WA-MA-4

Maintenance Manual
WAM-120

Issue: B Date: 13-Sep-2011

INTRODUCTION

This document is based on experience gained to date with installations of WAM engines for experimental aircraft. No claim is made regarding the airworthiness or otherwise of installations based on suggestions contained herein. Wilksch Airmotive Ltd offers these suggestions without prejudice and cannot be held liable for non-certificated or "Experimental" engine products.

In future these suggestions may be modified in the light of further experience.
Any relevant experiences and observations can be reported directly to WAM.
This document may be subject to change without notice.

WAM engines do not comply with any national or federal safety regulations for aircraft. They are intended for use in non-certificated aircraft and only in circumstances in which an engine failure will not compromise safety. Please check that installation aspects conform to WAM recommendations and have been approved by the applicable regulatory authority. Please become familiar with this manual before carrying out any maintenance on the engine. Refer to Wilksch Airmotive for further details.

DESCRIPTION

WAM engines are turbocharged two-stroke engines using a compression ignition or "diesel" cycle. Like all diesel engines, combustion temperature is achieved by compression and no spark plugs are required. Unlike conventional gasoline two-stroke engines WAM engines use a camshaft and valves for the exhaust process and piston ports for inlet. As well as the turbocharger, a roots blower is used to force air into the cylinders. The roots blower serves this function at starting and low load conditions while the turbocharger provides the additional boost required at cruise and full rating. The turbocharger has the advantage of a high compressor efficiency and inherent compensation for ambient pressure (altitude). As well as providing reliable starting and off-load running, the roots blower can also serve as a source of air pressure for in-cockpit instruments.

The inverted in-line configuration achieves a modular family of engines with packaging well suited to installation on a wide range of propeller driven aircraft. The high mounted crankshaft assists in achieving sufficient propeller clearance and a "wet" oil sump at the bottom of the engines provides a simple lubrication system suitable for most non-aerobatic aircraft. The camshaft and fuel injection pump are driven by gears and no timing adjustment is required during the normal life of the engine.

A conventional pump-line-nozzle fuel system is used with indirect injection. A mechanical control unit (MCU) is used to achieve engine control over the required range of conditions. This includes idle stabilisation, fuel cut-off during descents and fuel increase during cranking.

Provision is made to drive engine accessories such as vacuum pumps, hydraulic pumps, auxiliary alternators and a propeller governor.

The engine can run on a range of fuels compatible with the diesel cycle. Because of storage and regulatory issues not all of these fuels are recommended and/or authorised. Individual engine rating sheets will show expected MAP at maximum Np on the rated fuel. Different fuel densities will affect power achieved slightly. If a denser fuel than

the rating fuel type is used, the pilot must use the MAP gauge to respect the rated peak MAP (and hence power). For example, if the engine is rated on Jet-A1 fuel, use of (denser) road diesel would overrate the engine by typically 5% if the MAP limit were not respected. Conversely, if a less dense fuel is used, a power reduction will result and MAP will not need to be monitored to respect the rating (but reduced aircraft performance must be considered).

OPERATION

An operations manual (WA-MA-2) is available to give you all the necessary information to enjoy a long and happy life with your Wilksch engine. Please refer to our website for the latest issue and any relevant service information.

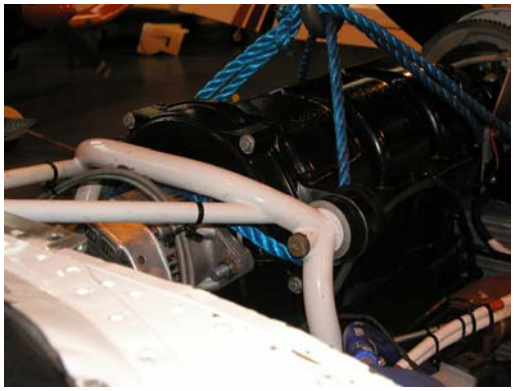
SCHEDULE

A copy of the maintenance schedule is provided in Appendix I to this manual. It has been designed for you to be able to photocopy the relevant pages and use them to complete your maintenance action. If you do this, you must ensure that you are copying from the latest issue Manual and Appendix. The latest edition of the manual is available from our website.

PROCEDURES

The procedures listed below are for your guidance. There are items on the engine that if disturbed, may cause damage to the engine or invalidate your warranty. If a task or a problem is not mentioned below then you must contact WAM before proceeding.

