ENGINE OVERHAUL, ASSEMBLY AND PARTS BOOK

FOR

JABIRU GENERATION 4 2200 AND 3300 AIRCRAFT ENGINES

DOCUMENT No. JEM0004-3

This Manual has been prepared as a guide to correctly overhaul Jabiru Generation 4 2200 & 3300 production engines commencing from serial numbers 22A3811 and 33A2770 respectively. The configuration changes presented in this Manual do not impact on the interface, performance and operability of the 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. Manuals are also updated periodically with the latest revisions available from the web site. Failure to maintain the engine or aircraft with current service information may render the aircraft un-airworthy and void Jabiru's Limited, Express Warranty.

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

1.1 Table of Figures

1.2 Table of Tables

1.3 List of manual changes

Issue	List of Changes	Issued By	Date
1	Initial Issue	AS	4/12/17
2	- Add Tacho tag torque setting - Update flywheel installation (section 4.13) to include wear plate - Update torque settings - Update section 4.10 to include flat dipstick - Update section 4.1 to include counter bored pushrod manifolds - Update 4.4 to include the External pushrod tube O-ring cylinder head - Add torque setting for ignition coil retaining screws - Update section 4.1 and 4.8 for 3/8” through bolts - Remove washer under tacho pickup bolt (section 4.13) - Remove fuel pump drip tray from 2200 (section 4.14) - Add introduction - Add clearances for Broad Lobe Oil pump - Add washers to oil pump assembly - Add Cast intergral centred flywheels - Add reground crankshaft sizes	AS	5/12/17 11/12/17 09/01/18 10/01/18 30/01/18 31/01/18 01/02/18 02/02/18 4/05/18 14/05/18 26/09/18 05/12/18
3	- Remove Oil pump clearances (section 11.3.4) - Oil pump inspection (section 3.8) - Add Loctite 620 to Gudgeon pin circlip installation - Torque settings section (3.11.3) - Warning regarding oil additives (section 5)	AS	08/04/19

1.4 Introduction to the Jabiru Gen4 2200 and 3300 overhaul manual

This manual prescribes procedures for the disassembly, basic inspection and reassembly of the generation 4 Jabiru 2200 and 3300 configuration engines.

It should be noted that that particularly in regards to overhaul assemblies it is impossible for ever scenario to be detailed in this manual. Hence the high importance that only those individuals who have been trained and have sufficient experience in overhaul Jabiru aircraft engine should attempt to do so.

The standard overhaul intervals for Jabiru generation 4 engines are stated below:

- Top end overhaul must be conducted not more than **1000 hours TIS** after a previous Overhaul interval.
- Full Top and bottom overhaul must be conducted not more than **2000 hours TIS** after a previous Full Overhaul interval.
- Operating in adverse conditions, prolonged periods of harsh operating practices or other abnormal practices will likely necessitate overhaul intervals be shortened to adequately maintain safe operability of the engine. This is up to the discretion of and is the responsibility of operators and maintainers to determine if a more regular overhaul interval must be adopted for a given engine.
- Aircraft incidents which cause a propeller strike or other damage usually necessitate a **bulk strip** of the engine regardless of the number of hours run since last overhaul.

1. Special procedures related to engine overhaul

This section details some primary procedures conducted as deemed necessary if certain condition are suspected. These should be conducted BEFORE disassembly if required.

1.5 Crankshaft friction test

- A crankshaft friction test is used to determine if an engine has a fretted crankcase. If the results of this test indicate fretting, the crankcase will need to be split and the crankcase halves reworked (which is beyond the scope of a standard top end overhaul).

NOTE
The engine crankshaft friction test must be conducted when the engine is cold

- Remove one spark plug from each cylinder. Turn the engine over several times. Position the crankshaft so that the magnets are almost lined up with the ignition coils, see Figure 1. Then using a spring balance at the tip of the propeller blade, (take care not to damage the propeller blade) pull the prop slowly in the direction of rotation. Take note of the reading on the scale as you do this. You will only get about 150mm of movement before the camshaft causes the prop to move more easily.

  Note: It may be difficult to attach a spring balance to the tip of a composite scimitar propeller, in this case choose and mark a location as close to the tip as possible. Mark the same location on all blades, for consistent measurements.

- Rotate the prop a ½ turn and measure the force to pull the propeller again. Repeat until you have at least three consistent readings.
- For each through bolt and stud bolt, undo the nuts about half a turn, then using a calibrated torque wrench, tighten each of the through bolts and stud bolt nuts the to the torque setting specified in section 0.
- Perform the propeller pull-tests again (again obtain at least three consistent readings). In doing the pull tests a second time ensure that you are turning the engine over in the same position as last time (i.e. the position of the coil magnets and cam lobe should be the same). If the force measurements obtained are more than 400 grams larger than measurements taken before the through bolts were re tightened, it shows that fretting of the crankcase has reduced main bearing clearances to an unacceptable level. The engine should be disassembled and the crankcase repaired by a Jabiru Authorised facility.

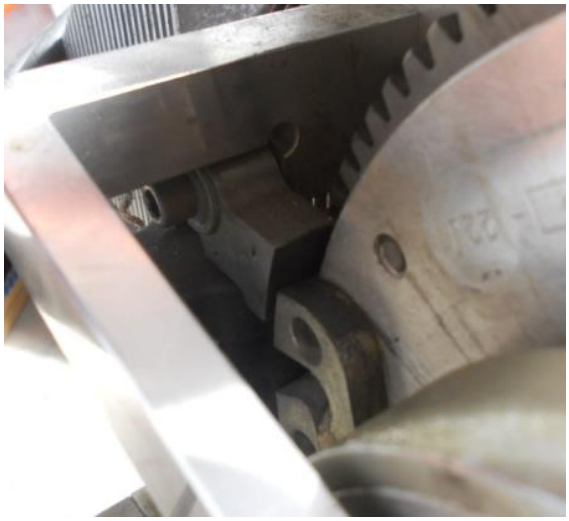


Figure 1 Coil position for crankshaft friction test.

- Use a spring balance that can read at least 3 kg with a maximum of 50 gram increments.

Figure 2 Suitable spring balance.

WARNING

Through-bolts & studs are highly loaded. Never torque nuts above the torque setting given in Section 0 or damage to the bolts will result. Accurate wrench calibration & compensation for any adaptors used is vital when working on these parts.

The results of this test are an indicator only. False negatives and positives are possible. If in doubt, disassemble the engine and inspect to be sure.

1.6 Prop Strike Inspection

- If a propeller strike incident occurs a basic propeller strike inspection must be conducted.
- Check the crankshaft and prop flange for run out as shown below.

