. Because initial learning experiences often have lasting effects on knowledge acquisition, a phenomenon known as the primacy effect (Yeh & Chen, 2021), correcting inaccurate AI-generated content may require substantial retraining. In aviation maintenance education, where technical accuracy is closely linked to professional competence and safety, these errors can adversely affect student learning, professional judgment, and long-term safety outcomes (FAA, 2023a; Hawkins & Orlady, 1993; Wiegmann & Shappell, 2003).

The literature consistently emphasizes that the most effective educational use of GenAI occurs through human-AI collaboration, in which GenAI augments rather than replaces instructor expertise (Grewal et al., 2024; Mak et al., 2025; Viet, 2025). Effective AI-assisted curriculum development therefore requires more than writing a single prompt. It involves an iterative process of prompting, evaluation, correction, technical verification, and instructor revision to ensure the accuracy and educational suitability of generated materials (Chang & Wong, 2025; Viet, 2025). A qualified instructor should direct GenAI using approved technical references and instructional resources to ensure that course content aligns with Title 14 Code of Federal Regulations (C.F.R.) Part 147 requirements, Aviation Mechanic Airman Certification Standards (ACS), manufacturer guidance, and other approved references (FAA, 2023a; FAA, 2024; FAA, 2026).

Although educators are increasingly experimenting with GenAI technologies, relatively little attention has been devoted to documenting the specific processes for transforming AI-generated outputs into usable curriculum materials (Fu et al., 2024; Chang & Wong, 2025). Academic discussions of GenAI in education often focus on academic integrity, ethical use, governance, student applications, and institutional policy development (García-López & Trujillo-Liñán, 2025; Mak et al., 2025; Viet, 2025). By comparison, few studies examine the practical mechanics of using GenAI effectively during curriculum development or describe instructor-controlled procedures for validating and refining AI-generated content (Chang & Wong, 2025; Fu et al., 2024). Therefore, this investigation documented an instructor-controlled process for using GenAI to support aviation maintenance curriculum development and used those observations to propose a framework for GenAI-assisted curriculum development. The investigation does not determine whether GenAI can replace an experienced instructor or independently create instructional materials; rather, it positions GenAI as a support tool within an instructor-controlled curriculum-development process.

Literature Review

GenAI has become increasingly integrated into higher education, with applications spanning instructional content, assessment, feedback, adaptive learning, and administrative tasks (Fu et al., 2024; Wang & Li, 2026). Beyond student-facing applications, recent research has examined GenAI as a tool for faculty work. In a systematic review of 33 studies, Liang et al. (2025) identified instructional material generation, workload reduction, evaluation, and implementation challenges. Similarly, Belkina et al. (2025) found that empirical research on practical GenAI implementation in higher education remains limited. Collectively, this literature suggests that GenAI can support instructional productivity while highlighting the need for structured implementation.

GenAI's ability to generate and synthesize content may be particularly useful for curriculum development. A systematic review of 159 publications found that GenAI can improve productivity by generating content, synthesizing information, and managing knowledge (Al Naqbi et al., 2024). In education, these capabilities can help instructors develop instructional materials, learning activities, examples, assessments, and course content (Liang et al., 2025; Noroozi et al., 2024). However, researchers generally view GenAI as augmenting professional expertise rather than replacing it (Grewal et al., 2024). Effective AI-assisted curriculum development therefore requires instructors to evaluate and refine generated content, rather than treating AI outputs as finished instructional products.

A significant concern is the accuracy and reliability of AI-generated information. Reviews of GenAI in higher education identify hallucinations, inaccurate outputs, bias, privacy concerns, academic integrity issues, and overreliance as persistent challenges (García-López & Trujillo-Liñán, 2025; Mak et al., 2025; Viet, 2025). Research on AI-generated misinformation further shows that increasingly sophisticated GenAI content can be difficult to distinguish from accurate information (Cazzamatta & Sarısakaloğlu, 2025). Consequently, human oversight, accountability, and verification are consistently identified as essential to responsible GenAI use in education (Chang & Wong, 2025; García-López & Trujillo-Liñán, 2025; Viet, 2025). For curriculum development, this oversight must include evaluating factual accuracy, disciplinary appropriateness, alignment with learning outcomes, and pedagogical suitability.

