INSTRUCTION AND MAINTENANCE MANUAL
FOR
JABIRU 2200 AIRCRAFT ENGINE

DOCUMENT No. JEM2204-10

This Manual has been prepared as a guide to correctly operate, maintain and service the Jabiru 2200 engine.

It is the owner's responsibility to regularly check the Jabiru web site at www.jabiru.net.au for applicable Service Bulletins and have them implemented as soon as possible. Failure to do this may render the aircraft un-airworthy and void Jabiru's Limited, Express Warranty.

This document is controlled while it remains on the Jabiru server. Once this no longer applies the document becomes uncontrolled.

Should you have any questions or doubts about the contents of this manual, please contact Jabiru Aircraft Pty Ltd.

Applicable to Jabiru 2200 Models from S/No 2068 and above (Hydraulic Lifter Type)

1 Table of Contents

1 TABLE OF CONTENTS 2
1.1 TABLE OF FIGURES 4
1.2 LIST OF EFFECTIVE PAGES 4
2 DESCRIPTION 5
2.1 MODEL 5
2.2 GENERAL INFORMATION 5
2.3 GENERAL DESCRIPTION 6
2.4 DETAILS 8
2.5 MANUFACTURER 8
2.6 ENGINE MANUALS 8
2.7 ADDITIONAL SERVICE INFORMATION 8
3 SPECIFICATIONS 9
3.1 ENGINE MODELS 9
3.1.1 2200J 9
3.1.2 2200B 9
3.1.3 2200C 9
3.1.4 2200A 9
3.2 GENERAL SPECIFICATIONS & EQUIPMENT 9
3.3 PERFORMANCE 10
3.3.1 Engine Ratings 10
3.4 FUEL 11
3.5 LUBRICANT 11
3.5.1 Run in Period 11
3.5.2 Normal Operations 11
3.6 COOLING SYSTEM 11
3.7 OPERATING SPEEDS AND LIMITS 12
3.7.1 Ground Operating Limits 12
3.7.2 In-Flight Operating Limits 12
3.8 PROPELLER SELECTION & SPECIFICATIONS 12
3.9 DIMENSIONS 13
3.10 DENOMINATION OF CYLINDERS 13
3.11 DISTRIBUTOR CYLINDER MAP 14
3.12 POWER CURVE 14
4 OPERATING INSTRUCTIONS 16
4.1 PRE-START CHECKS 16
4.2 STARTING PROCEDURE 16
4.2.1 Cold Engine 16
4.2.2 Warm Engine 16
4.3 WARMING UP PERIOD, GROUND TEST 16
4.4 TAKE-OFF 16
4.5 ENGINE STOP 17
4.6 ENGINE STOP AND START DURING FLIGHT 17
5 CHECKS ON ENGINE & INSTALLATION 18
5.1 DAILY CHECKS 18
5.2 PERIODIC CHECKS 19
5.3 CHECK AFTER INITIAL 10 HOURS 19
5.4 CHECK AFTER INITIAL 25 HOURS 20
5.5 50 HOURS CHECK 20
5.6 100 HOURS CHECK 20
5.7 200 HOURS CHECK 20
5.8 ENGINE OVERHAULS 21
5.9 ENGINE PRESERVATION 21
5.9.1 Flyable Storage 21
5.9.2 Returning Engine to Service From Flyable Storage 21
5.9.3 Temporary Storage 21
5.9.4 Inspection During Storage 22

5.9.5 Indefinite Storage 22
5.9.6 Returning Engine to Service After Temporary Storage 22
5.9.7 New Engine Storage 23
5.9.8 Operation in Winter 23
5.9.9 Carburettor Icing 24
5.9.9.1 Icing Due to Water in fuel 24
5.9.9.2 Icing Due to High Air Humidity. 24

6 MAINTENANCE 25

6.1 LUBRICATION SYSTEM 25
6.2 AIR INTAKE FILTER 25
6.3 CARBURETOR ADJUSTMENT 25
6.4 COMPRESSION CHECK 26
6.4.1 Compression Gauge: 26
6.4.2 Pressure Differential Test: 26
6.5 IGNITION SYSTEM 27
6.5.1 High-Tension Lead Connections 27
6.5.2 Spark Plugs 28
6.6 EXHAUST SYSTEM 28
6.7 BOLTS AND NUTS 28
6.8 TAPPET ADJUSTMENT / HYDRAULIC VALVE LIFTERS 28
6.9 VALVE ROCKERS 30
6.10 HEAD BOLTS 30
6.11 TACHOMETER AND SENDER 30
6.12 ADDITIONAL CHECKS – POST SERVICE 30
6.12.1 Propeller 30
6.12.2 Engine 31
6.12.3 Fuel System 31
6.13 SPECIAL MAINTENANCE GUIDANCE 31
6.13.1 Special Maintenance – Non-Approved Propellers 31
6.14 ENGINE INSPECTION CHART 33

7 SERVICE & REPAIR 35

7.1 SERVICE INTERVAL TOLERANCE 35
7.2 ENGINE OVERHAUL AND TBO 35
7.2.1 Full Overhaul 35
7.2.2 Top End Overhaul 35
7.3 ENGINE REMOVAL PROCEDURE 36
7.4 ENGINE INSTALLATION 37
7.5 PROP STRIKE INSPECTION 38

8 NOTES BEFORE STARTING ENGINE 40

9 TABLE OF LUBRICANTS 42

10 TORQUE SPECIFICATION FOR BOLTS & NUTS 43

10.1 PRESCRIBED SEALANTS AND PRIMERS 43
10.2 ELECTRICAL SYSTEMS SPECIFICATIONS 43

11 OPERATING NOTES – QUICK REFERENCE GUIDE 44

11.1 NEW ENGINE NOTES 44
11.2 NORMAL OPERATION NOTES 45
11.2.1 Regular Checks 45
11.2.2 Oil 46
11.2.3 Engine Cooling 46
11.2.4 Consumables 47
11.2.5 Starting 47

12 TROUBLE SHOOTING 48

12.1 TROUBLESHOOTING TABLES 48
12.1.1 Engine Won't Start 48
12.1.2 Engine Idles Unsteadily After Warm-Up Period: Smoky Exhaust 48
12.1.3 Engine Runs Erratically or Misfires Occasionally 48
12.1.4 Engine Runs Too Hot - Oil Temperature Above 110°C (230°F) 49
12.1.5 Unsatisfactory Power Output 49

12.1.6 Low Oil Pressure 49
12.1.7 Engine Keeps Running with Ignition Off 49
12.1.8 Excessive Oil Consumption 49
12.1.9 Knocking Under Load 50
12.1.10 Engine Hard to Start at Low Temperature 50
12.1.11 Hydraulic Valve Lifters 50
12.2 TROUBLESHOOTING QUICK GUIDE 51
12.2.1 Low Oil Pressure 51
12.2.2 Flicking Of Oil Pressure Gauge 51
12.2.3 CHT 51
12.2.4 RPM 51
12.2.5 Magneto Checks 51
12.2.6 Rough Cylinder Running 51
12.2.7 Carby Breather 51
12.2.8 Limitations 51
13 AIRWORTHINESS LIMITATIONS SECTION 52
14 NEW ENGINE – JABIRU'S LIMITED, EXPRESS WARRANTY 53
15 JABIRU'S LIMITED, EXPRESS WARRANTY: CLAIM FORM 55

1.1 Table of Figures

Figure 1. Drawing 9404041/1 Engine Dimensions 13
Figure 2. Cylinder Denomination & Firing Order 13
Figure 3. Distributor Cylinder Map 14
Figure 4. Power Curve 14
Figure 5. Power Curve, 2200C, 2200B Engines 15
Figure 6. High-Tension Lead Connections 27
Figure 7. Cam Identification Markings 29
Figure 8 Dial Indicator Position for Crankshaft & Prop Flange Run Out 38
Figure 9 – Head Bolt Locations 40
Figure 10. Oil System Schematic 42

1.2 List of Effective Pages

This manual is revised as a complete document. All pages must display the same revision number.

Issue Notes:

1	Update Torque Values	
2	Update Propeller Installation Details	
3	Update Maintenance Schedule	Oct 2006
4	Add tolerance to servicing intervals	Jan 2007
5	Add hydraulic lifter maintenance requirement	Jul 2008
6	Add additional hydraulic lifter information	Nov 2008
7	Add new engine storage details	Dec 2009
8	Prop flange fitting details added	May 2010
9	Starter motor overhaul, prop strike details added	Jun 2010
10	Remove overhaul information, ref overhaul manual	Apr 2011

2 Description

2.1 Model

All Jabiru 2200 Engine Models from S/No 2068 on.

2.2 General Information

WARNING:

Jabiru Aircraft Pty Ltd has devoted significant resources and testing to develop the Jabiru 2200 aircraft engine. This engine is intended to be installed in accordance with the details given in the "INSTALLATION MANUAL FOR JABIRU 2200 AIRCRAFT ENGINE", document No. JEM2202. Any other uses or applications may be extremely hazardous, leading to property damage, or injury or death of persons on or in the vicinity of the vehicle. Jabiru Aircraft Pty Ltd does not support the use of this engine in any applications which do not meet the requirements of the "INSTALLATION MANUAL FOR JABIRU 2200 AIRCRAFT ENGINE". Any non-compliant installation may render the aircraft un-airworthy and will void any warranty issued by Jabiru.

The Jabiru 2200 aircraft engine is designed to be operated and maintained only in strict accordance with this instruction and maintenance manual. Any variation of any kind, including alteration to any component at all, whether replacement, relocation, modification or otherwise which is not strictly in accordance with this manual may lead to dramatic changes in the performance of the engine and may cause unexpected engine stoppage, engine damage or harm to other parts of the aircraft to which it may be fitted and may lead to injury or death. Jabiru Aircraft Pty Ltd does not support any modifications to the engine, its parts, or components. Any such actions may render the aircraft un-airworthy and will void any warranty issued by Jabiru.

Maintenance and modification cannot be supervised by the manufacturer. Maintenance requires extreme cleanliness, exact parts, precise workmanship and proper consumables. It is your responsibility to ensure absolute attention to detail no matter who may become involved in work on this engine. Your safety, your life and your passenger's lives rely on precise and accurate following of instructions in this manual.

In exchange for the engine manual provided by Jabiru Aircraft Pty. Ltd. ("Jabiru") I hereby agree to waive, release, and hold Jabiru harmless from any injury, loss, damage, or mishap that I, my spouse, heirs, or next of kin may suffer as a result of my use of any Jabiru product, except to the extent due to gross negligence or willful misconduct by Jabiru. I understand that proper skills and training are essential to minimize the unavoidable risks of property damage, serious bodily injury and death that arise from the use of Jabiru products.

2.3 General Description

It is said that "aircraft are designed around available engines".

Jabiru believe that the Jabiru range of very light engines offers opportunities for light aircraft designers to develop a new generation of light aircraft.

Jabiru engines are designed to be manufactured in small batch quantities using the very latest Computer Numerically Controlled (CNC) machine tools. All Jabiru engines are manufactured and assembled in a very modern factory in Bundaberg where each engine is run in on a Dynometer and calibrated before delivery. The crankcase halves, cylinder heads, crankshaft, starter motor housings, gearbox cover (the gearbox powers the distributor rotors) and coil mounts – together with many smaller components are machined from solid. The sump (oil pan) is the only casting. The cylinders are machined from bar 4140 chrome molybdenum alloy steel, with the pistons running directly in the steel bores. The crankshaft is also machined from 4140 chrome molybdenum alloy steel, the journals of which are precision ground prior to being Magnaflux inspected. The camshaft is manufactured from 4140 chrome molybdenum alloy steel – with nitrided journals & cams.

The propeller is direct crankshaft driven and does not use a reduction gearbox. This facilitates its light-weight design and keeps maintenance costs to a minimum. The crankshaft features a removable propeller flange which enables the easy replacement of the front crankshaft seal and provides for a propeller shaft extension to be fitted, should this be required for particular applications. Cylinder heads are machined from solid aluminium billet, thereby providing a substantive quality trail to material source. Connecting rods are machined from 4140 alloy steel and the 45mm big end bearings are of the automotive slipper type.

Many components of the engines are sourced from outside suppliers. These items include camshaft followers, and the bendix gear in the starter motor. The ignition coils are also sourced from outside suppliers, and are modified by Jabiru for their own particular application.

An integral alternator using rare earth magnets provides alternating current for battery charging and electrical accessories. The alternator is attached to the flywheel and is driven directly by the crankshaft. The ignition system is a transistorised electronic system; two fixed coils mounted adjacent to the flywheel are energised by rare earth magnets attached to the flywheel. The passing of the coils by the magnets creates the high voltage current which is then transported by high tension leads to the centre post of two automotive type distributors (which are simply rotors and caps) before distribution to automotive spark plugs, two in the top of each cylinder head. The ignition system is fixed timing and, therefore, removes the need for timing adjustment. The ignition system is fully redundant, self-generating and does not depend on battery power.

The crankshaft is designed with a double bearing at the propeller flange end and a main bearing between each big end; it therefore does not have flying webs. 48mm main bearings are also of the automotive slipper type. Thrust bearings are located fore and aft of the front double bearing allowing either tractor or pusher installation.

Pistons are manufactured to Jabiru design by a major manufacturer, they are fitted with 3 rings, the top rings being cast iron to complement the chrome molybdenum cylinder bores. Valves are 7mm (stem dia) which are purpose manufactured for the Jabiru engine.

The valve gear includes pushrods from the hydraulic cam followers to forged steel valve rockers mounted on a shaft through a Teflon coated bronze-steel bush. Valve guides are manufactured from aluminium/bronze, as is found in larger aero engines and high performance racing engines.

Replaceable valve seats are of nickel steel and are shrunk into the aluminium cylinder heads. The valve gear is lubricated via the hollow pushrods.

An internal gear pump is driven directly by the camshaft & provides engine lubrication via an oil circuit which includes an automotive spin-on filter, oil cooler and in-built relief valve.

The standard engines are supplied with two Ram-air cooling ducts, which have been developed by Jabiru to facilitate the cooling of the engine and direct air from the propeller to the critical areas of the engine, particularly the cylinder heads and barrels. The fitment of these ducts is a great bonus for the home builder or engine installer, as they remove the need to design and manufacture baffles and the establishment of a plenum chamber, which is the traditional method of cooling air-cooled aircraft engines. The fact that these baffles and plenum chamber are not required also ensures a "cleaner" engine installation, which in turn facilitates maintenance and inspection of the engine and engine component. So the hard work of engine installation has largely been done for you by the Jabiru design team. RAMAIR ducts are available for tractor or pusher configurations. Special ducts are available for certain installations.

