Preventive Maintenance and Airworthiness Directives

Session Time: One, 50-minute session

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

A deep understanding of how an aircraft operates, which enables a pilot to fly an aircraft to its maximum capabilities in both normal and abnormal situations. (EU5)

ESSENTIAL QUESTIONS

1. Benjamin Franklin said, “an ounce of prevention is worth a pound of cure.” How does that saying apply to aviation?
2. What is the aircraft owner’s role in ensuring an aircraft is ready for flight?
3. What is the pilot’s role in ensuring an aircraft is ready for flight?

LEARNING GOALS

Students Will Know

- The purpose of Airworthiness Directives and Special Flight Permits
- The importance of preventive maintenance and what kind of preventive maintenance items can be performed by pilots
- The responsibilities of aircraft owners and pilots as they relate to maintenance.

Students Will Be Able To

- *Summarize* the importance of preventive maintenance and the ramifications for not performing preventive maintenance. (DOK-L2)
- *Analyze* an Airworthiness Directive and determine the required course of action. (DOK-L4, DOK-L2)

ASSESSMENT EVIDENCE

Warm-up
During a Think-Pair-Share exercise, students will infer why car owners can perform more of their own maintenance than aircraft owners.

Formative Assessment
Students will analyze an actual Airworthiness Directive issued by the FAA and answers a series of questions.

Summative Assessment
Students will write several paragraphs about preventive maintenance, its benefits, and the ramifications of not performing preventive maintenance.

LESSON PREPARATION

MATERIALS/RESOURCES

- Preventive Maintenance and Airworthiness Directives Presentation
- Preventive Maintenance and Airworthiness Directives Student Activity
- Preventive Maintenance and Airworthiness Directives Teacher Notes

Recommended Student Reading

- **Pilot's Handbook of Aeronautical Knowledge**
  Chapter Nine, Pages 9-10 through 9-12 https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/media/11_phak_ch9.pdf

LESSON SUMMARY

Lesson 1: Preventive Maintenance and Airworthiness Directives

The lesson begins with students inferring why aircraft maintenance and documentation differs from that of automobiles.

Students will then learn about who is responsible for ensuring an aircraft is airworthy for flight. A discussion on preventive maintenance will help students understand its importance for flight safety. This section concludes with an optional review of the preventive maintenance items the FAA allows a pilot to perform. An AOPA Air Safety Institute quiz on preventive maintenance is also provided.

The content of the lesson concludes with airworthiness directives (AD) and an activity in which students review an actual AD issued by the FAA and answer questions about it.

At the end of the lesson, students will write several paragraphs about preventive maintenance, its benefits, and the ramifications of not performing preventive maintenance.

BACKGROUND

Preventive maintenance is maintenance that is regularly performed on a piece of equipment to lessen the likelihood of it failing. It is performed while the equipment is still working so that it does not break down unexpectedly. Simple or minor maintenance designed to keep an aircraft operating or to replace small standard parts is considered preventive maintenance.

Preventive maintenance is the first level of keeping an aircraft in good and safe flying condition. Regulations identify a specific list of over 30 preventive maintenance items that pilots can perform on their own aircraft.

An Airworthiness Directive, commonly referred to as an AD, is a tool used by the FAA to communicate unsafe operating conditions relating to aircraft and aircraft equipment to aircraft owners. These unsafe conditions can exist because of a design defect, maintenance, or other causes. Airworthiness directives (ADs) are issued usually as a result of factors arising from accidents and/or service difficulty reports made to the FAA.

MISCONCEPTIONS

It may seem that a person would have to be a certified Airframe and Powerplant mechanic (A&P) to work on an aircraft. In actuality, the FAA allows and encourages pilots and aircraft owners to perform preventive maintenance on their own aircraft. By performing routine maintenance on an aircraft, a pilot not only gains personal satisfaction but also becomes better educated about the equipment they fly.

DIFFERENTIATION

To support student motivation in the **EXPLORE** section, create a game where students will compete to answer questions related to the types of maintenance that can be performed by pilots and the types of maintenance that require a certificated A&P mechanic.

To support student comprehension in the **EXPLORE** section, give students the opportunity to review examples of Airworthiness Directives in small groups. Highlight important sections of the document as an example and provide students with a question list for analyzing ADs prior to the summative assessment.

LEARNING PLAN

ENGAGE

Teacher Material: Preventive Maintenance and Airworthiness Directives Presentation

Slides 1-3: Introduce the topic and learning objectives of the lesson.

Slide 4: Conduct the **Warm-Up**.

Warm-Up

Ask students to think about some of the maintenance they have done on cars or seen their parents do on cars. Explain to students that for the most part, anyone can make modifications to a car without any required permissions or documentation.

This is not true for aircraft owners. There are many restrictions on aircraft owners regarding the kind of maintenance and alterations they can perform if they aren't a certificated airframe and powerplant (A&P) mechanic.