These concerns are especially significant in aviation maintenance education, where the curriculum is tied to technical competency, regulatory requirements, and aviation safety. Aviation Maintenance Technician Schools (AMTS) operate under FAA requirements outlined in 14 C.F.R. Part 147, and FAA instructional materials emphasize technical knowledge, aircraft systems, maintenance procedures, human factors, professionalism, and sound decision-making (FAA, 2023a, 2023b, 2023c, 2026). Human factors research likewise identifies training, procedures, communication, supervision, and organizational conditions as contributors to aviation safety (Reason, 1990, 1997; Wiegmann & Shappell, 2003). Thus, inaccurate instructional content may extend beyond academic performance and shape the knowledge and practices of future aviation maintenance professionals. Research on learning also suggests that early instructional experiences can shape later learning, further supporting careful control of foundational course content (Yeh & Chen, 2021).

Although research on GenAI in education is expanding rapidly, a gap remains between recognizing the value of human oversight and providing practical processes for implementing it. Existing research has examined GenAI ethics, student use, educational outcomes, and, increasingly, faculty applications, but it offers limited guidance on how instructors can systematically use GenAI to develop and validate curriculum (Belkina et al., 2025; Fu et al., 2024; Liang et al., 2025). This gap is particularly relevant to aviation maintenance education, where technical accuracy and regulatory compliance are essential. An instructor-controlled framework could address this gap by positioning GenAI as a curriculum-development and productivity tool while retaining instructor responsibility for content validation, regulatory compliance, pedagogical alignment, and final approval. This proposed framework could extend the emerging GenAI-in-education literature by offering a systematic process suited to general technical education.

GenAI-Assisted Curriculum Development Process

At the beginning of the Fall 2026 semester, I was assigned to teach an introductory aviation electronics course that I had not previously taught. Although I had experience teaching aviation maintenance and electronics-related subjects, developing this course required becoming familiar with existing instructional materials, identifying content gaps, and developing lecture activities and supporting instructional resources. This process provided an opportunity to explore GenAI as a course development tool.

Additional resources available to me included the course textbook, previously used instructional material, older textbooks, projects, and lectures. Most of these materials required updating and expansion before classroom implementation. I revised approximately four weeks of classroom lectures, along with corresponding laboratory projects, quizzes, reviews, and a module examination. The method described in this paper was developed through iterative use, observation, correction, and contemplation of these materials during curriculum development. An important instructional objective is to explain not only what technically occurs but also the underlying physics principles. For example, when teaching an N-channel MOSFET, I explain how the electric field produced by the gate voltage forms a conducting channel, allowing current to flow between the source and drain without mechanical contacts, rather than it being just a voltage-activated switch. During the early phases of course development, I made notes and used GenAI to consolidate related concepts into infographics. Viewing multiple concepts together allowed me to examine their relationships and develop a broader understanding of the subject matter.

The infographic provided in Appendix A illustrates an example of the material studied during the initial curriculum development process. The infographic consolidates related information onto one page, allowing me to examine relationships among related concepts. In the example in Figure 1, the infographic (Appendix A) supported the development of an instructional slide explaining high-pass and low-pass filters.

After studying the instructional materials, I entered the learning objectives into GenAI in plain language and used GenAI to revise them into the institutionally-approved format for integration into the syllabus. GenAI was used in two ways at this stage of development. First, GenAI was prompted to generate specific instructional content or materials. Second, GenAI was used as a prompt development partner. When a generated result failed to achieve the intended goal or objective, I revised the prompt either by adding manual prompts or by asking GenAI to suggest changes. I checked technical accuracy against relevant references and judged instructional suitability using my teaching experience. If prompt revision did not fix the problem, I decomposed the task into smaller subtasks.

