

The ATEC JOURNAL

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THE CASE FOR
MODERNIZING THE
MECHANIC AIRMAN
CERTIFICATION
STANDARDS

TRAINING AIDS
ON A BUDGET





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 Spring 2026 edition of the Journal features two timely, relevant, and practical articles.

Rhonda Cooper examines the gaps between the current ACS and what is required of today's entry-level mechanics. She outlines a data-informed approach to modernize the ACS, making the ACS a better reflection of modern aviation maintenance.

James Barker discusses a unique approach to building budget-friendly maintenance trainers. While attaining high levels of realism in training usually comes at a high cost, he describes the design of a trainer that is realistic, functional, and inexpensive.

One of my old professors often said that we are standing on the shoulders of giants. He usually said this in the context of publications, implying that we build on other people's findings, research, and experience. I want to continue to encourage the ATEC community to share your expertise, research, best practices, and opinions by contributing articles to the Journal. As editor, my goal is to ensure the peer review process is collegial and constructive.

I want to thank our authors for their valuable contributions to the Journal. I also want to thank the Editorial Board for their continued dedication and effort.

Daniel Siao

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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 and current participants is available at www.atec-amt.org/committees.

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.

LEGISLATIVE COMMITTEE

The Legislative Committee remains actively engaged with congressional offices, federal agencies, and industry stakeholders on key workforce and regulatory priorities impacting aviation maintenance education. ATEC continued advocacy efforts surrounding FAA workforce-development funding, emphasizing the importance of sustained investment in aviation maintenance technician pipeline programs.

In preparation for the upcoming Fly-in, the committee refined its advocacy priorities and pursuing high-level agency officials to address attendees this Fall. We will begin coordinating congressional hill meeting in August, so register soon to ensure we can coordinate appropriate delegations to engage directly with federal lawmakers.

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

To register for the ATEC Washington Fly-in, scheduled for Sept. 22-25, visit www.atec-amt.org/events/2026-fly-in.



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ANNUAL CONFERENCE COMMITTEE

The 2026 ATEC Annual Conference in Portland was a tremendous success, bringing together aviation maintenance educators, industry leaders, regulators, and workforce-development partners from across the country. Hosted by the Alaska Airlines Group and Portland Community College, the event featured four days of collaboration, professional development, and networking focused on the future of aviation technical education.

Planning is already underway for the 2027 Annual Conference, with committee members evaluating attendee feedback and identifying opportunities to expand engagement with industry partners, exhibitors, and first-time attendees. Watch for the call for presentations to come out this summer, and registration to open in October. In the meantime, mark your calendars for April 4-7.

For more information about the upcoming conference, visit www.atec-amt.org/events/2027-annual-conference.



JIM HALL
MEETING PLANNING CHAIR
 Vice President, Aviation and Workforce Development,
 WSU Tech

REGULATORY COMMITTEE

The Regulatory Committee continues to support working group efforts to modernize the Mechanic Airman Certification Standards (ACS) and related FAA guidance materials. Representatives from across the country participated in collaborative working sessions to review proposed revisions and identify opportunities to better align certification standards with current industry practices. This ongoing work has included coordination with FAA representatives and industry stakeholders.

In addition to ACS-related initiatives, the committee continued discussions with FAA testing representatives and PSI Services regarding testing accessibility and consistency. Members also provided support and guidance to schools pursuing Organization Designation Authorization (ODA) privileges and advocated for increased flexibility within the mechanic testing and certification process.

The committee remains engaged in broader workforce initiatives, including efforts to streamline pathways for military-trained maintainers and encourage earlier participation in the testing process for mechanic applicants.

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



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CHOOSE AEROSPACE

Choose Aerospace has continued to expand its national footprint and strengthen the aviation maintenance talent pipeline. Student participation and school engagement continued to grow, with 1237 students enrolled in the Choose Aerospace general aviation maintenance curriculum this academic year.

Momentum surrounding the ATEC General Aviation Maintenance Credential remains strong, with additional students earning the credential and increased employer recognition of its value as an entry-level workforce indicator. The organization also continues to expand matriculation opportunities into FAA-certificated part 147 aviation maintenance technician schools, helping students transition more seamlessly from secondary aviation programs into post-secondary technical training.

The Choose Aerospace SkillPointe Scholarship Fund saw its inaugural year, distributing \$50,000 in scholarships to A&P students. We also received national recognition of the program in March, Choose Aerospace was named a 2026 Aviation Week Grant Laureates Award Winner in the MRO category.

Choose Aerospace is now accepting applications for the 2026-27 academic year, and actively seeking industry donors to support growth and scaling of the program. For more information, visit www.chooseaerospace.org/.



KELLY FILGO

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DIRECTOR OF OPERATIONS**

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ATEC ACADEMY

Over the last six months, the Academy completed another successful cohort while welcoming additional participants from colleges, technical centers, and aviation training organizations nationwide. Since the program's launch, participation has continued to increase as schools seek additional resources to support instructor recruitment, retention, and classroom effectiveness.

The Academy's blended-learning format continues to receive strong feedback from participants, combining in-person instruction with several weeks of guided virtual coursework. Topics include active learning strategies, lesson planning, student engagement, assessment methods, classroom management, and effective delivery of hands-on lab instruction.

Committee leaders also continued evaluating opportunities to expand Academy offerings and develop additional training resources tailored to aviation maintenance educators and program administrators. Upcoming cohorts planned for later this year are expected to continue supporting the growing demand for qualified instructors throughout the aviation maintenance education community.