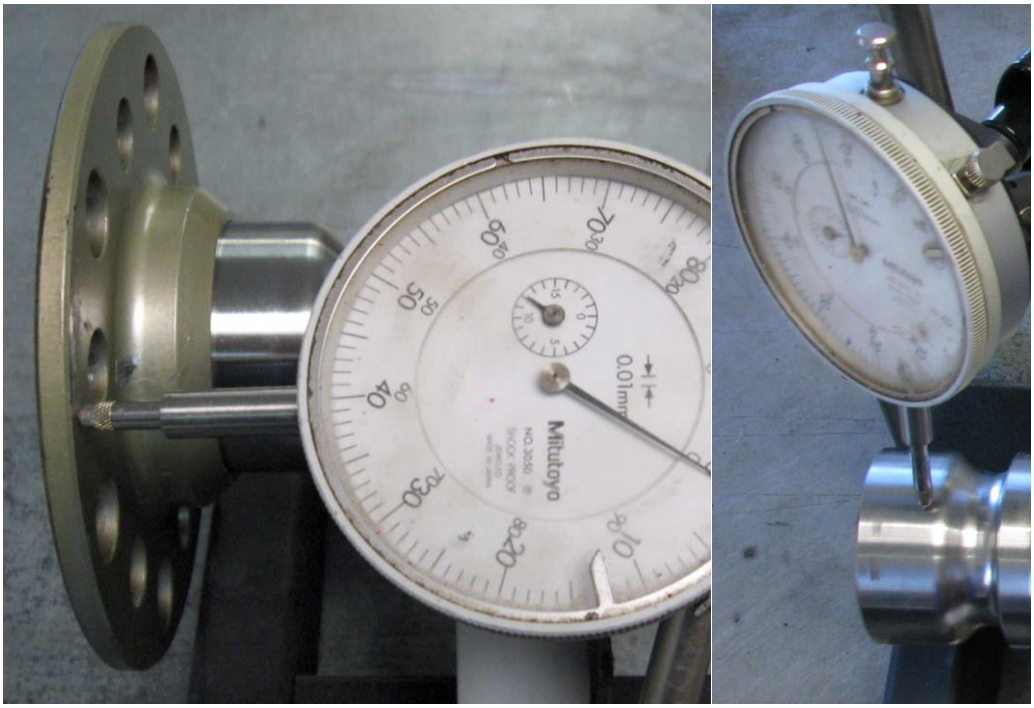


Figure 3 – Dial Indicator Position for Crankshaft & Prop Flange Run Out

- 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.

WARNING

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.

2 Disassembly procedures

The degree of disassembly depends on degree of overhaul. This section lists the disassembly required for top end overhaul and full overhaul respectively. Disassembly is treated as being essentially the reverse of assembly so reference to figures presented in the assembly instructions can be made.

2.1 Overhaul disassembly (Top end and Full Overhaul)

- Before disassembly ensure the oil is drained from the engine
- Mount engine of vertical engine build stand.
- Remove retaining capscrews and remove starter motor.
- Loosen hose clamps, remove Carburettor with fuel pump and fuel pump drip tray and remove rubber carburettor mount.
- Remove distributor clamp retaining screws; remove distributor cap clamps, distributor caps and the lead set.
- Remove spark plugs.
- Remove rotor buttons from rotor shafts.
- Remove retaining screws, remove ignition coils.
- Remove retaining screws, Remove alternator stator.
    - Unless the alternator stator is found to be unserviceable it does not need to be removed from the stator mount.
    - Remove the roll pins from the stator mount.
- Remove retaining screws, remove clamp turtles, remove exhaust pipes and upper induction pipes, with O-rings / copper gasket rings.
- Remove lower induction pipes from the plenum chamber; remove the lower induction pipe O-rings.
- Remove Oil filter, Oil filter adaptor, and oil cooler adapter plate
    - The hose tails do not need to be removed from the oil cooler adaptor plate
    - If an offset oil cooler adaptor plate is fitted (usually on engine built with a reworked billet crankcase) the Maltese cross fitting does not need to be removed.
- Remove circlip and remove oil pressure relief valve, spring and washers
- Remove oil pump assembly
- Before disassembly set a calibrated torque wrench to the setting prescribed for flywheel attachment screws (see section 3.11.3) and conduct a torque check on the flywheel screws.
- Remove flywheel screws and washers.
- Lever flywheel off the crankshaft dowel using a pair of large broad flat screwdrivers on opposite sides.
    - Inspect the attachment bolt holes, If deep Nordloc washer indentations are present (i.e. flywheel was installed without a steel wear plate) then the aluminium flywheel centre must be disassembled and replaced.
    - Generally the ring gear is unserviceable at overhaul, apply heat with a heat gun to the ring gear and remove the ring gear.
    - The remainder of the flywheel (pole plates, alternator magnets) do not need to be disassembled.
- Remove all gear box retaining capscrews and washers.
- Carefully lever the gear box off the engine.
    - Press out the rear crankshaft seal.
    - Push the rotor shafts out of the gearbox.
    - Remove rotor shafts (with gears attached)
    - Remove retaining capscrews and remove distributor mount plates.
    - Press out distributor seals from the distributor mount plates.
    - Press out distributor shaft bushes from the distributor gearbox.
- Remove the back plate retaining capscrews and washers.
    - The two 1/4-NPT plugs in the back plate need not be removed
- Carefully lever the crank gear off the crankshaft.
- Remove the flywheel dowel pins using a dowel pin removal tool.
- Remove the retaining screws and heat shield.
- If a machined plenum chamber is fitted, remove the retaining screws and remove the machined plenum
    - Disassembly the machined plenum chamber.
- Remove the dipstick tube retaining grub screw.
- Pull out the dipstick tube assembly with the dipstick.
    - Neither the dipstick tube assembly or dipstick itself need be disassembled, except that the dipstick cap O-ring should be removed and replaced.
- Remove the sump plug and oil temperature sender.

- Remove the retaining screws and remove the sump from the engine
- Remove through bolt and stud bolt nuts and washers
    - For a Top End Overhaul the nuts and washers on the two front short studs need not be removed
- Remove cylinder head / barrel assemblies, from the cylinder heads:
    - Remove pushrods and pushrod tubes
    - Remove retaining screws, rocker covers and rocker cover O-rings
    - Remove retaining screw, press out rocker shaft, remove rockers. Press out rocker bushes, remove rocker shaft O-rings
    - Install each cylinder head on a valve spring compressing jig, compress each valve and remove top spring washer, valve springs and bottom spring washer.
    - **DO NOT SEPERATE THE CYLINDER HEAD FROM THE CYLINDER BARREL**. The cylinder head barrel must remain as a complete unit in order to be serviceable.
- Remove through bolts from the engine:
    - Leave the stud bolts in place for now.
- Use circlip pliers to remove the bottom piston circlips.
- Push gudgeon pins out and remove pistons with piston rings.

For TOP END OVERHAUL continue in section 2.2

2.2 Continued disassembly (Top End Overhaul)

Before further disassembly the crankcase halves must be retained securely using the still installed stud bolts (see Figure 4 below).

- Place stud bolt extension slugs over each of the four long stud bolts.
- Install washers and nuts and tighten each to the 20ft.lb.