1. LIFTING



The engine is not provided with any dedicated lifting eyes or attachments therefore please take careful note of the following information. You must use a rope or lifting strap capable of supporting at least twice the engine weight to allow for extra strain whilst lifting and manoeuvring the engine into position and likewise a suitable crane. Place the rope or strap around the nose of the crankcase against the cylinder block. Now pass it below the upper engine mount lugs and over the top of the alternator housing (refer to illustration). If you are using a thick rope or strap it may help to place the propeller side mount rubbers into the lugs before lifting the engine, as the rope/strap may interfere with their fitting. Alternatively you may place the rope/strap around the nose of the crankcase against the cylinder block and just the alternator body. The engine may be allowed to stand on the sump to aid its storage. Please be careful when lifting the engine and ensure that any knots or strap joins are secure and remain so during the lifting process. Always wear appropriate safety equipment.

2. ENGINE REMOVAL

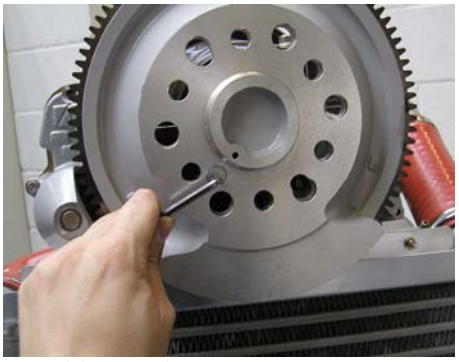
Remove the cowlings and turn off aircraft fuel selector. Isolate the aircraft battery. Place a suitable container or catchment tray under the engine to catch any spillages. Drain the oil and the coolant systems (refer to appropriate sections in this manual). Disconnect the wiring loom making a note of the plugs positions and routing. Disconnect fuel inlet and return hoses at the fuel pump and blank the fittings and hose ends. Blanks are available from WAM. Disconnect the engine control cables. Disconnect the air inlet hose and blank off the turbo inlet. Remove the exhaust muffler. Disconnect the oil cooler hoses (if fitted) and blank off the connections. Disconnect any hoses to a remote mounted cooling pack if fitted.

Using a suitable crane and lifting strap (refer to “lifting” section in this manual for recommendations) support the engine. Please note – you may need to support your aircraft fuselage as removing the engine weight from the aircraft may cause it to tip over. With the engine weight supported undo the four engine mounting bolts and remove the rubbers. Slowly withdraw the engine from the frame making sure that there is nothing obstructing or snagging its progress. The engine may be rested on the sump for ease of storage.

3. ENGINE INSTALLATION

Before starting to install the engine, give the engine bay a good clean. This will aid in inspecting for any cracks or damage. Ensure that any wiring or hoses are supported clear of the frame to allow the engine to fit in without catching or snagging. Also be aware of any controls etc that may need to be routed around parts as the engine is positioned into the mount. Inspect the engine frame for security and check all its attachments for tightness and welded joints for cracks. Inspect the engine rubbers for condition and sagging, change if required. Lift the engine into the frame (refer to lifting section for recommended lifting procedures). On some installations it may be necessary to attach the rear engine controls before the engine is fitted onto the mount, due to restricted access. Fit mount rubbers and tighten bolts. Torque to 40 ft.lbs. Remove the crane and lifting strap. Recheck bolt torque. Connect wiring loom and connect coolant hoses to expansion bottle, if removed. Fill coolant system (Refer to “Coolant draining and filling” section for correct method). Connect engine control cables. Check for full range of movement and freedom from stiffness or binding. Please note a duplicate inspection is required for disturbed engine controls. Setting up of engine controls is discussed in the Installation Manual WA-MA-1. Reconnect fuel inlet and return hoses. Turn on fuel selector and run electric fuel pump (if fitted) to check for leaks. Reconnect oil cooler and/or hoses. If any cooling pack parts are mounted away from the engine in your particular installation then connect the relevant hoses and tighten their clamps. Fit propeller and torque to manufacturer's requirements. Check engine oil and coolant levels. Carry out engine ground run and check for leaks. Re-check engine oil and coolant levels and adjust as required. If adjusting the coolant level be aware of the hot pressurised fluid, please refer to “coolant draining and filling” section. If all is normal then fit cowlings and return aircraft to service.