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



MIKE SASSO

ATEC ACADEMY CHAIR

Airframe & Powerplant Chief,
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The Case for Modernizing the Mechanic Airman Certification Standards

RHONDA COOPER

Rhonda Cooper is an instructional systems designer and certificated Aviation Maintenance Technician with more than twenty years of experience in aviation maintenance training, curriculum development, and competency based instructional design across higher education and industry. Her background includes national level service leading ATEC's AMT ACS Working Group in the modernization of the Mechanic Airman Certification Standards, as well as prior leadership as Chair of Airlines for America's Maintenance Training Network and lead writer for the revision of ATA Specification 104.

Cooper's experience spans instructional systems design roles at The Boeing Company, curriculum and assessment development for FAA approved AMT programs, and technical editing and publication work supporting aviation maintenance education. She holds a Master of Arts in Education (Curriculum & Instruction), a Bachelor of Science in Business Administration, FAA Airframe and Powerplant certificates, and additional credentials in technical writing and instructional practice.

ABSTRACT

The FAA's Mechanic Airman Certification Standards (ACS) brought knowledge, risk management, and skill expectations together for the first time. As a living document, the ACS is intended to undergo regular reviews. That time is now: Industry demand, workforce data, and the rapid evolution of aircraft systems have created a clear gap between the current ACS structure and the competencies required of today's entry level mechanics. This article examines those gaps and outlines a data informed approach to modernizing the ACS around measurable competencies. The goal is to support more reliable assessment, clearer instructional alignment, and improved workforce readiness. While any future changes would follow the Federal Aviation Administration's (FAA) rulemaking and public comment process, this work provides a foundation for that discussion by identifying where the ACS can better reflect the demands of contemporary aviation maintenance.

The Aviation Technician Education Council (ATEC) is currently facilitating a working group to recommend updates to the FAA's Mechanic Airman Certification Standards. The proposed revision modernizes Aviation Maintenance Technician (AMT) training and assessment by shifting from topic-based lists to a competency-anchored, cognitively aligned framework that improves instructional clarity, assessment reliability, and alignment with real-world maintenance practices. This revision is needed as industry demand, workforce data, and the rapid evolution of aircraft systems have created a clear gap between the current ACS structure and the competencies required of today's entry level mechanics (ATEC, 2024; ATEC, 2025; Boeing Commercial Airplanes, 2025; U.S. GAO, 2020; U.S. GAO, 2023).

The Challenge

The current FAA Mechanic ACS brought knowledge, risks, and skill expectations into a single document for the first time (FAA, 2022). The ACS is designed to be a living document—allowing for regular review to stay current with industry advancements. This proposed revision is the product of this initial review process and is grounded in data, guidance, and expertise.

Research from national aviation workforce studies, federal task force reports, and industry analyses document gaps in entry-level mechanical readiness, declining informal technical experience, and the need for clearer, measurable competency expectations (ATEC, 2024; ATEC, 2025; U.S. GAO, 2020; U.S. GAO, 2023). These findings consistently point to the importance of defining observable, measurable standards for certification.

The Working Group also reviewed Phase One findings from an unpublished Clemson University study (Clemson University, n.d.). That phase examined the current state of aviation maintenance curriculum and workforce requirements and evaluated the existing ACS to identify gaps between the

standards and the competencies required of aviation maintenance professionals. The findings still offered useful insight into areas where the ACS may lack clarity or alignment with industry expectations.

Beyond formal research, the Working Group gathered qualitative data from industry representatives through Airlines for America's Maintenance Training Network (Airlines for America, n.d.), as well as from Subject Matter Experts (SMEs) with decades of experience in aviation maintenance, instruction, and certification. Their observations and professional judgment have been essential in identifying the competencies required of an entry-level mechanic and in validating the structure and content of the proposed revisions.

These combined data sources—research literature, academic study findings, industry feedback, and SME expertise—have informed the organization, terminology, and performance expectations in the proposed ACS (see Airlines for America, n.d.; ATEC, 2024; ATEC, 2025; Clemson University, n.d.).

With a review of every knowledge, risk management, and skill element within all subjects, the following structural and cognitive limitations were identified:

- Lack of cognitive clarity. Knowledge, risk, and skill elements are listed without a consistent cognitive framework, making it difficult for end users to map instructional content to the ACS.
- Duplication across subjects and certificates. Repeated or overlapping elements appear in multiple subject areas, complicating curriculum design and leading to redundant evaluation during testing.
- Loss of teaching and performance levels. The removal of explicit performance levels makes determining the expected depth and breadth of knowledge and skill difficult, which requires instructors to independently determine cognitive rigor and search handbooks for appropriate coverage.
- Inconsistent use of Bloom's taxonomy. Many elements rely on topic lists rather than measurable learning outcomes, leaving content interpretation open to individual judgment and contributing to inconsistent training.
- Uneven risk management structure. Risk management

statements vary widely in phrasing and specificity, making it difficult to determine which hazards, decisions, or mitigations are essential for assessment.

- Skills not anchored to supporting knowledge. Many skill tasks lack associated knowledge learning objectives, forcing instructors to infer prerequisite understanding from experience or external sources.
- Inconsistent or unclear skill phrasing. Variability in task wording can lead to uneven interpretation by Designated Mechanic Examiners (DMEs), potentially contributing to inconsistent certification outcomes.
- Industry demands demonstrable competencies. Employers consistently emphasize the need for entry-level AMTs who can perform foundational maintenance tasks—not simply recall information—highlighting the need for a performance based standard.