The engine is fitted with a 1.5 kW starter motor, which is also manufactured by Jabiru and provides very effective starting. The engine has very low vibration levels, however it is also supported by four large rubber shock mounts attached to the engine mounts at the rear of the engine. An optional bed mount is available.

The fuel induction system comprises a BING pressure compensating carburettor. Following carburation, the fuel/air mixture is drawn through a swept plenum chamber bolted to the sump casting, in which the mixture is warmed prior to entering short induction tubes attached to the cylinder heads.

An effective stainless steel exhaust and muffler system is fitted as standard equipment, ensuring very quiet operations, which in the Jabiru aircraft have been measured at 62dB at 1000' full power flyover.

For those owners wanting to fit vacuum instruments to their aircraft the Jabiru engine design includes an optional vacuum pump drive, direct mounted through a coupling on the rear of the crankshaft.

The Jabiru engine is manufactured within an Australian Civil Aviation Safety Authority (CASA) approved Quality Assurance System to exacting standards.

Jabiru recommend a TBO of 2000 hours, with a top end overhaul done at 1000 hours, or when engine condition indicates the need to overhaul earlier.

2.4 Details

- 4 Stroke
- 4 Cylinder Horizontally Opposed
- 1 Central Camshaft
- Push Rods
- Over Head Valves (OHV)
- Hydraulic Valve Lifters with Automatic Adjustment
- Ram Air Cooled
- Wet Sump Lubrication
- Direct Propeller Drive
- Dual Transistorised Magneto Ignition
- Integrated AC Generator
- Electric Starter
- Mechanical Fuel Pump
- Naturally Aspirated – 1 Pressure Compensating Carburettor
- 6 Bearing Crankshaft

2.5 Manufacturer

Jabiru Aircraft Pty Ltd,
P.O. Box 5792,
Bundaberg West,
Queensland 4670

2.6 Engine Manuals

JEM2204 - Instruction and Maintenance Manual
JEM2202 - Installation Manual
JEM2203 - Parts Book
JEM0001 - Overhaul Manual

All manuals are available on the Jabiru web site www.jabiru.net.au

2.7 Additional Service Information

Occasionally new or expanded service information will be made available to customers in the form of Jabiru Service Bulletins or Jabiru Service Letters. Jabiru distributes this information to owners of certain types of Jabiru product. However, it is strongly recommended that owners and operators regularly visit the Jabiru Australia website – www.jabiru.net.au – or the website of their local Jabiru representative to check for new or updated additional service information.

3 Specifications

3.1 Engine Models

3.1.1 2200J

- The Jabiru 2200J Engine is certified to the CS-22 Subpart H Design Standard by the Civil Aviation Safety Authority of Australia.
- The CASA Type Certificate Number for the 2200J Engine is 160-2. Specifications of the engine are available on the Type Certificate Data Sheet attached to the Type Certificate.
- At the time of writing, copies of all Type Certificates for Jabiru products are available from the CASA website - http://www.casa.gov.au/casadata/cota/aust.htm

3.1.2 2200B

- The Jabiru 2200B Engine has been certified as a part of the Jabiru J160-C Aircraft.
- The CASA Type Certificate Number for the J160-C Aircraft is VA-515.
- 2200B engines with a serial number of 22B001 and above are Manufacturer Certified to the ASTM F2339 design standard.

3.1.3 2200C

- The Jabiru 2200C Engine is certified to the CS-22 Subpart H Design Standard by the Civil Aviation Safety Authority of Australia.
- The CASA Type Certificate Number for the 2200C Engine is VE-501. Specifications of the engine are available on the Type Certificate Data Sheet attached to the Type Certificate.
- At the time of writing, copies of all Type Certificates for Jabiru products are available from the CASA website - http://www.casa.gov.au/casadata/cota/aust.htm
- The Jabiru 2200C Engine is rated at 60kW (80 hp).
- 2200C engines with a serial number of 22C001 and above are Manufacturer Certified to the ASTM F2339 design standard.

3.1.4 2200A

- 2200A engines with a serial number of 22A1845 and above are Manufacturer Certified to the ASTM F2339 design standard.
- Modern Jabiru 2200A Engines are rated at 63kW (85hp). Nominally, this applies to engines with a serial number above approximately 22A-2068, however any engine which meets a certain configuration (for example, after an overhaul) will produce this power level. The power difference compared to older models is due to minor, evolutionary changes to the engine design.

3.2 General Specifications & Equipment

- Displacement	:	2200 cc
- Bore	:	97.5 mm
- Stroke	:	74 mm
- Compression Ratio	:	8 :1
- Direction of Rotation of Prop Shaft	:	Clockwise – Pilot's view – Tractor Applications
- Ramp Weight	:	61 kg (134 lbs) Complete including Exhaust, Carburettor, Starter Motor, Alternator & Ignition System.
- Ignition Unit	:	Jabiru dual ignition - breakerless transistorized. Battery independent
- Ignition Timing	:	25° BTDC
- Firing Order	:	1 – 3 – 2 – 4
- DC Output	:	10 Amps up to engine S/No. 22A-2661 17 Amps engine S/No. 22A-2661 and 22C-001 onwards
- Fuel Consumption		

	@ 75% Power	:	13 l/hr (3.5 US gal/hr)
-	Fuel	:	AVGAS 100/130. MOGAS with RON Octane Rating 95 or above may be used if AVGAS is not available.
-	Oil	:	Aero Oil W Multigrade 15W-50, or equivalent Lubricant complying with MIL-L-22851C, or Lycoming Spec. 301F, or Teledyne – Continental Spec MHF-24B
-	Oil Capacity	:	2.3 L (2.2 quarts)
-	Spark Plugs	:	NGK D9EA – Automotive Electrode Gap: 0.55 - 0.6mm (0.022" - 0.024")
-	Generator	:	Jabiru, permanently excited single phase AC generator with rectifier/regulator
-	Carburettor	:	BING constant depression Type 94/40
-	Air Intake Filter	:	folder paper cartridge type
-	Fuel Filtration	:	0.1 mm (100 Micron) maximum particle size.
-	Fuel Pump	:	Camshaft driven diaphragm type
-	Starting System	:	Electric 12 V / 1.5 kW
-	Oil Filter	:	RYCO Z 386 or equivalent

3.3 Performance

Static sea level ratings under the following conditions:-

- International Standard Atmospheric conditions at sea level.
- Aircraft service equipment drives unloaded. (Vacuum Pump not fitted)
- Full rich fuel/air mixture.
- Maximum cylinder head temperature.
- Standard Jabiru air filter and cold air.
- Standard exhaust muffler.

3.3.1 Engine Ratings

Table 1 – Engine Ratings

Model:	2200C, 2200B	All Other 2200 Models
Maximum Power	60 kW (80 hp) @ 3300 RPM - ISO STD Conditions	63 kW (85 hp) @ 3300 RPM - ISO STD Conditions

Note: These apply only to engines meeting the configurations detailed within this manual.

- Fuel Consumption 21 L/hr @ Takeoff/Max Continuous Rating
- Oil Consumption 0.1 L/hr (max)

3.4 Fuel

Fuel: AVGAS 100 LL & AVGAS 100/130
Leaded and Unleaded Automotive Gasoline above 95 Octane RON may be used if AVGAS is not available
Detailed fuel information is available in Jabiru Service Letter JSL007.
Current Jabiru Service Bulletins & Letters available at www.jabiru.net.au

Oil: The following chart is intended to assist in choosing the correct grade of oil and must be considered as a guide only. Multiviscosity grades can also be used as indicated

Average Ambient Temperature	Mineral Grades	Ashless Dispersant Grades
Above 35° C (95°F)	SAE 60	SAE 60
15° C to 35°C (59° to 95°F)	SAE 50	SAE 50
-17°C to 25°C (1° to 77°F)	SAE 40	SAE 40

Equivalence of SAE and commonly used Commercial Grade designations:					
SAE:	20	30	40	50	60
Commercial:	55	35	80	100	120

3.5 Lubricant

3.5.1 Run in Period

Oil Weight:	80	100	120
Outside Air Temperature	-17°C to 25°C (1° to 77°F)	15°C to 35°C (59° to 95°F)	Above 35°C (95°F)

3.5.2 Normal Operations

Oil Weight:	W80	W100	W120
Outside Air Temperature	-17°C to 25°C (1° to 77°F)	15°C to 35°C (59° to 95°F)	Above 35°C (95°F)

3.6 Cooling System

Free air cooled. Ensure that Ram-air ducts are correctly fitted & located.

The required pressure drop across the cylinders at 1.3 V_s (clean stall speed) is 4.3 cm (1.7") water gauge, minimum. A minimum of 6cm (2.4") is recommended at cruise speed.

3.7 Operating Speeds and Limits

3.7.1 Ground Operating Limits

Idle Speed	Nom	900 RPM (set while engine is hot)
Oil Pressure – Idle	Min	80 kPa (11 psi)
	Max	525 kPa (76 psi)
Oil Temperature:	Max.	100°C (212°F)
Max. CHT		180°C (356°F)

Note: If ground temperature limits are reached, shut the engine down or cool it by pointing the aircraft into wind.

3.7.2 In-Flight Operating Limits

Maximum Speed		3300 RPM
Maximum Continuous Speed		3300 RPM
Idle Speed		900 RPM (set while engine is hot)
Oil Pressure – Normal Operations	Min	220 kPa (31 psi)
	Max	525 kPa (76 psi)
– Idle	Min	80 kPa (11 psi)
– Starting & Warm up	Max	525 kPa (76 psi)
Oil Temperature:	Min	15°C (59°F)
	Max.	118 °C (244°F)
Oil Continuous Temperature		80 - 100°C (176° - 212°F)
Max. CHT (Climb)		200°C (392°F)
Max Continuous CHT (Cruise)		180°C (356°F)

Notes:

- Time with CHT at between 180°C and 200°C is not to exceed 5 Minutes
- (Read Cylinder Head Temperature – CHT – under the spark plug nearest to the exhaust on the hottest cylinder).

EGT Continuous Limits:		
EGT (Mid-Range / Cruise):	Min	680° - 720°C (1256° - 1328°F)
EGT (Above 70% Power):	Min	640° - 680°C (1184° - 1256°F)

Note: An EGT gauge is not included as standard equipment on the Jabiru 2200 engine, though a system can be supplied as an option.

3.8 Propeller Selection & Specifications

WARNING:

Correct propeller selection, tuning and maintenance are vital for the safe operation of this engine. The guidance given herein and in the Engine Installation Manual must be adhered to for safe operation.

- Many propeller brands and models **are not approved** by Jabiru Aircraft. Operators may choose to use these propellers, **however they do so at their own risk**. For information on which propellers are approved, please contact Jabiru P/L or our local representative.
- Propeller selection is discussed in detail in the Jabiru 2200 Engine Installation Manual.
- 2-bladed, fixed-pitch wooden propellers manufactured by reputable companies are recommended by Jabiru Aircraft.
- All propellers must be maintained in accordance to the propeller manufacturer's requirements in conjunction with Jabiru Aircraft P/L requirements.
- A maximum moment of inertia of 0.25 kgm^2 is recommended for the propeller assembly.