4. CONVERTING TO VARIABLE PITCH OPERATION



Remove governor drive pad blank. Clean mounting face. Fit Governor (refer to “Change propeller governor” section). As part of fitting the governor you may have to remove the propeller, if fitted, and starter ring gear, if not you will have to remove them now. Refer to the “Propeller section”. The ring gear is removed by taking out the locating screw and tapping it with a soft hammer. With the ring gear removed you will see a small brass pin protruding from the crank (see illustration). This pin blocks the oil transfer hole to the propeller for fixed pitch operation. Remove the pin with your fingers or a pair of pliers may be used. Refit the ring gear ensuring that the o-ring is

present (see illustration). Some grease applied to the o-ring will help keep it from falling out whilst fitting. Offer up the ring gear to the crank spigot and locate it using the screw. Gently and evenly tap the ring gear until it butts up against the crank flange. Screw in the alignment screw but do not tighten. This is for alignment purposes only and must not be allowed to cause a problem with prop fitting. Fit your new variable pitch propeller in accordance with the manufacturer's recommendations. Fit your cockpit control cable and route through to the governor. Connect to the governor and check for full range of movement and freedom from binding. Carry out ground runs and check propeller cycling and for leaks. The propeller cycling may be slow initially until the oil has had a chance to remove all the air from the chamber. You can carry out a full power rpm check on the ground but be aware that you may not be able to hold the aircraft on the brakes and also there is an increased risk of stone damage to the blades. Your propeller and governor should be set so only minor adjustments may be necessary. Refer to propeller and governor manufacturer's recommendations for adjustment procedures.

5. OIL CHANGE

This preferably carried out when the engine is hot. Place a suitable container under the drain position at the rear of the engine sump, capable of holding at least 6lts. Take adequate precautions to avoid the hot oil splashing onto your skin. Undo the drain valve or remove the bung. When the oil has stopped draining, refit bung or close drain valve. Wirelock in accordance with standard aeronautical practise ,if required. Fill the engine with 6 Litres of the current recommended oil (see Appendix 4). Carry out an engine ground run and check for leaks. Check the oil level and adjust as required.

- Ensure that the oil is disposed of in accordance with the latest environment agency regulations.

6. OIL FILTER CHANGE

Original fitment shown. Later engines have a vertical mounted filter to help avoid mess. The procedure below is the same for both.
Place a catchment tray under the engine. Unscrew filter. Lubricate the rubber seal of the new oil filter with either clean engine oil or a silicone type grease. Screw on the new filter until the seal touches the mating face of the filter housing. Tighten a further ½ turn by hand. Carry out an engine ground run and check for leaks.

- Ensure that any oily waste is disposed of in accordance with the latest environment agency regulations.

7. AIR FILTER SERVICING

Instructions for cleaning, maintaining and re-oiling Air Filters
Cleaning
The preferred method to clean this filter is to use a Silkolene cleaning fluid or a suitable solvent to remove dust/dirt contaminants. You may also use a liquid detergent (washing up liquid) and warm water to remove the dust /dirt. You could clean the filter in a bath of petrol if necessary (Always use suitable protective equipment). The adhesives and materials used in the filter are petrol resistant but the adhesives are not totally water-resistant so washing in warm water is tolerated but under no circumstances should the filter be left to soak as in time this will break down the adhesive. Water encountered in normal use (i.e. rain, spray etc) will have no adverse effect on the filter.

Now immerse the filter in the cleaning solution and agitate so that it goes into the filter foam and draws the dust/dirt out. Once happy that the entire oil residue has been removed, dispose of the solution in the appropriate manner. Rinse through in clean water 2-3 times to remove any remnants of the detergent/ solvent. After cleaning, the filter should be allowed to dry thoroughly. Do not use a high-pressure air line or a hot air blower. Try when time allows to leave the filter to air dry.

Re-oiling

Re-oiling with Silkolene Foam Air Filter Oil (WAM Part No. 001703) involves spraying the oil to give a medium covering all over. When the filter has been coated, work or 'massage' the oil into the depth of the foam for a couple of minutes. The filters are fairly robust and will allow compression while working the oil in.

Other oils are available on the market for this purpose. We know that the Silkolene product is suitable, and the use of any other product is at entirely your own risk.

8. FUEL FILTER REPLACEMENT

Turn aircraft fuel selector off. Rotate the bolt head on the bottom of the filter bowl and remove the filter assy. Inspect filter and bowl for contamination. If anything significant is found then please refer to Wilksch Airmotive before proceeding. Change all the sealing rings as supplied in the kit with the new filter, and refit. The upper bowl seal may require some grease to prevent it falling from the groove in the flange. Tighten bowl nut. Turn on fuel selector and check for leaks. Carry out engine run and re-check for leaks.

