Annual Inspection Guide for Single-Engine Aircraft

Complete FAA-Compliant Inspection Procedures

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1. Introduction

The annual inspection is a comprehensive examination of an aircraft's airworthiness conducted in accordance with Federal Aviation Administration (FAA) regulations. This document provides detailed procedures for conducting a complete annual inspection on single-engine aircraft, ensuring compliance with all applicable regulations and maintaining the highest safety standards.

Purpose: To establish standardized procedures for annual inspections that meet or exceed FAA requirements while ensuring thorough evaluation of aircraft airworthiness.

Scope: This guide covers all aspects of annual inspections for single-engine aircraft under 12,500 pounds maximum gross weight, operated under Part 91 of the Federal Aviation Regulations.

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2. Regulatory Framework

2.1 Primary Regulations

14 CFR Part 43 - Maintenance, Preventive Maintenance, Rebuilding, and Alteration

- Section 43.15: Additional performance rules for inspections
- Appendix D: Scope and detail of items to be included in annual and 100-hour inspections

14 CFR Part 91 - General Operating and Flight Rules

- Section 91.409: Inspections (annual inspection requirements)
- Section 91.417: Maintenance records

14 CFR Part 65 - Certification: Airmen Other Than Flight Crewmembers

- Subpart D: Mechanics

2.2 Supporting Documents

- FAA Advisory Circular AC 43.13-1B: Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair
- FAA Advisory Circular AC 43.13-2B: Acceptable Methods, Techniques, and Practices - Aircraft Alterations
- FAA Advisory Circular AC 43-9C: Maintenance Records
- FAA Order 8900.1: Flight Standards Information Management System

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3. Inspector Qualifications

3.1 Certification Requirements

Per 14 CFR 43.7, annual inspections must be performed by:

- A person holding a mechanic certificate with airframe and powerplant ratings
- A certificated repair station
- The manufacturer of the aircraft

3.2 Inspection Authorization (IA)

For return to service after annual inspection, the inspector must hold:

- An Inspection Authorization (IA) issued under Part 65
- Current and valid mechanic certificate
- Recent experience requirements per 14 CFR 65.92

3.3 Continuing Education

- Completion of required recurrent training
- Familiarity with current airworthiness directives
- Knowledge of manufacturer service bulletins
- Understanding of current inspection techniques and equipment

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4. Pre-Inspection Preparation

4.1 Aircraft Documentation Review

Required Documents:

- Aircraft registration certificate
- Airworthiness certificate
- Aircraft maintenance records
- Weight and balance data
- Equipment list

- Approved flight manual or pilot's operating handbook

Records Examination:

- Previous inspection entries
- Maintenance actions since last inspection
- Compliance with airworthiness directives
- Major repairs and alterations (Form 337)
- Service difficulty reports

4.2 Inspection Planning

Facility Requirements:

- Adequate lighting (minimum 50 foot-candles)
- Proper ventilation
- Access equipment (platforms, ladders, work stands)
- Inspection tools and equipment
- Safety equipment and first aid supplies

Aircraft Preparation:

- Clean aircraft exterior and accessible interior areas
- Remove inspection panels and access covers
- Drain fuel if required for specific inspections
- Position aircraft for optimal access
- Secure aircraft properly

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5. Airframe Inspection

5.1 Fuselage Structure

External Inspection:

- Skin condition for cracks, corrosion, and damage
- Rivets and fasteners for security and condition

- Windows and doors for proper operation and sealing
- Antenna installations and mounting hardware
- Static ports and pitot tubes for obstruction

Internal Inspection:

- Frame and bulkhead condition
- Control cable routing and condition
- Electrical wiring and clamps
- Insulation and soundproofing material
- Baggage compartment structure and tie-down fittings

5.2 Wing Structure

Wing Box Inspection:

- Spar condition and attachment bolts
- Rib structure and skin attachment
- Fuel tank mounting and condition
- Wing root and tip fairings
- Control surface attachment points

Control Surfaces:

- Aileron hinges and brackets
- Balance weights and attachment
- Control surface fabric or skin condition
- Trim tabs and actuating mechanisms

5.3 Empennage

Horizontal Stabilizer:

- Structure condition and attachment
- Elevator hinges and control linkages
- Trim tab operation and rigging

- Static system connections if applicable

Vertical Stabilizer:

- Rudder hinges and control system
- Antenna mounting if installed
- Navigation light installation
- Tail tie-down provisions

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6. Powerplant Inspection

6.1 Engine External Inspection

Cowling and Baffles:

- Cowling attachment and condition
- Cooling air baffles and seals
- Air intake screens and condition
- Cowl flaps operation (if equipped)

Engine Mount:

- Mount structure and attachment bolts
- Engine shock mounts and hardware
- Grounding straps and connections
- Firewall condition and penetrations

6.2 Engine Accessories

Ignition System:

- Magneto condition and timing
- Spark plug condition and gap
- Ignition harness and shielding
- Ignition switch operation

Fuel System Components:

- Engine-driven fuel pump
- Fuel manifold and nozzles
- Fuel control unit (if equipped)
- Fuel lines and connections

Oil System:

- Oil pump and pressure relief valve
- Oil cooler and lines
- Oil filter and bypass valve
- Oil temperature and pressure sensors

6.3 Engine Internal Inspection

Compression Test:

- Cylinder compression readings
- Documentation of results
- Investigation of low compression cylinders
- Valve operation verification

Borescope Inspection:

- Cylinder barrel condition
- Piston and ring condition
- Valve condition and deposits
- Combustion chamber inspection

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7. Propeller Inspection

7.1 Fixed-Pitch Propellers

Blade Inspection:

- Leading edge condition and nicks
- Trailing edge condition

- Blade face and back surface
- Tip condition and erosion

Hub Inspection:

- Hub-to-engine attachment bolts
- Hub condition and cracks
- Spinner attachment and condition
- Safety wire and cotter pins

7.2 Constant-Speed Propellers

Propeller Governor:

- Governor operation and adjustment
- Oil lines and connections
- Control cable and linkage
- Governor mounting and security

Hub Mechanism:

- Hub internal condition (if accessible)
- Blade retention and clamps
- Grease fittings and lubrication
- Blade angle indication system

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8. Electrical System Inspection

8.1 Power Generation

Alternator/Generator:

- Mounting and drive belt condition
- Brush condition and spring tension
- Commutator or slip ring condition
- Voltage regulator operation

Battery:

- Battery condition and electrolyte level
- Terminal condition and corrosion
- Battery box and ventilation
- Charging system operation

8.2 Electrical Distribution

Wiring Harnesses:

- Wire condition and insulation
- Chafing protection and routing
- Connector condition and security
- Grounding connections

Circuit Protection:

- Circuit breaker operation
- Fuse condition and ratings
- Master switch operation
- Bus bar condition and connections

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9. Fuel System Inspection

9.1 Fuel Tanks

Tank Structure:

- Tank condition and leaks
- Fuel quantity transmitter
- Fuel caps and venting
- Tank mounting and supports

Fuel Lines:

- Fuel line condition and routing

- Fittings and connections
- Fuel filters and strainers
- Fuel selector valve operation

9.2 Fuel System Components

Fuel Pumps:

- Mechanical pump operation
- Electric boost pump (if equipped)
- Fuel pressure regulation
- Pump mounting and connections

Fuel Injection System:

- Fuel manifold and nozzles
- Fuel control unit
- Mixture control operation
- Fuel flow indication

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10. Flight Control System Inspection

10.1 Primary Controls

Control Surfaces:

- Aileron, elevator, and rudder condition
- Hinge pins and bushings
- Control surface balance and rigging
- Trim tab operation

Control Linkages:

- Cable tension and condition
- Pulleys and fairleads
- Control stops and limits

- Turnbuckles and safety wire

10.2 Control System Operation

Cockpit Controls:

- Control stick/yoke operation
- Rudder pedal operation
- Trim wheel/switch operation
- Control lock mechanism (if equipped)

Flight Control Rigging:

- Control surface travel limits
- Cable tension measurements
- Control system friction and bind
- Trim tab neutral position

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11. Landing Gear Inspection

11.1 Fixed Landing Gear

Main Gear:

- Strut condition and attachment
- Wheel and tire condition
- Brake system operation
- Shock absorption system

Nose Gear:

- Nose wheel steering system
- Shimmy damper condition
- Tire wear patterns
- Wheel fairing condition

11.2 Retractable Landing Gear

Actuation System:

- Hydraulic or electric operation
- Gear doors and linkages
- Position indicators
- Emergency extension system

Gear Components:

- Gear struts and cylinders
- Retraction mechanisms
- Gear locks and safety systems
- Wheel well condition

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12. Instruments and Avionics

12.1 Flight Instruments

Pitot-Static System:

- Altimeter accuracy check
- Airspeed indicator operation
- Vertical speed indicator
- Static system leak check

Gyroscopic Instruments:

- Attitude indicator operation
- Heading indicator accuracy
- Turn coordinator function
- Vacuum system operation

12.2 Engine Instruments

Engine Monitoring:

- Oil pressure and temperature

- Cylinder head temperature
- Exhaust gas temperature
- Engine RPM indication

Fuel System Instruments:

- Fuel quantity indication
- Fuel flow indication (if equipped)
- Fuel pressure indication
- Low fuel warning systems

12.3 Avionics Systems

Communication Equipment:

- Radio operation and clarity
- Antenna condition and mounting
- Microphone and headset jacks
- Intercom system operation

Navigation Equipment:

- GPS system operation
- VOR/ILS receiver checks
- DME equipment function
- Transponder operation

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13. Interior and Emergency Equipment

13.1 Cabin Interior

Seats and Restraints:

- Seat condition and attachment
- Seat belt and shoulder harness
- Seat adjustment mechanisms

- Cargo restraint systems

Interior Panels:

- Panel condition and attachment
- Carpet and upholstery
- Window condition and operation
- Door handles and locks

13.2 Emergency Equipment

Required Equipment:

- First aid kit contents and expiration
- Fire extinguisher condition
- Emergency locator transmitter (ELT)
- Survival equipment (if required)

Safety Equipment:

- Emergency exits and operation
- Placards and markings
- Flight manual accessibility
- Weight and balance data

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14. Required Documentation Review

14.1 Airworthiness Certificate

Certificate Validity:

- Standard or special airworthiness certificate
- Category and class designation
- Any limitations or restrictions
- Certificate condition and legibility

14.2 Registration Certificate

Registration Requirements:

- Current registration certificate
- Aircraft identification number
- Owner information accuracy
- Registration renewal date

14.3 Operating Limitations

Pilot's Operating Handbook:

- Current revision status
- Required supplements
- Weight and balance information
- Performance charts and data

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15. Airworthiness Directives (ADs)

15.1 AD Research and Compliance

AD Search Process:

- Current AD database search
- Manufacturer-specific ADs
- Component manufacturer ADs
- Recurring AD compliance

Compliance Verification:

- AD compliance records review
- Next compliance due dates
- Method of compliance verification
- Parts manufacturer participation

15.2 AD Documentation

Required Records:

- AD compliance entries
- Next compliance due
- Method of compliance used
- Parts and materials used

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16. Service Bulletins and Modifications

16.1 Service Bulletin Review

Manufacturer Bulletins:

- Current service bulletin status
- Recommended actions taken
- Safety-related bulletins
- Fleet-wide issues

16.2 Modifications and STCs

Supplemental Type Certificates:

- STC compliance and documentation
- Installation requirements met
- Continuing airworthiness requirements
- Weight and balance impact

Field Approvals:

- Form 337 documentation
- Engineering data review
- Installation inspection
- Operating limitations compliance

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17. Inspection Discrepancies

17.1 Discrepancy Classification

Minor Discrepancies:

- Items not affecting airworthiness
- Routine maintenance items
- Cosmetic issues
- Non-safety related defects

Major Discrepancies:

- Items affecting airworthiness
- Safety-related defects
- Structural problems
- Systems malfunctions

17.2 Discrepancy Resolution

Repair Requirements:

- Approved repair procedures
- Parts and materials requirements
- Qualified personnel requirements
- Inspection of repairs

Documentation:

- Discrepancy list preparation
- Repair approval process
- Return to service entries
- Record keeping requirements

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18. Return to Service

18.1 Inspection Completion

Final Inspection:

- All discrepancies resolved

- All access panels installed
- All inspection items completed
- Systems operational checks

18.2 Logbook Entries

Required Information:

- Date of inspection
- Total aircraft time
- Inspector name and certificate number
- Statement of airworthiness
- Next inspection due date

Entry Format (per 14 CFR 43.11): "I certify that this aircraft has been inspected in accordance with an annual inspection and was determined to be in airworthy condition in accordance with 14 CFR Part 43."

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19. Record Keeping Requirements

19.1 Maintenance Records

Required Records (per 14 CFR 91.417):

- Total time in service
- Current status of life-limited parts
- Time since last overhaul
- Current inspection status
- Major alterations and repairs

Record Retention:

- Maintenance records: Until work is repeated or superseded
- Major alterations: Permanently retained
- Annual inspections: Until next annual completed
- AD compliance: Until superseded

19.2 Documentation Standards

Entry Requirements:

- Legible handwriting or typed entries
- Permanent ink or electronic records
- Complete information required
- Proper authorization signatures

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20. Appendices

Appendix A: 14 CFR Part 43, Appendix D - Inspection Scope

Complete text of regulatory requirements for annual and 100-hour inspections

Appendix B: Inspection Forms and Checklists

Standardized forms for:

- Pre-inspection aircraft preparation
- Airframe inspection checklist
- Powerplant inspection checklist
- Systems inspection checklist
- Discrepancy tracking form

Appendix C: Reference Materials

FAA Advisory Circulars:

- AC 43.13-1B: Acceptable Methods, Techniques, and Practices
- AC 43.13-2B: Aircraft Alterations
- AC 43-9C: Maintenance Records
- AC 65-30A: Inspection Authorization Information Guide

Manufacturer Resources:

- Service manuals and bulletins
- Parts catalogs

- Illustrated parts breakdowns
- Maintenance planning documents

Appendix D: Inspection Tools and Equipment

Required Tools:

- Basic hand tools
- Precision measuring instruments
- Inspection aids (mirrors, lights, borescopes)
- Test equipment for systems checks

Calibration Requirements:

- Torque wrenches
- Pressure gauges
- Electrical test equipment
- Precision measuring tools

Conclusion

This comprehensive guide provides the framework for conducting thorough annual inspections on single-engine aircraft in accordance with FAA regulations. Regular training, staying current with regulatory changes, and maintaining high inspection standards are essential for ensuring continued airworthiness and flight safety.

The inspection process requires careful attention to detail, proper documentation, and adherence to approved procedures. When in doubt, consult manufacturer documentation, FAA guidance, or seek assistance from experienced maintenance professionals.

Remember: The annual inspection is not just a regulatory requirement—it's a critical safety process that ensures aircraft remain airworthy and safe for flight operations.

This document is based on current FAA regulations and guidance as of January 2025. Always consult current regulations and manufacturer documentation for the most up-to-date requirements.