Cessna Single Engine Safety Initiative

Please have your computer volume turned on for this presentation.
Cessna Single Engine Airplanes

- 145,000 produced between 1946-1986
- Average age is 42 years old
- Made of aluminum
- Certified CAR 3
Single Engine Safety Initiative

- Cessna has developed a structural inspection program to assure the continued safe operation of single engine airplanes
- Visual inspection techniques are utilized to detect
  - Corrosion
  - Cracks caused by metal fatigue
Single Engine Safety Initiative

- Why Inspect?
  - Corrosion (rust) and metal fatigue are inevitable
  - Corrosion and metal fatigue reduce the load carrying capability of the airframe
  - Like people, airplanes age, and more frequent and intrusive inspections are required to maintain health (safety)
What is Corrosion?

- Corrosion is the attack on metal by an electrochemical reaction to the surrounding environment.
- Electrochemical corrosion can best be compared to a battery cell.

2024-T3 (aluminum sheet)
Corrosion Prevention

- The key to corrosion prevention is to keep the airframe free of moisture (electrolyte)
- A major contributing factor to corrosion is the environment. Corrosion is more likely to be found on airplanes operating in
  - Coastal environments
  - Areas that contain high amounts of industrial particles and fumes in the atmosphere
Corrosion Prevention

- There are several common options available to shield the aluminum from electrolytes including:
  - Cladding
  - Chemical Treatments
  - Sealants
  - Corrosion Prevention Compounds (CPCs)
Corrosion Prevention

- **Cladding**
  - 2024 sheet can be coated ("clad") with very thin layers (.001") of pure aluminum to protect from corrosion
  - The sheet material is vulnerable when the cladding is compromised such as at drilled rivet holes

- **Chemical Treatments**
  - Alodine or other chemical treatments are used to enhance the corrosion resistance of the pure aluminum cladding
Corrosion Prevention

- **Sealants**
  - Paint is the most commonly used sealant for corrosion protection
    - A good paint job using modern polyurethane paints is the best defense against airframe corrosion
  - The airframe interior of most pre-1986 airframes were not painted (primed)

- **Corrosion Preventive Compounds (CPCs)**
  - Effective means for protecting those parts of an airframe that were not originally protected from corrosion
Corrosion Prevention

- Continual inspections and preventative maintenance are required to keep the airframe metal from corroding
  - Thorough rinsing and cleaning of airplane will remove salt and other corrosive agents
  - Chipped or delaminating paint needs to be properly stripped or sanded and re-painted
  - During severe weather or wet conditions, airplanes should be covered and sheltered
What is Metal Fatigue?

- Metal fatigue occurs when a metal is subjected to repeated loading and unloading.
- Eventually microscopic cracks will form and these cracks will grow until the structure can no longer hold the load and the structure will suddenly fracture.
Corrosion and Metal Fatigue

- Corrosion and metal fatigue both reduce the load carrying capability of the airframe.
- Corrosion and fatigue are not entirely independent processes - corrosion affects the expected fatigue life of airframe parts.
  - Corrosion pitting creates a stress concentration which leads to crack initiation and potentially faster crack growth.
  - Corrosion reduces the thickness of a part and therefore increases the stress in the part.
Corrosion Examples

- Cabin Interior – All Models
- Model 177/210 Cantilever Carry-Thru
- Model 177/210 Cantilever Wing Attachments
- Model 200 Series Elevators
- Main Landing Gear – All Models
- Strut Braced Wings
Cabin Interior – All Models

- Cabin is susceptible to corrosion given that it:
  - May leak when it rains
  - May be stored in un-insulated hangar or on the flight line
  - Stays warm as the airplane goes through thermal cycles during flight
    - Condensation will form on the interior skin
    - Moisture is absorbed by insulation and upholstery materials
  - Not often treated with corrosion prevention products
  - Headliner is not always removed during an annual
Cabin Interior – All Models

Corrosion
177/210 Cantilever Carry-Thru

- Provides the primary means of carrying wing loads across the fuselage
- Corrosion occurs when
  - Ducting contacts lightening holes in beam, or
  - Moisture accumulates on I-beam surface
- Limited repairability
Models 177/210 Cantilever Carry-Thru
Models 177/210 Cantilever Carry-Thru

Corrosion

Corrosion Pitting

Corrosion
Models 177/210 Cantilever Wing Attach

- Primary load carrying member
- Corrosion is common on the carry-thru lugs and the wing attach fittings
  - Tight fitting faces act as a moisture trap
Models 177/210 Cantilever Wing Attach

- Carry-Thru Spar Lug
- Wing Attach Fitting
- Corrosion Pitting

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- Wing Attach Fitting
- Corrosion Pitting
Model 200 Series Elevators

- Foam filled trim tab and foam filled trailing edge
  - Absorbs moisture
    - Results in corrosion
    - Changes elevator balance
  - When trim tab skin thins due to corrosion, the actuator can pull the fasteners through skin and disconnect
  - Inspect for pinholes, surface roughness, bubbling
  - Not repairable
Model 200 Series Elevators

Hole caused by corrosion

Crack
Main Landing Gear

- Made from 6150M High-Strength Steel
- A pit as small as .005” can initiate a fatigue crack which will result in fracture of the gear
- Keep surface painted with polyurethane paint and blend out pits per Service Manual
Strut Braced Wing Front Spar

- Wing spar made from several sheets of 2024-T3 aluminum clad riveted together
- Strut attaches at wing splice joint
- Corrosion observed in underlying sheets
Strut Braced Wing Front Spar
Strut Braced Wing Front Spar

Corrosion Product
Strut Braced Wing Front Spar
Metal Fatigue Examples

- 200 Series Horizontal Stabilizer
- Model 172/175 Horizontal Stabilizer
- Model 150/152 Vertical Stabilizer Attach
- Models 172/182/206/210 Forward Doorpost at Strut Attachment
- Rudder Pedal Bar Assembly – All Models
- Engine Mount Truss
200 Series Horizontal Stabilizer Front Spar

Cracks in Spar Web

Crack
200 Series Horizontal Front Spar Attach

Crack
Model 172/175 Horizontal Front Spar

Cracks
Model 150/152 Vertical Stabilizer Attach
Models 172/182/206/210 Forward Doorpost at Strut Attachment
Rudder Pedal Bar Assembly – All Models

Crack
Engine Mount Truss
Inspection Program Details

- Inspections
  - Based on field history
  - Reviewed by customer focus group

- Inspection Details
  - Corrosion prevention and control program
    - Directed visual inspections for corrosion completed during annual
  - ~15-20 visual inspections to inspect for cracks
    - Borescope and magnifying glass required to complete inspections
  - ~5 inspections based on existing service bulletins
Inspection Program Details

- Specialized NDI techniques required
  - When corrosion is found
  - When cracking is suspected
  - When required by existing service bulletin
  - For high time airplanes (12,000+ hours) or severe usage airplanes (6,000+ hours)
Inspection Program Availability

- Revised inspection program will be published in the airplane service manual
  - 200 Series airplanes – December 2011
  - 100 Series airplanes – 2nd Quarter 2012
  - Compliance Date
    - 200 Series airplanes – December 2013
    - 100 Series airplanes – June 2014
Conclusion

- Safety is a partnership between owners, manufacturers and the FAA
- Report anomalies to the Customer Service or Regulatory Authority

For more information contact:
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