Technical accuracy presented an additional challenge. In some instances, GenAI generated circuit designs that would have been unsafe to construct. For example, I prompted GenAI to produce a clean drawing of a bridge rectifier connected through a transformer to a source outlet. The circuit was intended to support the study of power supply and address failure points for troubleshooting skills. The resulting GenAI diagram directly shorted the transformer and, if constructed, would have presented a fire hazard. Although the GenAI drawing looked professional, it was technically inaccurate. As a result, all technical diagrams were independently checked for accuracy.

An example of an inaccurate GenAI technical diagram is shown in Figure 2. When prompted to reconstruct an old Radio Shack drawing originally constructed by Forrest Mims III, GenAI generated a drawing containing errors not present in the original drawing. If a student were to attempt to construct it as drawn, it would result in a fire hazard. The major errors are outlined in red in Figure 2. The final drawing presented for the students to construct was significantly altered to be safe. The image was used for educational purposes only.

Throughout the curriculum-development process, I encountered several recurring challenges when using GenAI. These challenges required changes to prompting, task organization, and continued instructional review. Some tasks required relatively little GenAI prompt refinement, whereas others required substantial re-prompting and instructor intervention. Table 1 summarizes tasks according to the relative level of prompt refinement and intervention required. The full sequence of curriculum development can be viewed in Appendix B.