3.9 Dimensions

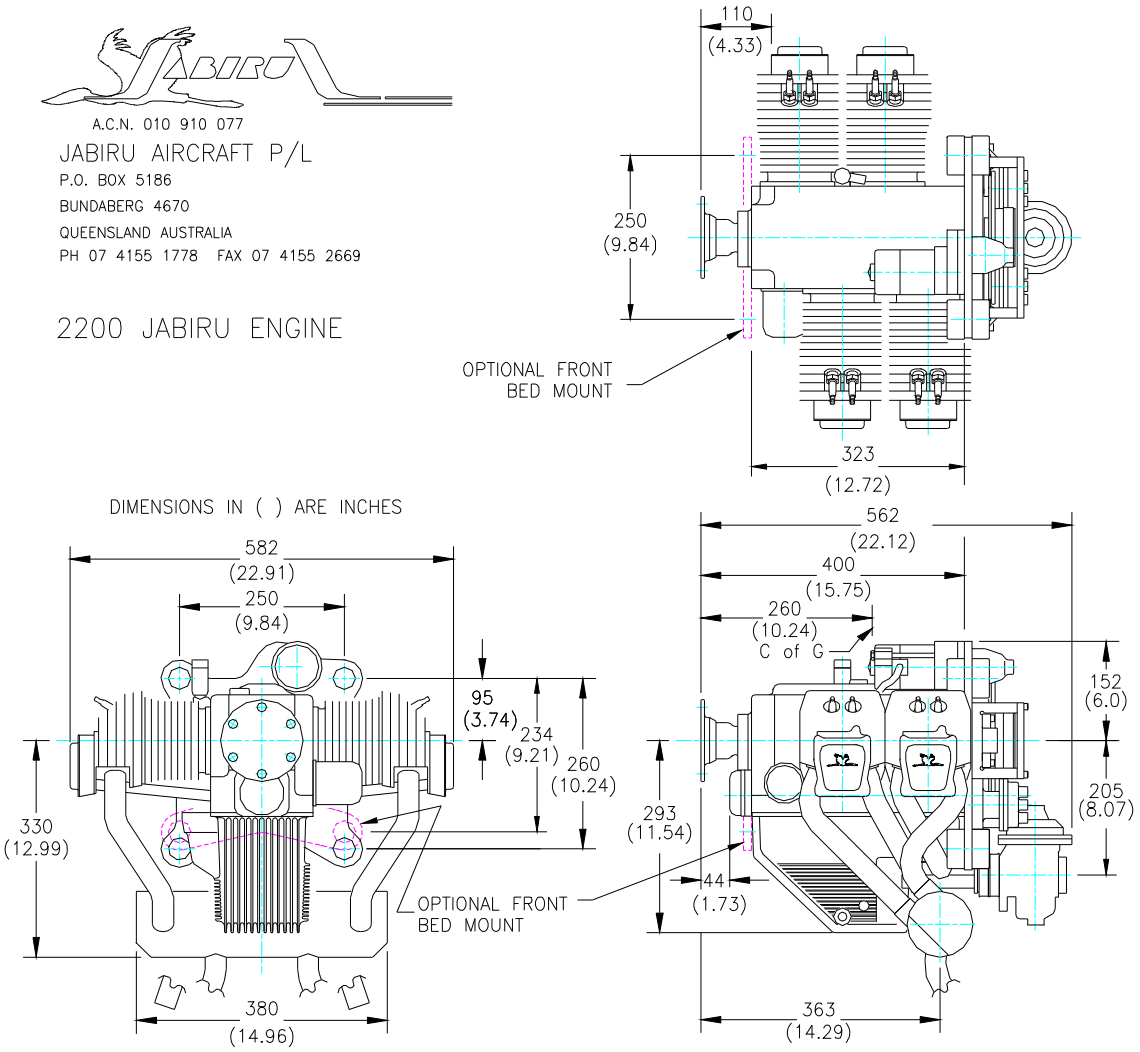

Figure 1. Drawing 9404041/1 Engine Dimensions

3.10 Denomination Of Cylinders

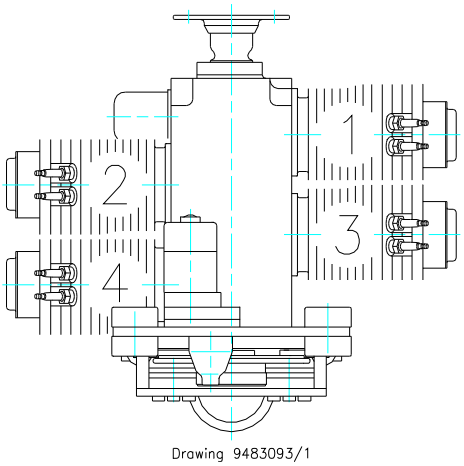

Figure 2. Cylinder Denomination & Firing Order

Cylinder Firing Order: 1 – 3 – 2 – 4

3.11 Distributor Cylinder Map

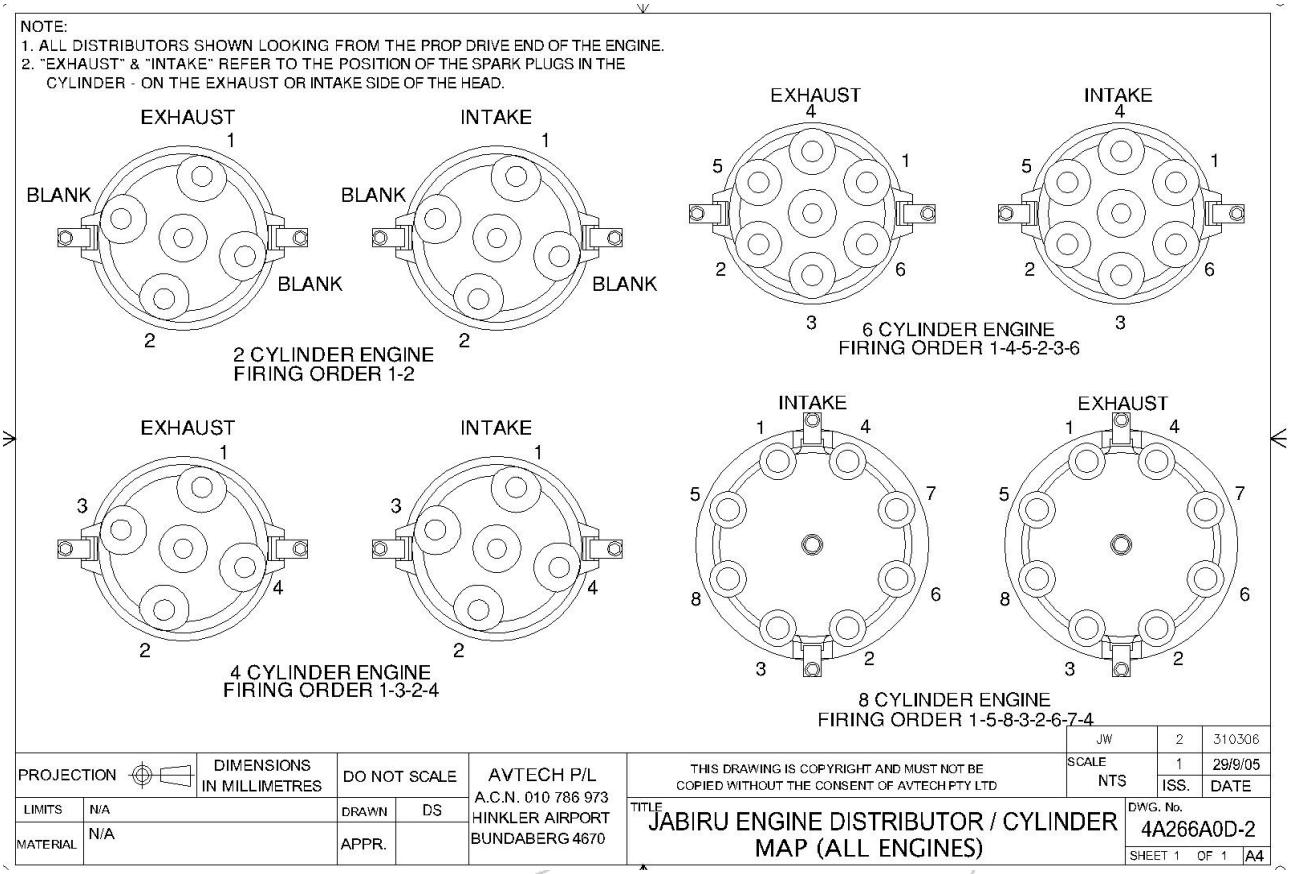

Figure 3. Distributor Cylinder Map

3.12 Power Curve

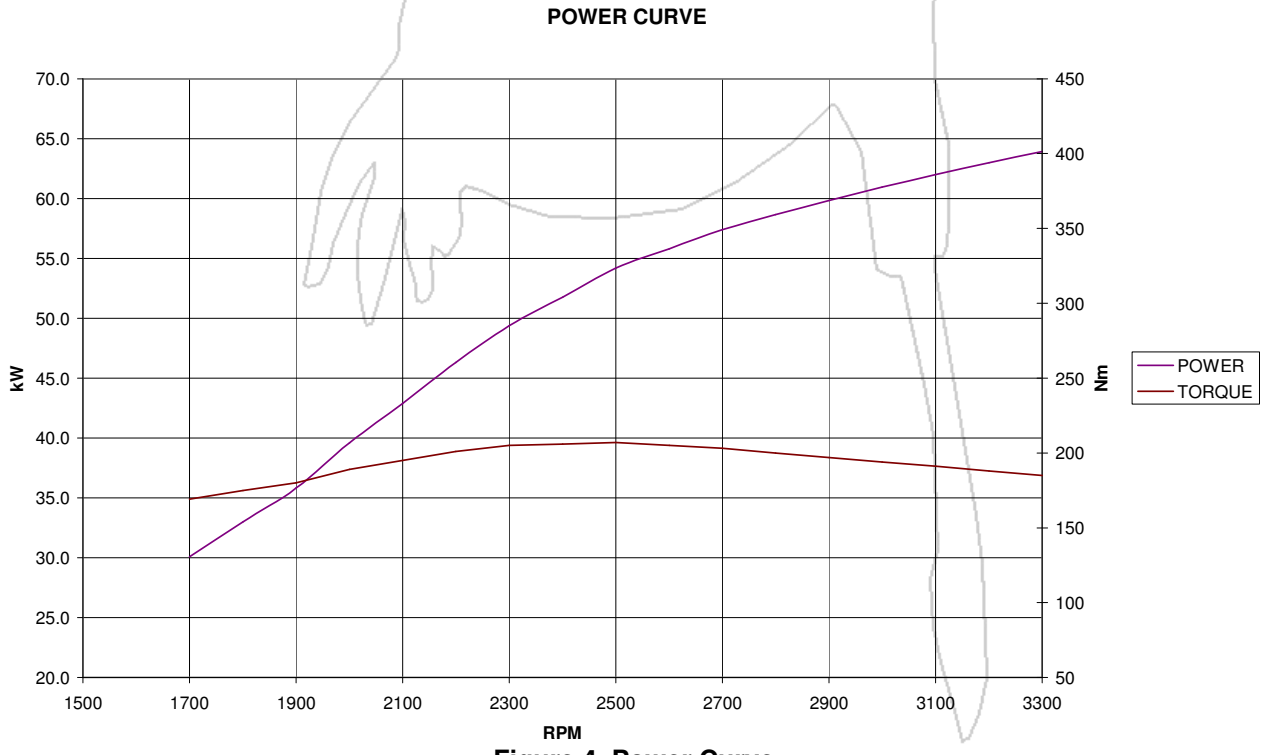

Figure 4. Power Curve

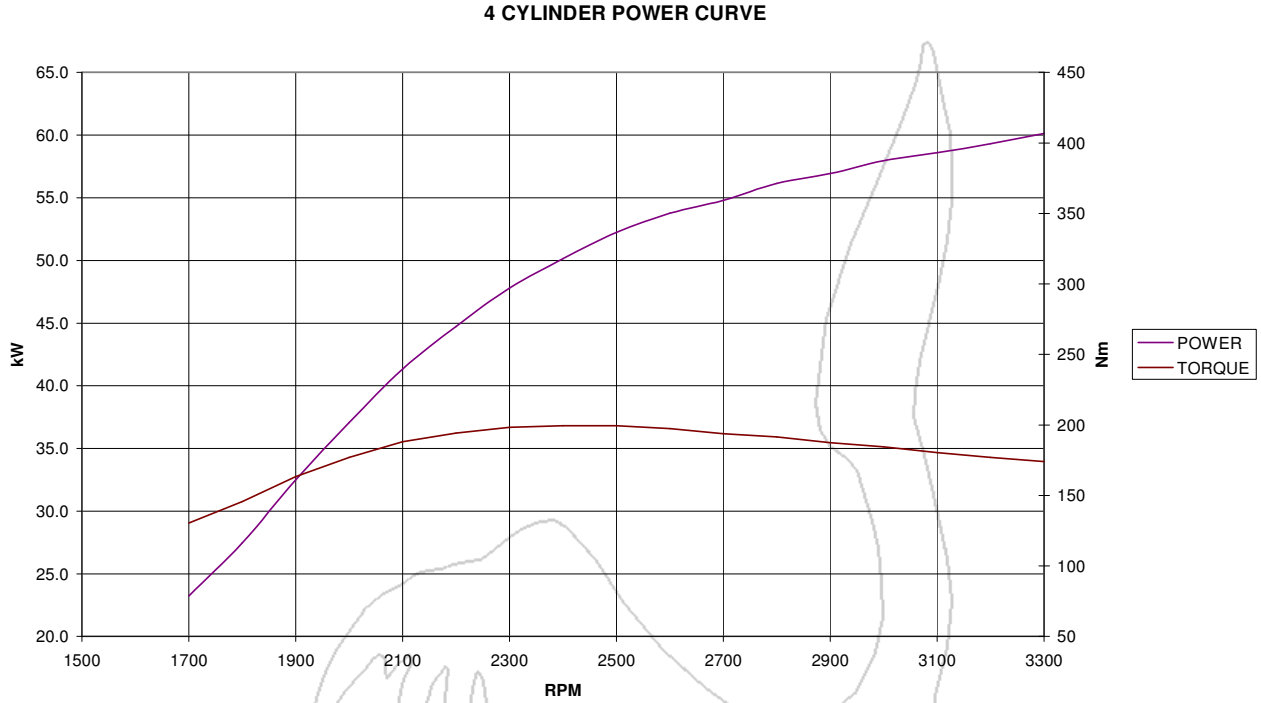

Figure 5. Power Curve, 2200C, 2200B Engines

Note: Multiply Kilowatts (kW) by 1.341 to get Horesepower (hp).
i.e. 63.5 kW x 1.341 = 85 hp.

4 OPERATING INSTRUCTIONS

To ensure that the engine operates reliably, carefully observe all of the operating & maintenance instructions.

4.1 Pre-Start Checks

- Daily Checks (See Paragraph 5.1)
- Move throttle position to FULL & check for ease of movement over the entire range. Return to idle before attempting to start engine.

4.2 Starting Procedure

Notes:

- Activate Starter for a maximum of 20 seconds, followed by a cooling period of 1 minute.
- When engine runs, adjust the throttle to achieve smooth running at approximately 1200 RPM. Deactivate Choke. Check Oil Pressure has risen within 5 seconds - if not, shut down.
- It is strongly recommended to crank the engine to obtain oil pressure following an oil change before starting.

4.2.1 Cold Engine

Fuel Tap	OPEN
Choke	ON – HOLD (in cold conditions less than 20°C)
Fuel Pump	ON for 10 seconds then off
Throttle	CLOSED to stop: “cracked” throttle degrades choke
Master	ON
Ignition	BOTH ON
Starter	PRESS

4.2.2 Warm Engine

As for cold start, with the following differences:

Choke	OFF
Throttle	Slightly “Cracked” from off position (approx 2%).

4.3 Warming Up Period, Ground Test

Start the warming up period with the engine running at 1200 RPM. Continue at 2000 RPM depending on ambient temperature, until oil temperature reaches 15°C (59°F). Check the two ignition circuits at 2000 RPM. Note: - RPM with only one ignition should not drop by more than 100 RPM.

DO NOT apply full power until CHT reaches 100 °C (212°F)

DO NOT apply full power until Oil Temperature reaches 50°C (104°F)

DO NOT allow cylinder heads to rise above 150°C (302°F) during ground running.

4.4 Take-Off

- Climb with the engine at maximum continuous power.
- Observe Oil & Cylinder Head Temperatures & Oil Pressure.
- Max RPM at Full Throttle is 3300 RPM
- **Limits must not be exceeded !**

4.5 Engine Stop

In normal conditions, cooling down the engine during descent & taxiing will permit the engine to be stopped by switching OFF the ignitions.

4.6 Engine Stop and Start During Flight

Reduce power to 2000 RPM to cool engine for 30 seconds, then to idle. Switch ignitions OFF. Starting procedure is the same as ground starting, without choke for a warm engine & with choke for a cold engine. Note: Engine cools quickly with propeller stopped in flight. Choke will therefore normally be needed to restart. Do not apply the starter motor if the propeller is windmilling.

5 CHECKS ON ENGINE & INSTALLATION

5.1 Daily Checks

- Ensure free movement of throttle & choke cables.

- Check Oil Level, replenish if necessary.
  - i) Check oil level by screwing in cap fully before withdrawing
  - ii) Oil level should be between the MAX & MIN marks - but must never be below the MIN mark.
  - iii) Before long periods of operation, ensure that the level is at least at the mid position.
  - iv) Difference in the oil quantity between MAX & MIN mark is 300 mL (0.317 US Quarts).
  - v) See section 11.1 for first 25 hours of Operation.
  - vi) Overfilling is detrimental to the engine.

- Check lubrication & fuel system for leaks.
  - i) Visually inspect for signs of leakage on the ground where the aircraft was parked overnight
  - ii) Inspect the oil cooler for leaks through the cowl opening
  - iii) Visually inspect the underside of the aircraft for fresh oil or fuel residue.

- Check exhaust system for security.
  - i) Wriggle the exhaust tail pipes by hand, checking for excessive movement, rubbing on cowls or unusual noises.

- With Ignition & Master OFF, and throttle closed, turn propeller by hand & observe engine for odd noises or heavy movements. Check for regular compression. If irregular, refer to Trouble Shooting section of this Manual for corrective action.