How the Working Group Approached the Proposed Revision

The guiding question throughout the revision process was: What must an entry-level AMT know and be able to do within the first year on the job? To support 14 CFR Part 65 Subpart D, every knowledge, risk management, and skill element was reviewed through this lens to propose a comprehensive revision:

- Removing duplication. Redundant elements were removed, and similar or related items were consolidated. Clarifying language was added to define scope and reduce ambiguity.
- Applying pedagogy ordering. Although the ACS is not a curriculum, it is used to confirm curriculum alignment. Subjects and elements were reorganized into a logical learning sequence, and subtopic headings were added for clarity. Foundational knowledge was moved to the appropriate General subjects.
- Aligning ACS subjects with the Air Transport Association (ATA) Standard Numbering System structure (Air Transport Association of America, 2024). Airframe and Powerplant subjects were reorganized and, where appropriate, renamed to align with ATA chapter numbers.
- Integrating Bloom's taxonomy. Each knowledge element now includes a specific cognitive verb aligned

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with the associated skill task. This supports measurable outcomes and helps instructors calibrate instructional depth.

- Ensuring audit-defensible alignment. A comprehensive gap analysis confirmed that each skill element is supported by corresponding knowledge and risk elements, creating a coherent, scaffolded, and aligned performance standards.
- Adding subject-level competencies. Generic introductory statements were replaced with explicit competencies that describe what the applicant must be able to do in real-world maintenance contexts.
- Introducing Competency Domains for Aircraft Mechanics. These domains describe the professional behaviors expected of certificated mechanics. They are not test items but provide applicants and evaluators with a shared understanding of expected performance.

Bloom's Taxonomy: Bringing Cognitive Consistency and Clarity to the ACS

The transition to the ACS structure inadvertently removed the performance levels that once guided instructional depth. As a result, cognitive rigor became inconsistent across subjects.

The revision restores that clarity by embedding Bloom's taxonomy directly into each knowledge element. For example, troubleshooting requires the applicant to:

- understand system operation
- analyze discrepancies
- evaluate test results
- apply corrective actions

These verbs help instructors design training, develop rubrics, and maintain consistency across faculty. They also align AMT education with broader higher education standards and support measurable, defensible assessment.

The Shift to Competencies: What Changed and Why It Matters

The revised ACS includes two levels of competencies: subject level competencies and overarching Competency

Domains for Aircraft Mechanics.

Subject-Level Competencies define what an entry-level AMT must be able to do—not just what they must know and supported by the knowledge learning objective elements, risk management elements, and skill task elements. They are foundational and remain relevant even as technology evolves.

These competencies support performance based assessment, reduce ambiguity, and help programs design modular, stackable learning experiences. Examples include:

- **General – Inspection and Troubleshooting Concepts and Techniques**

Apply systematic troubleshooting principles by isolating faults, interpreting data, verifying discrepancies, and confirming corrective action while managing human factors.

- **Airframe – Water and Waste Systems**

Identify system components, explain operating principles, and apply inspection and regulatory requirements to ensure sanitation and continued airworthiness.

- **Powerplant – Propellers**

Inspect and maintain propeller systems, components, and operational characteristics.

Competency Domains for Aircraft Mechanics describe the professional behaviors expected of certificated mechanics. They align with the International Civil Aviation Organization's (ICAO) competency framework and support the FAA's long term movement toward competency based training and assessment (ICAO, 2021).

Practical Benefits for End Users

The proposed revision was written with end users in mind—because the working group members are end users themselves. The revision provides clear benefits for each stakeholder group:

- For instructors: The ACS, when used as a shared reference, can help instructor calibration and consistency by aligning expectations across faculty, reduce variation in grading and feedback, and providing consistent messaging to learners.

