

AC AX40/AX50 piston build sheets for 5.125” and 5.250” bores

Engine Number		Job number	
Date		Engine builder	

SECTION 1 - Piston assembly and sleeve work instructions

PISTON ORIENTATION

- Each AX40/AX50 piston has a pin bore offset towards the skirts major thrust direction, marked by a machined dimple located on the thrust skirt.

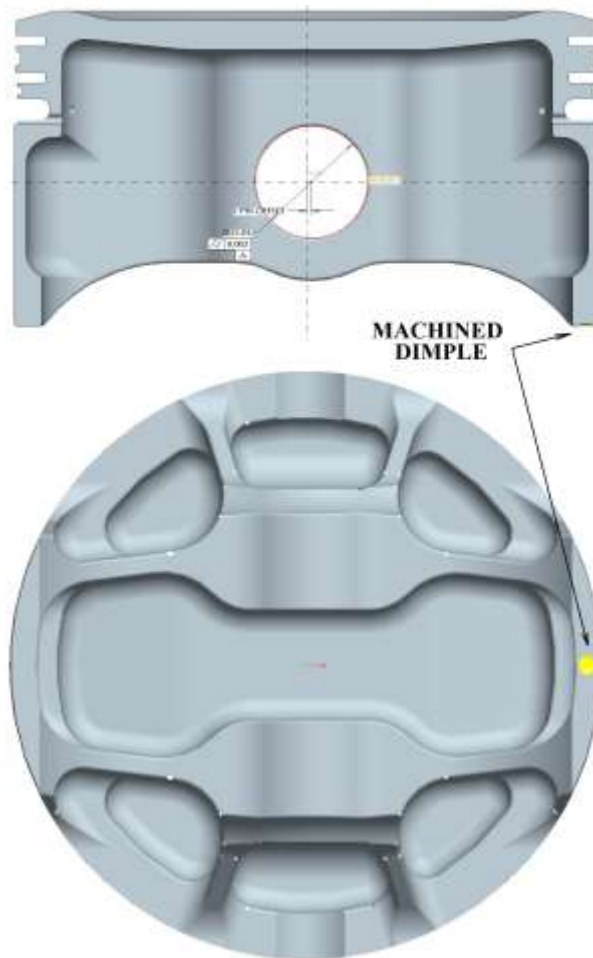


Figure 1 – piston dimple position

- Pistons are orientated dependent on crankshaft rotation; please refer to figures 2.
- Please note - viewing position is from the prop towards pilot's cockpit.