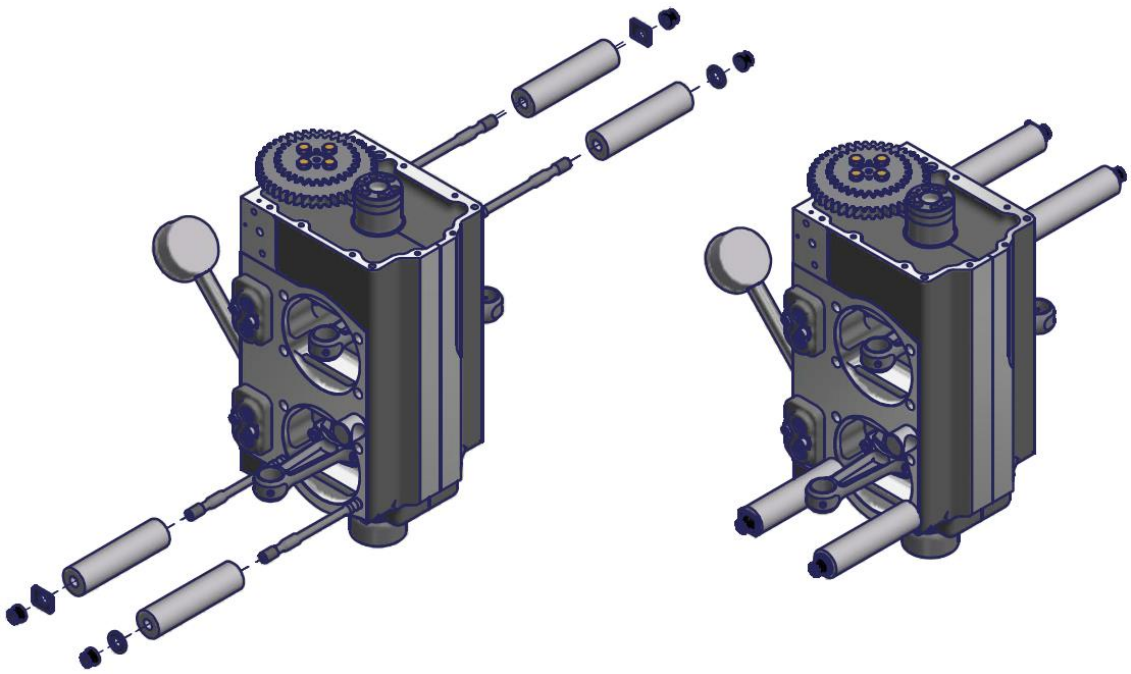


Figure 4 - Securing crankcase halves for Top End Overhaul

- Remove Capscrews and pushrod tube manifolds.
    - Remove roller hydraulic lifter retaining plates and the lifters themselves.

2.3 Continued disassembly (Full Overhaul)

- Split the two crankcase halves apart:
    - This is conveniently done by tapping on the head of each stud bolt in turn with a soft mallet to gradually separate the two crankcase halves.
    - With the two crankcase halves separated, remove the stud bolts using a stud removal tool (applying heat to the base of the stud will also help).
    - Remove main bearing shells and thrust washers.
    - Remove retaining screws, pushrod manifolds, lifter retainer plates and roller hydraulic lifters.
    - The oil dipstick tube mount **does not** need to be removed from the right crankcase halve.
    - Apply heat to the oil strainer and tap off using a soft mallet.
    - Apply heat to the oil pickup tube and remove out the front of the right crankcase half.
    - Remove the front and rear 1/8-NPT seal plugs, remove the front grub screws.
    - Remove dowels from the crankcase halves using a dowel removal tool.
    - Remove dowel O-rings using a pick.
- Take the camshaft and apply heat to the threads of the retaining bolts.
    - Remove retaining bolts
    - Remove Large and small cam gears and spacer plate.
- Apply heat to the conrod bolt threads, remove conrod bolts
- Disassemble conrods from the crankshaft, remove conrod bearings
- Take the crankshaft down from the vertical engine stand and install in a rubber jaw vice
- Apply heat to the propeller flange capscrews, remove capscrews, remove propeller flange

WARNING

The propeller flange screws are retained with Loctite 620. Great care must be taken in removing these screws or they may break during removal resulting in the crankshaft becoming unserviceable.

- Ram out welsh plugs using a long draft and mallet.

3 General overhaul procedures

- Refer to Section 3.12 for the lists of serviceable and mandatory replacement items.
- Discard all items listed as mandatory replacement items.
- Carefully clean and inspect all items listed as "**reusable upon inspection**". Not all possible scenarios can be listed and the relative condition of parts is subject to the engine overhauler's knowledge and experience. The following details essential inspections of critical parts.

3.1 Crankcase halves

- Inspect the machined mating faces (between the two halves) for signs of fretting. If fretting can be detected (either by observation and/or by feeling roughness against your fingernail across the affected area – see Figure 5) then it must be corrected by having both case halves surface skimmed and the bearing tunnels bored to the correct dimensions before returning to service.
- This is a task requiring specialised tools and experience and must be outsourced to a Jabiru approved maintenance facility.

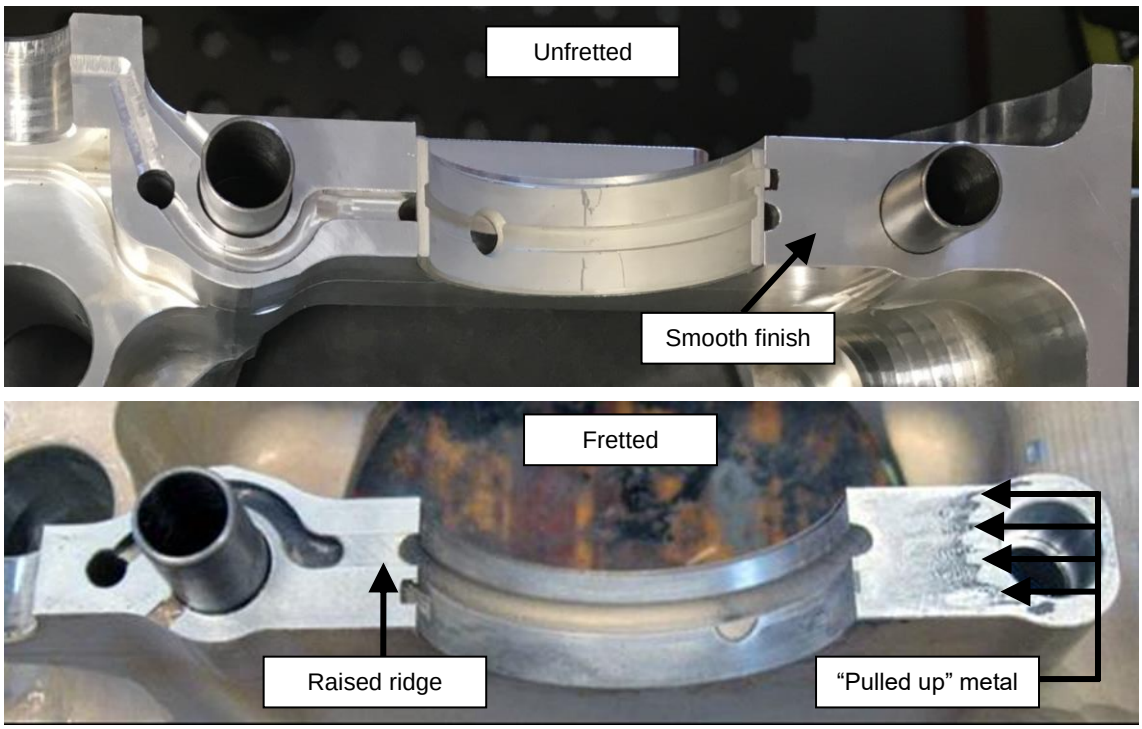


Figure 5 – Crankcase fretted vs unfretted

- Also inspect the general condition, check the cylinder base mating faces are in good condition and not fretted, check the condition of the oil galleries, cam tunnel, crankshaft tunnel, and thrust faces.

3.2 Cylinder head barrel assemblies

- Again it is stated how important it is that the cylinder head and cylinder barrel are NOT SEPERATED. The seal between the cylinder head and barrel will not be recovered if the two components are reassembled.
- The first critical inspection to make is the cylinder bore. Check the condition of the ceramic liner, measure the bores at the positions noted in section 4.4 and check that the bore sizes and out-of-roundness values are within the limits specified in section 3.11.4. Cylinders with out-of-roundness values outside the specified limits cannot be reworked and are unserviceable.
- Check the condition of the seal between the cylinder head and barrel. If there are any signs of combustion gas leakage the cylinder head barrel is unserviceable and must not be used.
- Check the condition of the valve seats and valve guides.
    - Measure the valve guide bores with go-nogo gauges and check they are within the tolerances specified.
    - Guides smaller than specified can be reamed out to the correct size.
    - If guides are larger than specified the entire cylinder head is unserviceable and must not be used.
    - Valve seats must not have receded into the cylinder head.

