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SERVICE BULLETIN: JSB 012-2

Issue: 2

Date: 22nd December 2010

Subject: Jabiru Engine Flywheel Attachment

Issue	Reason for Issue	Issue Status
1	Original Issue	CANCELLED
2	Update for later engine configurations, change inspection intervals	CURRENT

1 Table of Contents

2 Applicability

All Jabiru 2200 engines
All Jabiru 3300 engines

Note that this Bulletin also applies to engines operating in Light Sport Aircraft categories.

3 Background

3.1 JSB012 Issue 2

Since Issue 1 of this bulletin was released in 2006 there have been very few incidences of damage to the flywheel attaching hardware. However in late 2010 there was an engine failure of a Jabiru 3300 engine caused by a failure of the flywheel mounting screws. Due to this event Jabiru are revising the maintenance schedule of all engines to include a regular inspection of the flywheel screws.

JSB012-1 (Issue 1) is **cancelled** and must not be referred to.

3.2 General

The flywheels of Jabiru Engines are retained to the crankshaft by six cap screws. In early 2200 engines these screws were ¼", while later 2200 engines and all 3300 engines use 5/16" screws.

If the flywheel screws fail the flywheel will partially or fully separate from the crankshaft. This results in a loss of ignition timing and/or valve timing, damage to the alternator and ignition coils and a stoppage of the engine.

3.3 Potential Causes

There are many things which can either cause these screws to fail directly or contribute to an eventual failure in some way. These include:

Excess Lubrication	The connection between the crankshaft and the flywheel relies partially on friction to transmit torque from one part to another. Excess oil in the flywheel attachment from leaky seals etc can reduce the friction between the parts and so reduce the strength of the connection.
Prop strike	Any time when the tip of the propeller touches another object it will send a spike of torque along the crank which can overload the flywheel screws
Abrupt Engine Stoppage	An engine which has experienced an abrupt stoppage – such as is caused by valve or piston failure – will have experienced an overload on the flywheel screws
Propeller Bolt Tension	If the propeller bolts loose tension the propeller may move and fret on the mounting flange of the engine. This results in an increase in the vibration being reflected back down the crankshaft and can damage the flywheel mounting screws
Propeller Balance	An out-of-balance propeller creates extra vibration
Propeller Condition	A propeller with uneven pitch or one damaged blade creates extra vibration

Propeller Drive Bushes	If the drive spigots (also known as drive bushes) which go through the engine flange into the propeller are a loose fit in the propeller then the propeller will not be properly restrained – which has the same effect as running with insufficient propeller bolt tension (Note that this generally only occurs on propellers which have been previously damaged by running with badly tensioned propeller bolts).
Propellers	While rare, some cases of damage to the flywheel screws due to the installation of a prototype composite propeller have been recorded.
Propeller Flange	Jabiru Aircraft propeller flanges are made to exacting tolerances. Use of a different, non-approved propeller flange is strongly discouraged. Inspection of non-OEM flanges fitted to some engines has shown poor machining – leading to the propeller running off-axis or out of true, creating extra vibration
Damaged Flywheel	Once a flywheel has run with loose or damaged screws it is likely that the flywheel itself will have been damaged – the loose screws move in the flywheel, elongating the holes. In extreme cases this can lead to repeated screw breakages and the need to replace the flywheel

As with any aero engine, the propeller fitted to Jabiru Engines is vital in helping to absorb engine vibrations. If the connection between the engine and propeller deteriorates or the propeller runs less smoothly for any reason, damaging vibrations can be applied to the crankshaft. This explains why most of the items on the list above deal with the propeller which is literally at the opposite end of the crankshaft to the flywheel. The effects being discussed can be visualized as being similar to Newton's Cradle (Figure 1) – a ball hits at one end and in response another ball flies off at the opposite end. In the case of the engine, any vibration or impact at the propeller passes through the crank and tries to fling the flywheel off.