Figure 1: High-Pass and Low-Pass Filter Presentation Slide Example

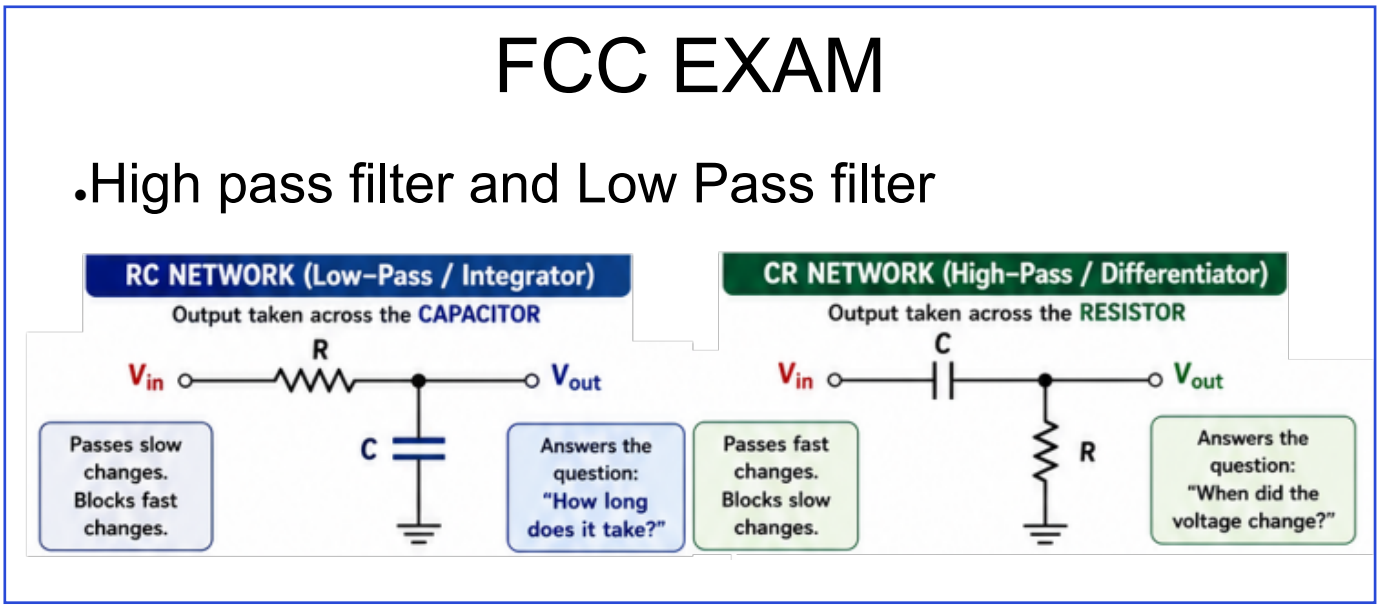

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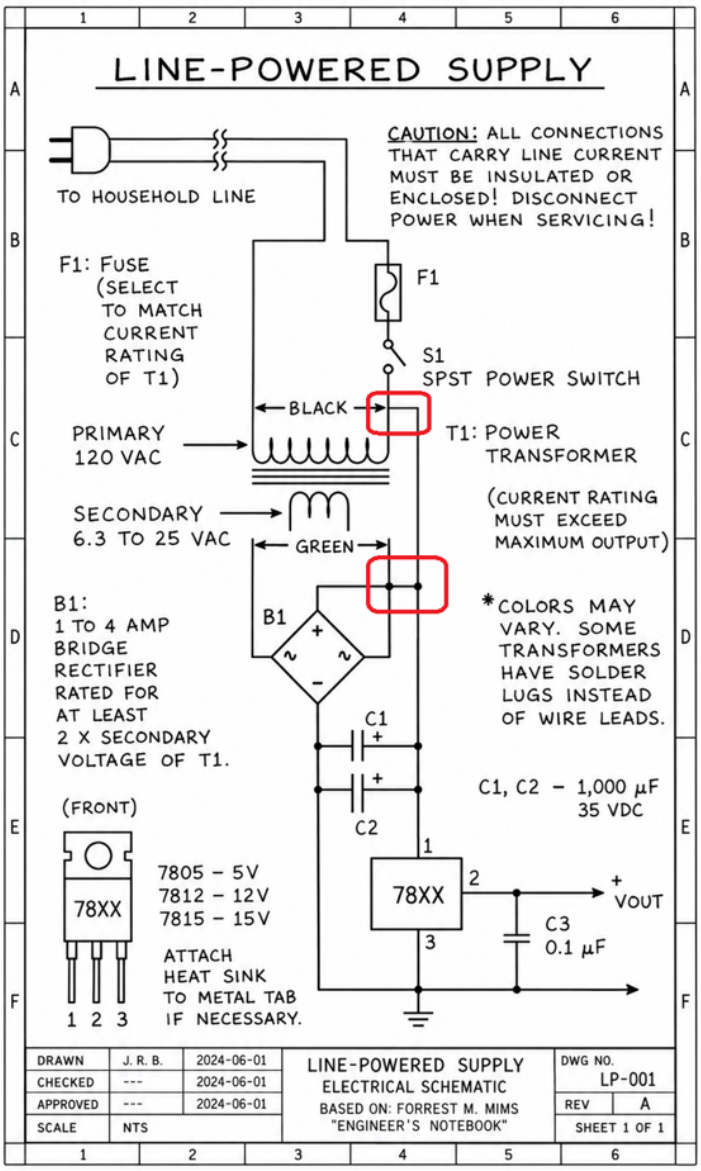
Figure 2: Example of an inaccurate GenAI-generated power supply circuit



Note: The original line-powered supply circuit was published by Mims (1988, p. 48). The AI-generated reconstruction used in this study introduced electrical errors that are not present in the original schematic.

Framework for GenAI-Assisted Curriculum Development

The iterative curriculum-development process described above was synthesized into a proposed Framework for GenAI-Assisted Curriculum Development (Table 2). The framework organizes the observed process into five stages: (1) Review and Define, (2) Organize and Develop, (3) Refine and Correct, (4) Verify and Prototype, and (5) Develop and Validate Assessments. Across all five stages, GenAI served as a curriculum-development support tool, while the instructor remained responsible for determining instructional objectives, evaluating generated content, verifying technical accuracy, and making final instructional and assessment decisions. The framework is derived from an exploratory development process and has not yet been empirically evaluated for efficacy or effectiveness. Instead, the framework provides a foundation for future research to systematically evaluate and refine its processes, outcomes, and applicability.