CAUTION:
Prior to pulling through the propeller by hand, both ignition circuits & the Master Switch must be switched OFF, the brakes applied and the throttle closed.

WARNING
A hot engine may fire with the ignition/s switched OFF.
DO NOT TURN OVER A HOT ENGINE BY HAND

CAUTION:
A common cause of low compression is poorly sealing valves. Continued operation in this condition will result in damage to valves, valve seats, valve guides & overhead gear.

- Prior to takeoff - follow the Starting & Warm Up procedure, observe the engine behavior & throttle response.

- Check temperatures & pressures. Conduct a short ground test at full power (a few seconds) (consult aircraft Flight Manual).

NOTE:
Prolonged running at full power on the ground can cause engine overheating & damage unless special, oversized air ducts and oil coolers are used.

5.2 Periodic Checks

- Basic Inspection Checklists are given below. Note that depending on the aircraft's use, some items may need checking at more frequent intervals than those specified. For example, when operating from dusty dirt runways the air cleaner will need attention at reduced intervals.
- After the initial 10 hours, check in accordance with para. 5.3.
- After the initial 25 hours, check in accordance with para. 5.4.
- After 50 hours of operation, check in accordance with para. 5.5 & thereafter after each 50 hours of operation.
- After 100 hours of operation, check in accordance with para. 5.6 and thereafter after each 100 hours of operation.
- After 200 hours of operation, check in accordance with para. 5.7 and thereafter after each 200 hours of operation.
- At TBO, overhaul in accordance with the latest approved revision of the Jabiru Engine Overhaul Manual.

5.3 Check after initial 10 Hours

- Details of specific operations are shown in "Maintenance" section of this manual.
- Remove engine cowlings
- Check engine mounts.
- Thoroughly check engine for missing or loose bolts, nuts, pins, etc.
- Check fit of cooling air ducts & baffles. Check the engine (including oil cooler) for signs of abrasion against cowls and ducts.
- Check induction and exhaust flange for loose bolts.
- Check safety wires, ignition wiring & hose connections.
- Retorque cylinder head bolts at 20 ft.lbs in diagonal pattern
- Check exhaust system, check exhaust cap screw tensions.
- Check fuel system for leaks & abrasion.
- Check wiring for damage & for tightness.
- Test run engine.
  - i) Turn engine on starter with both ignitions OFF until oil pressure registers
  - ii) Start engine. Observe starting, warm up & acceleration behavior to maximum RPM (10 seconds max)
  - iii) Check temperatures & pressures.
  - iv) Stop Engine.

5.4 Check After Initial 25 Hours

Details of specific operations are shown in Chapter 6 "Maintenance" of this manual.

- Remove engine cowlings
- Check engine mounts.
- Thoroughly check engine for missing or loose bolts, nuts, pins, etc.
- Check fit of cooling air ducts & baffles. Check the engine (including oil cooler) for signs of abrasion against cowls and ducts.
- Check induction and exhaust flange for loose bolts.
- Check safety wires, ignition wiring & hose connections.
- Oil Change. Refer to Chapter 6 “Maintenance” for details. Use normal aviation running oil.
- Change oil filter. Inspect old filter for excessive contamination, metal filings etc.
- Retorque cylinder head bolts at 20 ft.lbs in diagonal pattern
- Check exhaust system, check exhaust cap screw tensions.
- Check fuel system for leaks & abrasion.
- Check wiring for damage & for tightness.
- Test run engine.
  - v) Turn engine on starter with both ignitions OFF until oil pressure registers
  - vi) Start engine. Observe starting, warm up & acceleration behavior to maximum RPM (10 seconds max)
  - vii) Check temperatures & pressures.
  - viii) Stop Engine.

5.5 50 Hours Check

- Details of specific operations are shown in "Maintenance" section of this manual.
- Conduct the items shown under 25 Hour Check above (include oil and filter change)

5.6 100 Hours Check

- Details of specific operations are shown in "Maintenance" section of this manual.
- Conduct the items shown under 25 and 50 Hour Checks (include oil and filter change)
- Renew spark plugs.

5.7 200 Hours Check

- Details of specific operations are shown in "Maintenance" section of this manual.

- Conduct the items shown under 25, 50 and 100 Hour Checks.

5.8 Engine Overhauls

- The Overhaul Manual for the Jabiru 2200 and 3300 engines must be referred to for engine overhaul procedures.

- The overhaul work must be carried out to Jabiru specifications at an approved aeronautical service facility or by an approved Jabiru Service Centre.

- If necessary, changes to the TBO Limit due to operational experience, will be announced by Jabiru in a Service Bulletin.

5.9 Engine Preservation

The following procedures assume that the engine is installed in a Jabiru airframe. For other aircraft types, refer to the manufacturer's service manual. If the engine is not fitted to an airframe, ignore those items referring to the airframe.

Note: Failure to store the engine for a long period of time, in excess of 90 days, without taking the preventative measures as outlined in the manual will affect claims upon Jabiru's Limited, Express Warranty.

5.9.1 Flyable Storage

- Flyable storage is defined as a maximum of 30 days non-operational storage.

- Ensure that the engine has been stopped by turning off the fuel valve, ensuring all fuel is drained from the carburettor bowl.

- Fit covers to engine induction air inlet and exhaust outlets to minimize moisture ingress to cylinders.

- Every 7th day the propeller should be rotated through 5 revolutions, without running the engine. Leave the propeller in the horizontal position to ensure even distribution of liquids in the wood. If left in the vertical position, liquids will drain to the lower tip resulting in an unbalanced propeller. Note that intake & exhaust covers should be removed before performing this task.

CAUTION
Ensure that the Master and Ignition Switches are **OFF** before turning engine.

5.9.2 Returning Engine to Service From Flyable Storage

After flyable storage, returning the engine to service is accomplished by performing a thorough pre-flight inspection. Ensure all protective covers are removed from the intake & exhaust.

5.9.3 Temporary Storage

- Temporary storage is defined as aircraft in non-operational status for a maximum of 90 days (nominal – depending on ambient temperature, humidity etc).

- Disconnect or remove battery.

- Treat as for flyable storage (see details above), plus:
  i) For temporary storage, fill fuel tank with correct grade of fuel (to prevent moisture accumulation).

Then:

- Disconnect spark plug leads and remove spark plugs from each cylinder.

- Using a spray atomiser, spray corrosion inhibitor through the spark plug hole with the piston down, then rotate until both valves are open and re-spray to coat the induction and exhaust system. When all cylinders are treated leave prop horizontal and retreat each cylinder.

NOTE: Use Shell Aero fluid 2UN (MIL-C-6529C Type 1) Corrosion Preventive Concentrate or similar engine preservative.

CAUTION
Ensure that the Master and Ignition Switches are OFF!

- Install spark plugs and connect leads.

- Seal exhaust pipes. Attach a red streamer to each seal.

- DO NOT seal fuel tank breather.

- Attach a warning placard to the propeller stating that vents and breathers have been sealed and prop should not be turned.

- The engine must not be started with the seals in place.

5.9.4 Inspection During Storage

- Generally inspect airframe and clean as necessary.

- Inspect the interior of at least one cylinder through the spark plug hole for corrosion at least once a month.

- If, at the end of the 90 day period, the aircraft is to be continued in non-operational storage -- repeat Steps 1-5 above (most will only need to be checked).

5.9.5 Indefinite Storage

For indefinite storage, treat the engine as per Temporary Storage Section above. In Addition:

- Drain fuel tank & ensure carburettor bowl is empty by running engine with fuel valve off until it stops, or by draining the bowl manually.

- Long term storage: Flood the cylinder / sump with corrosion inhibitor. Periodically remove one spark plug per head, turn engine over then replace spark plugs.

5.9.6 Returning Engine to Service After Temporary Storage

After temporary storage, the procedures for returning the aircraft to service are as follows:

- Check battery charge level and install.

- Check carburettor air filter and service if necessary.

- Remove warning placard from propeller.
- Remove inlet & exhaust covers.
- Remove, clean and gap spark plugs.
- Drain all oil before rotating. While spark plugs are removed, rotate propeller several revolutions using the starter to clear excess corrosion inhibitor from cylinders.

CAUTION
Ensure that the Master and Ignition Switches are OFF!

- Install spark plugs -- torque to 11 Nm (8 ft/lbs).
- Check fuel filter -- replace if necessary.
- If returning to service after indefinite storage, fill fuel tank with correct grade of fuel.
- Check fuel tank and fuel lines for moisture and sediment. Drain enough fuel to eliminate any moisture and sediment.
- Check fuel tank breather is clear.
- Perform a thorough pre-flight inspection.
- Start and warm engine.

5.9.7 New Engine Storage

- In many cases new or overhauled engines may be stored for some months or years before being installed in an aircraft. All engines are treated with corrosion inhibitor by Jabiru Aircraft Australia before shipping from the factory, however this treatment is roughly equivalent to that described in Section 5.9.3 above. It is intended for a maximum life of approximately 90 days – though the exact effective life of the treatment depends on the ambient temperature, humidity etc.

- If an engine is to be stored before use the owner must:
  i) Install the engine within 90 days (nominally) of the engine leaving the factory, or
  ii) Repeat the Temporary Storage procedures given in Section 5.9.3 at a suitable interval (90 days nominally, depending on ambient temperature, humidity etc) and periodically inspect the engine in accordance with Section and 5.9.4, or
  iii) Treat and maintain the engine for Indefinite Storage per Section 5.9.5 above.

- When the engine is to be run the storage measures must be reversed as detailed in the appropriate sections above.

5.9.8 Operation in Winter

- It is recommended to carry out an engine service prior to the start of the cold season. For selection of oil, consult the table of lubricants given in the Engine Specifications above. Follow the following advice for operation at extremely low temperatures:

5.9.9 Carburettor Icing

It is important to distinguish between two kinds of icing:
Icing due to water in fuel, and
i) Icing due to high air humidity.

5.9.9.1 Icing Due to Water in fuel

Water in fuel will accumulate at the lower parts of the fuel system & can lead to freezing of fuel lines, filters or jets. Remedies are:

a) Drain, using fuel tank water drain.
b) Ensure fuelling without traces of water. If in doubt, use a chamois as a filter.
c) Install a generously sized water separator.
d) Ensure that fuel lines do not permit the accumulation of water.
e) Add up to 2% isopropyl to fuel. Note: Addition of alcohol raises vapour pressure and may aggravate vapour lock in warm weather; this practice should be used only when needed and not in warm weather.

IMPORTANT
Fuels containing alcohol always carry a small amount of water in solution. In situations where there are changes in temperature, or where there is an increase in alcohol content, water (or a mixture of water & alcohol) may settle & could cause problems.

CAUTION:
Do not add any form of alcohol (including automotive fuels with Ethanol or similar additives) to a Jabiru Aircraft fiberglass fuel tank unless directed otherwise by the aircraft operating manual. The sealant used in some (older) tanks will be damaged if it comes into contact with alcohol, leading to leaks.

f) Prevent condensation of humidity, ie avoid temperature differences between the aircraft & fuel.

5.9.9.2 Icing Due to High Air Humidity.

Carburettor icing due to humidity may occur in the carburettor venturi & leads to performance loss due to changes in the mixture.

The only effective remedy is to preheat the intake air by use of the Carburettor Heat Control.

CAUTION
When using auto fuels, ensure all components of the fuel delivery system are cooled to prevent fuel vaporization.

6 MAINTENANCE

6.1 Lubrication System

- Oil Change as required. Oil Filter Change as required. Visual Check for Leaks.
- Drain the oil while engine is still warm.
- Change the oil filter at every 50 hourly inspection.
- Fill with oil. (approx 2.3 litres)
- Check oil level then run the engine. The MAX mark must not be exceeded after the engine has been run to ensure that all lines, filters etc are full.
- Use only registered brand oils meeting the specification detailed in Para. 2.5.
- DO NOT drain the oil cooler during a normal oil change. The cooler holds only a small amount of old oil which has negligible effect on the new oil. Taking the hoses on & off the cooler can prematurely age the oil lines and lead to hoses slipping off the cooler.

6.2 Air Intake Filter

- Clean filter by removing from the intake housing & blowing compressed air against the direction of the intake flow.
- For operation in heavy dust conditions, clean air filter at shorter intervals than recommended for normal conditions.
- A clogged filter will reduce engine performance as well as promote premature engine wear.

6.3 Carburetor Adjustment

- Idle stop screw is a 7mm screw against throttle lever. Adjust its position to adjust engine idle speed.
- Standard idle mixture screw position is 1-1/4 turns out. Fine adjustment may be necessary to give a smooth idle.
- The mixture is set by selecting jet sizes. As supplied, the engine has jets to suit a majority of installations, however, the mixture may be affected by running a propeller which does not meet the requirements listed in the installation manual or by ambient temperature extremes. If an engine is to used in these situations an EGT gauge should be fitted and monitored against the limits specified above.

CAUTION: Do not change carburetor settings without consulting with Jabiru Aircraft or our local authorised representative. If EGT readings fall outside the range given above, contact Jabiru Aircraft or our local authorised representative.

- The carburetor automatically adjusts the mixture to account for altitude.

IMPORTANT

- Check carburetor joints for degradation.
- Check carburetor linkage for full & free movement, correct positioning of stops and security.

6.4 Compression Check

6.4.1 Compression Gauge:

- Measure compression using a compression tracer. Readings are taken with fully open throttle valve at engine oil temperature between 30° & 70°C (90° to 160°F).

- If readings are below 6 bar (90 psi) a check of the pistons, cylinders, valves & cylinder heads must be undertaken.

6.4.2 Pressure Differential Test:

- Check using a pressure loss or leakage tester eg SUN or BOSCH tester; max. allowable pressure loss is 25%.

As an alternative to a compression test, a pressure differential test (Leak down) can be carried out. This is a much better test of the condition of rings, bore, head sealing and valve. This is the normal test used in aviation and requires specific equipment.

The test is carried out with the engine in warm to hot condition. Input pressure is best set at 80 PSI; a second gauge reads the differential. This is done with piston on TDC on the firing stroke. Note that the propeller needs to be restrained. A differential of lower than 80/60 (or generally, a 25% loss) indicates a problem.

Problems can be better identified using the leak down:

i) Blow by through the crankcase vent indicates worn rings or bore
ii) Leaking from carby indicates a poor intake valve seal
iii) Leaking from exhaust indicates a poor exhaust valve seal
iv) Head leak indicates poor head to cylinder seal

With the problem narrowed down, correction work can more easily be carried out.

- A Pressure Differential Tester can be made by placing an orifice of 1 mm ID and 3mm length between two pressure gauges. This will give the same result as with the above instrument. Max. pressure drop is 25%.

