



28 September 2023

BLADE FLAP - GYROPLANE

- CONTENT:** A. Definitions
B. Type of blade flap
C. Preventative training.

This document must be interpreted / read / applied together with the following two YouTube videos.

1. https://youtu.be/ON_QdVHJRHI
2. <https://youtu.be/GOIa05fRDxQ>

A. DEFINITIONS. – Blade flap / Blade sailing / Retreating blade stall / Dissymmetry of lift

1. ROTORCRAFT FLYING HANDBOOK Chapter 20 page 20-1 to 20-2

On a gyroplane with a semi-rigid teeter-head rotor system, blade flap may develop if too much airflow passes through the rotor system while it is operated at low rpm. This is most often the result of taxiing too fast for a given rotor speed. Unequal lift acting on the advancing and retreating blades can cause the blades to teeter to the maximum allowed by the rotor head design. The blades then hit the teeter stops, creating a vibration that may be felt in the cyclic control. The frequency of the vibration corresponds to the speed of the rotor. With the blades hitting the stop twice during each revolution. If the flapping is not controlled, the situation can grow worse as the blades begin to flex and bend. Because the system is operated at low rpm there is not enough centrifugal force acting on the blades to keep them rigid. The shock of hitting the teeter stops combined with uneven lift along the length of the blade causes an undulation to begin, which can increase in severity if allowed to progress.

2. THE GYROCOPTER PILOTS HANDBOOK. PHIL HARWOOD
Page 50

BLADE FLAP

“BLADE FLAP” is what happens to the rotor when wind gets below a stationary blade. Blade flap may result in the rearmost blade hitting either the tail of the Gyrocopter, or an object/person who is standing too close to the Gyrocopter. (Reference to a static gyro blade)



BLADE SAILING Phil Howard page 65

Blade Sailing is simply the effect of blade flap when the blades are turning slowly. As a slowly rotating blade turns into wind, if the wind is exposed to the underside of the blade it will flap up causing the other blade to flap down. As the blade are turning, the rising blade will move out of wind, and it will start to flap down at the same time as the other blade rises also catching the wind on the underside. This motion will become greater with each revolution and there is a real possibility of the tip of a blade touching against the ground at the side of the Gyrocopter or hitting the side of the tail.

BLADE SAILING CANNOT HAPPEN IN FLIGHT DUE TO THE SIGNIFICANT CENTRIFUGAL FORCE ACCTING ON THE BLADES.

Blade sailing could occur during a very fast take off ground run if the blades have not reached a safe rpm.

RETREATING BLADE STALL Phil Howard page 65 - 66

Retreating blade stall is something that happens to your rotor system when you are on the ground. Your blades are rotating at a slow speed and there is a strong flow of air blowing over the Gyrocopter. The effect of retreating blade stall is that your blades will trash from side to side possibly hitting the ground. The propeller or the tail and the stick will have a violent side by side movement twice per rotor revolution.

To understand what causes retreating blade stall, it is necessary to understand the concept “ DISSYMMETRY OF LIFT “

DISSYMMETRY OF LIFT Phil Howard page 66

Dissymmetry of lift occurs whenever there is a forward component of airflow as well as a rotational component of airflow, this happens in forward flight as well as on the ground. As your blades turn you will always have a blade that is turning INTO wind and a blade that is turning OUT OF wind. *Advancing blade* and *retreating blade*



B. TYPES OF BLADE STALL/FLAP

1. SLOW SPEED BLADE FLAP (Referring to slow speed of undercarriage and slow speed of spinning rotor)

a) Taxiing blade flap (with spinning rotor)

This can happen after a landing and pilot backtracks / vacate runway / to hanger and is most noticeable in high wind conditions.

PREVENTION: After landing be aware of wind direction and stick position. Stop rotor as soon as possible. If taxiing with spinning rotor be aware of stick position and wind direction while changing direction while taxiing.

b) FIRST TAKE OFF. Pilot/student not adhering to pre rotation procedures. Pilot/student attempt to take off with low rotor rpm and applies too much power too soon.

c) Take off after stop and go exercises. – pilot/ student allowing rotor to decay below safe (200) rpm. Add too much power too soon.

SLOW SPEED BLADE FLAP WARNING SIGNALS.

Sideways movement of stick *twice per rotor revolution* (TUC TUC) to the **left** during take off or taxiing into wind. To the **right** if taxiing out of wind with spinning rotor. The speed of TUC TUC depends on speed of rotor.

On TUC NO 3 IT IS TO LATE. DAMAGE TO ROTOR/PROP/TAILPLANE will occur.