Table 1: GenAI Tasks by Level of Prompt Refinement and Instructor Intervention

Required less prompt refinement	Required more prompt refinement and some
• Brainstorming. • Identifying areas for further instructor preparation. (Knowledge Attrition) (Changes in the field) • Developing conceptual overviews. • Organizing dispersed information. • Generating proposed instructional content. • Producing initial assessment item pools.	• FAA-Approved Data Safety-critical technical diagrams and tasks. • Technically precise representations. • Large, poorly bounded projects. • Unverified explanations.

Ethical Considerations

To uphold ethical responsibility, instructors should verify all technical information in GenAI products. As subject matter experts, AMTS instructors need to closely evaluate the GenAI products at each step of the process, appropriately document GenAI use, and maintain control of all pedagogical processes. Because FAA guidance is dynamic, instructors should stay current on all publications and ACS standards to better evaluate GenAI products. Furthermore, instructors should take time to teach students responsible GenAI use and inform students whenever instructors use GenAI products. Transparency in instructor use can help maintain students' trust and model ethical GenAI use in educational settings.

Table 2: Proposed Framework for GenAI-Assisted Curriculum Development

Step	Stage	GenAI Role	Instructor Role
1	Review and Define	Help consolidate existing information and revise learning objectives into the required format.	Review course requirements, existing instructional materials, textbooks, and technical references; identify content gaps; establish learning objectives and instructional boundaries.
2	Organize and Develop	Assist with organizing subject matter, generating outlines, developing instructional content, and consolidating related concepts through tools such as infographics.	Compare GenAI outputs with existing materials and technical references; determine appropriate content, instructional level, sequencing, and presentation of concepts.
3	Refine and Correct	Support iterative prompt revision and suggest modifications when outputs do not meet the intended objective.	Evaluate generated outputs; revise prompts; decompose unsuccessful tasks into smaller subtasks; restart with a clean context and newly constructed prompt when necessary.
4	Verify and Prototype	Generate proposed technical materials, diagrams, circuits, and laboratory-project concepts.	Independently verify technical accuracy and instructional appropriateness; correct or reject inaccurate content; prototype circuits and laboratory activities before student use.
5	Develop and Validate Assessments	Use completed lectures and laboratory materials as source content to generate review questions, assessment items, and response options.	Review generated items for accuracy, relevance, rigor, and alignment with learning objectives; remove inappropriate or peripheral items; retain final responsibility for all assessment decisions.

Instructors must also avoid copying GenAI outputs without carefully reviewing the material. Additionally, instructors should not use GenAI as the sole content source for educational and curricular materials. Title 14 C.F.R. Part 147 instructors should be well-versed in all federal publications related to their field of study. Further, instructors should not rely on GenAI to interpret federal regulations; instead, they should read the regulations themselves to ensure GenAI outputs are correct. Finally, instructors should not delegate assessment decisions to GenAI.

Limitations

The framework presented in this paper is proposed as an initial, literature-informed approach to GenAI-assisted curriculum development and has not yet been empirically evaluated for efficacy or effectiveness. The framework was derived from the curriculum-development experience of one instructor within a specific aviation electronics course and institutional context. The instructor's extensive teaching, curriculum-development, and technical experience may have influenced the ability to identify, evaluate, and correct GenAI-generated content. Additionally, the exploratory process did not evaluate student-learning outcomes or compare GenAI-assisted curriculum development with other development approaches.

Recommendations and Conclusion

Recommendations for future research related to the use of GenAI in developing curricular materials include additional research to evaluate the impact of materials created with GenAI assistance on student learning. Further research should look at the quality of curriculum developed with GenAI assistance and the effectiveness of AI-generated assessments in evaluating student learning. Further

studies should also evaluate faculty perceptions regarding the quality of GenAI-created education materials and their inclusion in classroom instruction.

This exploratory experience suggests that GenAI may improve efficiency for some curriculum-development tasks, although the amount of instructor intervention varied substantially by task. Regardless, human expertise and oversight remain indispensable in aviation maintenance education to ensure materials produced are accurate and align with federal regulations and standards. Although the proposed framework provides a practical, ethical approach to integrating GenAI into curriculum development, it still needs further validation.