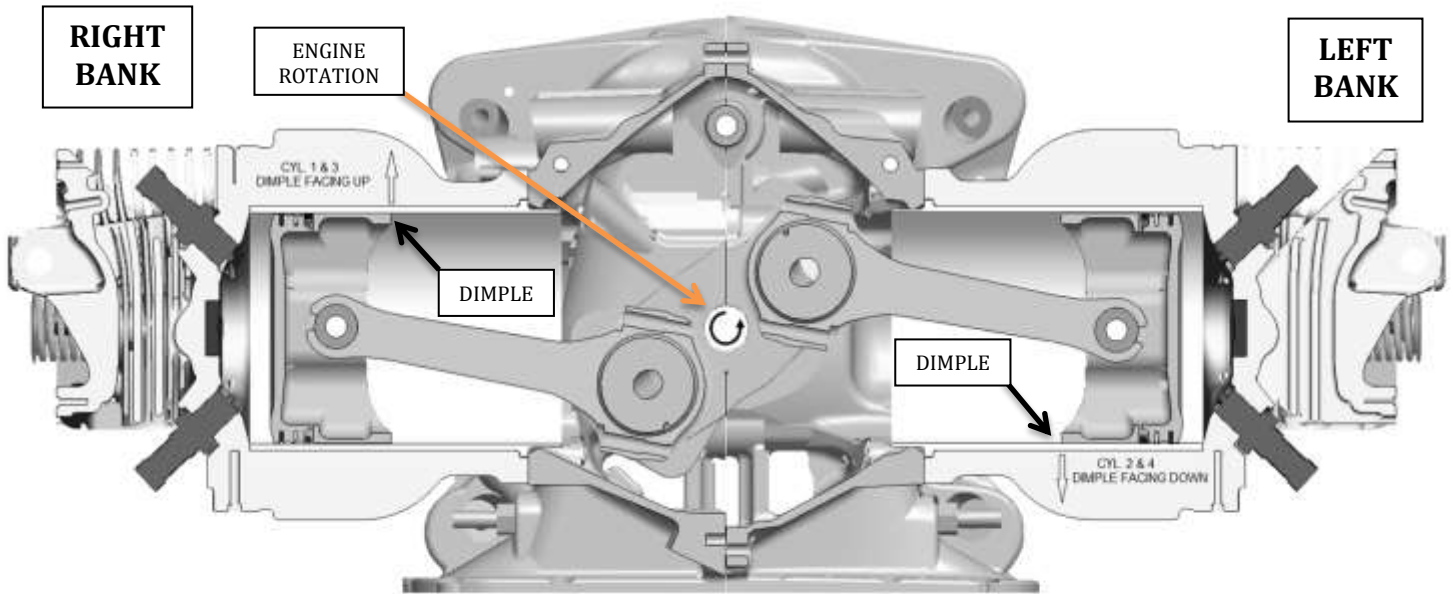


Figure 2 – Piston orientation

CHECK ITEMS

- i. Correct piston orientation
- ii. Logged pictures of left and right bank pistons

	Initial/Date	
	Initial/Date	

PISTON NUMBERING

- AX40 5.125” – AX40-14-005
- AX40 5.250” – AX40-14-001
- AX50 5.125” – AX50-14-002
- AX50 5.250” – AX50-14-001

CLEANING, LUBRICATION AND CHECKS

- Thoroughly clean pistons (AX50-14-002), wrist pins (AX50-14-017) and Nikasil™ cylinder sleeve walls. (AX50-11-005). Check all piston edges and corners for loose burrs and remove accordingly, especially the ring packs oil drain back oils.
- Nikasil™ plated bores require thorough and repeated cleaning to make sure all loose debris, honing oils and metal contaminants are removed from crosshatch. We suggest the following procedure.

- Wash with hot soap water, running a sponge around the entire ID surface.
- Rinse with clean running water, then remove excess water and dry.
- Using automatic transmission fluid (ATF) with a clean lint free rag, wipe the bore in a circular motion to remove any remaining particles. The ATF has a higher viscosity and particles will stick to the thicker liquid.
- Wipe entire surface with a very light penetrating oil (WD-40) and wipe entirely dry with a clean lint cloth to ensure crosshatch is clean.
- Apply a thin layer of Phillips 66 X/C 20W-50 oil or a similar equivalent to the ID surface using a clean lint cloth.
- It is prohibited to apply lubricants to the combustion chamber after pistons are fitted.

CHECK ITEMS

- iii. Nikasil bores cleaned and lubricated with Phillips 66 X/C 20W-50 Initial/Date
- Apply a thin layer of engine oil between the following parts:-
 - Rings & grooves – apply to rings top, bottom and OD surfaces, rotate between thumb and forefinger for 100% coverage. See **Section2 – ring pack instructions** before lubrication or fitment.
 - Pin bore & pin – apply to both piston pin bore surfaces, rotate finger for 100% coverage.
 - Rod small end bore & pin – apply to rod small end bore surface, rotate finger for 100% coverage.
 - Valve stems & guides – apply to the valve stems.
 - Valve collet groove & keepers – apply to valve collet groove.

CHECK ITEMS

- iv. All assemblies lubricated with Phillips 66 X/C 20W-50
Initial/Date
- WE DO NOT RECOMMEND USING SYNTHETIC OIL OR ANY AFTERMARKET OIL ADDITIVES until the rings have properly seated.
 - Engine oil to be completely drained and replenished with Phillips 66 X/C 20W-50 oil and A9 treatment after break-in with the first oil change between 20 hours to 25 hours of operation. All oil filters should be replaced and screens thoroughly cleaned.
 - USE OF THE ENGINE WITHOUT AN AIR FILTER IS PROHIBITED AND VOIDS WARRANTY.
 - USE OF THE CORRECT PISTON OIL SQUIRT JETS IS MANDATORY AND WILL VOID WARRANTY IF NOT USED.