9. COOLANT DRAINING AND REFILLING

This should be accomplished with the engine cold. When the engine has just been run the coolant system is hot and pressurised, removing the expansion tank cap will result in hot fluid and possibly steam venting which can cause serious burns. Always assume the system has pressure. Remove the expansion tank cap slowly to allow any residual pressure to vent out. Place a suitable container capable of holding at least 5lts of fluid under the radiator lower hose connection. Squeeze together the legs of the hose clamp and move it rearwards. The lower hose connection can now be removed. Allow the fluid to drain completely. Please note that in certain installations, especially tail-draggers, there may still be some fluid trapped in the block. You can either remove the hose connection onto the water pump or tilt the aircraft to try to remove as much as possible. Reconnect any disturbed hose connections. Fill the system via the expansion tank cap to the MAX level. Leave the cap resting on the top of the tank and allow the fluid to settle for a few minutes. Please take note that the engine requires a minimum of 3.5lts, if anything less goes in check your system for blockages or airlocks. If in doubt please contact Wilksch Airmotive and DO NOT run the engine. There have not been any cases of air being trapped in the system if filled correctly. You can help check your fluid fill by squeezing the flexible hose between the coolant pump and lower radiator connection. You should be able to audibly hear the fluid moving around the system and see the level rise and fall in the expansion tank. After having done this allow the level to settle for several minutes and re-check/adjust level as required. Once you are happy that the system is full refit and tighten the expansion tank cap. Carry out an engine ground run. Allow the engine to warm up to at least 80 deg. C to allow the thermostat to open. Continue the ground run for a further 5 mins. This allows the coolant to fill the upper portion of the coolant radiator and bleed any air out into the expansion tank. Shut down the engine and check the system for leaks and fluid level. If the level does need adjusting then DO NOT be tempted to remove the expansion tank cap. Remember the hot pressurised fluid! Allow the engine to cool and the pressure to dissipate first. If there is a leak from a hose joint then check that the hose clamp is positioned correctly (see illustrations below). If the clamps position is suspect then try repositioning it and recheck for leaks after a further engine run.

CORRECT POSITION
Clamp positioned around the flat away from the bulbed end

INCORRECT
Positioned at an angle not clamping fully on the flat

INCORRECT
Too far along the hose pinching along the bulbed end

10. REMOVE AND REFIT ALTERNATOR

Ensure that the battery master switch is off and pull the alternator circuit breakers (if fitted). Disconnect the feed, excitation and speed wire (if fitted). The alternator drive consists of a square block, which is driven by a square hole in the back of the crank gear. Between the two squares are four lengths of rubber bar to absorb any shock pulses being transmitted to the alternator drive. When removing the alternator these four rubbers may well drop out. Please place a rag or something suitable underneath the alternator to catch the rubbers if they fall. Undo the two M10 nuts and withdraw the alternator. Inspect the four rubbers for condition and replace if required. Place the four rubbers on the flat faces of the alternator drive coupling. The rubbers are slightly longer than the distance between the faces and should grip in place. If they do not, then replace them. Place the alternator onto the studs and slowly move it forwards. Check the rubber alignment against the hole in the crank gear. If necessary rotate the alternator to align. Use a long screwdriver to help guide the rubbers into the gear fitting. Push the alternator on by hand until it butts up against the rear timing cover. Don't try and force it on, one of the rubbers may have moved and is now snagging. Refit nuts and torque (See Appendix II). Reconnect wiring. Carry out an engine ground run and check that the alternator can be turned on and off and is charging properly. Please note that the engine may be run without the alternator fitted, however the M10 nuts must be refitted and tightened to prevent loosening of the studs.

11. REMOVE AND REFIT STARTER MOTOR

Disconnect the aircraft battery for safety. Disconnect the wiring from the solenoid. Remove the four nuts and remove the starter from the studs. Fit new starter on, refit nuts and torque (see Appendix II).
Reconnect wiring and Battery. Carry out ground start checks.

12. CHANGE PROPELLER GOVERNOR

The removal of the governor, dependant upon the model, may require removal of the propeller and the starter ring gear. If so refer to the appropriate section for their removal. Disconnect the cable control from the governor and its bracket. Undo the four attachment nuts and remove. Discard the gasket. Fit governor with a new gasket making sure that the filter screen protrusion is towards the governor. You may need to turn the crank or governor to align the spline drive. Tighten nuts and torque. Refit control cable and test for correct travel. Carry out normal engine ground

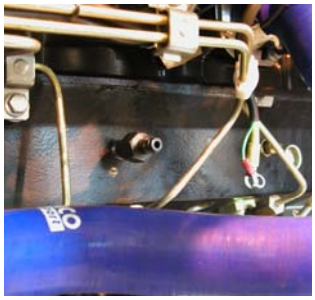
run and cycle the propeller control. Initially it may take longer for the prop to react until all the oilways are refilled with oil. Shut down and check for leaks. Next check the engine for achievement of max (100%) Np. Please be very careful if trying to conduct this statically as engine power may well be able to overcome normal aircraft brakes and there is an increased risk of prop damage from debris. If the engine is not achieving 100% Np then please refer to governor manufacturers instructions for adjustment.