CAUTION: Poor compression can be an indication of a serious problem. For example, continued operation with poor compression due to a poorly-sealing valve can lead to eventual **valve failure** and **heavy damage to the piston, con-rod, barrel and head. If low compression is found which cannot be solved by reference to the Troubleshooting section below, please contact Jabiru Aircraft or our local authorized representative.**

6.5 Ignition System

6.5.1 High-Tension Lead Connections

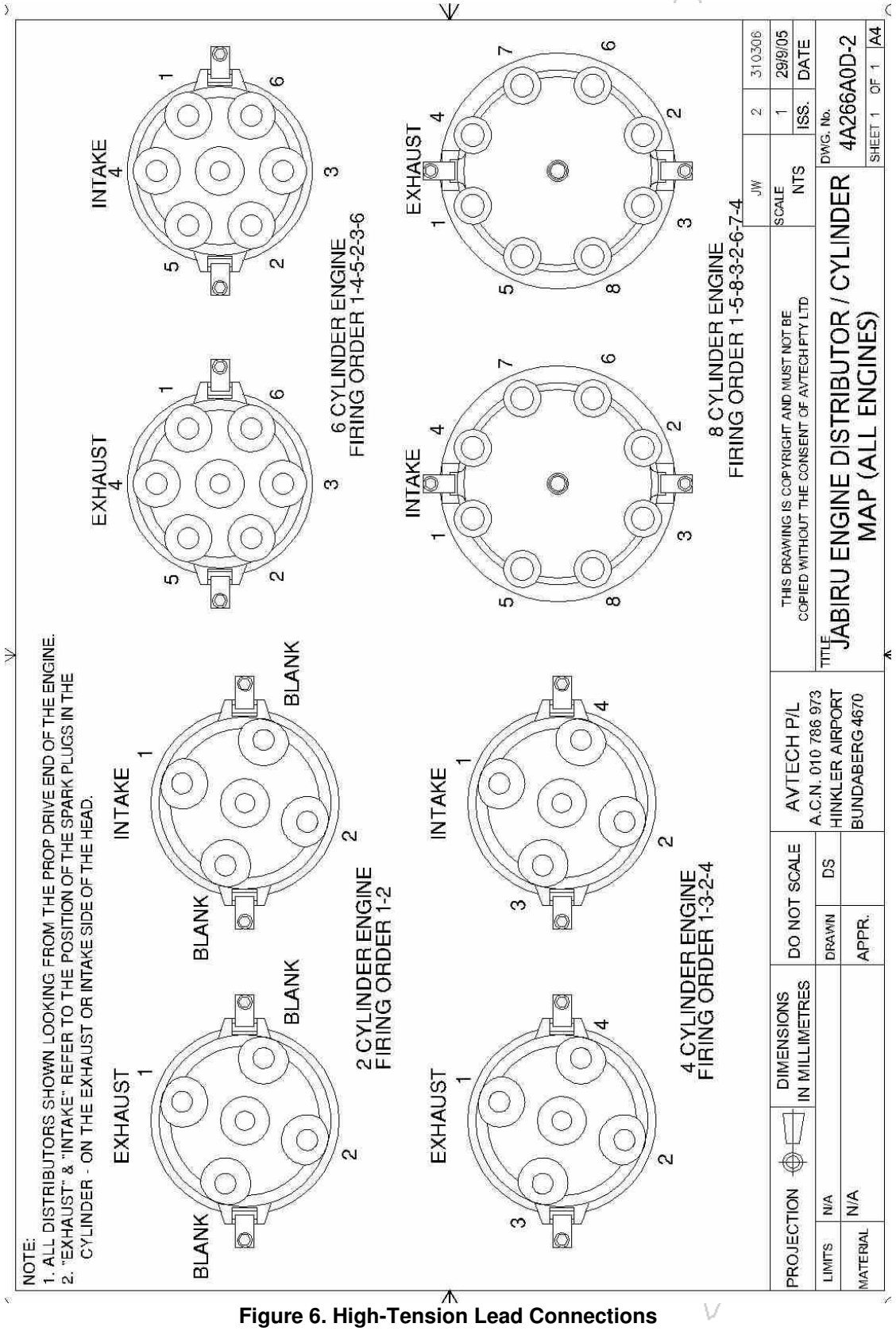

Figure 6. High-Tension Lead Connections

Figure 6 above shows the High-Tension lead connections between the distributors and the spark plugs.

6.5.2 Spark Plugs

- Do not use steel or brass brushes for cleaning & never sandblast plugs.
- Clean with plastic brush in a solvent.
- Check electrode gap & if necessary, adjust to 0.55 - 0.6mm (0.022" - 0.024") by carefully bending the electrode.
- Recommended Plugs: NGK D9EA.
- Use suitable anti-seize on thread.

IMPORTANT
Only tighten spark plugs on cold engine & only to the torque values shown in Section 9 using appropriate anti-seize compound

Note: When plugs are removed from a warm engine, the inspection of the tip of the spark plug can be used to indicate the health of the engine:

- *Brown to Dark Brown* :- Plug & calibration is correct.
- *Velvet Black*:- Mixture too rich. Check choke. Insufficient air intake. Check for clogged air filter.
- *Oily, Glossy Coating:- Misfiring. Too much oil in combustion chamber. Worn cylinder & piston rings.*
- *Whitish with Melt Droplets*:- Mixture too lean. Leaking valves.

CAUTION: This guide is only relevant when running the engine on AVGAS. Unleaded fuels give different plug colours which are generally unsuitable for use in evaluating engine tuning.

6.6 Exhaust System

- Visual check for damage, rubbing, leaks & general condition.

6.7 Bolts and Nuts

- Check for tightness, re-torque if necessary (see Section 9).

Note: Cylinder Base Nuts are factory set and must NOT be checked for tension at periodic service intervals.

6.8 Tappet Adjustment / Hydraulic Valve Lifters

- The Hydraulic Valve Lifters used in the engine automatically adjust for any valve movement, so periodic adjustment of the valve clearances is not required, however the valve lifters are a serviceable item and some monitoring is required to ensure they are working properly.
- EITHER – Remove each rocker cover and check that each lifter has not collapsed. This is done by turning the crankshaft so that the valve is fully in the closed position, then feeling the

rocker by hand. There should be no free rotation of the rocker. Press down on the pushrod end of the rocker – the lifter should feel hard, with minimal movement possible under thumb pressure. Note that the correct method for finding this point is to turn the crank until the valve is fully open, then turning the crankshaft through one complete revolution to rotate the cam lobe away from the lifter.

- OR – after the service, idle the engine, listen for loud tapping noises and feel for rough running. This must be carried out with the cowls removed. Note that due to the need to have a person at the controls of the aircraft, this is a two-person job.

CAUTION:
Whenever the engine is running there must be a qualified person inside the aircraft, at the controls. Under NO circumstances run the engine without a qualified person at the controls

- Troubleshooting information is given in Section 12.1.11

- Air can be caught inside the lifters after maintenance. Running the engine at a high idle - approx 1500 RPM – will expel the air but may take up to 15 minutes. When fitting lifters after inspection or maintenance they should be filled by injecting oil into the hole in the side of the lifter. Care must be taken to ensure all air is removed.

- Several different hydraulic lifters have been used in Jabiru 2200 engines. The cam P/No. fitted to the engine must be known when ordering replacement lifters. This information can be found from the engine's S/No. or from its overhaul records.

- The type of lifter must be matched correctly to the cam design. Use of mismatched parts will cause reduced engine power and possible engine damage.

- Figure 7 shows identification markings on a P/No. 4A432A0D cam – it has two "rings" machined at the oil pump end and two small "spots" machined at the drive gear end. Similarly, P/No. 4A430A0D cams are marked with one "ring", and one "spot". Engines assembled with these cam types must use a Jabiru P/No. PE4A001 Hydraulic Lifter. These cams are standard in engines with S/No. 22A-2850 & 22C-001 onwards.

- Cams manufactured **without** any identification "rings" or "spots" must use a Jabiru P/No. 4A294C0D Hydraulic Lifter.

- The different types of Hydraulic Lifter are not marked and the difference requires disassembly and careful measuring using a micrometer to detect. Accordingly, care must be taken to ensure different types of lifter are not confused during maintenance.

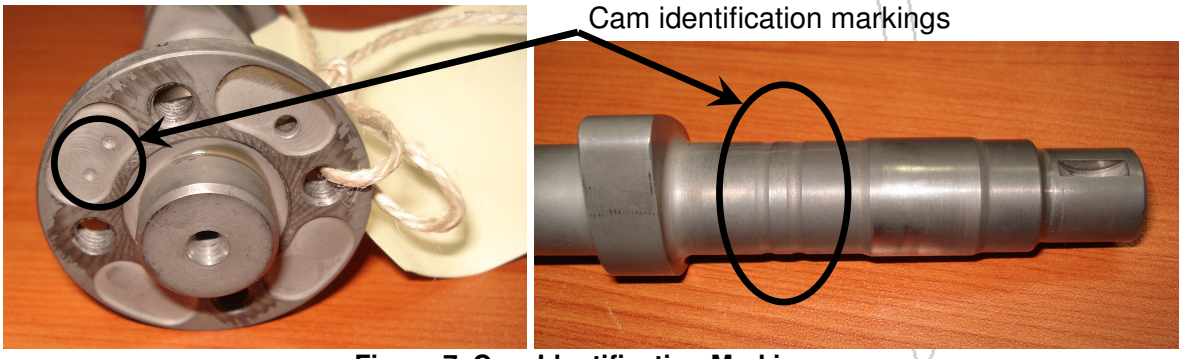

Figure 7. Cam Identification Markings

- Hydraulic Lifters can be 'bled' back while installed by using a suitable tool to push rocker/pushrod assembly back to enable a small gap on rocker to valve tip. Total bleed-back is less than 2 mm. More details are given in the engine overhaul manual.

Hydraulic lifters can be removed for inspection using the following method:

- Remove the rocker pivot shaft, rockers and pushrods from the cylinder to be inspected.
- Remove the pushrod tube retaining circlips from the cylinder head and slide the pushrod tubes out through the head.
- Remove the hydraulic lifter adaptors from the crankcase.
- Remove the lifters.

Whenever lifters are removed the working face of the cam and the lifter should be inspected for damage. If damage is found, contact Jabiru Aircraft P/L or our local representative for further guidance.

6.9 Valve Rockers

- The condition of the bushes fitted to the valve rockers must be monitored. This can be done by a visual inspection with the rocker cover removed – check for visible movement of the rocker on the shaft, visible degradation of the bush material etc.
- This should be done as a part of the hydraulic lifter inspections noted above.

6.10 Head Bolts

- Head bolts are torqued to 20 ft.lb. when cold.
- Carry out this adjustment after five hours of operation and again after ten hours of operation. The bolts should thereafter be checked annually or as specified below.

6.11 Tachometer and Sender

- Many apparent engine problems can be caused through inaccurate tachometers. Where engine performance is observed to be outside limits, the tachometer should be checked against a calibrated instrument.
- Tachometer sender gap is 0.4mm (0.016"). The sender must have at least 60% covered by the tags fitted to the gearbox side of the flywheel.
- Ensure both tags are equal distance from sender.

6.12 Additional Checks – Post Service

- Check engine for ease of starting. Conduct idle test run. Checklist of engine inspection.

6.12.1 Propeller

- Check spinner, spinner flange, screws, prop, tension, spinner and prop tracking.

CAUTION:
The maintenance schedules given in this manual are designed for engines which use a propeller and propeller flange approved by Jabiru Aircraft Australia.

Operators using non-approved parts do so at their own risk.
Jabiru Aircraft strongly recommend operators using non-approved parts follow a system of extra preventative maintenance checks to monitor their engine. This should be based on Section 6.13.1 below.
Airworthiness and issues when claiming upon Jabiru's Limited, Express Warranty may also result.

6.12.2 Engine

- Carburettor, carburetor heat system, carburetor attachment
- Air filter
- Engine baffles and air ducts
- Front crankcase seal
- Hoses, lines and fittings
- Intake system.
- Exhaust system, including muffler, springs and heat muff
- Ignition harness, spark plugs, coils, distributor caps and rotors
- Electrical wiring, starter, solenoid and electrical connections.
- Fuel pump
- Engine controls and linkages
- Engine mount rubbers & mount structure.
- Oil system tubes and hoses, oil cooler. Oil & filter change and filter inspection if due.
- Firewall
- Engine cowlings and clips
- All SCAT Hoses and Clamps.

6.12.3 Fuel System

- Fuel filter
- Fuel drain valve
- Carburetor bowl
- Fuel tank vent, cap and placards
- Fuel shut-off valve and placards
- Electronic fuel boost pump and fittings
- Fuel lines and connectors, fire sleeves.

6.13 Special Maintenance Guidance

- This manual has been prepared to provide instruction & maintenance requirements for operating a Jabiru engine. As much as possible the information contained herein applies to all engines, however the following paragraphs detail additional maintenance recommendations for certain engines.

6.13.1 Special Maintenance – Non-Approved Propellers

- As noted, operators who choose to fit a non-approved propeller to their Jabiru engine do so at their own risk and a system of additional maintenance is recommended to monitor the engine for possible detrimental effects.
- This section has been added to the manual to help guide such maintenance. However, as we cannot anticipate every combination of engine, airframe and propeller this is strictly of an informational basis. It is not a complete or inclusive maintenance schedule, rather an overall guide directing which areas are likely to need additional attention.

WARNING

Using a non-approved propeller may lead to unforeseen operational, airworthiness, safety, financial or legal problems. Jabiru Aircraft accept no responsibility for such issues.

- The following are recommended IN ADDITION to the normal engine maintenance program.
- Where the maintenance requirements listed below differ from those of a third-party supplier the lesser time interval should be used. i.e. if the table below calls for the propeller to be re-balanced annually but the propeller manufacturer recommends balancing every 100 hours or 6 months then the propeller manufacturer's recommendations should be used.
- Visual inspections of the propeller and propeller flange installation should check for excess metal oxide (appears as rust) or black chaffing dust originating from the flange. This is often an early indication of movement between the parts and potential failure. Oil leaks etc in this area and around the flywheel must be addressed quickly as they can both cause and mask other problems.

		Annual Inspection	Each 500 Hours	Each 100 Hours	Each 50 Hours
1	Spinner, spinner flange & hardware – Check condition.			*	*	*
2	Propeller general condition – visual/hand check		*	*	*	*
3	Propeller blade pitch, tracking			*	*	*
4	Propeller mounting hardware (bolts, nuts, bushes etc) tension & condition check			*	*	*
5	Propeller balance				*	*
6	Propeller flange installation – visual inspection (no disassembly required)		*	*	*	*
7	Propeller flange screws – **REPLACE** Refer to engine overhaul manual for guidance				*	
8	Propeller flange run-out check (per prop strike inspection detailed below)				*	
9	Crank run-out check (per prop strike inspection detailed below)				*	
10	Flywheel Screws – **REPLACE** Refer to engine overhaul manual for guidance				*	

6.14 Engine Inspection Chart

Note:
READ ALL INSPECTION RQUIREMENTS PARAGRAPHS PRIOR TO USING THESE CHARTS.