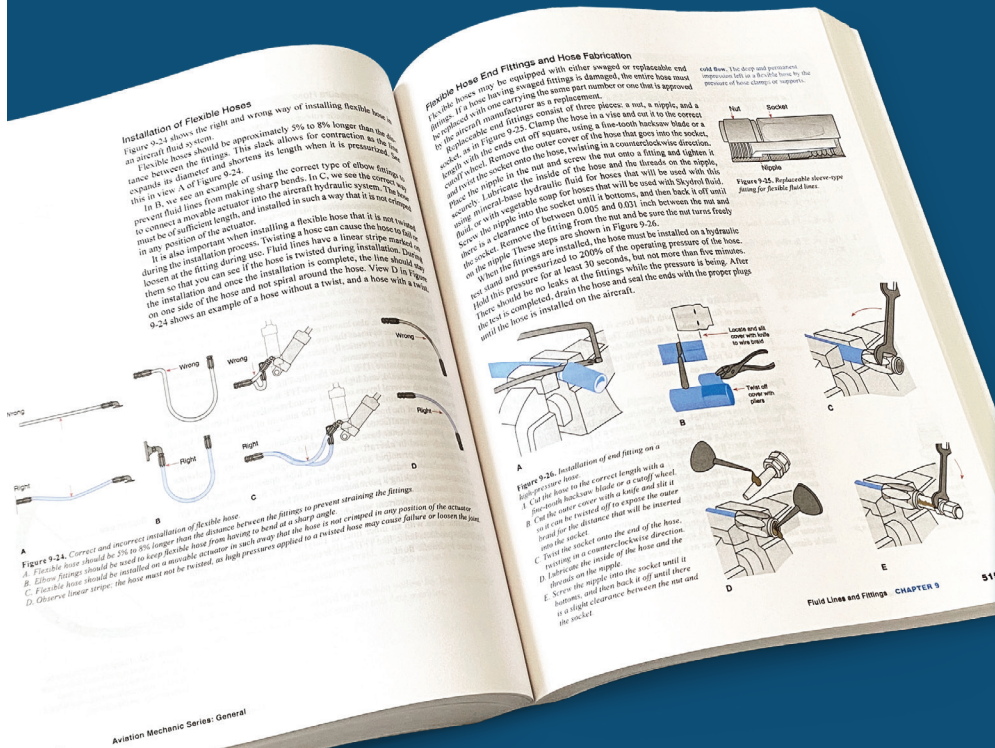
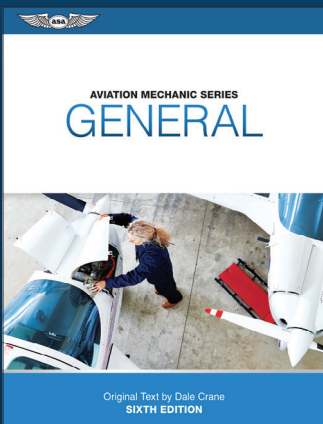
The ACS is intentionally scaffolded to support pro-



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gressive learning. Knowledge elements provide clear learning objectives, risk elements integrate judgment and safety, and skill elements define observable performance. Together they support:

- clearer curriculum mapping
 - more consistent assessment design
 - reduced ambiguity in defining “entry-level”
- For applicants: The ACS provides transparent expectations and a clearer understanding of the professional behaviors expected in real-world maintenance environments.
 - For DMEs: The revised structure clarifies the intent of each skill task, supports consistent evaluation, and reduces subjectivity. Competency Domains help examiners evaluate applicants holistically—knowledge, skill, and judgment.
 - For employers: The ACS helps employers align hiring and onboarding with certification level competence. Graduates enter the workforce with clearer, more measurable foundational competencies.

Conclusion: A More Coherent, Competency Aligned Future for AMT Education

The proposed revision is evolutionary, not revolutionary. It strengthens instructional quality, improves assessment reliability, and positions AMT education to adapt to emerging technologies. It provides a durable, measurable framework that supports both certification and workforce readiness.

The revision process has been transparent, data informed, and grounded in the central question of 14 CFR Part 65 Subpart D: What must the entry-level mechanic know and do? Through structured SME input, research review, and iterative analysis, the proposed ACS offers clearer expectations, more consistent structure, and a stronger foundation for the next generation of aviation maintenance professionals.

As with any change to certification standards, the proposed revisions would undergo the FAA’s established rulemaking and public comment process, ensuring transparency and ample time for schools and industry to prepare.

To review the full ACS revision proposal and Companion Guide visit the ATEC website.

References

- Air Transport Association of America. (2024). ATA standard numbering system (iSpec 2200, Revision 2024.1). Airlines for America.
- Aviation Technician Education Council. (2024). 2024 pipeline report. ATEC & Oliver Wyman. https://assets.noviams.com/novi-file-uploads/atec/atec_pipereport24_042624_v3w__1_-e893db0d.pdf
- Aviation Technician Education Council. (2025). 2025 pipeline report. ATEC & Oliver Wyman. https://assets.noviams.com/novi-file-uploads/atec/Pipeline_Report_11_07_25.pdf
- Aviation Technician Education Council. (2025). The 2025 Boeing Technician Outlook: A Closer Look - Aviation Technician Education Council. ATEC. <https://www.atec-amt.org/news/the-2025-boeing-technician-outlook-a-closer-look>
- Airlines for America. (n.d.). Maintenance Training Network industry feedback (Internal qualitative data).
- Boeing Commercial Airplanes. (2025). Pilot and technician outlook 2025–2044. <https://www.boeing.com/commercial/market/pilot-technician-outlook/>
- Clemson University. (n.d.). Phase one findings: Aviation maintenance curriculum and workforce requirements gap analysis [Unpublished study summary].
- Federal Aviation Administration. (2021). Aviation mechanic general, airframe, and powerplant airman certification standards (FAA S ACS 1). https://www.faa.gov/training_testing/testing/acs/Aviation_Mechanic_Certification_Standards.pdf
- Federal Aviation Administration. (2022). Companion guide to the aviation mechanic general, airframe, and powerplant airman certification standards (FAA G ACS 1). https://www.faa.gov/sites/faa.gov/files/training_testing/testing/acs/amt_acs_companion_guide.pdf
- Federal Aviation Administration. (2024). Aviation workforce development grants—Maintenance technical workers. https://www.faa.gov/about/office_org/headquarters_offices/ang/grants/awd/technical
- International Civil Aviation Organization. (2021). Manual on competency based training and assessment for aircraft maintenance personnel (Doc 10098, 1st ed.).
- Moore, J. (2025, July 22). Boeing Trims Pilot Demand Forecast Slightly. Aircraft Owners and Pilots Association. <https://www.aopa.org/news-and-media/all-news/2025/july/22/boeing-trims-pilot-demand-forecast-slightly>
- U.S. Government Accountability Office. (2020). Aviation maintenance: Additional coordination and data could advance FAA efforts to promote a robust, diverse workforce (GAO 20 206). <https://www.gao.gov/products/gao-20-206>
- U.S. Government Accountability Office. (2023). Aviation workforce: Supply of airline pilots and aircraft mechanics (GAO 23 106769). <https://www.gao.gov/products/gao-23-106769>