In a Think-Pair-Share, ask students to think of at least two reasons for the difference. Students should think individually about the question. Pair each student with another student or a small group to discuss the question. Finally, ask student groups to share their answers as part of a whole-class discussion.

[DOK-L2; *infer*]

Questions

Reasons for why maintenance requirements on a car and an airplane may be different.

- *Improper maintenance or repairs of aircraft have more dire consequences than for an automobile, which can simply pull off the road if something goes wrong.*
- *Uninvolved people on the ground are more at risk should an aircraft fail.*
- *Most aircraft systems are more complex than automobile systems, and it's important that the public have confidence in the safety of air travel.*

EXPLORE

Teacher Material: Preventive Maintenance and Airworthiness Directives Presentation

Slide 5: In a class discussion, ask students to name who has ultimate responsibility for ensuring an aircraft is airworthy before it flies.

Questions

Who is responsible for ensuring an aircraft is airworthy before it flies?
While the aircraft owner is primarily responsible for ensuring their aircraft is maintained and operating properly and within regulation, it does not relieve the pilot (also referred to as the operator) from the responsibility of determining the airworthiness of the aircraft prior to and during a flight. Both the owner and the pilot have responsibilities for ensuring an aircraft is airworthy prior to every flight.

Slide 6: An aircraft owner and/or the pilot must ensure a number of items have been completed prior to flight. These include:

- An airworthiness certificate and registration is onboard
- Compliance with airworthiness directives
- All required inspections have been completed
- Necessary maintenance has been performed and recorded

These terms and requirements will be explained in this lesson.

EXPLAIN

Teacher Materials: Preventive Maintenance and Airworthiness Directives Presentation, Preventive Maintenance and Airworthiness Directives Teacher Notes
Student Material: Preventive Maintenance and Airworthiness Directives Student Activity

Slide 7: Preventive maintenance is maintenance that is regularly performed on a piece of equipment to lessen the likelihood of it failing. It is performed while the equipment is still working so that it does not break down unexpectedly.

Preventive maintenance is the first level of keeping an aircraft in good and safe flying condition. By performing routine maintenance on an aircraft, a pilot not only gains personal satisfaction but also becomes better educated about the equipment they fly.

The FAA provides a detailed list of preventive maintenance items that pilots can perform. They are listed in the FAA Regulations (14 CFR part 43, appendix A(c)). The items in this appendix are the only ones approved for preventive maintenance. They include minor maintenance or the replacement of small standard parts. Preventive maintenance does not include items that require complex assembly.

Preventive maintenance can be performed by a pilot who owns or operates the aircraft and holds at least a Private Pilot certificate. Pilots who hold a Sport Pilot certificate can perform preventive maintenance on a light sport aircraft they own or operate. Preventive maintenance can also be performed by a certificated mechanic, authorized repair station, and other maintenance professionals.

Slide 8: Provide a few examples of preventive maintenance items that a pilot can accomplish. As the list is read, ask students to recall what they learned about these systems in previous lessons and what kinds of malfunctions they might be preventing by taking these actions.

For example: Replenishing hydraulic fluid may prevent retractable landing gear from getting stuck in the retracted position prior to landing. Students learned in the lesson on Hydraulics and Landing Gear (Unit 8, Section A, Lesson 3) that hydraulic fluid is required to extend retractable landing gear. A hydraulic system that is low on hydraulic fluid may not be able to provide the hydraulic pressure required to lower the landing gear.

Slide 9: A pilot who performs preventive maintenance must make a record of the work performed in the maintenance records of the aircraft.

The entry must include three important items:

- The type of work performed and a brief description of its extent;
- The date of completion of the work performed;
- The pilot's name, signature, the certificate number, and kind of certificate held by the pilot

A typical logbook entry for an oil change is included on the slide.

Teaching Tips

Teachers may wish to share the full list of preventive maintenance items allowed by the FAA. This AOPA webpage provides an easy-to-read list of these items: https://www.aopa.org/news-and-media/all-news/2012/june/01/answers-for-pilots-preventive-maintenance

Teachers may also provide students the list above and then ask them to take this 10-question quiz on preventive maintenance from the AOPA Air Safety Institute: https://www.aopa.org/lms/quizzes/presentQuiz.cfm?course=853&quiz=1

Slide 10: Ask students if they can recall the items that an aircraft owner and/or the pilot must ensure have been completed prior to flight to know that the aircraft is airworthy. These include:

- An airworthiness certificate and registration is onboard
- Compliance with airworthiness directives
- All required inspections have been completed
- Necessary maintenance has been performed and recorded

In the next part of the lesson, students will learn about Airworthiness Directives.

Slide 11: An Airworthiness Directive, commonly referred to as an AD, is a tool used by the FAA to communicate unsafe operating conditions relating to aircraft and aircraft equipment to aircraft owners. These unsafe conditions can exist because of a design defect, maintenance, or other causes. Airworthiness directives (ADs) are issued usually as a result of factors arising from accidents and/or service difficulty reports made to the FAA.

