



Model Communiqué

King Air Series

Communiqué # 2011-05
August, 2011

ATA 61 - Four-Bladed Propellers Reactionless Mode Resonant Vibration

There have been some questions recently about a propeller vibration resonance known as "reactionless mode". Reactionless mode is a vibration resonance that may affect propellers with four or more blades, when operated under certain conditions. In December of 2005, the FAA issued Special Airworthiness Information Bulletin (SAIB) NE-06-13 to alert operators of this issue. A copy is attached for your convenience.

FAA Advisory Circular 20-66B also provides the definition of reactionless mode as follows:

"Propellers with four or more blades will also have a resonant frequency known as the reactionless mode of vibration. The primary characteristic of this mode is a 2P or 3P frequency, depending on the number of blades, with all loads canceled in the hub. This mode of vibration is excited primarily on the ground when surface winds are from behind the propeller disc (cross-wind) and can generate high loads in the mid-blade and blade shank/retention area. Most installations with these characteristics are subject to operating restrictions to prevent continuous operation within the rpm range in which these modes can be excited."

For King Air model airplanes equipped with four-bladed propellers, reactionless mode may occur during sustained ground operations with the propeller set to a low rpm (below the minimum idle rpm listed in the Limitations Section of the Pilot's Operating Handbook [POH]), and with a quartering tailwind. Extended ground operation within the reactionless mode rpm range may cause very high stresses on propeller blades and hubs. The propeller is not affected by the resonance when passing through this range during startup and shutdown.

The minimum propeller and N1 rpm limitations in the POH are designed to ensure that the propellers are not operated in or near the reactionless mode rpm range. As a result, it is important to ensure that the engines' N1 and propeller rpm are rigged properly in accordance with the applicable Hawker Beechcraft Corporation (HBC) Maintenance Manual and that the propeller tachometer is accurate. It is HBC's expectation that pilots and mechanics will comply with the N1 and propeller low idle rpm limitations stated in Section 2 of the POH whenever the engines are operated. This will ensure that the propeller idle rpm does not fall below the minimum rpm listed in the POH when the engines are placed at idle.



SPECIAL AIRWORTHINESS INFORMATION BULLETIN

Aircraft Certification Service
Washington, DC

U.S. Department
of Transportation

**Federal Aviation
Administration**

NE-06-13
December 12, 2005

<http://www.faa.gov/aircraft/safety/alerts/SAIB>

This is information only. Recommendations aren't mandatory.

Introduction

This Special Airworthiness Information Bulletin (SAIB) alerts you, owners, operators, pilots, mechanics, and certificated repair facilities of **all turboprop airplanes using propellers with four or more blades**, to check propeller idle RPM settings and any propeller RPM restrictions or limitations, and to **adhere to the propeller RPM restrictions or limitations**. We recently learned of several turboprop aircraft with engine idle speeds set within the propeller restricted RPM range, which could become a potential safety of flight issue.

Background

We have become aware of a potential safety of flight issues that could exist on numerous turbine powered aircraft using propellers with four or more blades. The subject propellers are installed on, but not limited to the following aircraft:

Manufacturer	Models
Air Tractor, Inc.	AT-501, AT-502, AT-502A, AT-502B, AT-503, AT-503A, AT-602, AT-802
Bombardier, Inc.	DHC-6-100,-200,-300
Cessna Aircraft Company, The	441
Fairchild	Merlin, Metroliner
Mitsubishi Heavy Industries, Ltd.	MU-2B Series

Manufacturer	Models
Pilatus Aircraft Limited	PC-6, PC-7, PC-12
Piper Aircraft, Inc., The New	PA-31T, T1, T2, T3
Raytheon Aircraft Company	A100 Series, A200, B100 Series, B200, B300, C90 Series, C99
Short Brothers PLC	SC-7 (Skyvan), SD3-30, SD3-60
SOCATA - Groupe Aerospatiale	TBM 700
Twin Commander Aircraft Corporation	690 Series

The propeller installations are controlled by the various airframe manufacturers Type Certificate (TC) or by Supplemental Type Certificate (STC) holders.