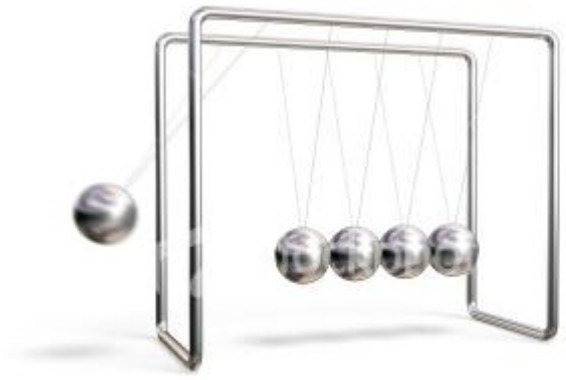

Figure 1 – Newton's Cradle

Jabiru Service Bulletin JSB 014 was also raised to coincide with the original issue of this bulletin. Its purpose is to increase owner awareness of the design and maintenance requirements of propellers. A loose or rough-running propeller will cause engine damage no matter how robust the engine design. Because of this, the following bulletin acts in concert with JSB 014 – failure to follow the recommendations of **either** bulletin will result in an incomplete approach which does not deliver the improvements to operating safety intended.

4 Recommendations:

4.1 Propeller Installation

Jabiru Service Bulletin JSB 014 provides information and recommendations for installing and maintaining all propeller types.

Jabiru Aircraft consider compliance with JSB 014 mandatory for all aircraft being used for air work (such as training, hire & glider towing).

4.2 Propeller Strike

Jabiru Aircraft require that all the flywheel screws be replaced whenever the aircraft has experienced any propeller strike. The propeller flange must also be checked for run-out, and in some cases the crankshaft must be replaced. Refer to the current engine Instruction & Maintenance Manual for details. Where in doubt, contact Jabiru Aircraft or our local authorised representative for advice.

4.3 Upgrade at Engine Overhaul

Jabiru Aircraft recommend that all engines be updated to include 5/16" screws and flywheel dowels at the major overhaul (2000-hr TTIS overhaul). This is considered a minimum upgrade standard; it is recommended that wherever possible the engine be altered to accommodate the "starfish" adaptor at the same time.

Drilling fixtures and instructions are available from Jabiru Aircraft to allow modification of older crankshafts and mating parts to accommodate dowels. Note that these are only available at authorised Jabiru Engine maintainers.

4.4 Configuration Notes:

The details given below are for the engine configuration at manufacture. Engines which have been overhauled or updated since manufacture may not conform to their original configuration.

Engines which have been updated since manufacture are to be treated as defined by their configuration – i.e. if for example, engine 22A-400 has been overhauled and upgraded to use 5/16" screws with dowels then the engine is to be treated as defined in Section 4.7.

All other engine models (2200B, 3300L etc) are cross-referenced to the original "A" build number at Jabiru – i.e. a 2200B engine will have its original 2200A build number on file. Operators wishing to know their ""A" serial number should contact Jabiru Aircraft or our local authorised representative. Alternatively the engine configuration can be determined by direct inspection of the engine.

Configuration	S/No. Range	Required Action	Maintenance Schedule
¼" Flywheel screws, 2200 only	001 - 436	Section 4.5	Section 5.1
5/16" Flywheel screws only – no dowels	2200; 437-2057 3300; 0-836	Section 4.6	Section 5.3
5/16" Flywheel screws with dowels	2200; 2058-2731 3300; 837-1521	Section 4.7	Section 5.4
5/16" Flywheel screws with dowels and "Starfish" flywheel adaptor	2200; 2732 on 3300; 1522 on	Section 4.8	Section 5.5

4.5 2200 Engines up to S/No. 436 (1/4" Flywheel Screws)

a) Engines which have ¼" screws may remain in service in their current configuration until major overhaul (2000-hr TTIS). During the major overhaul the engine is to be updated by an Authorised Jabiru Engine maintainer. Refer to Section 4.3 above

b) If the original ¼" bolts are still in place, check the flywheel screw tensions as detailed in Section 7.2. If any loose or broken screws are found, replace **all** the screws in accordance with the procedure given in Section 7.3.

c) Maintain the engine in accordance with the Modified Maintenance Schedule A in Section 6 below.

