



# AIRWORTHINESS BULLETIN

AWB 63-002 Issue: 4 - 8 March 2019

## Bell 206 Freewheel Unit Failures - Mast Yielding / Main Rotor Separation

An Airworthiness Bulletin is an advisory document that alerts, educates and makes recommendations about airworthiness matters. Recommendations in this bulletin are not mandatory.

### 1. Effectivity

All Bell 206 Jet Ranger and Long Ranger series helicopters.

### 2. Purpose

Alert operators, pilots and maintainers to critical freewheel unit lubrication issues in order to reduce the possibility of torsional main rotor mast yielding and in-flight separation of the main rotor head from the mast.

### 3. Background

Defect report investigations into continuing failures of main transmission freewheel units in Australia and a near fatal incident in Canada demonstrate that a malfunctioning freewheel causes varying degrees of main rotor mast failure, ranging from torsional yield to complete separation of the rotor head from the main rotor mast.

#### Mast Separation Failure



During the final stages of a practice power-recovery autorotation, the pilot rolled the throttle to full power. The engine spooled up to 100% but the free-wheel unit did not engage the engine to the transmission.

Rotor RPM decayed as the collective was raised to cushion the landing at the end of the descent, at which point the freewheel unit suddenly engaged.

The inertia built up by the engine was immediately resisted by the mass of the decelerating rotor system and the shock resulted in the main rotor head separating from the mast. The touchdown was firm and the helicopter slid about 5 feet.

Fig 1. - Main rotor mast to rotor head separation failure. Accompanying text is a summary based on TSB Aviation Investigation Report A11C0152.



The investigation found that the free wheel unit had failed due to lack of lubrication caused by debris in the oil supply restrictor or oil jet, the same prime causal factor for freewheel failures and mast yielding in Australia.

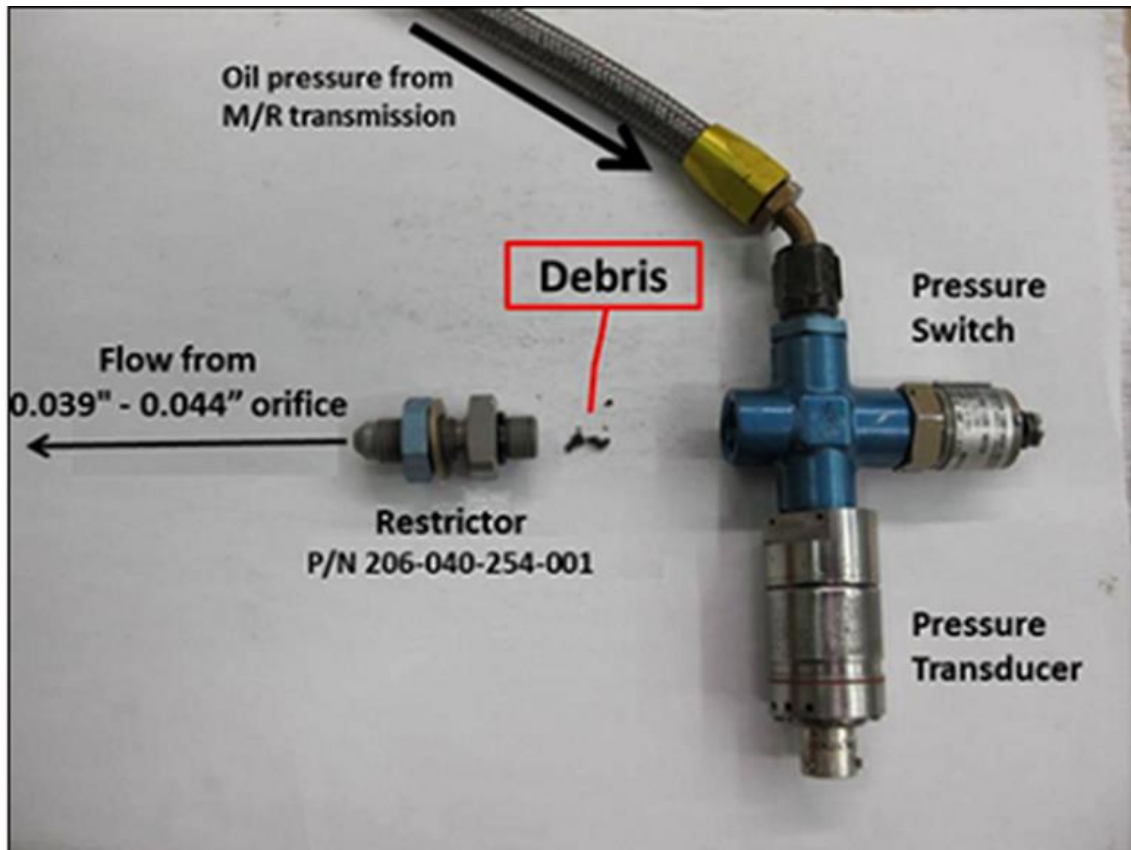


Fig. 2 - General arrangement of the failed freewheel oil supply, also note the debris blocking the restrictor or oil jet. (Ref. TSB Aviation Investigation Report A11C0152).