		Annual Inspection	Each 200 Hours	Each 100 Hours	Each 50 Hours
PROPELLER					
11	Spinner	*	*	*	
12	Spinner Flange	*	*	*	
13	Spinner screws	*	*	*	
14	Propeller	*	*	*	
15	Propeller bolts/nuts - Tension	*	*	*	
16	Spinner / Prop Tracking	*	*	*	
ENGINE & ENGINE COMPARTMENT					
	Check for oil, fuel exhaust & induction leaks, then clean entire engine & compartment before inspection.				
•	Check flywheel screw tensions to 24lb.ft[1]	*			
•	Carburetor air filter – Check & replace if required	*	*	*	*
•	Engine baffles and air ducts				*
•	Cylinders				*
•	Crankcase & front crankcase seal				*
•	Fuel hoses, lines and fittings	*	*	*	
•	Intake and exhaust systems	*	*	*	
•	Ignition harness, distributor caps & rotors	*	*	*	

[1] Note: if any screws rotate they must be removed, crankshaft and screw threads cleaned then re-installed with fresh Loctite 620 (Use no more than the size of a match head). Do not remove all flywheel screws at once or loss of valve timing may occur.

	Annual Inspection	Each 200 Hours	Each 100 Hours	Each 50 Hours
• Spark plugs		*	*	*
• Compression check or leak-down check			*	*
• Electrical wiring			*	*
• Fuel pump			*	*
• Engine controls and linkages			*	*
• Engine mounts, mount structure			*	*
• Starter, solenoid and electrical connections			*	*
• Coils and electrical connections			*	*
• Carburettor heat system			*	*
• Throttle and linkage			*	*
• Carburettor			*	*
• Oil system tubes and hoses			*	*
• Firewall				*
• Engine cowlings and clips			*	*
• Exhaust system – including muffler		*	*	*
• Cylinder Head bolt tension		*	*	*
• Hydraulic Lifter & Rocker Inspection (Section 6.8 & 6.9 above)			*	*
• Oil & filter change		*	*	*
• SCAT hose condition			*	*
Fuel System				
1 Fuel filters, drain valves, carburetor bowl			*	*
2 Electronic fuel boost pump and fittings				*
3 Fuel lines and connectors			*	*
4 Fire sleeves			*	*

7 SERVICE & REPAIR

7.1 Service Interval Tolerance

- A tolerance of plus or minus 3 hours is allowable on all service intervals set within this manual

7.2 Engine Overhaul and TBO

- These are carried out only by the manufacturer, Jabiru Aircraft Pty Ltd or by a specifically approved Jabiru Engine Service Centre (contact Jabiru for details).

- The engine must be sent in a complete state, with logbook, to Jabiru (or the Approved Service Centre) after reaching the TBO limit.

- Changes to TBO due to operational experience will be advised by Jabiru via Service Bulletin

- Engines have full overhauls at 2000 hours with a Top End being done at around 1000 hours. This is also subject to certain conditions: overhauls are influenced by condition.

7.2.1 Full Overhaul

- Full overhauls must be carried out as detailed in the latest approved revision of the Jabiru Engine Overhaul Manual.

- During a full overhaul all parts are cleaned, measured, inspected and recorded in the prescribed build sheets in the manual. Parts that are replaced during a full overhaul include:- Pistons, gudgeons and circlips, rings, main bearings, conrod bearings, thrust bearings, conrod bolts, all orings gaskets and seals, fuel pump, valves, induction hoses, rubber oil feed tees, spark plugs, rotors, head bolts, intake/exhaust studs, fuel hose, oil filter, oil hoses, flywheel bolts, prop flange bolts, woodruff key (oil pump), crankcase through-bolts and crankcase studs. Cylinder, heads and dizzy shafts are usually replaced at a full overhaul, depending on condition.

- As a part of the overhaul process the engine must be run-in. Again, the procedure given in the Jabiru Engine Overhaul Manual must be used. Details are given in that manual, however note that **if the run in is performed on the ground large air cooling ducts and a large oil cooler must be used**. The engine can also be run-in, in the aircraft in the air with caution, using the run in program as the guide. Section 11.1 Early Operation of an engine must be understood. Initial performance data must be recorded. New engines and engines overhauled by Jabiru Aircraft (Australia) are dispatched already run-in – no further running-in is required.

7.2.2 Top End Overhaul

- Top End Overhauls must be carried out as detailed in the latest approved revision of the Jabiru Engine Overhaul Manual.

- Parts replaced include:- Conrod bearings, pistons, gudgeon pins and circlips, rings, valves, all relevant O rings and gaskets, head bolts, spark plugs, induction hose joiners, rotors, relevant cap screws and fuel line. Other parts for inspection, measure and clean or replace are oil pump, starter, alternator, fuel pump, coils, ignition leads, oil seals, induction and exhaust capscrews, carby, heads and barrels.

- As a part of the overhaul process the engine must be run-in. Again, the procedure given in the Jabiru Engine Overhaul Manual must be used. Details are given in that manual, however note that **if the run in is performed on the ground large air cooling ducts and a large oil**

cooler must be used. The engine can also be run-in, in the aircraft in the air with caution, using the run in program as the guide. Section 11.1 Early Operation of an engine must be understood. Initial performance data must be recorded. New engines and engines overhauled by Jabiru Aircraft (Australia) are dispatched already run-in – no further running-in is required.

7.3 Engine Removal Procedure

No.	Operation	Tools Required
1	Remove Spinner and Propeller	Phillips Screwdriver 7/16" Socket 7/16" Spanner
2	Remove Carby Heat hose from hot-air muff on muffler	Flat-bladed Screwdriver
3	Remove Air Inlet Hose from Carburettor and blank off Carburettor and Air Cleaner	Flat-bladed Screwdriver 2 Plugs
4	Disconnect Throttle Cable	Long Nose Pliers
5	Disconnect Choke Lever	Long Nose Pliers
6	Remove Oil Breather Line	Flat-bladed Screwdriver
7	Remove Fuel Line from Fuel Pump and plug Fuel Line and Fuel Pump	Flat-bladed Screwdriver 1/4" Plugs
8	Remove starter Motor Cable from Solenoid	7/16" R/OE spanner
9	Disconnect Earth at Battery	10mm R/OE
10	Remove Oil Pressure Gauge Lead	-
11	Remove Oil Temperature Gauge Lead	-
12	Remove Hourmeter Lead (if fitted)	Screwdriver
13	Remove Cylinder Head Temperature Gauge Lead	- (disconnect at cold junction)
14	Remove Exhaust Gas temperature Gauge Lead	-
15	Remove Tacho Lead	-
16	Remove Left and Right Ignition Coil Leads	-
17	Remove Muffler Assy	3/16" Ball End Allen Key
18	Undo Engine Mount Bolts	7/16" Tube Socket 7/16" Spanner
19	Remove Engine from Engine Mount Frame	-

7.4 Engine Installation

No.	Operation	Tools Required
1	Fit engine to engine mount	-
2	Torque engine mount bolts	7/16 Tube Socket 7/16 Ring Open End Spanner
3	Fit muffler (if not already fitted) and fit carburettor heat muff and hose	3/16 Ball End Allen Key
4	Connect left and right ignition coils leads	-
5	Connect Tacho sender	-
6	Connect exhaust gas temp (if fitted)	-
7	Connect cylinder head sender	18mm Spark Plug socket
8	Connect hourmeter	Screw Driver
9	Connect oil temp gauge sender	
10	Connect oil pressure gauge sender	
11	Connect starter	7/16 Ring Open End Spanner
12	Connect Battery (Earth lead first)	10mm Ring Open End Spanner
13	Connect fuel line	Screw Driver
14	Connect Oil Breather	Screw Driver
15	Connect Choke Cable	Long Nose Pliers
16	Connect Throttle Cable	Long Nose Pliers
17	Connect Air Inlet	Screw Driver
18	Fit Propeller and spinner	7/16 Ring Open End Spanner 7/16 Torque Wrench Phillips Screw Driver
19	Fit Cooling Ducts	3/16 Allen Key
20	Prime Fuel system with electric pump and inspect for leaks	-
21	Check for oil. Fill if needed.	2.3L oil (2.43 US quarts)
22	Wind over to get oil pressure	-
23	Start and inspect for leaks	-

No.	Operation	Tools Required
24	Test Fly *Note: First flight is a test flight so fly conservatively*	-
25	Remove Cowls and inspect for anything loose, rubbing or leaking.	-
26	Check Head bolt tensions torqued to 20 ft. lb.	-
27	At25 hours inspect engine installation. Change oil and filter. Cut filter open and inspect. Check engine leak down	-
28	If oil consumption is stable fill with W100 (W80 in cold conditions and W120 in very hot conditions). If it is still using oil remain on run in oil or seek advice from Jabiru Aircraft or local authorized representative	-

7.5 Prop Strike Inspection

After ground contact with the propeller, check the crankshaft and prop flange for run out as shown below.

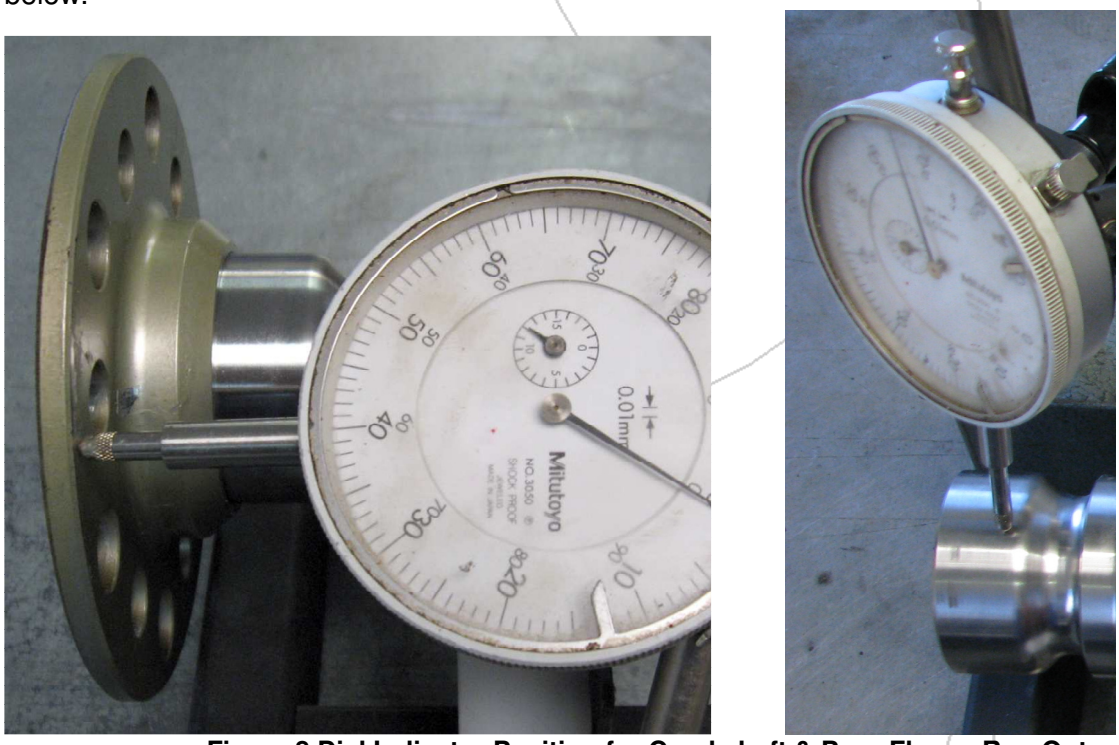

Figure 8 Dial Indicator Position for Crankshaft & Prop Flange Run Out

- Remove one spark plug from each head.
- Carefully sand off paint on crank diameter and prop flange where dial indicator will be located.
- Position dial indicator onto crank as shown above and eliminate main bearing clearance by bearing down on crank when rotating. Rotate crankshaft to measure crankshaft run out,

normally expect to see 0.01 - 0.03 mm, but if run out exceeds of 0.08 mm the crankshaft must be replaced.

- Position dial indicator onto prop flange as shown above, eliminate end float by either pulling or pushing flange when rotating. Rotate prop flange to measure the face run out, normally expect to see 0.02 - 0.06 mm, but if run out exceeds 0.08 mm then replace the prop flange.

Note:

- If the crankshaft run-out exceeds the above limit the engine has to be stripped and the crankshaft replaced.
- The flywheel retaining cap screws (6) need to be replaced after any prop strike.

Even if the above run out requirements are met and depending on the severity of the prop strike, it could be prudent that an engine strip be performed and the crankshaft MPI tested, as internal damage may have occurred and can only be revealed by stripping the engine.

The decision to run an engine after a prop strike and after carrying out the above run out checks, rests with the owner. If you have any doubt about the action to take, then consult the Jabiru factory or your Authorised Jabiru dealer for advice.

Engines running a non-Jabiru propeller (especially composite propellers), must check the tension of the 6 flywheel cap screws at each service to determine that the cap screws meet the torque requirement, if not, then replace the cap screws and apply Loctite to the screws on assembly.

If an engine stoppage due to force is not recorded in the logbook and not advised to Jabiru, the liability for all subsequent and consequential damage will remain with the owner.

This applies to both prior to and after engine overhaul. If a crankshaft has been severely stressed but measurements and MPI testing indicates a sound item it is Jabiru policy to not re-use, but replace with a new crankshaft.

8 Notes Before Starting Engine

Jabiru Aircraft Pty Ltd
2200 Hydraulic Lifter Engine

WARNING

This engine has been run in and is ready for flight. This engine uses hydraulic lifters for valve operation.

DO NOT GROUND RUN THIS ENGINE

This engine has been inhibited and the oil system drained. Before first start of new engine, remove 1 spark plug from each head. Add the required run-in oil to sump (2.3 litres), engine must have oil cooler fitted. Press starter to obtain oil pressure and to throw out excess inhibiting oil in cylinders. Replace plugs. NOTE: ALL plastic bungs must be removed

Note: Cylinder heads have a 1/8 NPT plug to be unscrewed to uncover head bolt No. 5. After torquing, reset plug.

CAUTION: Do not over-tighten. Over-tightening will eventually loosen fit between plug & head to the point where the plug will not be secure.