4.6 2200 Engine S/No. 437 to 2057. 3300 Engine S/No. 0 to 836 (5/16" screws, no dowels)

a) Engines which have 5/16" screws but no dowels may remain in service in their current configuration until major overhaul (2000-hr TTIS). During the major overhaul the engine is to be updated by an Authorised Jabiru Engine maintainer. Refer to Section 4.3 above.

b) Check the flywheel screw tensions as detailed in Section 7.2. If any loose or broken screws are found, replace **all** the screws in accordance with the procedure given in Section 7.3.

c) Maintain the engine as detailed in Modified Maintenance Schedule A in Section 6 below.

4.7 2200 Engines S/No. 2058 and Above. 3300 S/No. 837 and Above (5/16" screws & dowels)

a) Engines which have 5/16" screws plus dowels may remain in service in their current configuration until major overhaul (2000-hr TTIS). During the major overhaul the engine may be updated by an Authorised Jabiru Engine maintainer. Refer to Section 4.3 above.

b) Check the flywheel screw tensions as detailed in Section 7.2. If any loose or broken screws are found, replace **all** the screws in accordance with the procedure given in Section 7.3.

c) Maintain the engine as detailed in Modified Maintenance Schedule A in Section 6 below.

4.8 2200 Engines S/No. 2732 and Above. 3300 S/No. 1522 and Above ("Starfish")

a) Check the flywheel screw tensions as detailed in Section 7.2. If any loose or broken screws are found, replace **all** the screws in accordance with the procedure given in Section 7.3.

b) Maintain the engine as detailed in Modified Maintenance Schedule A in Section 6 below.

5 Compliance:

Where calendar time spans are given below, the start date is taken to be the date of issue of this Service Bulletin - 22nd December 2010.

Note that Jabiru Aircraft consider the recommendations below mandatory for all aircraft being used for air work (such as training, hire & glider towing).

5.1 Engines with Less Than 200 Hours TTIS / Less Than 200 Hours Since Full Overhaul

a) Any engine within the first 200 hours total time in service or within 200 hours of a full overhaul does not require a special inspection. Inspect the screws when the engine reaches 200 hours TTIS/TSO and thereafter at the interval defined in Modified Maintenance Schedule A in Section 6 below. This is applicable to all engine models and configurations.

5.2 Engines with 1/4" Flywheel Screws

a) Refer to Jabiru Service Bulletin JSB 014 and treat the propeller installation as detailed.
b) Check flywheel screw tensions within the next 6 months or 50 operational hours whichever is the sooner – unless the engine falls into the category detailed in Section 5.1
c) Maintain the engine in accordance with the Modified Maintenance Schedule A in Section 6 below from receipt of this Bulletin.
d) At major overhaul (2000-hr TTIS) upgrade the engine as detailed in Section 4.3.

5.3 Engines with 5/16" Flywheel Screws and No Dowels

a) Refer to Jabiru Service Bulletin JSB 014 and treat the propeller installation as detailed.
b) Check flywheel screw tensions within the next 6 months or 50 operational hours whichever is the sooner – unless the engine falls into the category detailed in Section 5.1
c) Maintain the engine in accordance with the Modified Maintenance Schedule A in Section 6 below from receipt of this Bulletin.
d) At major overhaul (2000-hr TTIS) upgrade the engine as detailed in Section 4.3.

5.4 Engines with 5/16" Flywheel Screws and Dowels

b) Refer to Jabiru Service Bulletin JSB 014 and treat the propeller installation as detailed.
c) Check flywheel screw tensions within the next 6 months or 50 operational hours whichever is the sooner – unless the engine falls into the category detailed in Section 5.1
d) Maintain the engine in accordance with the Modified Maintenance Schedule A in Section 6 below from receipt of this Bulletin.
e) At major overhaul (2000-hr TTIS) upgrade the engine as detailed in Section 4.3.

5.5 Engines with "Starfish" Adaptor

a) Refer to Jabiru Service Bulletin JSB 014 and treat the propeller installation as detailed.
b) Check flywheel screw tensions within the next 6 months or 50 operational hours whichever is the sooner – unless the engine falls into the category detailed in Section 5.1
c) Maintain the engine in accordance with the Modified Maintenance Schedule A in Section 6 below from receipt of this Bulletin.