CHECK ITEMS

- v. Phillips oil 20w-50 with A9 treatment
- vi. Oil and filters changed, screens cleaned
- vii. Air installed correctly
- viii. Piston oil squirters installed correctly

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- During trial assembly or mock-up, verify the dome and valve pockets on the pistons match the combustion chamber and valve diameters of your cylinder heads. Hand turn engine to check valves do not contact pistons.
- Measure assembled piston and rod weights to match each to the closest nominal value.
- The pin locks require no lubricant. Install the end of one lock at 90 degrees from the pick lock groove. Use a stiff small bladed screwdriver and insert the tip into the pick lock groove while you wedge the lock into the groove without kinking or deforming the lock. After the first lock is in place, seat the lock by solidly hitting the wrist pin with a brass drift pin. Now install the connecting rod and the second lock. Seat the 2nd lock in the same manner as the first. Just as a precaution, we recommend hitting each side of the wrist pin with the brass drift pin an additional time. Perform these functions on a cloth towel or soft rubber pad so no damage to the piston occurs.
- Wire locks orientated with open ends pointing towards the crank or 6 o'clock position. This reduces the lock compressing and unseating during high rpm.

CHECK ITEMS

- ix. Pistons and locks installed correctly

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SECTION 2 - Ring pack instructions

PREPARATION

- AC's 5.125" ring pack (AX50-14-034, AX50-14-035 and AX50-14-036) and 5.250" ring pack (AX50-14-008, AX50-14-009 and AX50-14-010) has been specially coated and does NOT require additional cleaning. Only use a clean lint cloth to remove oil, grease etc.
- Top compression ring (AX50-14-034, -008), second Napier oil control ring (AX50-14-035, -009) and 3-piece oil control ring (AX50-14-036, -010) are bagged together for each bore.

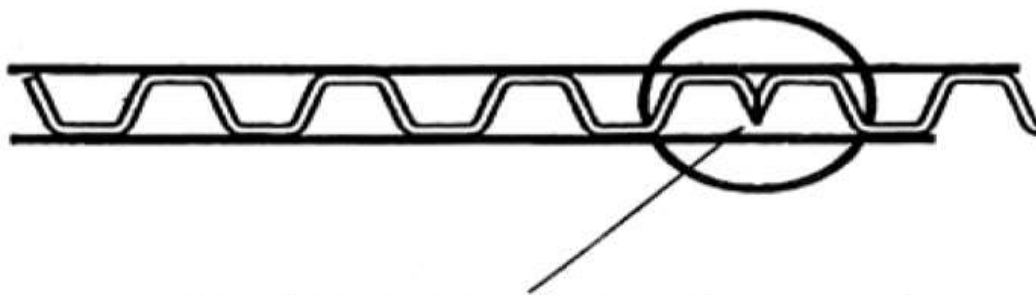
Label complete ring sets for each cylinder. No modifications or adjustments are necessary to any of the rings. All gaps and tensions fall within SAE specifications and tangential tensions have been optimized for AC's Nikasil cylinder bore.

END GAP

- Top compression (AX50-14-034, -008) and second oil control (AX50-14-035, -009) rings are sized with end gaps between 0.8 ± 0.1 and 1.0 ± 0.1 mm respectively.
- Oil control ring rails (AX50-14-036, -010) are sized with end gaps between 1.0 ± 0.1 mm.
- No gap modifications should be needed.