- During assembly a vacuum check will reveal the serviceability of the valve seats. Poor vacuum results can be corrected by lightly recutting seats and lapping valves onto the seat using a valve grinding paste.
- All cylinder head reworking processes require specialised tools and experience and must only be attempted by those with sufficient training.

3.3 Crankshaft

- Crankshafts should not be reworked in any way.
- The crankshaft main and conrod journals should be measured to verify that the sizes lie within the allowable limits prescribed in section 3.11.4.
- At full overhaul the crankshaft must undergo a Magnetic Particle Inspection (MPI) conducted by a certified facility. The MPI certificate must be included in the rebuild log for that engine.
- All steel parts should be inspected by the magnetic particle inspection (MPI) method. The successful detection of structural failure by magnetic particle inspection demands skill and experience on the part of operating personnel.
- Too rigid an interpretation may result in the rejection of a sound part, while on the other hand, a part showing a dangerous indication may be returned to service as a result of over-casual diagnosis. In general, areas of stress concentration must be watched closely for fatigue cracks. These areas include such locations as keyways, radii in the corners of the crankshaft, gear teeth, small holes and fillets.

3.4 Conrods

- Inspect each rod visually for straightness and marking. Note that each rod/end cap pair is marked with a unique ID number and must only be refitted as a matched pair.
- The connecting rods must now be inspected for structural integrity with MPI (Magnetic Particle Inspection). Note that for MPI the rod must be as clean as possible – usually all burnt oil deposits must be removed.
- The rods must be subjected to a thorough visual inspection for straightness / trueness. As noted above, any rod which has been subjected to unusual loads must be discarded but otherwise a careful visual inspection of these parts is sufficient. Uneven bearing wear or abnormal small end wear are indicators of an untrue rod.

3.5 Camshaft

- The camshaft lobes should be inspected for any dents, evidence of overheating of excessive wear, all of which would make the camshaft unserviceable.
- Cam bearing lobes should be measured to check they are within the tolerance prescribed in section 3.11.4.

3.6 Other components

- For all other reusable components check the general condition. Including excessive wear, dents cracks or heat related damage.
- On the back plate check the engine mount ‘eyes’ are not bent, also check for cracks.

3.7 Carburettor

- Check correct jetting.
- Clean as needed.

3.8 Oil Pump

- Basic measurement methods of the Oil pump gears and housing does not indicate if these components are serviceable. To qualify these parts for reuse and serviceability, check operational history of the oil pump and if oil pressure readings have been within accepted parameters, the pump will not require replacement. In lieu of this, a check of the oil pressure readings during the test run of the engine will indicate serviceability of the pump. Oil temperature must be at least 85°C for this test to be valid.

3.9 Cleaning

3.9.1 Materials and Processes

- Two processes are involved in cleaning engine parts; degreasing to remove dirt and sludge (soft carbon) which form the bulk of the cleaning required, and the removal of hard carbon by decarbonizing, brushing or scraping and grit-blasting.
- In many cases this manual recommends washing parts using Kerosene. In these cases any similar suitable solvent (such as diesel fuel) may be used at the discretion of the overhauler.

3.9.2 Degreasing

- Degreasing is best accomplished by immersing or flooding the part in kerosene or a suitable commercial solvent such as Varsol or Perm-A-Chlor and agitating with a brush.
- Overhaulers are warned against the use of any water-mixed degreasing solutions containing caustic compounds or soap. Such compounds, in addition to being potentially harmful to aluminium, may become impregnated in the pores of the metal and cause oil foaming when the engine is returned to service.

3.9.3 Removal of hard carbon

- While the degreasing solution will remove dirt, grease and soft carbon, deposits of hard carbon will almost invariably remain on some interior surfaces. To facilitate removal, these deposits must first be loosened by immersion in a decarbonising solution (usually heated). A variety of commercial decarbonising agents are available, including products such as Redik DKT, Gunk, Penetrol, etc. Only hydrocarbon based decarbonisers should be used: refer to the note above regarding water-mixed degreasing solutions.
- Decarbonizing will usually loosen most of the hard carbon deposits remaining after degreasing; the complete removal of all hard carbon, however, generally requires brushing or scraping. All of these operations demand care on the part of the mechanic to avoid damage to machined surfaces. In particular, wire brushes and metal scrapers must never be used on any bearing or contact surface.
- At the conclusion of cleaning operations, rinse the parts in petroleum solvent, water, dry and remove any loose particles by air blasting. Apply a liberal coating of engine oil or other anti-corrosion product to all steel surfaces.

3.10 Assembly and Parts book

3.11 General assembly instructions

3.11.1 Use of Loctite

- Whenever Loctite is used ensure the threads of both the screws or bolts and the holes are completely clean of oil and dirt. Always prime both the holes and screws or bolts with Loctite 747 before applying the locking compound.
- Typically Loctite should be applies to the first 4-5 threads of a fastener unless otherwise stated.
- Make sure the Loctite settles in the root of the threads before assembly.
- Ensure assembly is completed in good time and that the fastener is installed to required torque before the Loctite cures. It is good practice to mark fasteners with a paint pen after they have be installed to torque with Loctite, this precluded the need to ask one's self weather a fastener has been installed with Loctite to torque or is just a temporary fit item.

3.11.2 Use of a crows foot tool on torque wrenches

$$With\ a\ crows\ foot\ set\ the\ Torque\ wrench\ to\ \ldots = Required\ Torque\ Setting \times \left(\frac{L1}{L1+L2}\right).$$