Training Aids on a Budget

JAMES BARKER

James Barker is an assistant professor of aviation at Southern Illinois University Carbondale. Originally an auto and heavy machinery mechanic, James expanded to aviation in 2017. He holds both a bachelor's and master's degree in the field of aviation as well as airframe and powerplant certifications. Specializations were obtained in both the areas of Avionics and Advanced propulsion. The owner of an automotive restoration shop and faculty advisor of two separate aircraft maintenance RSOs, Mr. Barker is interested in all things maintenance.

ABSTRACT

Aircraft maintenance technicians can be trained using a variety of different approaches, each with their own advantages and disadvantages. Training students how to work on instruments for the first time while utilizing a real aircraft provides an immersive experience but can prove expensive and difficult to maintain. Training boards offer a simpler approach to instruction but may lack the realism needed to prepare students for real world experiences.

My solution was to create a trainer that takes the best of both worlds while mitigating the disadvantages. Utilizing a retired Frasca flight simulator as a foundation, the simulator was gutted then retrofitted with a working pitot-static instrument system. The alterations were completed in one twentieth of the time quoted to obtain a pre-built instrument system training board from a supplier. The cost to convert the Frasca was sixteen times less than purchasing the pre-built unit. Beyond the cost and time savings, the Frasca blends elements of a training board with elements of a real aircraft. The Frasca is small and portable, which is like a training aid. It is easily stored in a corner when not in use and features a realistic looking cockpit. This forces students to navigate objects like the yoke, seat, and throttle while interacting with the instrument panel, much like a real aircraft. However, the nose of the Frasca can be opened by the instructor to view the backside of the instrument panel. This allows the instructor to inspect students' work without crawling underneath the panel. It also offers the unique opportunity to show students a different view of the system and easily allows for tracing of connections and component locations similar to a training board. The Frasca trainer is also less expensive to maintain and provides ample opportunities to expand its use.

Training Aids on a Budget

Aircraft and their many components are bound by regulations, certifications, tests, and inspections. While necessary to ensure high quality and reliability, a byproduct is high cost (Rossini, 2021). Cost is an issue that I battle daily within a Part 147 maintenance facility. With rising costs outpacing budget, it has become difficult to purchase aircraft for training and the parts and equipment necessary to maintain them. Faced with issues like this, some turn to alternatives such as training boards to save space, money, avoid down time, and eliminate the need to store aircraft support equipment. A 2025 case study conducted in Korea on university aircraft maintenance students echoed many of the same key advantages to using training aids in certain scenarios instead of real aircraft (Lee & Yoon, 2025). Although training boards may be less expensive than aircraft, they are still quite expensive. Additionally, training boards are often assembled in a way that best shows system flow, similar to a system schematic. Therefore, they are best at teaching the theory of operation but lack the ability to fully replicate maintenance conditions such as working in tight spots or around systems that are unrelated to your current task. I have created a cost-effective alternative that is less expensive than premanufactured training boards, while still offering many of the benefits of real aircraft and training boards.

While having a complete aircraft can be beneficial, it is not always the best option depending on the material being taught and the skill level of the students. For example, a class is assigned to remove and reinstall an altimeter before performing a pitot-static pressure test. Other than lecturing over the topic, these students have not worked on an instrument system before. They are given a small reciprocating engine aircraft with analog instrumentation to accomplish this task. What issues could arise from this project? First, students must navigate the numerous systems that are present but not associated with the task at hand. This can lead to confusion as they try to identify the correct connections among a sea of wiring and cables. This is often performed while having to lie upside down beneath the instrument panel. Second, they must also navigate the interior of the aircraft with seats, control systems, and other interior panels. In my experience as an instructor, both examples can and have caused a lot of damage. While using a real aircraft creates the most realistic environment for the project, it also creates wear and tear. Additionally, it becomes more difficult for an instructor to verify a student's work, an almost impossible task when required to supervise several groups simultaneously. Climbing under the instrument panel of an aircraft to inspect the work of dozens of students can also be physically challenging.

The Solution

A specially constructed trainer that is tailored to specific tasks could serve as an intermediate training tool. Instead of going directly from classroom discussion to real aircraft, students are first introduced to the trainers. The trainers would bridge the gap between theory-based training boards and actual hands-on application.

Where do we obtain trainers?

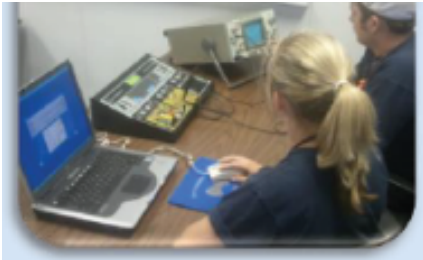
Although a few companies exist that specialize in building training aids for aviation maintenance schools, they have three major problems: They are expensive, they are built to order, and they often lack practical application. Aviation maintenance training aids traditionally come in the form of a board or stand with aircraft components bolted to them to create a three-dimensional schematic. While these are efficient at teaching theory and operation (mental application), they are limited in their ability to replicate the experience of working on a real aircraft (physical application). They can perform maintenance on a system mounted to a board, but this does not accurately reflect the accessibility issues, physical positioning of components, and visibility restrictions associated with a real aircraft. The other issue is that built-to-order trainers typically experience a significant delay between ordering and receiving the products. When I reached out to a premier aircraft training system manufacturer in March of 2026, their wait time was 10-12 months, which was a decrease from the 12-14-month estimate given in March of 2025. While both aircraft and training boards have its benefits and drawbacks, building a trainer that combines the two captures the benefits of both.