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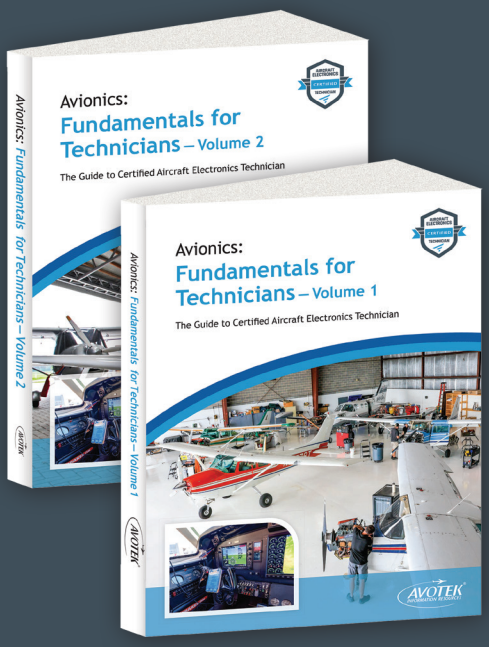

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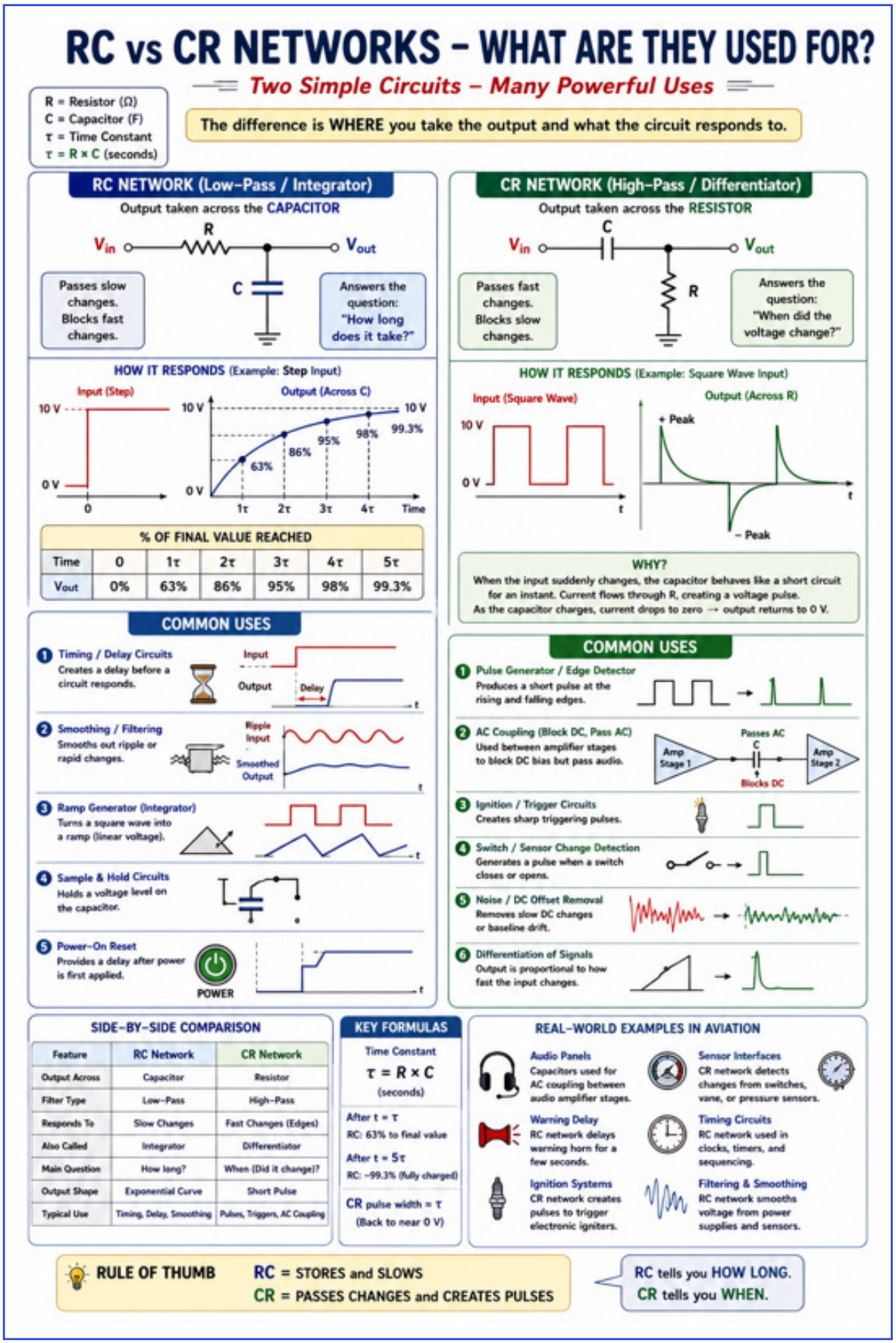
Appendix A: Comprehension Infographic Example