The minimum propeller idle RPM operating restriction is the result of a specific vibratory resonant condition known as a “reactionless mode”. Ground operation at or near a reactionless mode vibratory resonance might cause very high stresses in propeller blades and hubs. These high stresses are more severe when operating in a tailing wind condition. Often times the flight crew cannot feel the resulting high propeller vibratory stress that can occur at certain propeller RPM’s. If the propeller is operating within a restricted RPM range or below a minimum RPM restriction for an extended period of time, the propeller blades and hub may become un-airworthy due to fatigue. Hub or blade failure has the potential to cause a catastrophic event due to

blade separation. These propeller RPM restrictions might be either below or above the propeller idle RPM range and are of equal importance. The RPM restrictions might vary with different airframe, engine/ propeller applications.

The propeller operating restrictions or limitations are found in the Airplane Flight Manual (AFM) or Airplane Flight Manual Supplement (AFMS). The propeller RPM restrictions or limitations might not be marked on the instrumentation or placarded when proper rigging of the engine and propeller prevents the propeller from operating in a restricted region. Therefore, it might not be evident, without checking the AFM or AFMS that the propeller is operating in a restricted region if the RPM has not been rigged correctly.

You must ensure the propeller is rigged in accordance with applicable TC holder or STC holder propeller installation and rigging instructions, and set proper minimum propeller RPM, engine idle speed, and engine torque settings. Depending on the application, it is possible that the mechanic could improperly rig the ground RPM or the pilot could manually control the engine such that the propeller is operating at a restricted RPM. Since either the mechanic or pilot could cause improper operation and since they might be unaware of the serious effects of such operation, both the AFM and the Airplane Maintenance Manual (AMM) should contain a clear statement of the propeller operating restriction and an informative warning.

The following is a suggested AFM warning note:

WARNING

STABILIZED GROUND OPERATION WITHIN THE PROPELLER RESTRICTED RPM RANGE CAN GENERATE HIGH PROPELLER STRESSES AND RESULT IN PROPELLER FAILURE AND LOSS OF CONTROL OF THE AIRCRAFT.

The following is a suggested AMM warning note:

WARNING

STABILIZED GROUND OPERATION WITHIN THE PROPELLER RESTRICTED RPM RANGE CAN GENERATE HIGH PROPELLER STRESSES AND RESULT IN FATIGUE DAMAGE TO THE PROPELLER. THIS DAMAGE CAN LEAD TO A REDUCED PROPELLER FATIGUE LIFE, PROPELLER FAILURE, AND LOSS OF CONTROL OF THE AIRCRAFT. THE PROPELLER RESTRICTED RPM RANGE IS DEFINED IN THE AIRPLANE FLIGHT MANUAL. CONTACT THE AIRCRAFT OR PROPELLER MANUFACTURER FOR CORRECTIVE ACTIONS IF A PROPELLER RESTRICTION OR LIMITATION IS VIOLATED.

Recommendation

We strongly recommend that you:

- Check the AFM or AFMS to determine if there are any propeller RPM restrictions or limitations.
- Check the accuracy of the tachometer.
- Check the propeller RPM settings to determine if the propeller is operating within a propeller restricted RPM range or below a minimum propeller RPM.
- Contact the propeller manufacturer for corrective action if the propeller has been operated in such a way as to violate the operating restrictions or limitations.
- Correct the propeller RPM setting, if necessary. Refer to the applicable installation and rigging instructions for the adjustment of engine torque, engine idle speed, and propeller RPM setting.
- Adhere to the propeller RPM restrictions or limitations.
- Make sure a clear statement of the propeller operating restriction and an informative warning is in the AFM and the AMM.

For Further Information Contact

Hartzell Propellers;

FAA Contact; Tim Smyth, Aerospace Engineer, FAA Chicago Aircraft Certification Office, Propulsion Branch, ACE-118C, 2300 East Devon Avenue, Des Plaines, IL 60018; phone: (847) 294-7132, fax: (847) 294-7834

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FAA Contact; Jeff Janusz, Aerospace Engineer, FAA Wichita Aircraft Certification Office, Propulsion Branch, ACE-116W, 1801 Airport Road, Room 100, Wichita, KS 67209; phone: (316) 946-4148; fax: (316) 946-4107.

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Hamilton Sundstrand, Avia, or Dowty Propellers;

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