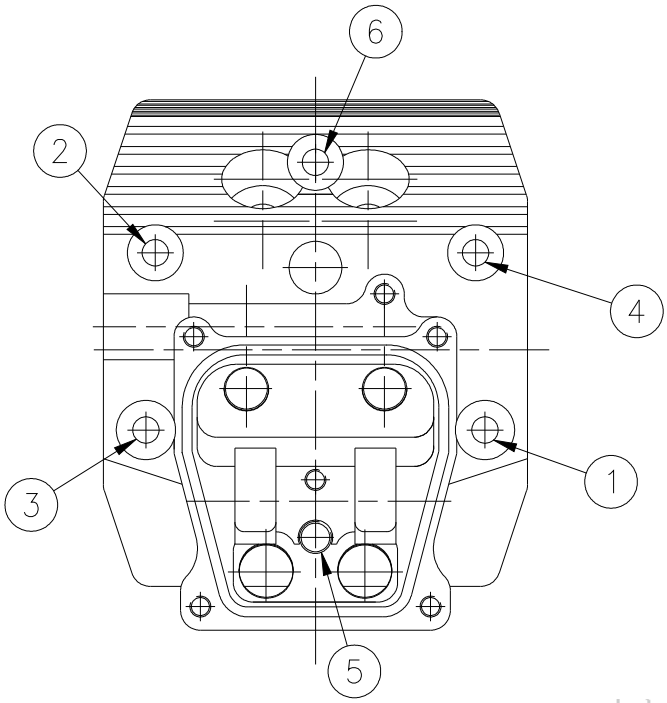

Figure 9 – Head Bolt Locations

- If the engine is run on the ground before flight use minimum power settings and minimum time to avoid overheating. If the engine is to be run at more than idle power on the ground extra-large cooling ducts and oil cooler will be required.

- For the first 25 hours of operation, add 2.2 litres of Shell 100 oil. After 25 hours drain oil, check torque of cylinder head bolts to 20 ft lbs.

- Use 2.2 litres of W100 oil for normal operation or W80 oil for cold weather operation. Shell also manufacture a multigrade oil Aeroshell 15W50 which is particularly suited for operations in cold climates.

CAUTION: UNDER NO CIRCUMSTANCES USE AUTOMOTIVE OIL IN THIS ENGINE.
Use only oils which are designed for Air Cooled Aero Engines.

- Some brands of automotive oils have been shown to cause very rapid cylinder wear. This will not be covered under Jabiru's Limited, Express warranty.

- Operate engine only on AVGAS 100LL or highest octane available MOGAS (Min octane 95 RON). Failure to do so could result in engine damage and void Jabiru's Limited Express Warranty.

CAUTION:
USE OF OIL/FUEL ADDITIVES VOIDS JABIRU'S LIMITED, EXPRESS WARRANTY

9 TABLE OF LUBRICANTS

Use only oils of registered brands meeting the specification detailed at para. 2.5.

Acceptable engine lubricating oils:

Run in Period

Oil	80	100	120
Outside Air Temp	-17°C to 25°C	15°C to 35°C	Above 35°C

Normal Operations

Oil	W80	W100	W120
Outside Air Temp	-17°C to 25°C	15°C to 35°C	Above 35°C

Note: Multigrade aviation oils are also available.

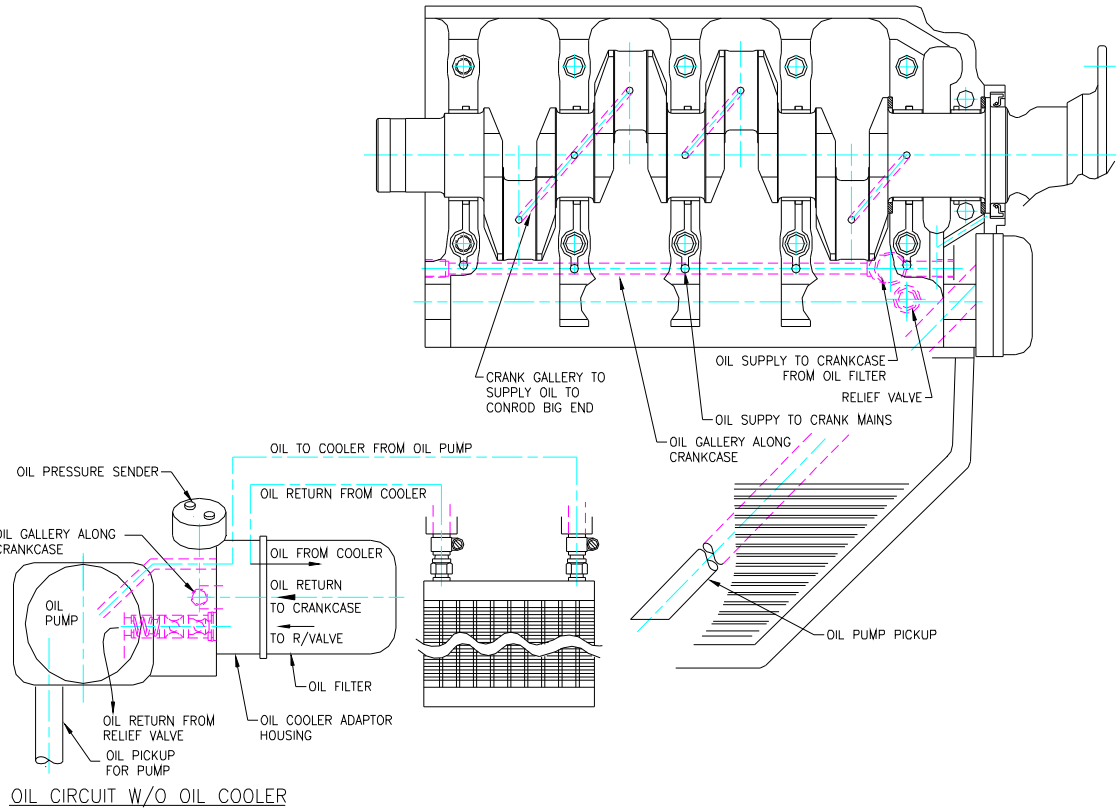

Figure 10. Oil System Schematic

10 TORQUE SPECIFICATION FOR BOLTS & NUTS

Part	Nom. Dia (mm)	Torque nm (ft.lbs)
Spark Plugs	12mm	11 (8)
Cylinder Head Bolts	5/16"	34 (24)
Flywheel/Gear Bolts	5/16"	34 (24)
Crankshaft Prop Flange Cap Screws (Lockwire – for std length flange only)	3/8"	40 (30)
Tappet Cover Cap Screws	1/4"	7 (5)
Starter Motor Bolts	1/4"	11 (8)
Carburettor Flange Bolts	1/4"	11 (8)
Alternator & Coil Mount Bolts	1/4"	14 (10)
Propeller Bolts	1/4"	9.5 (7)

Initially head bolts are assembled at 24 Ft Lb. After 25 hours head bolts can be checked at 20 Ft Lb.

10.1 PRESCRIBED SEALANTS AND PRIMERS

Item	Sealant
Engine Mount Bolts	Loctite 243
Spark Plugs NGK D9EA*	
Spark Plug Lubricant	Loctite "Nickel Anti-Seize"
Prop Mount	Loctite 620
Flywheel – Crank bolts	Loctite 620

* Tighten to finger tight to seat, then with plug socket turn an additional ½ turn (8 ft/lbs) for a new plug.

** All gasket areas use Loctite 'Gasket Eliminator' 515

*** LOCTITE CURE ACCELERATOR 7471 used on threads before LOCTITE

10.2 ELECTRICAL SYSTEMS SPECIFICATIONS

(All Dimensions are in Millimetres)

Ignition	Primary Resistance	8.8R to 1.0R
	Secondary Resistance	5.9kR to 7.1kR
	Coil Gap	0.27
	Plug Gap	0.55
	Ignition Harness Resistance	6.7kR per 300mm of length
Alternator	Coil Resistance	0.2 to 0.3 at 20°C
	Coil Earth Resistance	Infinite
	A.C. Output	40 VAC at 2750 RPM
	D.C. Output	14.2 VDA at 2750 RPM
Tacho	Coil Resistance	160 to 170R
	Gap	0.4

11 Operating Notes – Quick Reference Guide

11.1 New Engine Notes

- **This engine has been ground run to a specific run in program and is ready for flight.**
- **The engine has been *INHIBITED.* However if you intend to store it for any length of time please refer to Section 5.7.3 of *INSTRUCTION AND MAINTENANCE MANUAL.* Removing spark plugs and turning over will help periodically.**
- **Before initial start add oil to engine (2.3 litres with cooler), remove one plug per head and turn the engine over on the starter to remove excess inhibitor. Once oil pressure is obtained replace plugs and continue start-up sequence.**
- **Remove <u>ALL</u> plastic bungs on engine before starting. EXHAUST (4) CARBY (2) OIL VENT (1) FUEL PUMP (1)**
- ***VARY* your RPM when flying with a new engine.**
- **The idle cannot be set on the DYNO. Adjust throttle stop to obtain 900-950 RPM when engine is warm before first flight.**
- **Do not "Baby" a new engine. The purpose of breaking in an engine correctly is to ensure a long reliable life. All moving parts need freeing up especially piston rings to cylinder walls. This is best accomplished when the greatest B.M.E.P. (Break Mean Effective Pressure) occurs. That is at 75% power and above. Early running of an engine should include periods at high RPM and power settings.**
- **Failure to operate at realistic power settings could be detrimental to engine condition & long-term performance.**
- **Always take off using full power – especially when the engine is new.**
- **Avoid heat build up – monitor CHT and oil temps. Note that Initial temps will be elevated due to the friction of a new engine. Careful monitoring by the pilot is needed during this initial period to ensure long life of the engine and its components.**
- **CIRCUIT WORK is a good sequence for initial run in work.**
  - **i) Abbreviate circuits initially**
  - **ii) Step climbs and climb at shallow angles & higher airspeeds**
  - **iii) Do not carry out glide approaches**
  - **iv) Gradually reduce power**
  - **v) Avoid sudden heating up and sudden cooling down**
- **When you change oil from the "run in" type to the "normal" oil at or around 25 hrs, replace oil filter.**

11.2 Normal Operation Notes

The following are tips to ensure a long life. They are intended to bring attention to important aspects of caring for a Jabiru 2200 engine. For details on the required work, refer to the main body of this manual.

11.2.1 Regular Checks

- With ignition and master OFF and throttle closed turn the prop by hand and observe engine for odd noises or heavy movements.

- Turn the engine over by hand before starting to check for regular compressions. If irregular (one cylinder with lower compression than others) a leak-down or similar pressure differential test should be done. If the results show a low-compression cylinder, contact Jabiru Aircraft or our authorized local representative.

- **Compression Test:** Condition of compression can be gauged by testing the engine with a compression gauge. The test is carried out with the engine warm, wide open throttle, **ignitions OFF**. Turn over on starter. A reading below 90 PSI may indicate removal of head and possibly cylinder.

- **Pressure Differential Test:** As an alternative to a compression test, a pressure differential test (Leak down) can be carried out. This is a much better test of the condition of rings, bore, head sealing and valve. This is the normal test used in aviation and requires specific equipment.

  The test is carried out with the engine in warm to hot condition. Pressure input of 80 PSI; a second gauge reads the differential. This is done with piston on TDC on the firing stroke. Note that the propeller needs to be restrained. A differential of lower than 80/60 indicates a problem.

Problems can be better identified using the leak down:

v) Blow by through the crankcase vent indicates worn rings or bore
vi) Leaking from carby indicates a poor intake valve seal
vii) Leaking from exhaust indicates a poor exhaust valve seal
viii) Head leak indicates poor head to cylinder seal

With the problem narrowed down, correction work can more easily be carried out.

- Your **Tension Wrench** should be accurate. It should be a “good” brand and have had some method of calibration. Even new wrenches can be un-calibrated and can vary to manufacturers claims.

- The **Coil Gap** can be adjusted easily by cutting a 15mm wide strip of plastic or thin card (thickness .010”). Place between magnets on flywheel and coil. Check both sides, that is each coil to each magnet (4 checks).

11.2.2 Oil

- Use a non-compounded *AVIATION* oil:-
  Aero Shell 100
  Mobil Red Band (EXXON Aviation Oil 100)
  BP Aviation Oil 100

- Use for 20-25 hours, then drain and replace with a compounded *AVIATION* oil:-

Aero Shell W100
Aero Shell 15W50 (for cooler climates)
Mobil Aero 100 (SAE 50) (EXXON Aero Elite 100)
BP Aero Oil D100/BP Multigrade Aero Oil D SAE 20 W 50
Aero Shell W 100 Plus

- The normal running oils are detergent and ashless dispersant types. See *MAINTENANCE SECTION 5.3*

- Oil capacity:
  The new engine will hold 2.3 litres with an oil cooler.
  On subsequent oil changes the engine will hold approx 2.2 litres.

- **Do not use any type of automotive oil.** Aviation oils have been blended specifically for the difficult operating conditions found in an air cooled aero engine operation and using automotive will be **extremely detrimental** to its operation.

- When you change oil from the “run in” type to the “normal” oil at or around 25 hrs replace oil filter. You may want to cut the filter open for inspection. It is usual in Jabiru engines to find a small amount of aluminium but definitely no metal. If bearing metal is present contact the Jabiru Service Department.

11.2.3 Engine Cooling

- Avoid prolonged ground running at elevated RPM. Engine can be over heated during ground operations – remember air ducts are designed for *in flight* cooling. Ground running at high power settings for more than a few minutes requires the use of special, oversize air ducts and oil cooler.

- Do not apply full power until CHT has reached at least 100°C (212°F)

- **ALWAYS TAKE OFF AT FULL POWER** – especially when the engine is new.

- For the first few take offs climb at a higher airspeed than normal to assist engine cooling. Reduce power at cross wind leg and shallow climb (lower nose).

- Avoid high nose altitude continual climbs. The higher the climb out speed the better for engine cooling. No low speed high nose altitude climb outs.

- RETORQUE heads on annual inspection.

- The ducts supplied with the engine need to be fitted. See Installation manual. Occasionally, periodic research and development dictates that changes must occur to cooling ducts. The ducts supplied with new engines will the latest types and may differ to those supplied with older engines.

11.2.4 Consumables

- Filters – Regular inspections are a must for fuel and air filters. Conditions will dictate when changed. The air box has a rubber flap to give partial inspection of air filter.

- Spark Plugs - NGK D9EA are recommended. Refer to main body of this manual for plug gap. Remember that plugs are installed at around 8 ft lb or given 1/2 turn after contact with head. 18mm Plug spanner used.

11.2.5 Starting

- A warm idle of around 900 RPM will automatically create the right starting environment. As the engine is run-in on a dynamometer the Idle set screw may have to be adjusted to give 900 RPM idle when warm.

- Normal start requires the application of choke with the throttle closed. With the throttle on the idle stop the butterfly in the throat body will be slightly cracked. The engine will be difficult to start if throttle is cracked open too far.