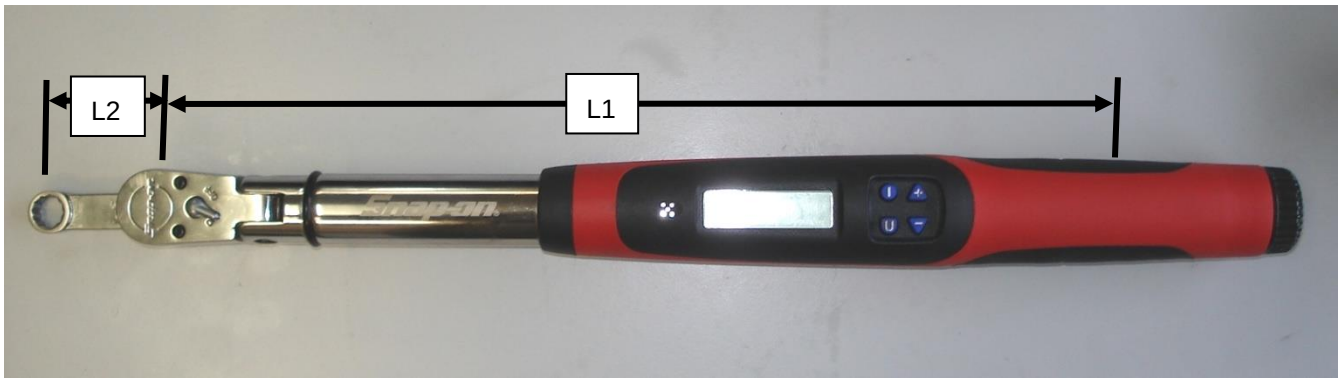


Figure 6 – Torque Wrench & Crows foot Adaptor Setting 1

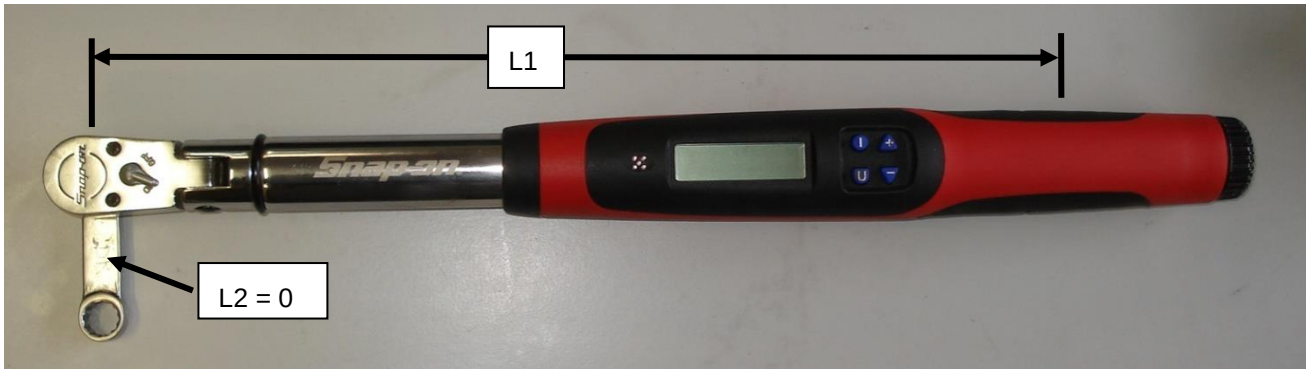


Figure 7 – Torque Wrench & Crows foot Adaptor Setting 2

In lieu of calculating the required torque setting a table is provided for common torque wrench and crows foot lengths calculated for the torque setting required for the through bolts and stud bolts.

Table 1 - Crows foot torque settings (35ft.lb)

35 ft.lb Torque required	With a crows foot setup as shown in Figure 6 (NOT Figure 7) set the torque wrench to…		
	Crows foot 2" long	**Crows foot 3" long**	**Crows foot 4" long**
Torque wrench 9" long	29 ft.lb	26 ft.lb	24 ft.lb
Torque wrench 10" long	29 ft.lb	27 ft.lb	25 ft.lb
Torque wrench 11" long	30 ft.lb	28 ft.lb	26 ft.lb
Torque wrench 12" long	30 ft.lb	28 ft.lb	26 ft.lb
Torque wrench 13" long	30 ft.lb	28 ft.lb	27 ft.lb
Torque wrench 14" long	31 ft.lb	29 ft.lb	27 ft.lb

Table 2 - Crows foot torque settings (30ft.lb)

30 ft.lb Torque required	With a crows foot setup as shown in Figure 6 (NOT Figure 7) set the torque wrench to…		
	Crows foot 2” long	**Crows foot 3” long**	**Crows foot 4” long**
Torque wrench 9” long	25 ft.lb	23 ft.lb	21 ft.lb
Torque wrench 10” long	25 ft.lb	23 ft.lb	21 ft.lb
Torque wrench 11” long	25 ft.lb	24 ft.lb	22 ft.lb
Torque wrench 12” long	26 ft.lb	24 ft.lb	23 ft.lb
Torque wrench 13” long	26 ft.lb	24 ft.lb	23 ft.lb
Torque wrench 14” long	26 ft.lb	25 ft.lb	23 ft.lb

3.11.3 Torque settings

Assembly	Hardware type	Torque setting ft.lb (N.m)
Camshaft gear attachment bolts	AN4 bolt	8 (11)
Propeller flange capscrews	3/8” UNF socket head capscrew	35 (47)
Connecting rod **(machined)** capscrews	5/16” UNF socket head capscrew	18 (24)
Connecting rod **(forged)** capscrews	5/16” UNF socket head capscrew	28 (38)
Pushrod Manifold capscrews	1/4" UNC socket head capscrew	6 (8)
Pushrod tube retaining capscrew	1/4" UNC socket head capscrew	6 (8)
Rocker shaft retaining capscrew	1/4" UNC socket head capscrew	6 (8)
Distributor mount plate capscrews	1/4" UNC socket head capscrew	6 (8)
Flywheel pole plate screws	10-32 Philips head screw	4 (5.5)
Flywheel cross piece bolts	AN4 bolt	8 (11)
Flywheel Tacho tag screws	10-32 Philips head screw	4 (5.5)
Alternator Stator mount screws	10-32 Philips head screw	4 (5.5)
Stator P-Clamp capscrew	1/4" UNC socket head capscrew	6 (8)
Alternator Circuit Breaker screws	8-32 Philips head screw	3 (4)
Through bolt, stud and short stud	**3/8-UNF** 12 point ARP wide flange nut	30 (40)
Through bolt, stud and short stud	**7/16-UNF** 12 point ARP wide flange nut	35 (47)
Rocker cover capscrews	1/4" UNC socket head capscrew	6 (8)
Sump attachment screws	1/4" UNC socket head capscrew	8 (11)
Oil temp sender	1/8 NPT	10 (13.5)
Sump blanking plug	1/2" UNC hex head plug	14 (19)
Dipstick grub screw	1/4" UNF socket head grub screw	4 (5.5)
Plenum chamber assembly screws	1/4" UNC socket head capscrew	6 (8)
Plenum chamber assembly screws	3/16" UNC socket head capscrew	6 (8)
Plenum / heat shield attach screws	1/4" UNC socket head capscrew	6 (8)
Back plate / gearbox retaining screws	1/4" UNC socket head capscrew	10 (14)
Back plate retaining screws	5/16" UNC socket head capscrew	14 (19)
Flywheel retaining screws	**3/8” UNF** socket head capscrew	35 (47)
Flywheel retaining screws	**5/16” UNF** socket head capscrew	29 (39)
Alternator mount screws	1/4" UNC socket head capscrew	8 (11)
Tacho pickup screw	5/16” UNC socket head capscrew	10 (14)
Fuel pump attachment screws	5/16" UNC socket head capscrew	16 (22)
Oil pump attachment screws	5/16" UNC socket head capscrew	14 (19)
Oil filter fitting	3/4" UNC stainless steel fitting	14 (19)
Oil pressure sender	1/8 NPT	8 (11)
Offset Oil filter adaptor screw	5/16" UNC socket head capscrew	18 (24)
Induction / exhaust turtle screws	5/16” UNC socket head capscrew	14 (19)

Distributor cap retaining screws	10-24 UNC socket head capscrew	6 (8)
Spark plugs	M12 x 1.25	14 (19) – New 12 (16) – Reinstallation
Ignition coil retaining screws	1/4" UNC socket head capscrew	8 (11)
Starter motor retaining screws	1/4" UNC socket head capscrew	8 (11)
Front seal housing screws	5/16" UNC socket head capscrew	14 (19)