Appendix B: Sequence of Curriculum Development

Development Activity	GenAI Role	Instructor Role	Problem Observed	Corrective Action
Initial content review	Summarize notes for comprehension	Review and study the material until sufficient understanding is achieved	GenAI was sometimes technically incorrect or did not correctly address the prompt	Prompt refinement and comparison to source materials (textbook, online sources, and technical references)
Development of learning objectives	Take course description and develop learning objectives	Review all materials for accuracy and completeness	None	None
Organizing presentation contents	Develop an outline for the subject	Review the outline in relation to the source materials	Omitted topics or included topics that did not match the course.	Manually add missing topics and/or edit subjects to align with subject matter
Material comprehension	Develop infographics or summarize material or act as tutor for unfamiliar material	Review and study the material until it is understood sufficiently to be taught	Inaccurate information or images in infographics	Review contradictory materials when presented and revise them or prompt with the provided source materials
Technical diagrams and circuits	Develop drawings for inclusion in projects	Review all and prototype when possible	Technically inaccurate schematics and visuals; repeated prompting sometimes reduced drawing accuracy	Manually revise or replace inaccurate drawings and verify technical accuracy
Prompt revision	Ask GenAI to improve the prompt or suggest changes to make the prompt more complete	Review all outcomes and continue to revise until correct	Sometimes continued revision did not result in accurate prompting	Restart with a fresh prompt, break the task into smaller components, work with individual components, and reconstruct the final product
Lab project development	Develop the first draft	Revise the draft and prototype all projects	Simplistic projects or overly complex projects that did not lend themselves to student construction	Revise the project and verify all processes for accurate application
Lab prototyping	Step-by-step assistant for project construction	Develop project and test all assumptions	None in relation to GenAI	Adjust projects until they are achievable for students
Review questions development	Review the presentations and labs and develop review questions for the end of the labs and for classroom reviews	Present materials and provide context for the materials; explain what students need to understand	GenAI occasionally focused on the least important parts of the lesson	Review all materials and remove irrelevant parts
Test bank development	Review all relevant materials and develop a test bank	Remove irrelevant parts and develop tests based on what remains	GenAI-generated questions sometimes focused on minutiae rather than the course objectives	Manually remove irrelevant material from the bank

WHY ATTEND
THE ATEC ANNUAL CONFERENCE?

Where aviation maintenance education and industry align to strengthen the workforce pipeline.

The ATEC Annual Conference brings together educators, industry leaders, and workforce partners to address the issues shaping the future of aviation maintenance. Sessions focus on workforce development, FAA updates, emerging technologies, and industry collaboration.

At a Glance

- Nearly 300 attendees from education, industry, and government
- 60+ speakers from FAA, NASA, industry, and education
- 30+ exhibitors showcasing workforce, training, and technology solutions
- National representation from schools, airlines, OEMs, MROs, and workforce organizations

Who Should Attend

Educators (Part 147 Schools, High Schools, Colleges)

Practical insights and connection to strengthen programs and support student success.