After being offered a pair of forty-year-old flight simulators headed for recycling, the decision was made to convert them into multiuse maintenance trainers. These flight simulators would be converted to include functioning pitot-static instrumentation for students to perform instrument removal and installation, as well as all related testing. Although I acquired two identical flight simulators to convert, I decided to start by modifying one and leaving the other intact. This allowed me to use the intact simulator as a reference in case I needed to reinstall anything that was removed during the build process. The instrument system trainer that resulted was not only inexpensive, compact, and had a short production time, but it blended both mental and physical training principles.



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I started with a retired Frasca 141 flight simulator as a building platform (see Figure 1).

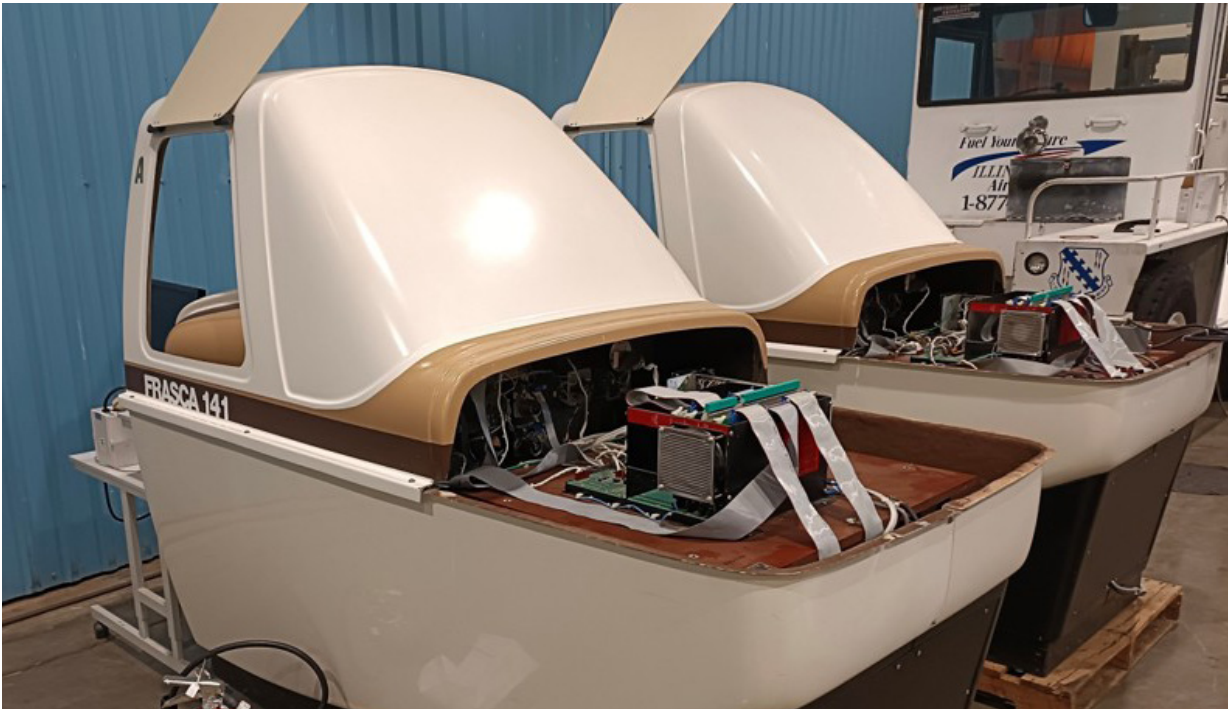


Figure 1
Intact Frasca 141 trainers

To clear up some space, I then removed the computer equipment, desk, and associated wiring from the machine (see Figure 2).



Figure 2
Frasca 141 operating equipment and power supply



Figure 3
Frasca 141 instrument panel

The Frasca 141 features a traditional analog instrument layout with standard instrument sizing (see Figure 3).

The computer-controlled instruments were originally airworthy instruments that were gutted by Frasca and outfitted with servo motors to move the instrument's needles. This made it extremely easy to retrofit the simulator with real pitot-static instrumentation (see Figure 4).

It was as easy as removing the 4 mounting screws, unplugging them, and replacing them with their real counterparts. All non-pitot static instrumentation was left in place at this time. Originally designed to train pilots for IFR flights, the cockpit was blacked out with fiberglass covering the cockpit where windows

Figure 4
Pitot-static instruments installed and plumbed



would be, but the coverings in the cockpit were removed to achieve greater realism and better natural lighting (see Figure 5).



Figure 5.
Frasca 141 trainers with window openings

Caster wheels were bolted to the trainer’s wooden base, making it mobile. Casters were chosen with the ability to lock the wheels on all four corners to ensure the trainer is stable and stationary during use. Once this was complete, attention turned back to the pitot-static instrumentation. A simple pitot tube and static port were installed on the left side of the trainer (see Figure 6).