3.11.4 Build tolerances and clearances

Part	New Build	Top End Overhaul	Full Overhaul
Prop flange run-out (measured at outer diameter)	0.060 Max	Per New Build	Per New Build
Crankshaft run-out	0.050 Max	Per New Build	Per New Build
Crankcase main bores (no bearing)	51.980 – 52.040	N/A	Per New Build
Crankcase main bores (bearings fitted) **– STD*** **	47.985 – 48.030	N/A	Per New Build
Crankcase main bores (bearings fitted) **– 0.25*** **	47.735 – 47.780	N/A	Per New Build
Crankcase main bores (bearings fitted) **– 0.50*** **	47.485 – 47.530	N/A	Per New Build
Crankshaft main journals – **STD*** **	47.930 – 47.950	N/A	Per New Build
Crankshaft main journals **(reground -0.25)*** **	47.680 – 47.700	N/A	Per New Build
Crankshaft main journals **(reground -0.50)*** **	47.430 – 47.450	N/A	Per New Build
Main bearing Clearance***	0.035 – 0.100	N/A	Per New Build
Crankshaft end float	0.20 - 0.80	N/A	Per New Build
Crankshaft thrust face	56.950 - 57.050	N/A	Per New Build
Crankcase crank thrust (bearings fitted)	56.650 - 56.850	N/A	Per New Build
Conrod big ends (no bearings)	48.015 – 48.030	Per New Build	Per New Build
Conrod big ends (bearings fitted)	45.040 - 45.070	Per New Build	Per New Build
Crankshaft big end journals	44.998 – 45.010	Per New Build	Per New Build
Conrod big end bearing clearance	0.04 – 0.08	Per New Build	Per New Build
Conrod big end bearing crush	0.05 – 0.20	Per New Build	Per New Build
Crankcase camshaft bores	19.99 – 20.05	N/A	Per New Build
Camshaft Journal diameter	19.94 – 19.95	N/A	Per New Build
Camshaft Journal clearance	0.04 – 0.11	N/A	Per New Build
Camshaft Valve lift	6.900 - 7.100	N/A	Per New Build
Camshaft Fuel pump lift	2.9 – 3.1 at cam	N/A	Per New Build
Crankcase cam thrust face diameter	14.95 – 15.10	N/A	Per New Build
Camshaft Thrust faces	15.18 – 15.25	N/A	Per New Build
Camshaft end float	0.05 - 0.50	N/A	Per New Build
Crankcase lifter bores	21.420 – 21.440	N/A	Per New Build
Lifter to crankcase bore clearance	0.19	N/A	Per New Build
Connecting rods small ends	23.020 – 23.030	Per New Build	Per New Build
Pistons gudgeon pin diameter	22.990 - 23.000	Per New Build	Per New Build
Gudgeon pin to piston	0.02 - 0.04	Per New Build	Per New Build
Connecting Rods Length between bore centres	109.95 – 110.05	Per New Build	Per New Build
Cylinder Bore diameter**	97.54 – 97.58	97.54 – 97.62	Per New Build
Cylinder bore out-of-roundness**	0.00 – 0.10	Per New Build	Per New Build
Piston diameter (across the skirt)**	97.48 – 97.52	Per New Build	Per New Build
Piston skirt to cylinder clearance**	0.05 – 0.10	Per New Build	Per New Build
Piston compression ring end gap	0.40 - 1.20	N/A	Per New Build

Piston compression ring side clearance	0.08 - 0.12	N/A	Per New Build
Valves Stem diameter Inlet and exhaust	6.970 - 6.990	Per New Build	Per New Build
Valves Guide ID Inlet and exhaust	7.040 – 7.050	Per New Build	Per New Build
Valve stem clearance	0.05 – 0.08	Per New Build	Per New Build
Difference between device vacuum and valve sealing vacuum (inlet and exhaust valves)	2 inHg (e.g. 28 inHg – 26inHg = 2inHg)	Per New Build	Per New Build
Pushrod length	211.75 – 212.25	Per New Build	Per New Build
Camshaft timing (maximum lift of exhaust lobe on cylinder #1)	68º – 72º after BDC	Per New Build	Per New Build
Double valve spring free length (outer spring) (inner spring)	45.50 – 46.50 40.500 - 41.500	Per New Build Per New Build	Per New Build Per New Build
Distributor shaft diameter	14.94 – 14.97	N/A	Per New Build
Distributor shaft post with bushes ID	15.000 - 15.030	N/A	Per New Build
Distributor shaft to post bush clearance	0.03 – 0.09	N/A	Per New Build
Distributor shaft end float	0.50 - 1.20	N/A	Per New Build
2200 sump: Dipstick length from top of cap to markings.	Full Mark: 314 – 316 Low Mark: 329 – 331	Per New Build	Per New Build
3300 sump: Dipstick length from top of cap to markings.	Full Mark: 279 – 281 Low Mark: 294 – 296	Per New Build	Per New Build
Piston, gudgeon, circlip, connecting rod, big-end bearing assembly weights – maximum difference between lightest and heaviest assembly used in engine	Up to 3g	Per New Build	Per New Build
Oil pump housing to outer rotor clearance	0.05 – 0.15	Per New Build	Per New Build
Oil pump inner rotor to outer rotor clearance	No basic measurement available (see section 3.8)		
Oil pump rotor end clearance	0.03 – 0.06	Per New Build	Per New Build
Ignition coil gap	0.25 – 0.30 (0.010” – 0.012”)	Per New Build	Per New Build
Spark Plug Gap	0.56 - 0.61 (0.022” - 0.024”)	Per New Build	Per New Build

**** Cylinder bore and piston measurements are only a typical range the more important factors to determine are the maximum out of roundness of the barrel and the piston skirt clearance.**

***** Crankshaft main journals can be reground to be fit with oversized bearings if required. The crankshaft journal to main bearing clearance is the same regardless of the size bearings used.**

3.11.5 List of approved compounds

This section provides a list of the compounds approved for use in the assembly of the Jabiru 2200C aircraft engine. The compound names are referenced throughout the stage assembly procedures.

	Loctite 243 • Medium strength thread locker • Generally used on Phillips headed screws and low tension socket head capscrews • Production Manual reference – *'Loctite 243'*
	Loctite 263 • High strength thread locker • Generally used on socket headed capscrews • Production Manual reference – *'Loctite 263'*
	Loctite 620 • Retaining compound, also used as an extreme high strength, high temp thread locker • Generally used on socket headed capscrews for critical connections • Production Manual reference – *'Loctite 620'*
	Loctite 290 • Wick-in thread locker / retaining compound • Used as secondary retainer on some bonded connections • Production Manual reference – *'Loctite 290' or 'Wick-in'*
	Loctite 518 • Rigid flange sealant • Used on many metal-to-metal sealing interfaces • Used to bond oil seals into housings • Production Manual reference – *'Loctite 518'*
	ThreeBond 1211 • Liquid white gasket sealant • Used on some metal-to-metal sealing interfaces • Production Manual reference – *'Three-Bond'* or *'3-bond'*
	Loctite Gasket sealant 2 • Flexible gasket sealant • Used primarily for the induction pipe seal • Production Manual reference – *'Black gasket sealant', 'Master gasket sealant'* or simply *'Gasket sealant'*
	Nulon L90 lubricant • High adhesion lubricant • Used to lubricate most moving parts during assembly providing protection during initial running • Production Manual reference – *'L90 lubricant'* or simply *'L90'*

	Bearing blue • High colour marking aid • Used to check interface fit on bearings, crankcase faces and poppet valve seal rings • Production Manual reference – *'Bearing blue'*
	Loctite C5-A • Copper based anti-seize lubricant • Used on threaded connections prone to corrosion seizure such as spark plugs, cylinder head bolts and pipe retaining capscrews • Production Manual reference – *'Copper-max'* or *'Anti-Seize Lubricant'*
	Torque seal • Anti-tamper compound • Sets dry to indicate movement between fasteners on critical connections • Production Manual reference – *'Torque seal'*
	Morey's High temperature grease • High temperature water proof grease • Used to lubricate some moving parts during assembly an for initial running • Production Manual reference – *'high temperature grease'* or *'high temp grease'*
	Dow corning 732 silicon sealant • Flexible silicon based sealant • Used to bond ignition magnets into the flywheel pole plates • Production Manual reference – *'732 silicon sealant'*
	RSpro: Heat Sink Compound Plus • Compound designed to maximise heat transfer between components • Used to sink the Alternator circuit breaker to the alternator mount plate Production Manual reference – *'Heat sink compound'*

3.12 Mandatory Replacement Items – Top end Overhaul

The reusable and mandatory replacement items are arranged in subassembly groups as defined by the parts list drawings provided in the assembly section. Items shown in **bold text** are not usually disassembled during a top end overhaul unless inspections warrant it.

