DEPARTMENT OF AEROSPACE ENGINEERING

19ASB303 AIRCRAFT MAINTENANCE ENGINEERING

UNIT-1 AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT

Case Study: Abnormal Vibrations During Engine Performance Test

Step 1: Identify the Symptoms and Gather Data

- **Detailed Observation:** Record the specific conditions under which the abnormal vibrations occur (e.g., RPM range, throttle setting, ambient temperature, etc.).
- **Instrument Readings:** Collect data from onboard sensors such as vibration meters, engine performance monitors, and exhaust gas temperature (EGT) sensors.
- **Visual Inspection:** Conduct a visual check for physical damage, loose components, or unusual wear and tear on the engine.

Step 2: Analyze Potential Causes

1. **Imbalance in Rotating Components:**
   - Possible issues with the fan, compressor, turbine, or propeller blades being damaged, misaligned, or unbalanced.
2. **Foreign Object Damage (FOD):**
   - Check for signs of debris or bird strikes that may have caused damage.
3. **Structural Issues:**
   - Inspect engine mounts, bearings, and supports for wear, fatigue, or loose connections.
4. **Engine Misalignment:**
   - Ensure the engine is properly aligned with the aircraft structure.
5. **Combustion Irregularities:**
   - Check for inconsistent fuel flow or ignition problems causing uneven combustion.
6. **Aerodynamic Disturbances:**
   - Verify that no airflow obstructions (such as nacelle damage or clogged intakes) are affecting performance.

Step 3: Troubleshooting Process

1. **Conduct a Borescope Inspection:**
   - Use a borescope to examine internal components like turbine blades, combustion chambers, and nozzle guide vanes for cracks, corrosion, or deposits.
2. **Perform Rotor Balancing:**
   - Dynamically balance the rotating components to eliminate any imbalances causing vibrations.
3. **Check for Engine Mount Integrity:**

- Tighten or replace worn engine mounts to minimize vibration transmission to the airframe.

4. **Review Maintenance Logs:**
   - Analyze previous maintenance records for recent part replacements or repairs that could have introduced the issue.
5. **Run Comparative Tests:**
   - Compare performance data with baseline readings from the manufacturer to identify deviations.

Step 4: Implement Corrective Measures

1. **Component Replacement or Repair:**
   - Replace damaged or worn components (e.g., bearings, blades) to restore balance and functionality.
2. **Rebalancing and Alignment:**
   - Rebalance the rotor assembly and ensure precise alignment of the engine with the airframe.
3. **Engine Calibration:**
   - Calibrate fuel systems and ignition timing to achieve smooth combustion.
4. **Inspection of Ancillary Systems:**
   - Examine and repair auxiliary systems such as fuel pumps, filters, and air intake systems.

Step 5: Verification and Final Testing

1. **Ground Run Test:**
   - Conduct a full engine run-up to verify that the vibration levels are within acceptable limits.
2. **Flight Test (if applicable):**
   - Perform a controlled flight test to confirm the engine operates normally under all conditions.
3. **Post-Test Documentation:**
   - Record findings, corrective actions, and test results for future reference and compliance with aviation regulations.

Conclusion

Abnormal vibrations in an engine during ground testing can arise from various mechanical, structural, or operational issues. A systematic approach, including thorough inspection, data analysis, troubleshooting, and corrective measures, is essential to ensure the engine's reliability and safety. Continuous monitoring and adherence to maintenance protocols will prevent recurrence of such issues.

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