INSTALLATION

- Order of installation: 1. Oil control ring (AX50-14-036, -010), second ring (AX50-14-035, -009), and last the top ring (AX50-14-034, -008).
- Wind on the oil rail expander, first with the crests upward and butting together. See [figure 3](#).
- Install the upper rail before installing the bottom rail. If you attempt to install the lower rail first the assembly will become tangled as the rail passes over the expander gap. Install the upper rail gap about 90° counterclockwise from the expander gap. Install the lower rail with the gap about 90° clockwise from the expander gap. The reason that rail gaps must be separate from each other and the expander gap is to avoid overstressing of the expander. If the two rails are fitted with their gaps in line the friction effect of the rail inners against the expander rail support pads will cause most of the relative movement to be concentrated over a small number of humps. This will cause the most highly stressed hump to break. Also, the expander will either overlap or become tangled if its gap is assembled in line with either or both of the rail gaps. See [figure 6](#).



Ends cannot overlap and must point to bottom of piston.

Figure 3

CHECK ITEMS

- x. Oil control expander correctly seated Initial/Date XXXXXXXXXX
- Next install the Napier oil control ring. This is a torsional ring and will need to be orientated with the dot towards the piston crown. See figure 4 & 5.

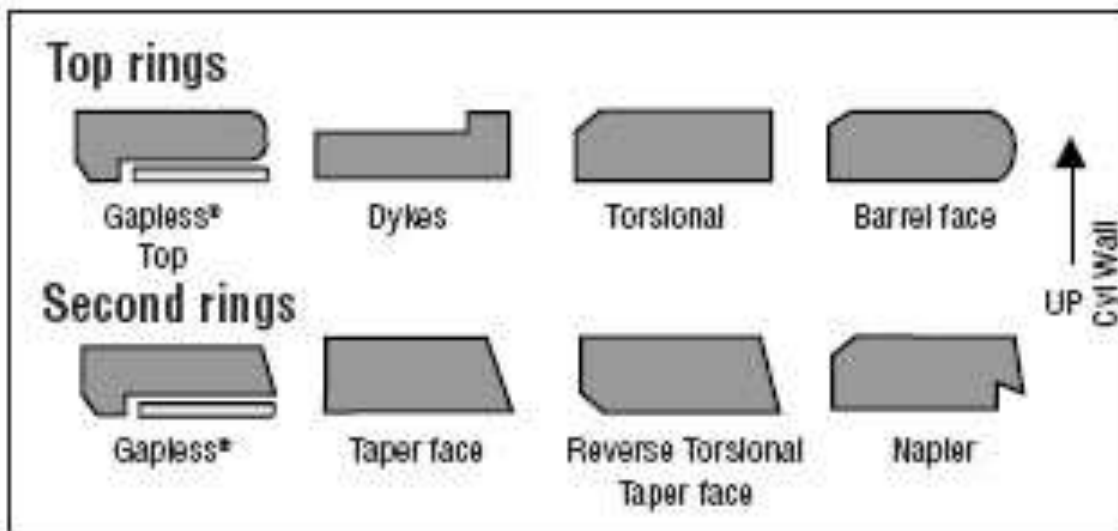


Figure 4

- Install top ring last. This is a torsional ring and will need to be orientated with the dot towards the piston crown. See figure 4 & 5.
- End gaps in the top two rings should be staggered approximately 180° apart as per figure 5.