With the lines connected, the trainer now had a working pitot-static instrument system. A traditional pitot-static test set can be hooked up to the trainer just like it would on an actual aircraft.

However, the trainer offers a distinct advantage in that the front fiberglass nose cover can be removed to view the backside of the instrument panel, as shown in the previous Figures. This allows students to see how the plumbing is connected to the instruments in a way not possible on most aircraft. It also offers the ability for instructors to verify the proper installation of components following student work on the trainer. Students still have to enter the cockpit and crawl beneath the instrument panel to remove instruments just like a real aircraft. [A1.1]The trainer still has throttles, rudder pedals, a yoke, and a seat to navigate around,



Figure 6
Frasca pitot tube and static port installation

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mimicking a real aircraft. The result is a trainer that takes up less space than an actual aircraft, can be tested in the same manner as an actual aircraft, and its instrument system can be viewed from both the front and the back when necessary. This means the trainer can serve the same function as a traditional training board while also offering a maintenance experience that better simulates real world conditions.

I also used this opportunity to incorporate my interest in 3D printing. For fun, I replicated an existing static port using Fusion 360 CAD software and printed a functional part out of ABS plastic. Other than the 3D printed static port, the rest of the pitot-static system used approved components.

What did it cost?

The total cost for the construction of this trainer was less than \$1,500. This included the purchase of magnetic compass, vertical speed indicator, altimeter, airspeed indicator, lines, fittings, and pitot tube. Taking the electrical cabling, computer components, and associated metal to the recyclers earned enough money to purchase the caster wheels for the trainer as well as the remaining miscellaneous hardware and consumables. This was built far faster and for much less than a prebuilt unit, which has a lead time of 10-12 months and over \$20,000 plus shipping. However, there are several advantages to the pre-built trainer: It features more instruments, it is of higher build quality, and it takes up less space. This trainer is shown in Figure 7 for reference.

How long did it take?

This Frasca 141 trainer was converted from stock configuration to functioning trainer in less than ten hours of labor, but the work was spread out over a few months. The first two hours were spent removing the cabling, old power supply, and computer equipment connected to the trainer. The third hour was spent jacking the trainer into the air and attaching caster wheels to the base. The next hour and a half were spent cutting out the fiberglass openings for the windshield and two side windows. The sixth hour was spent removing the old instrumentation and bolting in replacements. Hours seven and eight were used to plumb the pitot-static instruments and install the pitot tube and static port. The last two hours were spent installing a magnetic compass, testing the system for operation, and removing any sharp edges from the window openings. No special tools or equipment were needed to complete the conversion. Simple hand tools, a saw for the windows, and a drill were utilized.

When I convert the second Frasca simulator, the time required is expected to drop substantially. Learning how to remove the old equipment from the trainer and identifying what parts I needed to order took up a substantial amount of time

Additional Uses for the Trainer

The installation of a pitot-static system was just the first step of many. My goal is to continue adding additional systems to the trainer to create an even more efficient use of space, time, and money. For example, I

Figure 7
Prebuilt instrument trainer





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intend to install a 24-volt battery in the empty space in the nose of the trainer, as well as a standard ground power plug. The fake avionics would then be replaced with functional equipment and powered by the battery. The trainer could then be used for a wide range of projects involving aircraft power. Furthermore, I intend to install plexiglass windows into the trainer to cover the window cutouts made earlier. This would allow the trainer to be used for activities such as window polishing and cleaning. The installation of the magnetic compass and caster wheels earlier allows for complete basic compass swings. The installation of drilled head bolts in various locations throughout the trainer could also allow it to be used for safety wire and cable training. An electric vacuum pump powered by the same battery could be used to drive a set of vacuum instruments as well. The possibilities are vast, making this project one that will continuously evolve over time.

Beyond expanding the number of maintenance tasks accomplished using this trainer, I am also interested in expanding its audience. With some modifications, I am hopeful that the Frasca can be made to accommodate a wheelchair with the pilot's seat removed. This could allow students with disabilities the opportunity to engage in maintenance tasks that otherwise would not be available to them using traditional aircraft.

What about repair and maintenance?

As previously mentioned, one of the major disadvantages of using a real aircraft is the cost of maintenance. If someone breaks a part that is specific to that aircraft, it can be difficult to replace. This is especially true if the part is rare or even discontinued. When training to become a mechanic, students must go through the trial-and-error process of learning how it feels when a fitting or bolt is cross threaded or how to work in tight areas with limited access. Students learn from their mistakes, which usually results in the occasional damaged parts.

This trainer was built using inexpensive and readily available components. All efforts were made to use standard or generic components and to avoid using anything specialized. This eliminates the need to track down hard-to-find or costly replacement parts, as is often the case with real aircraft. During the construction of the trainer, all components were documented, including part numbers and vendors. If a student damages a component during training, a replacement can be ordered from that list. If a student damages a component specific to the Frasca trainer itself, several options are available. One such option is to substitute with a similar component. The benefit of the Frasca is that it does not replicate a specific aircraft. Therefore, it is easier to modify and swap out components to retain function. Another option is to obtain parts directly from Frasca. Despite being nearly forty years old, the Frasca trainer is still supported by the manufacturer, which maintains a customer service line and limited inventory for replacement parts. A third option is to fabricate components. With the use of an inexpensive 3D printer, replicating knobs, handles, and trim pieces becomes an achievable task for the novice fabricator.