- After the engine stars the choke should be pushed off. The choke is only used for a cold start. Prolonged cranking with choke on will “flood” the intake system, making starting difficult. Should this occur, leave the aircraft to sit for approx 10 minutes, or alternatively, clear the system on full throttle momentarily (mags off).

- If the Cranking speed is too slow (poor battery or starter fault) the ignitions will not fire, preventing starting. If jump starting is necessary, it point towards poor battery condition or faulty alternator charging. Further testing would then be required in these areas to identify the problem.

12 Trouble Shooting

12.1 Troubleshooting Tables

12.1.1 Engine Won't Start

	Possible Cause	Remedy
1)	Ignition OFF	Switch ON
2)	Spark plug gap too large	Adjust gap to 0.6-0.7mm or renew plugs
3)	Closed fuel tap or clogged filter	Open tap, renew filter, check fuel system for leaks
4)	No fuel in tank	Refuel
5)	Wrongly connected high tension leads	Connect as shown on leads
6)	Starting Speed too low, faulty or discharged battery	Recharge or replace battery
7)	Coil to Magnet gap too wide	Adjust to 0.25mm (0.010")
8)	High tension leads loose or damaged	Check or renew connections
9)	Dampness in distributors	Thoroughly dry internally
10)	Spark plugs damp due to condensation	Thoroughly dry both inside and outside of plugs
11)	Plug face wet by fuel due to excessive actuation of choke or overflow of carb	Dry spark plugs, trace possible faults in fuel system or over flow of carb.
12)	Float valve dirty or jammed	Clean or renew float valve
13)	Jets in carb. clogged	Clean jets
14)	Water in carb.	Drain & clean carb.,fuel line & filter. Water drain fuel tank
15)	Insufficient compression	Trace pressure loss & repair if necessary
16)	Engine damage	Inspect oil strainer filter & oil filter for metallic particles. If present, an engine overhaul may be necessary.

12.1.2 Engine Idles Unsteadily After Warm-Up Period: Smoky Exhaust

	Possible Cause	Remedy
1)	Choke activated	Close choke
2)	Float valve dirty, jammed or worn	Clean or renew float valve
3)	Intake manifold leak	Tighten all connections, renew faulty items

12.1.3 Engine Runs Erratically or Misfires Occasionally

	Possible Cause	Remedy
1)	Spark plug failure	Check plugs, clean inside & outside, adjust electrode gap. If necessary, renew plugs
2)	Faulty HT leads	Dry damp leads, renew damaged leads
3)	Faulty ignition unit	Renew ignition unit
4)	Clogged fuel filter	Renew fuel filter

12.1.4 Engine Runs Too Hot - Oil Temperature Above 110°C (230°F)

	Possible Cause	Remedy
1)	Too much oil in crankcase	Check oil level & adjust if necessary
2)	Low oil level	Check oil level & add oil if necessary
3)	Poor quality oil	Oil change, use specified oil
4)	Clogged oil filter	Change filter
5)	Excessive piston blow by	Common reason: worn or sticking piston rings, complete engine overhaul necessary
6)	Faulty bearings	If metallic particles are present in oil, complete engine overhaul necessary
7)	Faulty oil temperature gauge	Exchange gauge

12.1.5 Unsatisfactory Power Output

	Possible Cause	Remedy
1)	Ignition failure	Check ignition circuits; check wiring and pick-ups; replace ignition units.
2)	Too much oil in crankcase	Check oil level & adjust if necessary
3)	Insufficient fuel supply	Check fuel supply system
4)	Fuel not according to specifications	Re-fuel with specified fuel
5)	Incorrect throttle adjustment	Re-adjust throttle fitting
6)	Leak in air intake	Check and tighten all connections, check carby sockets.
7)	Carby diaphragm damage	renew diaphragm
8)	Hydraulic Lifter stuck / collapsed	Replace lifter(s)

12.1.6 Low Oil Pressure

	Possible Cause	Remedy
1)	Insufficient oil in sump	Check oil level & replenish as necessary
2)	High oil temperature	Refer to Para. 10.4
3)	Faulty pressure gauge, sender or wiring	Check gauge, sender & wiring. Renew as necessary.
4)	Faulty crankshaft bearings	Engine overhaul
5)	Relief valve not sealing	Inspect, replace back after cleaning

12.1.7 Engine Keeps Running with Ignition Off

	Possible Cause	Remedy
1)	Idle speed too high	Adjust to proper idle speed (900 RPM)
2)	Faulty ignition switch	Check switch & cables. Repair/replace as necessary
3)	Overheated engine	Conduct cooling run at 900 RPM

12.1.8 Excessive Oil Consumption

	Possible Cause	Remedy
1)	Worn, broken or wrongly fitted piston rings	Repair/engine overhaul necessary
2)	Poor oil quality	Oil change, use specified oil
3)	Worn valve guides	Repair of cylinder head necessary
4)	Oil leaks	Seal leaks

12.1.9 Knocking Under Load

	Possible Cause	Remedy
1)	Octane rating of fuel too low	Use fuel with higher octane rating
2)	Spark plug fitted without sealing washer	Ensure one sealing washer on each plug
3)	Heavy carbon deposits	Remove cylinder heads & in combustion chamber remove deposits. Determine oil consumption.

Notes:
- Running this engine on low octane fuel will cause piston damage and in extreme cases failure of the top ring gland or holed piston due to detonation.
- Changing the engine tuning to a leaner air fuel mix can cause piston damage.

12.1.10 Engine Hard to Start at Low Temperature

	Possible Cause	Remedy
1)	Starting speed too low	Preheat engine
2)	High oil pressure	At very low temperatures, a pressure reading of up to around 500 kpa doesn't necessarily indicate a malfunction
3)	Low battery charge	Fit fully charged battery

12.1.11 Hydraulic Valve Lifters

	Symptoms	Possible Cause	Remedy
1)	Engine noisy, "tapping" at idle	"Soft" lifter(s) due to lifter fault	Replace lifter(s)
		"Soft" lifter(s) due to low oil pressure	See Low Oil Pressure section above.
		"Soft" lifter(s) due to air in lifter	Run engine. Up to 15 minutes running may be required to completely expel air from the lifter. **OR** Remove lifter and manually fill with oil.
2)	Reduced engine power	Soft or stuck hydraulic lifter(s)	Replace lifter(s)
		"Soft" lifter(s) due to low oil pressure	See Low Oil Pressure section above.
		Lifters "pumping up" holding valves open	Reduce operating oil pressure (within limits)
			Replace lifter(s)
3)	Excess metal in oil filter	Cam / Lifter damage	Inspect lifter and cam working surfaces. Replace if damaged.

Notes:
- Refer to Section 6.8 for additional details on hydraulic lifter maintenance requirements.

12.2 Troubleshooting Quick Guide

12.2.1 Low Oil Pressure

- A sudden drop of pressure usually is caused by a piece of foreign matter lodging under the relief valve. Simply remove oil filter and cooler adaptor (if fitted). Remove matter by depressing plunger or removing relief mechanism. Replace and check operation by ground run. If low pressure persists the problem will need further investigation.

- High oil temperature can cause low oil pressure. Ensure oil temperature remains within limits at all times. The fitting of an approved oil cooler is strongly recommended. Overfilling the sump with oil can cause high oil temperature.

12.2.2 Flicking Of Oil Pressure Gauge

- It is not uncommon for the Jabiru engine to display flicking of the needle pointer for brief periods but still within normal operating regions. If it continues, check continuity of sender lead and or possible sender change. (We are assuming oil level is OK).

12.2.3 CHT

- If the gauge is not reading, the cause can be cause by a break in the sender wires or incorrect polarity.

- High readings can result from a poorly centred sender under the spark plug.

- Normal cruise CHT should not exceed 150°C and climb must not exceed 200°C. Air ducts supplied at present give results below these figures.

12.2.4 RPM

- Tacho's may need adjustment when a new engine is fitted. Inducted magnet sender units require coil gap to flywheel tags of .014" or .35mm.

12.2.5 Magneto Checks

- Possible causes of abnormal drop could be loose leads, faulty leads, rotor buttons, coil gaps, spark plugs.

12.2.6 Rough Cylinder Running

- Check plugs, ignition coils and the induction system for looseness.

12.2.7 Carby Breather

- Carburetors have a brass fitting for venting. This is must be connected to a fitting screwed into filtered side of the carby heat box

12.2.8 Limitations

- Jabiru recommend TBO of 2000 hrs, with a Top End overhaul at 1000 or when engine condition indicates the need for overhaul earlier.

CAREFULLY READ MANUALS SUPPLIED

13 Airworthiness Limitations Section

The Airworthiness Limitations Section is CASA Approved.

There are no Airworthiness Limitations pertaining to the Jabiru 2200C engine

Signed: .....

Date: .....

Dinh Nguyen
Delegate of the Authority

14 New Engine – Jabiru's Limited, Express Warranty

New Jabiru Aircraft Engines are covered by Jabiru's Limited, Express Warranty. Details of this warranty are given below.

NOTE:

JABIRU'S LIMITED, EXPRESS WARRANTY IS EXCLUSIVE, EXPRESSLY GIVEN AND HAS BEEN ACCEPTED IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, ORAL OR WRITTEN, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OTHER WARRANTIES IMPLIED IN LAW. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THAT WHICH IS DESCRIBED IN JABIRU'S LIMITED, EXPRESS WARRANTY.

Jabiru Aircraft Pty Ltd, hereinafter JABIRU warrants that it will make good without charge, any defect which appears in this engine.

Provided:

1. The defect has been notified in writing to JABIRU:
   - i) Before the engine has operated a total of 200 hours or,
   - ii) Within twelve (12) months of the date of delivery of the engine to the first retail purchaser.

Whichever comes first, and

2. The engine has been delivered to a JABIRU Approved Service Centre or such other service facility as advised by JABIRU, and

3. the engine has been installed in an aircraft type in accordance with a JABIRU approved installation system, and

4. The engine has been updated in accordance with JABIRU Service Bulletins before operation, and

5. The engine has been stored in accordance with the Engine Preservation instruction in the Jabiru Instruction & Maintenance Manual, and

6. JABIRU has determined that the defect complained of is one of workmanship and is not caused by:

   - i) Misuse or abuse of the engine such as by operation outside the approved Flight Manual, or Maintenance and Operation Manual, etc, or by neglect
   - ii) Improper installation, including overheating.
   - iii) Operation of the engine after it is known to be defective
   - iv) Accident or deliberate act
   - v) Atmospheric fallout or flood, hail, salt, wind, etc.
   - vi) Failure to carry out proper maintenance service
   - vii) Use of incorrect types and/or grades of fuel, oil or lubricants
   - viii) Alteration or modification of the engine by any party not authorised in writing by JABIRU
   - ix) The fitting of parts or accessories not marketed by JABIRU
   - x) Any work carried out on the engine by someone other than an Authorised JABIRU Service Centre or someone else authorised by JABIRU in writing,
   - xi) The use of any engine oil or fuel additives or oil stabilisers

BY JABIRU (or as otherwise decided by JABIRU) MAKING GOOD THE DEFECT BY REPAIR OR, AT THE OPTION OF JABIRU, BY REPLACEMENT.

Excluded from this Limited, Express Warranty are service items such as engine tuning, adjustments, replacement of air and oil filters, spark plugs, etc which are required as part of normal engine maintenance.

This Limited, Express Warranty is given to the person who is entitled to possession of the engine whether as owner, lessee or otherwise and is given in addition to all right conferred by law on that person.

Limited, Express Warranty repairs do not extend the original Limited, Express Warranty.

Due to the substantial number of problems that can arise due to installation errors, JABIRU shall not be liable for any labour and/or service charges for removal, reinstallation and adjustment which are the responsibility of the buyer and are not covered by this Limited, Express Warranty. Consequential damages and freight costs are also not covered by this Limited, Express Warranty.

JABIRU makes no representation that this engine is suitable for installation in any particular aircraft and the responsibility for determining such suitability rests with the Buyer.

Under no condition shall JABIRU or a JABIRU Authorised Service Centre be liable for any contingent costs through the engine or aircraft being out of service for whatever reason.

SPECIAL NOTICE TO OWNERS

AVAILABILITY OF SERVICE AND PARTS AFTER WARRANTY

JABIRU Aircraft Pty Ltd maintains a substantial stock of spare parts and operates a Service Exchange Programme in respect to some components. Every endeavor is made to ensure that JABIRU carries adequate stocks of service parts and that Authorised Service Agents are equipped to provide satisfactory service, but JABIRU does not make any promise that after the expiration of the Limited, Express Warranty such parts or service will be available, or available at any specific location or at any particular time.

UNAUTHORISED STATEMENTS IN RELATION TO JABIRU PRODUCTS

No JABIRU Authorised Service Centre or other person is authorised or permitted to give or make any statement assertion or undertaking in relation to the quality, performance, characteristics, descriptions or fitness for any purpose of any JABIRU product or in connection with the supply of any JABIRU product, which is at variance with any written statement assertion or undertaking on any of these subjects given or made by JABIRU in its published sales literature, and the company does not accept any such unauthorised action.

LIMITED, EXPRESS WARRANTY ON JABIRU REPLACEMENT PARTS

As a part of its Limited, Express Warranty, JABIRU warrants in respect of JABIRU parts and accessories required as replacement parts, that it will make good by repair or at its option by replacement any defect occurring in any such JABIRU parts and accessories within twelve (12) months from the date of acquisition. Normal wear and tear is excluded. This Limited, Express Warranty does not cover those parts listed as exclusions above and is subject to the same general exclusions.

15 Jabiru's Limited, Express Warranty: Claim Form

FROM:_____DATE:_____

ENGINE PARTS: **AIRFRAME PARTS:**

ENGINE NUMBER:_____ AIRFRAME KIT NUMBER:_____

PART NUMBER:_____TOTAL HOURS:_____

OWNER:_____PREVIOUS OWNER:_____

PART DESCRIPTION:_____

_____

CLAIM:_____

_____

FAULTY GOODS RETURNED: YES COURIER Co. REF NO:_____

NO

ALL GOODS THAT ARE BOXED AND HAVE TO PASS THROUGH CUSTOMS HAVE TO BE CLEANED AND FREE FROM CONTAMINATION WITH A STATEMENT ATTACHED SPECIFING HOW THEY WERE CLEANED AND THAT THEY ARE FREE OF DIRT AND GRASS SEEDS. IF THEY ARE NOT CLEANED TO CUSTOMS SATISFACTION AN EXTRA CLEANING CHARGE WILL APPLY.

IF THIS CLAIM FORM IS NOT COMPLETELY AND CORRECTLY COMPLETED WARRANTY MAY BE REFUSED.

OFFICE USE ONLY

APPROVED
NOT APPROVED

REASON _____

_____

PRINTED NAME:_____

SIGNED:_____ DATED:_____