It is mandatory for an aircraft owner/operator to comply with an AD. If an aircraft has outstanding airworthiness directives that have not been complied with, the aircraft is not considered airworthy. An entry must be made in the aircraft's logbooks showing compliance with the AD.

ADs specify the conditions under which the product may continue to be operated, and may include inspection, repair, replacement or other action. Some require a one-time inspection or modification. Others require a periodic inspection or part replacement. An AD might apply to all aircraft of a certain make or model, or only certain aircraft within a range of serial numbers. It may apply to all aircraft that have a certain component, such as a particular engine, propeller, or accessory.

Slide 12: ADs may be divided into two categories:

- Those of an emergency nature requiring immediate compliance prior to further flight, and
- Those of a less urgent nature requiring compliance within a specified period of time.

Checking an airplane's compliance with its ADs isn't something a pilot normally does, especially if renting airplanes. But it's not a bad idea to confer with the owner or a mechanic about ADs that apply to the aircraft you fly periodically. Often, an AD compliance table is part of the aircraft maintenance records, and you can get an idea about when recurring ADs are due by studying the table. Many flight schools keep a table that lists the required inspections, maintenance, and ADs, when they were completed—and when they are due—in their aircraft.

Slide 13: Show students this video that details inspections required by the FAA for certain airliner engines after a fan blade failed on a Southwest Airlines flight in 2018. Ask students to answer the following questions that pertain to this particular AD.

- "FAA Issues Rare Emergency Directive After Fatal Southwest Engine Failure" (Length 2:12) https://video.link/w/3JEk

Questions

Why was the AD issued?
A broken fan blade on a Southwest flight caused an engine explosion that killed one passenger.

What do the airlines have to inspect?
They must inspect fan blades for wear and tear.

How many days do they have to comply with the AD?
The engines must be inspected within 20 days

How many engines are affected by this AD?
681 engines worldwide

How often do the inspections have to be repeated?
Every 2 years

Slide 14: Conduct the **Formative Assessment**.

Formative Assessment

In this activity, students will analyze an actual AD issued by the FAA and answers a series of questions about it. Distribute a copy of **Preventive Maintenance and Airworthiness Directives Student Activity** to each student.

Correct answers are provided in **Preventive Maintenance and Airworthiness Directives Teacher Notes**.

[DOK-L2; a*nalyze*]

EXTEND

Teacher Material: Preventive Maintenance and Airworthiness Directives Presentation

Slide 15: What happens if a required inspection has lapsed, an AD hasn't been complied with, or required logbook entries haven't been made?

The aircraft becomes technically unairworthy, even if it would otherwise be safe to fly. To complicate the situation further, what if there was no one nearby who could repair or bring the aircraft back into compliance?

This situation is the purpose of a Special Flight Permit, which allows an aircraft that doesn't meet the definition of airworthy, but can fly safely, to be operated for a limited, specific purpose:

- The most common example is a ferry permit. For example, if your aircraft missed its annual inspection and is at an airport where there is no maintenance shop or mechanic that can do the annual, the FAA can issue a ferry permit to allow you to fly your airplane to a location where the inspection can be performed.
- Another instance is a special permit to fly overweight. For example, if someone wanted to ferry an aircraft across the Atlantic, it could only be done by installing extra fuel tanks and flying over the certificated maximum weight. A Special Flight Permit could allow that.

EVALUATE

Teacher Material: Preventive Maintenance and Airworthiness Directives Presentation

Slides 16-23: Quiz students on these questions from the Private Pilot Knowledge Test.

Slide 24: Conduct the **Summative Assessment**.

Summative Assessment

Ask students to write several paragraphs using the following prompt:

Describe what preventive maintenance is and explain why performing preventive maintenance is so important. Include the benefits of doing preventive maintenance and describe the ramifications that could occur if preventive maintenance is not performed regularly on aircraft.

[DOK-L2; *summarize, construct*]

Summative Assessment Scoring Rubric

Follows assignment instructions
Written explanation includes:

- A clear and accurate description of preventive maintenance
- An explanation as to why it is so important
- Several clear examples of the benefits and ramifications related to performing or not performing preventive maintenance

Organized explanation
Correct spelling and grammar
Contributions show in-depth thinking including analysis or synthesis of lesson objectives

Points	Performance Levels
9-10	Consistently demonstrates criteria
7-8	Usually demonstrates criteria
5-6	Sometimes demonstrates criteria
0-4	Rarely to never demonstrates criteria

STANDARDS ALIGNMENT

COMMON CORE STATE STANDARDS

- **RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
- **WHST.9-10.1** - Write arguments focused on discipline-specific content.
- **WHST.9-10.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **WHST.9-10.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- **WHST.9-10.9** - Draw evidence from informational texts to support analysis, reflection, and research.

REFERENCES

https://www.aopa.org/news-and-media/all-news/2012/june/01/answers-for-pilots-preventive-maintenance
https://www.aopa.org/go-fly/aircraft-and-ownership/maintenance-and-inspections
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