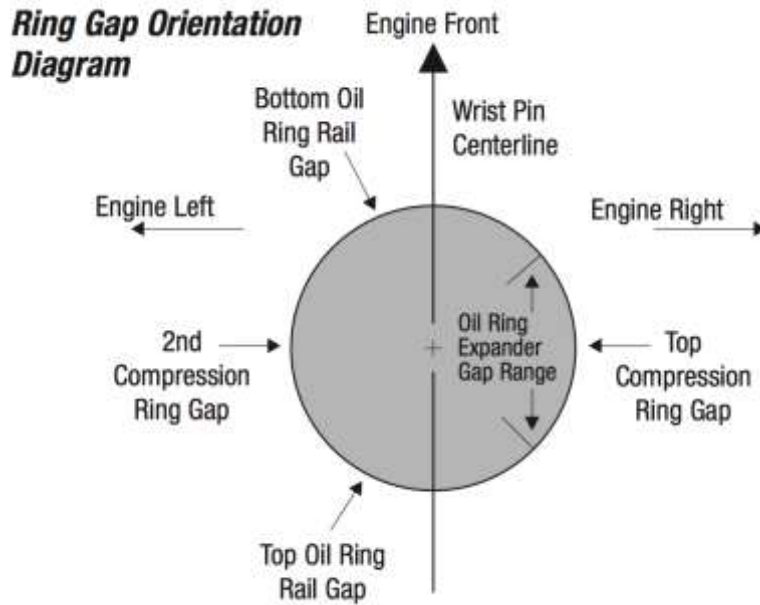


Figure 5

IMPORTANT CHECKS IN GROOVES

- Spin all rings in grooves to be sure that the rings are free and not binding.
- Back clearance can best be measured by pushing the ring into the piston ring groove until it bottoms against the root of the groove. The amount that the face of the ring is below the ring lands is the ring back clearance. It should not protrude beyond the lands when the ring is bottomed in the groove. See figure 6.

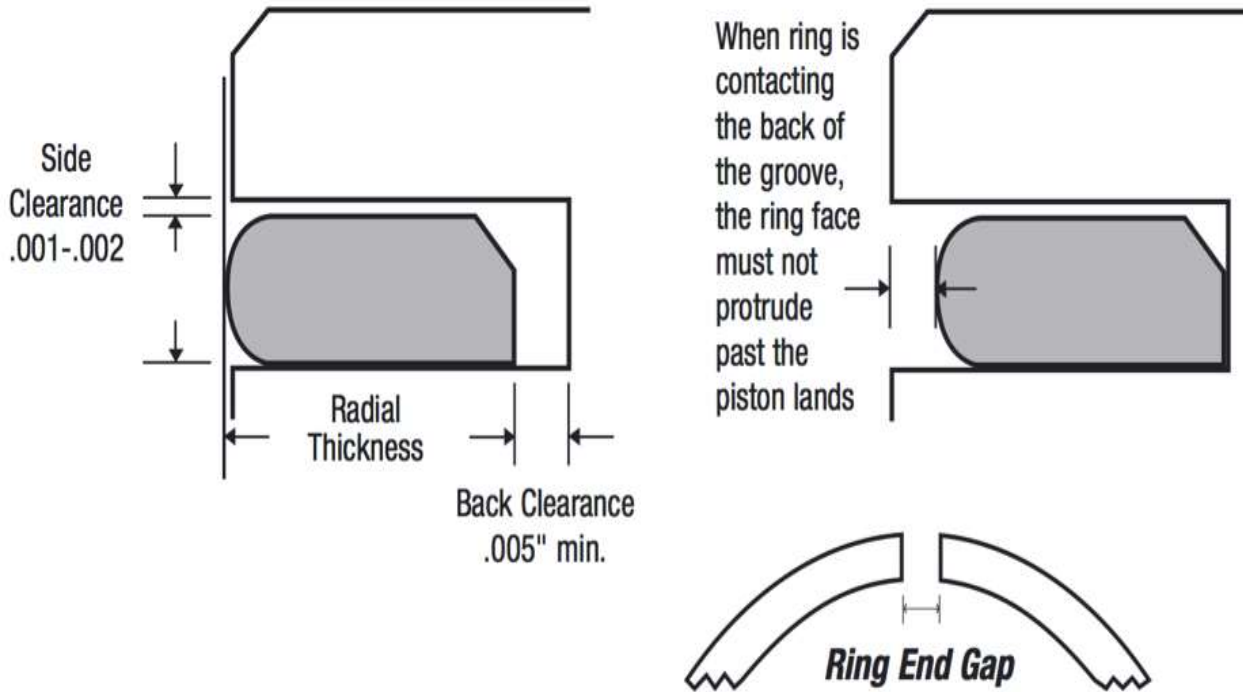


Figure 6

CHECK ITEMS

- xi. Rings seated, not binding and orientated correctly

Initial/Date [REDACTED]

BORE INSTALLATION

- Use AC's clam-clip ring compressor tool (AX50-92-001) to ease piston and rings into cylinder bore. DO NOT force, if resistance is felt check rings (*especially oil control rails*) have not been displaced from groove.