13. REMOVAL AND REFITTING OF PROPELLER

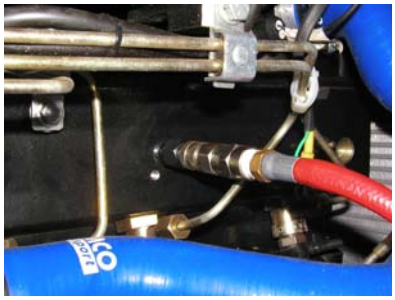
Please refer to the manufacturer's instructions for details on propeller removal and refitting. Specific attention should be paid to even torqueing of the attachment bolts/nuts and to check the tracking of the propeller blades.

14. COMPRESSION CHECK

Glow Plug



Adaptor Fitted

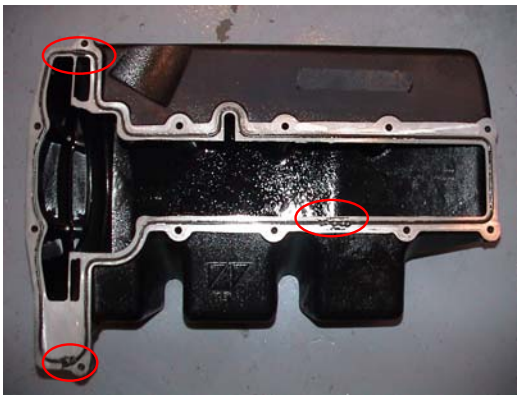


Compression Tester Connected

The compression check is done using the differential pressure method.
Start engine and warm up. Remember that the components are now hot, so please protect yourself accordingly whilst carrying out the check. This test is best carried out with two people, one to continuously hold the propeller and one to adjust the regulator. Sufficient air pressure from the tester on top of a piston, which is not quite at Top Dead Centre (TDC), will cause the propeller to rotate and may catch you unawares.
Remove the nuts that connect the glow plugs and wiring onto the glow rail and remove the glow rail. Remove the glow plugs. Screw in Wilksch Airmotive compression check adapter to No. 1 cylinder (nearest the prop) and torque. Rotate the propeller to get the piston near TDC. You should be able to hear the air rushing out of the adapter. Attach the differential pressure tester to the adapter. Slowly open the pressurise valve to show around 20 psi on the right hand gauge. Rotate the prop in the normal direction against this pressure until you feel a sudden decrease in the force required turning it. This is then TDC. If you go too far you will feel the prop trying to turn itself in the normal direction of rotation so be ready. When you are happy you are at TDC, then increase the pressure to show 80psi on the left-hand gauge. The right hand gauge now shows the pressure in the cylinder. Record this value. If the cylinder reading is below 60 psi then contact Wilksch for information on how to proceed. If all is satisfactory then repeat with No2 and 3 cylinder.
When complete clean and refit the glow plugs and torque. Refit glow rail and wiring. Carry out a normal ground run and check for correct operation.

15. OIL SUMP REMOVAL AND REFITTING

Sump removal is necessary to carry out the valve clearance check and for removing the injectors. Original sumps had the oil filter mounted horizontally. New sumps have been made so that the oil filter can be mounted vertically to allow a tighter exhaust muffler fit and to avoid mess when changing the filter. New sumps can be retrofitted at any time. The procedure below is the same for both types.
You may wish to drain the oil from the sump. It is not a necessity to, however you would need to make sure that the sump oil does not become contaminated with dust, debris or any fluids. Place a suitable tray beneath the engine to catch any residue. Remove the M6 bolts holding on the sump, some are recessed into the casting. Original sumps have two holes at the rear (visible in picture left), however these are no longer used. So don’t be worried if you find



them missing. Carefully lower the sump from the engine. It will be quite heavy if the oil has not been drained. Remove the sealing o-ring and discard.
If you drained the sump it is an ideal opportunity to give it a good clean and inspect it. Clean the mounting faces and place a new sealing o-ring onto the sump with the joint positioned along one of the long straight runs. You will need to use a drop of super-glue to join the ends of the o-ring chord together. It is also advisable to use a small amount of silicone sealant at the point where the o-ring is joined, at the "T" where the sump meets the timing cover/block joint (as indicated in the picture left) and at suitable points to ensure that the seal remains in the groove whilst fitting. Refit the sump and torque retaining bolts. Refill the sump if drained. Carry out a ground run and check for leaks. If all is satisfactory you can return the aircraft to service.