### Mast Yield

The freewheel unit can fail various ways. Impending failure may be indicated by severe vibration, and a squealing / grinding noise coming from the bearings and sprags during start-up.

Should the free wheel unit not engage immediately during start-up and then suddenly engage after the engine has already gained significant RPM (approximately 25%), the sudden shock of connecting the engine rotating at high speed to the high inertia of the stationary main rotor severely overloads many components, including the main rotor mast.

Free wheel failure of this kind usually results in a torsional yield failure of the main rotor mast, evidenced by a misalignment between the mast spline that engages with the main rotor head and the comparison spline in the mast below where the main rotor head engages with the mast splines. (See figure 3).



## Freewheel Oil Supply Filter

The Bell 206 freewheel unit (or one-way clutch) requires a continuous stream of cooling and lubricating oil during operation. This oil is provided under pressure from the main transmission oil system, and is delivered to the free wheel unit via a calibrated oil jet or orifice. When this oil jet becomes blocked, the flow of oil is interrupted, and causes abnormal wear and damage to the freewheel unit.

As with the investigation into the mast separation event in Canada, local investigations into mast yield events usually finds that the freewheel unit oil jet or metering orifice is blocked with debris, such as lint, corrosion, and 'O' ring fragments, typically from previous maintenance activity.

Previously, Bell Technical Bulletin TB 206-79-31 introduced a filter screen for the transmission oil out let, intended to prevent the restrictor becoming blocked with debris. Bell then issued an Information Letter IL 206-05-92 inspection and recall of the first filter to introduce an improved filter and to recommend that the filter be inspected at overhaul.

Transport Canada as the State of Design released an airworthiness directive CF-2016-13 to be carried out within 100 FH from the AD effective date 16 May 2016 that mandates a Bell Alert Service Bulletin requiring operators to inspect and clean fittings, restrictors, tubes, filters and the hose of the freewheel oil supply system. If a restrictor was found blocked during the inspection the AD required the removal, disassembly and to visually inspect the freewheel assembly prior to the next flight. The AD replaces the reducer with a new filter. The AD also incorporates cleaning and inspection of the freewheel oil supply system as a conditional inspection requirement defined in the AD mandated Alert Service Bulletin into the helicopter maintenance schedule.

Transport Canada considered that accomplishing the requirements of the mandates Bell Alert Service Bulletin was terminating action for the AD.

However, this AWB makes recommendations for operators to consider in order to reduce the possibility of torsional main rotor mast yielding and in-flight separation of the main rotor head from the mast.

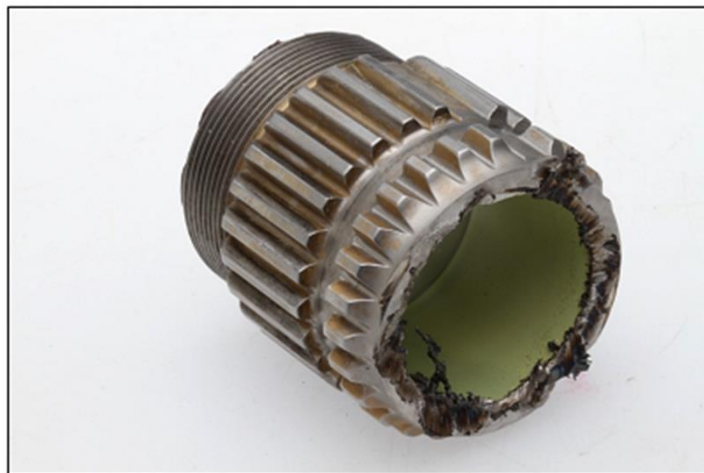


Fig. 3 - Upper mast stub which separated from the main rotor mast. (Ref. TSB Aviation Investigation Report A11C0152).



#### 4. Recommendations

Operators should consider:

1. In addition to the current AD requirements to inspect the one-way clutch oil supply orifice filter for cleanliness anytime an opening occurs to the freewheel oil supply between the restrictor and the filter, CASA recommends that the operator take action to ensure the filter is checked for cleanliness:
  - (i) Between 100 to 200 flying hours after the transmission has been opened for maintenance,
  - (ii) Following main transmission failure,
  - (iii) Whenever the main transmission is changed, or
  - (iv) The freewheel unit is removed or changed for any reason.
2. Activating the associated chip detector.

#### 5. Reporting

Defects in relation to the subject matter discussed in this Airworthiness Bulletin should be reported via the Defect Reporting System.

#### 6. Enquiries

Enquiries regarding the content of this Airworthiness Bulletin should be made via the direct link email address:

[AirworthinessBulletin@casa.gov.au](mailto:AirworthinessBulletin@casa.gov.au)

or in writing, to:

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