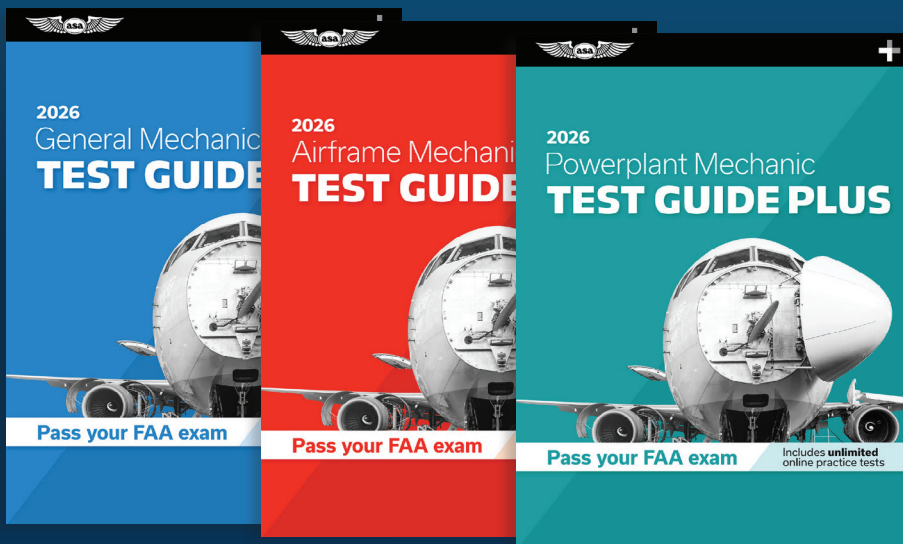
What about the cost of the trainer?

These trainers were acquired at no cost because they were going to be scrapped. I wanted to account for that, since others in most cases will have the additional cost of purchasing the trainer. A search online showed that prices ranged from free to as high as \$3,100. These trainers have served their purpose, and most of the owners are auctioning them off or giving them away to make room for newer and more advanced equipment. Although it does take more effort to locate similar Frasca 141 trainers than it does to hit the purchase button on a website, the cost savings are significant.



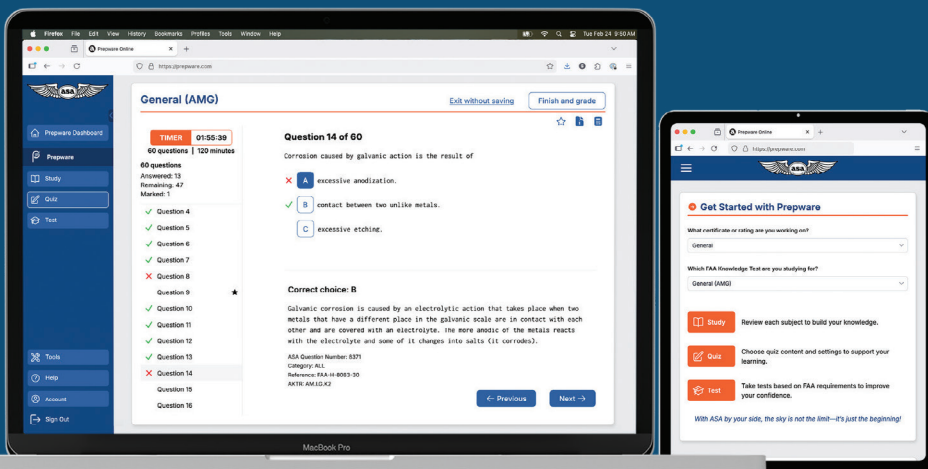
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Further research potential

Further research will be conducted. A pool of students will be assigned to either the converted Frasca 141, a traditional aircraft, or the previously mentioned prebuilt instrument trainer. All three groups will be carefully observed, and metrics such as quality of work, student learning outcomes, and issues encountered will be documented and compared. This research will study the assumptions made in this paper regarding the advantages of the converted Frasca 141.

Documentation

Another consideration is the use of aircraft maintenance manuals. Since this trainer is homemade, no official publications exist. However, this can be easily remedied by creating manuals specific to this trainer. As I continue to add components to the trainer, I continue to evolve the associated literature. Each new part that is installed gets added to this trainer's very own illustrated parts catalogue. Maintenance steps for these systems and components are written into the trainer's maintenance manual. These manuals can be updated as time goes on to accommodate any unexpected issues. For example, students routinely damage the same fitting on a static line. In that case, further maintenance instructions will hopefully reduce the confusion and the number of times it is damaged.[A2.1]

Conclusion

If funding is not a concern, buying directly from the manufacturer may be the easiest approach for a Part 147 training facility. However, if there are budget constraints, or you are intrigued by the other potential advantages mentioned, building your own trainer is a viable option. Aside from the obvious cost savings, it offers a hybrid approach to teaching maintenance. Only time and future research will tell if this inexpensive trainer proves worthwhile.

References

- Lee, J., & Yoon, S. (2025). Case study on the use of maintenance training devices in aviation maintenance education at university. *Asia-Pacific Journal of Convergent Research Interchange*, 11(5), 249-260. <http://apjcriweb.org/content/vol11no5/3.html>
- Rossini, T. (2021, September 20). Why are aircraft parts so expensive? *Inflight Pilot Training*. <https://inflightpilottraining.com/why-are-aircraft-parts-so-expensive/>

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