3.12.1 Crankcase subassembly (refer to section 4)

Items reusable upon inspection	Mandatory replacement items
Left side crankcase half	All O-rings (excluding crankcase dowel O-rings)
Right side crankcase half	Short stud bolts
Thrust bearings	Long stud bolts
Main journal bearing shells	Roller hydraulic lifters
Crankcase dowels	Pushrod manifold retaining capscrews and washers
Oil pickup tube	
Oil pickup mesh body	
Oil filler tube mount adaptor	
Pushrod manifolds	
Roller follower locking plate	

3.12.1 Camshaft subassembly (refer to section 4.2)

Items reusable upon inspection	Mandatory replacement items
Camshaft	
Large camshaft gear	
Small camshaft gear	
Camshaft gear spacer	
Camshaft gear retaining bolts and washers	

3.12.1 Crankshaft subassembly (refer to section 4.3)

Items reusable upon inspection	Mandatory replacement items
Crankshaft	
Conrods (including conrod caps and roll pins)	
Welsh plugs	
Conrod bearing shells	
Conrod retaining capscrews	

3.12.1 Cylinder subassemblies (refer to section 4.4)

Items reusable upon inspection	Mandatory replacement items
Rockers	Exhaust valves
Rocker shafts	Inlet valves
Cylinder head / barrel (includes valve guides and seats)	Valve collets
Pushrod tubes	Inner and outer valve springs
Pushrods	Top and bottom spring washers
	Rocker bushes
	All O-rings
	All circlips
	Pistons, gudgeon pins and piston rings
	All capscrews and washers

3.12.1 Distributor gearbox subassembly (refer to section 4.5)

Items reusable upon inspection	Mandatory replacement items
Distributor gear case	Distributor shaft bushes
Distributor cap mount plates	Distributor shaft seals
Distributor drive gear	Crankshaft rear seal
Distributor gear retaining rivets	All capscrews and washers
Distributor shaft	Rotor buttons

3.12.1 Flywheel subassembly (refer to section 4.6)

Items reusable upon inspection	Mandatory replacement items
Flywheel body	
Pole plates	
Pole magnets	
Pole plate retaining hardware	
Alternator magnets	
Alternator retaining ring	
Tacho pickups and retaining hardware	
Starter ring gear	
Flywheel hub piece	
Flywheel hub retaining bolts, nuts and washers	

3.12.1 Alternator subassembly (refer to section 4.7)

Items reusable upon inspection	Mandatory replacement items
Alternator mount	Roll pins
Alternator stator	
Alternator stator mount screws	

3.12.1 Joint engine assembly (refer to section 4.8)

Items reusable upon inspection	Mandatory replacement items
Stud bolts	Piston circlips
Rocker covers	All through bolt / stud bolt nuts and washers
	Rocker cover nuts and washers
	Rocker cover O-rings
	Through bolts
	Crankshaft gear

3.12.1 Sump installation (refer to section 4.10)

Items reusable upon inspection	Mandatory replacement items
Sump	Sump retaining capscrews
Oil dipstick assembly	All O-rings
Oil dipstick tube assembly	Sump plug gasket
Sump plug	Oil temperature sender
	Dipstick tube retaining grub screw

3.12.1 Plenum chamber and heat shield installation (refer to section 4.11)

Items reusable upon inspection	Mandatory replacement items
Plenum chamber halves	All retaining capscrews
Diffuser rods	All washers
Carburettor mount	All roll pins / dowel pins
Heat shield	

3.12.1 Back plate and gearbox installation (refer to section 4.12)

Items reusable upon inspection	Mandatory replacement items
Back plate 1/4-NPT seal plugs	All retaining capscrews
Oil gallery 1/8-NPT plug	All washers
Back plate	

3.12.1 Flywheel and alternator installation (refer to section 4.13)

Items reusable upon inspection	Mandatory replacement items
Flywheel steel washer wear plate	Flywheel retaining capscrews
	Flywheel dowel pins
	Flywheel Nordloc washers
	Alternator stator capscrews and washers

3.12.1 Fuel pump installation (refer to section 4.14)

Items reusable upon inspection	Mandatory replacement items
Fuel pump drip tray	Mechanical fuel pump
	Fuel pump pushrod
	Fuel pumps spacer and gaskets
	Fuel pump retaining screws and washers

3.12.1 Oil pump and filter installation (refer to section 4.15)

Items reusable upon inspection	Mandatory replacement items
Oil pressure relief valve plunger	Oil pressure relief valve spring
Oil filter threaded adaptor	Oil pressure relief valve washers and circlip
Oil cooler adaptor (and hose tails)	All O-rings
Oil pump inner gear (see section 3.8)	Oil filter
Oil pump outer gear (see section 3.8)	Oil pressure sender
Oil pump back plate (see section 3.8)	Woodruff key
Oil pump housing (see section 3.8)	All retaining capscrews
Scalloped oil filter attachment stub	

3.12.1 Exhaust and induction pipes installation (refer to section 4.16)

Items reusable upon inspection	Mandatory replacement items
Exhaust pipes	Rubber induction hoses
Upper and lower induction pipes	Induction hose clamps
	Induction exhaust pipe clamp turtles
	Retaining capscrews and Nordloc washers
	All O-rings
	Exhaust gasket copper rings

3.12.1 Ignition system installation (refer to section 4.17)

Items reusable upon inspection	Mandatory replacement items
Spark plug terminal nuts	Ignition coils and insulating fibre washers
Distributor cap clamps	Spark plugs
	Distributor caps
	Ignition lead set
	All retaining capscrews and washers

3.12.1 Carburettor and starter installation (refer to section 4.18)

Items reusable upon inspection	Mandatory replacement items
Carburettor assembly	Carburettor rubber coupling
Starter motor	All hose clamps
Carburettor earth strap	Fuel hose
	Fire sleeve
	All retaining capscrews and washers

3.12.1 Front seal and propeller flange installation (refer to section 4.19)

Items reusable upon inspection	Mandatory replacement items
Grub screws	Propeller flange dowel pins
1/8-NPT oil gallery plug	Propeller flange capscrews and washers
Propeller flange	Front seal
Front seal housing (if applicable)	Front seal housing retaining capscrews

3.13 Mandatory Replacement Items – Full Overhaul

The reusable and mandatory replacement items are arranged in subassembly groups as defined by the parts list drawings provided in the assembly section. Items shown in **bold blue text** are not usually disassembled during a full end overhaul unless inspections warrant it.