6 Modified Maintenance Schedule

6.1 Modified Maintenance Schedule A

The following is an extract taken from Section 6.12 of the 2200 Engine Instruction & Maintenance Manual. Note that the additional flywheel attachment maintenance applies equally to the 3300 engine.

Due to the importance of propeller maintenance to the flywheel attachment, the propeller maintenance schedule is reproduced here also. Note that this propeller maintenance schedule assumes the following:

- A Jabiru wooden propeller is used
- The propeller is fitted using the Belleville (spring) washer system detailed in Jabiru Service Bulletin JSB 009.
- The installation uses a propeller extension manufactured by Jabiru Aircraft

Any deviations from this configuration will require revisions to the maintenance schedule – refer to Jabiru Service Bulletin JSB 014 for details.

1/4" Screw Test Torque:	15lb.ft
5/16” Screw Test Torque:	24lb.ft
Installation Torques:	As per current engine Instruction & Maintenance Manual

Table 1. Modified Maintenance Schedule A

		Annual Inspection	Each 200 Hours	Each 100 Hours	
1	Check flywheel screw tensions			*	*
PROPELLER					
1	Spinner		*		*
2	Spinner Flange (removal not required)		*		*
3	Spinner screws		*		*
4	Propeller condition (removal not required)		*		*
5	Propeller screws/nuts – Tension		*		*
6	Spinner / Prop Tracking		*		*

7 Procedures

7.1 Loctite 620 Notes

Loctite 620 is specified below to retain the flywheel screws and secure the flywheel. Loctite 620 is an extreme strength, high temperature grade designed to retain bearings. When using it, follow the rules below:

- Only use as much as required/specified. Excess compound can make it nearly impossible to disassemble the parts later.
- Work fast. Loctite 620 can cure very quickly. All screws must be torqued to final settings as quickly as practical. Anything more than a minute is not recommended, particularly if cure accelerator spray (Loctite 7471) is used.
- Surface preparation is critical – threads must be cleaned and prepared properly.
- Removing bolts which have been retained with Loctite 620 can normally be achieved by heating the bolt to over 150°C using a pencil-point gas burner. Minimise direct heat applied to the head of the screw as this can weaken the drive socket – direct heat towards the thread as must as possible.

7.2 Procedure – Check Flywheel Screws

i) With reference to the engine's Instruction & Maintenance Manual, remove the alternator stator to allow access to the flywheel mounting screws.

ii) Visually inspect for broken cap screws.

iii) Test unbroken screws by applying a test torque to each. Use the appropriate test torque as defined in Section 6.

7.3 Procedure – Replace Flywheel Screws In-Situ

i) With reference to the engine's Instruction & Maintenance Manual, remove the alternator stator to allow access to the flywheel mounting screws.

ii) If a broken screw is found it must be removed using a "Screw Extractor - "Rigid" or similar tool (Available in Australia from "Blackwoods" stores). Note that this process is not straightforward and Jabiru Aircraft recommend only experienced mechanics attempt it. Once the broken screw is removed the thread and hole must be cleaned as detailed below.

iii) Remove one screw. Note that as Loctite is used on the screws they may be difficult to remove and care must be taken not to break the screw off. A pencil-type gas burner with a small flame may be used to heat the screws and soften the Loctite. If in doubt, contact Jabiru Aircraft or our local representative for advice.

iv) Clean out the thread in the crankshaft using a thread tap (either ¼" UNF or 5/16 UNF, depending on bolt size). Use only hand tools – do not fit the tap in an electric drill or similar as this reduces control and makes damage to the thread much more likely. Blow out the hole using compressed air.

v) Using a new flywheel screw, hand insert it into the crankshaft thread for three turns, then wriggle it. The screw should be a firm fit with minimal movement. If the tip of the screw moves by more than 1.5mm then the hole in the flywheel has been elongated and must be

repaired. If the screw has less movement than this, skip the following steps up to number xi). Note that only new "Unbrako" or "Brighton Best 1960-Series" screws are to be used.

vi) Remove all the remaining screws and remove the flywheel from the engine.

CAUTION

DO NOT TURN ENGINE CRANK WITH FLYWHEEL BOLTS REMOVED.