16. VALVE CLEARANCE CHECK

The inspection of the valve clearances is timed to coincide with the injector servicing to avoid task duplication. The sump must be removed to carry out the valve clearance check. Please read sump removal and installation section before proceeding. You may wish to drain the oil from the sump to carry out the check. It is not a necessity to, however you would need to make sure that the sump oil does not become contaminated with dust, debris or any fluids. Place a suitable tray beneath the engine to catch any residue. Refer to the sump removal section above. Carefully lower the sump from the engine. Remove the sealing o-ring and discard. You may wish to remove the glow plugs to make it easier to turn the prop. Again this is not absolutely necessary. Rotate the propeller until No1 cyl. cam lobes have their crown, or high point, facing away from the tappet as shown above. Using angled feeler gauges check the clearance between the cam and the tappets. You must use angled feeler gauges and NOT attempt to force straight ones through. This will give you false readings. The best way to get an accurate reading is using the "Go-NoGo" method. This involves finding the maximum size that fits (Go) easily through the gap with no resistance. Then find the minimum size that will not fit (NoGo) through. The size in-between will be the actual size. Remember that you should always try to measure using one feeler gauge only and not a stack of them to get the correct thickness to obtain an accurate reading. Rotate the prop and repeat the test on Nos. 2 and 3 cyl. Record the results and check them against the tolerances allowed (stated in Appendix 3). If they do not meet the required limits then contact WAM before proceeding. If all is satisfactory then report the results to WAM when completed. If you drained the sump it is an ideal opportunity to give it a good clean and inspect it. Clean the mounting faces and position a new sealing o-ring. Refer to the sump removal and installation section above. Refit the sump and torque retaining bolts. Refill the sump if drained. Carry out a ground run, check engine for correct operation and sump for leaks. If all is satisfactory you can return the aircraft to service.

17. REMOVAL AND REFITTING OF FUEL INJECTORS

This task will require the removal of the sump. Please read sump removal and installation section before proceeding. The inspection of the injectors is timed to coincide with the valve clearance check to avoid task duplication. Place a suitable tray beneath the engine to catch any residue. Remove the M6 bolts holding on the sump. Carefully drop the sump from the engine. Remove the sealing o-ring and discard. Disconnect fuel lines from the injectors and pump and remove their supporting clamps. Remove the leak-off hoses that connect the injectors. Using WAM special tool no.

001669 unscrew the injectors from the head. Screw in the new injectors by hand. Do not use the tool to start the injectors into the threads, damage may result. Rotate the injector core to position the inlet to the fuel line. The leak-off hose fittings may be rotated to align the hoses once the injectors are torqued; it is not necessary to align them at this stage. Whilst supporting the core in the correct orientation, tighten and torque the injector using tool no. 001669 to 40Nm. Recheck the alignment. If necessary slacken the nut and reposition, do not attempt to alter the line to fit the injector. Refit leak-off hoses and reconnect fuel lines. Refit disturbed clamps. If removed, clean the mounting faces and place a new sealing o-ring onto the sump with the joint positioned along one of the long straight runs. You will need to use a drop of super-glue to join the ends of the o-ring chord together. It is also advisable to use a small amount of silicone sealant at the point where the o-ring is joined, at the "T" where the sump meets the timing cover/block joint and at suitable points to ensure that the seal remains in the groove whilst fitting. Refit the sump and torque attaching bolts. Refill the sump if drained. Carry out a ground run and check for leaks. If all is satisfactory you can return the aircraft to service.

18. REMOVAL AND REFITTING OF COOLANT PUMP

Drain the coolant system (Ref. Coolant draining and refilling section). Disconnect the hose from the pump housing. Undo the bolt that connects the housing (or Volute) to the cylinder head. Undo the three cap head bolts that connect the volute to the rear head face. Slowly withdraw the volute. The pump may come out with the volute, if not then gently pull it out now. Replace the parts as necessary, however always replace the o-rings whenever the pump is disturbed. You will need to use some silicone type grease on the o-rings to prevent them from dropping out when re-installing and to aid fitting. It is best if you now place the pump rotor into the volute before fitting to the engine. Re-check before fitting that the o-ring is in position as it is very easy to pinch the seal when installing. Place the pump and volute onto the engine turning the pump gear as necessary in order to allow it to mesh with the timing gears. Place some silicone sealant (non-acetic acid type) onto the threads of the rear facing cap head bolts. Evenly tighten the rear facing cap head screws until you can fit the washer faced hexagon headed bolt. Fit this bolt and tighten, then slacken by 1/2 turn and nip back up. Now continue to evenly tighten the rear facing cap head screws and torque fully. Finally torque the washer faced hexagon headed bolt. Refit the coolant hose and clamp. Fill the coolant system and check for leaks (Ref. Coolant draining and refilling section). Carry out an engine ground run, check for leaks, correct readings and thermostat operation.