Corrective action if slow speed blade (b – c) flap is encountered. STICK FORWARD AND THROTTLE BACK SIMULTANEOUSLY.

2. HIGH SPEED BLADE FLAP (High speed refers to the UNDERCARRIGE speed being fast)

How to get into this situation – 2x scenarios.



a) Scenario 1

Pilot/student pre-rotates properly to 200 rotor rpm, then forgets to pull the stick fully back (Thus stick remains in full forward position) Pilot/student commences with his/her take off roll. After a time, pilot/student realizes he forgot the stick in forward position. Undercarriage now has a considerable speed. The rotor has also started to decay as NO AIRFLOW ADDED SPEED to the rotor. Pilot/student then pulls the stick back – HIGH SPEED BLADE FLAP follows. The advancing blade flips the gyro on its **LEFT SIDE**. Once the pull back on the stick has occurred -HIGH SPEED BLADE FLAP CANNOT BE CORRECTED
It can only be corrected if pilot realizes he has stick in full front position – CUT THE POWER and KEEP THE STICK IN FORWARD POSITION

b) Scenario 2

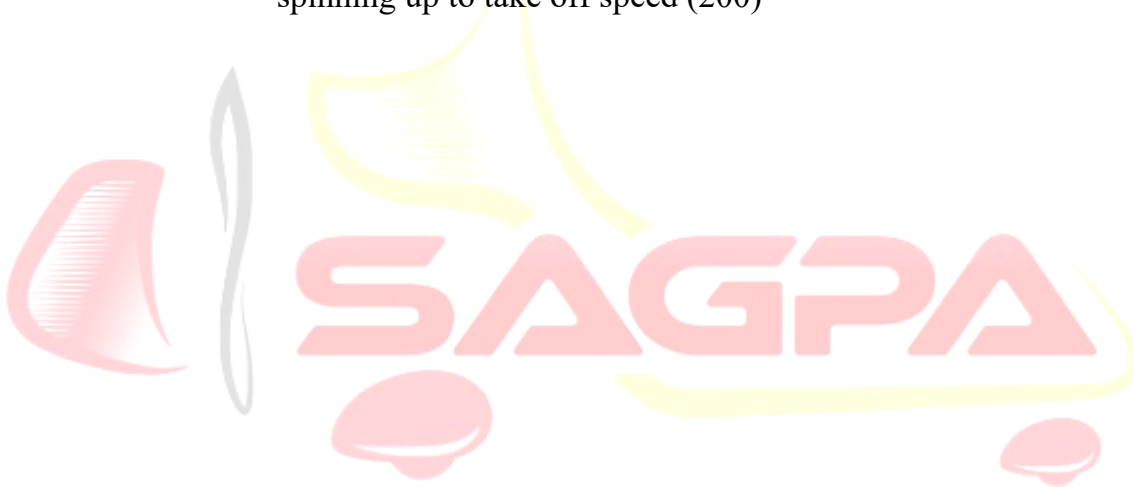
Pilot/student pre-rotates properly to 200 rotor rpm. Pilot/student pulls the stick back at 200 rotor rpm and commences with his /her take off roll.
After feeling the drag the pilot/student started managing the drag by slightly pushing the stich forward. Pilot pushes the stich TOO FAR FORWARD -thus not allowing the incoming relative airflow to spin the rotor up to flying speed.
End of runway/tree/realization that stick was pushed too far forward sets in. pilot/ student PULLS STICK BACK trying to force gyro into the air. HIGH SPEED BLADE FLAP follows – CANNOT RECOVER from this unless pilot / student realizes his/her mistake – CUT POWER AND HOLD STICK FULLY FORWARD.

C. PREVENTITAVE BLADE FLAP TRAINING.

1. Proper ground school lecture on BLADE FLAP.
2. During dual practical training:



- a) Practice **first time** take off's (use of pre-rotator) more regular. Force students to read rotor rpm loudly out to you. Thus, forcing the student to focus on Rotor rpm during take-off.
- b) Do **stop and go's** – allow rotor speed to decay to 200 and then take off again. Force students to read rotor rpm back to you.
- c) During dual training allow rotor rpm to decay to 150 rpm. Show and train students to **SLOWLY** increase rotor rpm to safe 200 rpm and then take off.
- d) Simulate the TUC TUC SLOW SPEED BLADE FLAP **WARNING SIGNAL** on the stick during takeoff roll with your hand with rotor rpm at 200 - thus forcing the student to be weary of the slow speed blade flap **warning signal**.
- e) Also simulate the TUC TUC warning signal during taxing with a spinning rotor to instill muscle memory.
- f) Train students to HEAR /LISTEN to the sound of the rotor spinning up to take off speed (200)



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