- FAA updates and regulatory insights
- Industry-informed curriculum strategies
- Student success and workforce readiness
- Employer and training partner connections
- Perkins-eligible professional development opportunities

Workforce & Policy Partners (Associations, Government, Nonprofits)

Collaborate across education, industry, and government to strengthen workforce initiatives.

- Engage with education and industry leaders
- Contribute to workforce development discussions
- Stay informed on regulatory and program updates
- Support initiatives that strengthen the technician pipeline

Industry (Airlines, Repair Stations, OEMs, Labor Organizations)

Connect with education partners and help shape the future workforce.

- Connect with training programs and emerging talent
- Help shape the future workforce
- Gain insight into education and workforce trends
- Build partnerships with schools and training providers

Why It Matters

As demand for aviation maintenance technicians grows, collaboration between education and industry is more important than ever. ATEC brings those stakeholders together to strengthen the workforce pipeline.

Register Now

Exhibitor and sponsorship opportunities are also available



ATEC Membership:

Your Seat at the Table — and a Voice in the Future

As an ATEC member, you don't just observe the future of technical workforce development — you help shape it. Membership ensures your program is represented, resourced, and positioned to thrive in a rapidly evolving aviation industry.

Representation: Your Voice. Your Influence.

ATEC protects and advances your interests at the regulatory and legislative levels, so you can focus on educating the next generation.

Our coalition helped drive the successful implementation of the industry-drafted new Part 147 — a major reform designed to give programs greater flexibility and relevance. When policy decisions affect your classrooms, ATEC ensures your voice is heard and your needs are prioritized.

Awareness: Stronger Student Pipelines

Through Choose Aerospace — developed in partnership with ATEC — your program gains access to a nationally recognized aviation maintenance curriculum used across the country to inspire students and grow enrollment.

You'll have tools to build new recruitment pipelines while industry partners strengthen local workforce networks to support your hiring outcomes.

Information: Stay Ahead of Change

ATEC keeps you informed so you can lead with confidence. Members receive:

- Monthly council newsletters
- The ATEC Journal (peer-reviewed teaching research and techniques)
- The annual Pipeline Report on aviation workforce trend
- Full access to the ATEC Library of resources

Access: A Powerful Professional Network

The Member Directory connects you to leaders across all FAA-certificated A&P schools. More than a contact list, it's a gateway to mentorship, collaboration, benchmarking, and problem-solving.

Resources: Practical Tools for Everyday Challenges

From webinars and compliance templates to direct access to executive leadership and peer expertise, ATEC equips you to manage Part 147 requirements and operational demands with confidence.

Have a regulatory question? We help you navigate it. Looking for proven solutions? "A Member Asked" connects you to real-world answers.

Recognition: Celebrate Excellence

ATEC celebrates excellence in aviation technician education through the prestigious Ivan D. Livi and James Rardon Awards. In addition, members can compete for professional development awards that support advanced training, instructional equipment, and seminar participation—helping programs and educators continue to grow and innovate.

Scholarships: Financial Support for Your Community

ATEC member students are eligible for Choose Aerospace scholarships.

Affinity Programs: Member-Only Savings

Through trusted partners, members receive discounts on products and services that support aviation technician education.

ATEC Academy: Develop Stronger Educators

The 10-week ATEC Academy equips instructors with practical, modern teaching strategies — from active learning and behavior management to assessment techniques and technology integration.

Members receive discounted registration and access to master educators within the ATEC community.

Events & Networking: Relationships that Move Careers Forward

Members receive discounted registration to the Annual Conference and Washington Fly-In, plus free regional outreach meetings.

The Bottom Line

ATEC membership isn't just about staying informed — it's about staying competitive, connected, and influential in aviation technician education.

You gain advocacy, resources, partnerships, visibility, and tools that strengthen your program today while shaping tomorrow's workforce.

Become a member at atec-amt.org/join

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