19. REPLACEMENT OF ENGINE SENSORS

All engine sensors fitted to the engine use aluminium washers for sealing WAM Part No 001240. Whenever you disturb any of the engine sensors theses washers must be replaced otherwise leaks may develop. Disconnect sensor and remove. Fit new sensor with a new sealing washer. Reconnect plug and carry out a ground run. Check for correct readings and leaks.
The fuel pressure sensor is fitted through the fuel filter support plate. You will need to hold the hose fitting on the other side of the plate, whilst turning the sensor. An o-ring is placed inside this union for sealing purposes. Check it for damage or replace it before fitting the new sensor.

20. TROUBLESHOOTING

Please contact WAM with any problems, troubles or defects at this time. Our philosophy is that by you letting us know of what problems you are having in service, we can gradually evolve the engine into the best in the marketplace. This, as I'm sure you will agree, is beneficial to all.

APPENDICES

I - MAINTENANCE SCHEDULE

	TASK DESCRIPTION	FREQUENCY (hrs)					
		50	100 1 yr.	500 2 yr.	1000	Note	INSP SIGN
1	Check oil and coolant levels for correct quantity	*	*	*	*		
2	Carry out normal ground run	*	*	*	*		
3	During ground run check all instrumentation for correct operation and figures	*	*	*	*		
4	Turn fuel selector to off position	*	*	*	*		
5	Following runs remove cowlings and check installation for leaks and evidence of chaffing/damage	*	*	*	*		
6	Drain engine oil. Refill with new oil.	*	*	*	*		
7	Remove and fit new oil filter	*	*	*	*		
8	Cut open removed oil filter and check contents for contamination.	*	*	*	*		
9	Remove Fuel Filter Bowl. Check bowl contents for contamination. Clean and refit with new filter element. Turn fuel selector back on and check for leaks	*	*	*	*		
10	Inspect exhaust system for leaks and cracking especially around any welded joints.	*	*	*	*		
11	Inspect inlet hose for condition and security of clamps	*	*	*	*		
12	Service Air Filter. Check its general condition, clean and re-oil foam type filter. Change if required.	*	*	*	*		
13	Remove inlet duct and inspect turbo impeller vanes for damage. Check rotor shaft for free movement and play. *Dirt is a sign of inefficient air filtration or a leak in the inlet duct.*		*	*	*		
14	Inspect intercooler inlet and outlet hoses for condition and their clamps for security.	*	*	*	*		
15	Inspect intercooler and coolant radiator for damage, cracks and security, condition of mounting.	*	*	*	*		
16	Remove sump. Remove fuel injectors. Send to WAM for test. Refit injectors and torque.			*	*	#4	
16A	Replace Pre combustion chambers to WA-SB-001B	*			*	#6	
17	Carry out valve clearance checks. Refit sump with a new o-ring and torque attaching bolts.			*	*	#5	
18	Remove glow plugs. Carry out compression check and record results. Clean, test and refit. Torque up.		*	*	*		
19	Check operation of all engine controls for correct travel, their routing and security of attachment.	*	*	*	*		
20	Inspect engine shock mounts for condition. Change if required or at TBE (see Note #3).		*	*	*		
21	Inspect engine frame for cracks and security	*	*	*	*		
22	Drain coolant. Check operation of low level sensor. Replace thermostat. Refill with coolant.			*	*		
23	Download CI-Log data and send to Wilksch Airmotive Ltd.	*	*	*	*		
24	Inspect all engine wiring for condition, chaffing and security	*	*	*	*		
25	Inspect oil cooler and hoses for leaks and condition.	*	*	*	*		
26	Inspect Propeller Governor for leaks, security, and that locking wire is intact.	*	*	*	*		
27	Inspect starter motor and ring gear for wear / damaged teeth.	*	*	*	*		
28	Inspect vacuum pump (if fitted) in accordance with the manufacturer's recommendations.					#2	
29	Inspect WAM instrument bleed air system hoses and regulator for condition and security.	*	*	*	*		