The flywheel bolts also retain the valve timing gear which is located inside the gear case and is not visible without disassembling the engine. Turning the crank with the flywheel removed will result in lost timing. Once lost, re-setting the timing requires significant disassembly of the engine and is a large job suitable for experienced technicians only.

vii) Measure the size of the mounting holes in the flywheel at the front face (which faces the flywheel). If the maximum measured diameter of three or more holes exceeds 8.5mm then the flywheel must be replaced. Lesser damage can be repaired as detailed in the following steps.

viii) Clean the flywheel-crankshaft mating face & the flywheel screw holes using Loctite 7471 cure accelerator. Re-fit the flywheel to the engine, taking care to line up the timing mark on the flywheel (a small hole drilled through near the attachment screws.) to the timing marks on the vacuum pump drive and the crankshaft. Locate the flywheel to the engine using one temporary bolt.

ix) Apply Loctite 620 to the replacement screws as detailed below. Place the replacement screws in the flywheel and screw into the crankshaft by 3 turns each (remove the temporary bolt once at least 2 of the replacement screws are in place).

x) Apply a small amount of Loctite 620 (approximately 2 match-heads worth) to the shanks of the new screws near the heads. This Loctite will bond the shank of the bolt to the flywheel and prevent movement. Tighten the screws in a diagonal pattern as noted below in point xii).

xi) Fit the replacement screw. As detailed in the current Instruction & Maintenance Manual, apply a small amount of Loctite 620 (approximately the size of a fat match head) to the tip of the bolt. Torque the screw to the tension detailed in the current issue of the Instruction & Maintenance Manual for the engine.

xii) One at a time, remove the remaining screws and replace them with new parts using the process detailed above. Note that a normal "star" or "diagonal" pattern must be used to avoid distorting the flywheel.

xiii) Re-install the alternator stator in accordance with the details given in the current engine Instruction and Maintenance Manual. Check the gaps between the ignition coils and the flywheel magnet plates in accordance with the details given in the appropriate Engine Instruction & Maintenance Manual.

8 Airworthiness Note:

8.1 General

Where required, work called for by this Bulletin must be carried out by authorised personnel only. In Australia this generally means the original builder of an Experimental-category aircraft (either RA-Aus or VH registered), an RA-Aus Level 2 holder for other RA-Aus aircraft or a Licensed Aircraft Maintenance Engineer (LAME).

On completion of the work, the authorised person must note the completion of the actions required by this bulletin in the aircraft's maintenance logbook. This note should refer to the completion of maintenance requirements of this Service Bulletin, indicate if any loose or broken screws were found, indicate the date of the work and the identity (including licence number where appropriate) of the person carrying out the work.

8.2 Manuals

The changes to maintenance procedures detailed below are being incorporated into all Jabiru Engine Instruction & Maintenance Manuals. Copies of the latest versions of these manuals are available from the Jabiru Aircraft web site www.jabiru.net.au As all the engine manuals are living documents which are regularly updated to include information developed during recent operational experience it is strongly recommended that all owners update their manuals to the latest revision. Manuals for solid lifter engines are also being maintained with the latest updates and are available to owners.

8.3 General Engine Maintenance Notes

- Always take care while working around the propeller – ensure the ignitions are turned OFF and that no-one is in the cockpit while working on the engine.
- Always use a good quality tension wrench.
- It is strongly recommended to check the accuracy of adjustable-type tension wrenches at least every year.
- The flywheel screws also retain the valve timing gear, so turning the crank with the flywheel removed will result in lost timing. Once lost, re-setting the timing requires significant disassembly of the engine and is a much larger job.

9 Reporting

To help monitor engines in service Jabiru Aircraft Australia requests that any engines found with broken flywheel screws be reported to us. Owners should contact Jabiru Aircraft (or our local representative) via email or fax:

Email: info@jabiru.net.au
Fax: +61 7 4155 2669

Please include the following details:

- Engine Serial Number
- Engine Time Since Overhaul
- Aircraft use & Maintenance (i.e. private use, maintained by owner **or** flying school use, maintained by RA-Aus Level 2).
- Propeller type
- Propeller extension type
- Any other relevant information.