Image 1 & 2 – AX50-92-001 clam-clip compressor tool

- Unwind the jubilee clip enough to allow the rings into the large portion of the tapered ID, making sure the piston crown is facing towards the smaller ID. You may slightly compress the 1st and 2nd rings to allow for fitment and make sure they are not binding anywhere. See Image 3.



Image 3 – AX40/AX50 piston with rings fitted to AX50-92-001 ring compressor tool

- Tighten jubilee clip and then firmly push piston down until the piston crown contacts the surface below. See Image 4 & 5.



Image 4 & 5 - AX40/AX50 piston in position to be installed into cylinder bore.

- Align compressor with piston over the cylinder flange and make sure both are concentric. See Image 6. Then push down equally from each end of the piston skirts. See Image 7.



Image 6 & 7 - AX50-92-001 tool in position and piston pushed into cylinder bore.

RING SEATING

- When first starting your engine to ensure proper ring seating, do not allow the engine to idle for long periods at a time. It is a good idea to mildly load the engine as soon as you can.
- Do not idle the engine, as idling does not break in any engine.

CHECK ITEMS

- xii. Piston and ring assembly moves freely

Initial/Date

SECTION 3 – Rod, bolt and bearing instructions

BOLT, SHELL BEARING LUBRICATION AND BOLT TORQUING

- Thoroughly clean rods, either the 360 2-bolt (AX50-01-015) or the 409 4-bolt (AX50-01-007) with an automotive parts type cleaning solvent before installation. The bolts are already greased and DO NOT require cleaning.
- All bolts should be lubricated under the heads as well as on the threads. We recommend Extreme Pressure Lube #3 or as an alternative, molybdenum base paste mixed with engine oil.
- Spread an adequate amount of the Extreme Pressure Lube #3 on the threads and under head to obtain a good seal. Extreme Pressure Lube #3 must not be mixed with grease or oils.
- Install rod big end shell bearings in the UPPER and LOWER positions. Make sure bearing tangs have enough clearance in rod tang slots. Lubricate both faces with CLEVITE engine assembly lube or equivalent.
- The preferred method to torque the bolt is by using the stretch figure below. In order to check bolt stretch, simply fixture one rod, leaving the cap portion free from clamping load. Measure both bolt lengths loose, then progressively tighten the bolt until the measured increase in length correlates with the figures below. Tighten progressively (3 steps) and use the indicated torque reading to tighten all the connecting rods in final assembly.

360 rod bolt torque procedure

RECOMMENDED STRETCH (mm)	TORQUE NOT TO EXCEED (Nm)
-	30 - initially
0.165 ± 0.025	68 - Final

409 rod bolt torque procedure

RECOMMENDED STRETCH (mm)	TORQUE NOT TO EXCEED (Nm)	BOLT SEQUENCE
-	10 - initially	#1, #4, #3, #2
0.135 ± 0.005	22 - Final	#1, #4, #3, #2

CHECK ITEMS

xiii. Rods lubricated and torqued

Initial/Date 

SECTION 4 – Running protocols and parameter checks

- Oil squirters: It is mandatory to fit adequately flowing oil squirt jets with AX50 cylinders. These will maintain lubrication and cooling to the reciprocating parts and cylinder bore surface.
- Cool Covers: The AX50/40 cylinders are designed to be used with the cool covers. In applications / installations that have adequate air-cooling, these might not be necessary. In regimes with high CHT's (CHT – cylinder head temperatures) of more than 400°F, it is essential that they be used.
- For continuous CHT's of 392°F with excursions to 450°F for 5 minutes during take off;
 - Maximum oil temperature, 230°F
 - Minimum oil pressure at idle, 22 psi
 - Oil pressure continuous operation, 55-80 psi
 - Oil pressure on cold engine start up, 100psi
- Oil gauge pick up point and the oil pressure reading that is displayed on the cockpit gauge. On almost all of the older Lycoming engine installations, oil pressure for the cockpit gauge is tapped from the rear of the engine, at the oil pump. This location is the highest oil pressure point in the engine. The correct source for the oil pressure reading is at the forward end of the copilot side oil gallery, which is the lowest oil pressure point in the engine.