30	Replace instrument bleed air system filter (if fitted). Cut open old filter and check for oil contamination.			*	*		
31	Inspect cowlings for damage and check condition of any baffles or ducting.	*	*	*	*		
32	Refit cowls and carry out engine ground run	*	*	*	*		
33	During run check operation of logger display and warning functions.	*	*	*	*		
34	Check installation for leaks and evidence of chaffing/damage. Inspect injector lines for support and damage.	*	*	*	*		
35	Check Wilksch Airmotive website for up to date service information.	*	*	*	*		
36	Report any findings to Wilksch Airmotive Ltd.	*	*	*	*		
37	Complete paperwork and make a log book entry.	*	*	*	*		
38	Replace starter motor				*		
39	Replace Alternator				*		
40	Overhaul propeller					#2	
41	Overhaul propeller governor					#2	
42	Replace vacuum pump (if fitted)					#2	
43	Return engine to Wilksch Airmotive Ltd for exchange					#3	

NOTES

1. At first 50,100,200,500 hour services notify WAM; WAM reserve the right to send a service representative to witness and assist (normal charges apply, see Warranty Terms and Conditions)
2. Specific maintenance, inspection, overhaul or replacement in accordance with the relevant manufacturers recommendations.
3. At Engine TBE (Time Between Exchange). Note that TBE is dependent upon hrs/time in service/engine cycles/load cycles. For the latest information refer to warranty documentation.
4. Service exchange kit available. Call Wilksch Airmotive for more information.
5. Report clearances to Wilksch Airmotive. If over service limits, do not attempt to rectify and consult Wilksch Airmotive before proceeding.
6. For WAM 100 Pre combustion chamber exchange interval 100 hours. Contact WAM to see if this has been extended

II – WAM-120 ENGINE FASTENER TORQUES

All screws, studs and fasteners to be lubricated with engine oil unless otherwise specified.

Anti-seize compound is ONLY to be used on exhaust bolts.

GENERAL TORQUES

M5 bolts	5Nm / 3.6 lbs.ft
M6 bolts	12Nm / 9 lbs.ft

M8 bolts	20Nm / 15 lbs.ft

SPECIFIC TORQUES

Timing cover bolts to Block M6	16Nm / 12lbs.ft.
Timing cover bolts to Block M8	20Nm / 15lbs.ft.
Speed Sensor hex bolt M6	5Nm / 3.6 lbs.ft.
Glow Plugs	12Nm / 9 lbs.ft.

FUEL DELIVERY VALVE HOLDERS-follow the procedure below:
Torque to 30Nm / 22 lbs.ft. and undo; repeat this twice more, then final torque to 35Nm / 26 lbs.ft.

OIL FILTER
Lubricate the rubber seal with clean engine oil or silicone grease. Spin filter on until seal contacts mounting flange and tighten a further ½ turn.

ENGINE MOUNTING BOLTS
Torque the AN7 mounting bolts to 54Nm / 40lbs.ft.

III - WAM-120 ENGINE CLEARANCES

Tappet clearances	0.35 to 0.40mm (0.014" to 0.016")

IV - RECOMMENDED FLUIDS AND LUBRICANTS

Engine Oil
Wilksch Part No. 001444 (10W40 DFS)

Coolant
Coolelf Supra 60/40 pre mixed coolant Wilksch Part No. 001487.

Fuel
JET A-1 is the only recommended aviation approved fuel.

The engine can run on a range of fuels compatible with the diesel cycle. Because of storage and regulatory issues not all of these fuels are recommended and/or authorised. Individual engine rating sheets will show expected MAP at maximum Np on the rated fuel. Different fuel densities will affect power achieved slightly. If a denser fuel than the rating fuel type is used, the pilot must use the MAP gauge to respect the rated peak MAP (and hence power). For example, if the engine is rated on Jet-A1 fuel, use of (denser) road diesel would overrate the engine by typically 5% if the MAP limit were not respected. Conversely, if a less dense fuel is used, a power reduction will result and

MAP will not need to be monitored to respect the rating (but reduced aircraft performance must be considered). Other fuels may also be subject to temperature limitations, please refer to the latest issue of the Operations Manual WA-MA-2 for further information or contact WAM.

Sealants

Where a silicone sealant is specified always use a type that does not contain acetic acid as an activator. This can cause corrosion.

A locking/sealing compound should be used on any studs that require fitting. Loctite grades 561 and 577 or any other equivalent is suitable. Please consult WAM for max and min stud heights. Severe damage can result from incorrect fitting of any studs.

V - SPECIAL TOOLS

The following special tools are available from WAM. Please call for details.

Injector removal/refitting tool.
Compression tester and glow plug adapter.
Angled feeler gauges.

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