CHECK ITEMS

xiv. Oil squirters installed

Initial/Date 

xv. Cool covers installed

Initial/Date 

xvi. Post test operating parameters are within range

Initial/Date 

xvii. Oil gauge reads the lowest pressure value

Initial/Date 

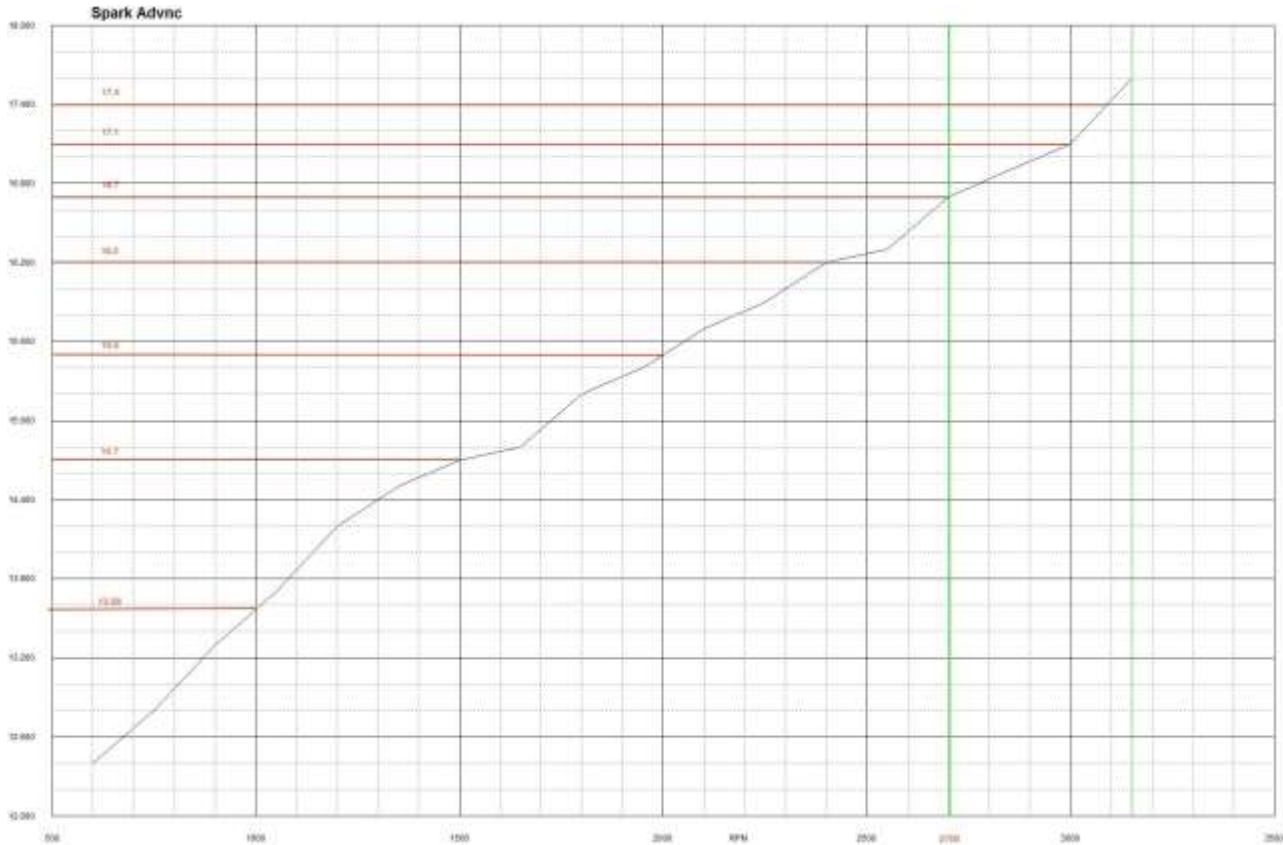
SECTION 5 – Operating limits of the AX40/AX50 Cylinders

Race, Max Continuous RPM:-	3050 rpm (prop dependent)
Normal Flight Max Continuous RPM:-	2700 rpm
CHT limit:-	430 °F Short use, no more than 7 minutes at higher temps, up to but no more than 470 °F permissible for emergencies. For maximum service life, operating temperatures between 150 °F 390 °F during continuous operation. <u>WARNING.</u> If prolonged use at higher temperatures for more than 7 minutes is encountered, the cylinders must be inspected by the factory.
EGT limit:-	1650 °F Upper limit 660 °F Lower limit
Oil Consumption:-	0.8Qts/Hour or less
Oil Type:-	Multigrade only.
Oil Grade:-	10W 30 20W 50
Traditional Aviation Oils:-	Recommended Oil, Amsoil “Z” rod 20W-50 Phillips X/C W15 W 50 AeroShell
Oil Temp:-	240 °F Max 180F~212 °F Normal operating
Oil Pressure:-	60 psi Min 90 psi Max Gauge or sensing line from front right side of engine.
Fuel:-	MOGAS, AVGAS, non leaded non aviation fuels with an octane rating of 87 or more, biofuels, E85, Ethanol, Methanol.
Spark Plugs:-	TOP PLUG:- NGK BR8EIX or DENSO IK24 BOTTOM PLUG:- NGK BR8EIX or DENSO IK24
ALTERNATE Plug:-	BOTTOM PLUG:- NGK BR9EIX or DENSO IK29 AX40, short cylinder uses M14 x 1.25 plugs

AX50, long cylinder uses both M14 x 1.25 and M18 x 1.5 plugs

When using magneto ignition ensure they are set to no more than 17deg max advance, ensure your ignition system is set to the graph limits or less.

Ignition Timing:-



SECTION 6 – Revision table

Version	Date	Changes
1.01	15-Jul-14	➤ Piston orientation included.
1.02	12-Nov-14	<ul style="list-style-type: none"> ➤ Nikasil cleaning instructions included. ➤ Ring sets changed to AX50-14-029, -030 and -031. ➤ Ring gap SAE specifications and sizes included. ➤ Ring gap sizing calculation removed. ➤ Ring installation expanded with AC'S ring compressor.
1.03	13-Nov-14	➤ Ring compressor notes updated.
1.04	27-Dec-14	➤ Piston orientation view position added.
1.05	15-Jan-15	<ul style="list-style-type: none"> ➤ Engine build and check tables added. ➤ Piston dimple orientation notation added. ➤ Engine build lubrication notes added. ➤ Air and oil filters change notes added.

		<ul style="list-style-type: none"> ➤ Ring sets changed to AX50-14-034, -035 and -037. ➤ Rod bolt lubrication notes changed.
1.06	22-Jan-15	<ul style="list-style-type: none"> ➤ Revision table and appendix added. ➤ Ring end gap notes changed.
1.07	16-Mar-15	<ul style="list-style-type: none"> ➤ Section 1 check items; added oil change after break in and oil squirters are mandatory. ➤ Section 4; running protocols and check items added. ➤ Highlighted blue color added for post test checks. ➤ Revision table section changed from 4 to 5.
1.08	18-Jun-15	<ul style="list-style-type: none"> ➤ Added piston and ring part numbering; AX40, 5.250” ➤ Referenced document to both AX40, AX50, 5.1250” and 5.250” assembly combinations.
1.09	28-Sep-15	<ul style="list-style-type: none"> ➤ Assembly powder and grease removed from builds.
1.10	21-Jun-16	<ul style="list-style-type: none"> ➤ 409 rod bolt torque procedure added and 360 table updated.
1.11	23-Aug-16	<ul style="list-style-type: none"> ➤ Piston orientation diagrams updated to simplify document. ➤ Section 5:- Operating limits of the AX40/AX50 Cylinders added.
1.12	09-Sep-16	<ul style="list-style-type: none"> ➤ Ignition timing graph and note updated.
1.13	22-Sep-16	<ul style="list-style-type: none"> ➤ AX40 and AX50 spark plug sizes added.
1.14	23-Oct-16	<ul style="list-style-type: none"> ➤ Page1, viewing orientation re. crank rotation corrected. ➤ “Confidentiality” removed from footnotes and replaced with “General Release Issue”.