3.13.1 Crankcase subassembly (refer to section 4)

Items reusable upon inspection	Mandatory replacement items
Left side crankcase half	Main journal bearing shells
Right side crankcase half	All O-rings
Crankcase dowels	Short stud bolts
Oil pickup tube	Long stud bolts
Oil pickup mesh body	Roller hydraulic lifters
Oil filler tube mount adaptor	Pushrod manifold retaining capscrews and washers
Pushrod manifolds	Roller follower locking plate
	Thrust bearings

3.13.2 Camshaft subassembly (refer to section 4.2)

Items reusable upon inspection	Mandatory replacement items
Camshaft	Camshaft gear spacer
Large camshaft gear	Camshaft gear retaining bolts and washers
Small camshaft gear	

3.13.3 Crankshaft subassembly (refer to section 4.3)

Items reusable upon inspection	Mandatory replacement items
Crankshaft	Welsh plugs
Conrods (including conrod caps and roll pins)	Conrod bearing shells
	Conrod retaining capscrews

3.13.4 Cylinder subassemblies (refer to section 4.4)

Items reusable upon inspection	Mandatory replacement items
Rockers	Exhaust valves
Rocker shafts	Inlet valves
Cylinder head / barrel (includes valve guides and seats)	Valve collets
Pushrod tubes	Inner and outer valve springs
Pushrods	Top and bottom spring washers
	Rocker bushes
	All O-rings
	All circlips
	Pistons, gudgeon pins and piston rings
	All capscrews and washers

3.13.5 Distributor gearbox subassembly (refer to section 4.5)

Items reusable upon inspection	Mandatory replacement items
Distributor gear case	Distributor shaft bushes
Distributor cap mount plates	Distributor shaft seals
Distributor drive gear	Crankshaft rear seal
	All capscrews and washers
	Distributor gear retaining rivets
	Rotor buttons
	Distributor shaft

3.13.6 Flywheel subassembly (refer to section 4.6)

Items reusable upon inspection	Mandatory replacement items
Flywheel body	Starter ring gear
Pole plates	
Pole magnets	
Pole plate retaining hardware	
Alternator magnets	
Alternator retaining ring	
Tacho pickups and retaining hardware	
Flywheel hub piece	
Flywheel hub retaining bolts, nuts and washers	

3.13.7 Alternator subassembly (refer to section 4.7)

Items reusable upon inspection	Mandatory replacement items
Alternator mount	Roll pins
Alternator stator	
Alternator stator mount screws	

3.13.8 Joint engine assembly (refer to section 4.8)

Items reusable upon inspection	Mandatory replacement items
Rocker covers	Piston circlips
	All through bolt / stud bolt nuts and washers
	Rocker cover nuts and washers
	Rocker cover O-rings
	Through bolts
	Stud bolts (long and short front bolts)
	Crankshaft gear

3.13.9 Sump installation (refer to section 4.10)

Items reusable upon inspection	Mandatory replacement items
Sump	Sump retaining capscrews
Oil dipstick assembly	All O-rings
Oil dipstick tube assembly	Sump plug gasket
Sump plug	Oil temperature sender
	Dipstick tube retaining grub screw

3.13.10 Plenum chamber and heat shield installation (refer to section 4.11)

Items reusable upon inspection	Mandatory replacement items
Plenum chamber halves	All retaining capscrews
Diffuser rods	All washers
Carburettor mount	All roll pins / dowel pins
Heat shield	

3.13.11 Back plate and gearbox installation (refer to section 4.12)

Items reusable upon inspection	Mandatory replacement items
Back plate 1/4-NPT seal plugs	Oil gallery 1/8-NPT plug
Back plate	All retaining capscrews
	All washers

3.13.12 Flywheel and alternator installation (refer to section 4.13)

Items reusable upon inspection	Mandatory replacement items
	Flywheel retaining capscrews
	Flywheel dowel pins
	Flywheel Nordloc washers
	Alternator stator capscrews and washers
	Flywheel steel washer wear plate

3.13.13 Fuel pump installation (refer to section 4.14)

Items reusable upon inspection	Mandatory replacement items
Fuel pump drip tray	Mechanical fuel pump
	Fuel pump pushrod
	Fuel pumps spacer and gaskets
	Fuel pump retaining screws and washers

3.13.14 Oil pump and filter installation (refer to section 4.15)

Items reusable upon inspection	Mandatory replacement items
Oil pressure relief valve plunger	Oil pressure relief valve spring
Oil filter threaded adaptor	Oil pressure relief valve washers and circlip
Oil cooler adaptor (and hose tails)	All O-rings
Oil pump inner gear	Oil filter
Oil pump outer gear	Oil pressure sender
Oil pump back plate	Woodruff key
Oil pump housing	All retaining capscrews
Scalloped oil filter attachment stub	

3.13.15 Exhaust and induction pipes installation (refer to section 4.16)

Items reusable upon inspection	Mandatory replacement items
Exhaust pipes	Rubber induction hoses
Upper and lower induction pipes	Induction hose clamps
	Induction exhaust pipe clamp turtles
	Retaining capscrews and Nordloc washers
	All O-rings

	Exhaust gasket copper rings

3.13.16 Ignition system installation (refer to section 4.17)

Items reusable upon inspection	Mandatory replacement items
Spark plug terminal nuts	Ignition coils and insulating fibre washers
Distributor cap clamps	Spark plugs
	Distributor caps
	Ignition lead set
	All retaining capscrews and washers

3.13.17 Carburettor and starter installation (refer to section 4.18)

Items reusable upon inspection	Mandatory replacement items
Carburettor assembly	Carburettor rubber coupling
Starter motor	All hose clamps
Carburettor earth strap	Fuel hose
	Fire sleeve
	All retaining capscrews and washers

3.13.18 Front seal and propeller flange installation (refer to section 4.19)

Items reusable upon inspection	Mandatory replacement items
Propeller flange	Grub screws
Front seal housing (if applicable)	1/8-NPT oil gallery plug
	Propeller flange dowel pins
	Propeller flange capscrews and washers
	Front seal
	Front seal housing retaining capscrews

4. Assembly procedures

The following subsections details the procedures used to assemble the various subassemblies of both 2200 and 3300 4th generation engine. All over-haulers must read these instructions in their entirety before attempting assembly of an engine. The 4th generation Jabiru engines have some significant differences in the assembly compared to previous generation engines. Some this to note regarding these instructions include:

- The subassemblies can potentially be done in any order however it is **highly recommended that each be done in the order presented in this manual**. This allows the assembler to build through the engine in a methodical way following the manual in the prescribed order and not having to refer back skip back and forth between sections.
    - It should also be noted that the build recording sheets (section 6) and the lists of mandatory replacement parts (section 3.12 and 3.13) are also presented in the same methodical order of subassemblies.
- Once the engine is joined (section 4.8). The instructions MUST be followed through in the order presented until completion.
- Each subassembly / installation assembly begins with a detailed parts list drawing. This can be referenced during the subassembly and also used as a picking list for ordering parts.
    - In general the 2200 engine is presented first, followed by the 3300 engine.
    - Some subassemblies have may have multiple configuration options (e.g. the machined induction plenum chamber or integral sump plenum chamber).
- During assembly the instructions will continually refer back to the Torque settings specified in section 0 and the build tolerances specified in section 3.11.4. For convenience these sections should be printed out separately and attached to the workstation wall for easy reference (without needing to turn back through the pages of this manual.
    - Always check the torque settings required. Many of the bolted connections in 4th generation engines have torque settings different to those of previous generations.
- The engine build log sheets (section 6) must also be printed out before beginning. As each subassembly is completed ensure that the relevant section of the build log is filled in COMPLETELY before moving on to the next one. Throughout the manual, prompts are included to remind to assembler to record the various measurements as the build proceeds.
    - *These prompts are given in blue italicised lettering for ease of visual reference.*
- Finally it cannot be overstated enough that despite the methodical layout of the assembly instructions provided. **THE ASSEMBLY OF 4TH GENERATION JABIRU ENGINES MUST ONLY BE ATTEMPTED BY PERSONS OF SUFFICIENT SKILL AND EXPERIENCE.**

4.1 Crankcase subassembly

4.1.1 2200 Crankcase subassembly – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4A527A0D-9	2210 CRANKCASE LS MACHINED	1
2	4A528A0D-10	2210 CRANKCASE RS MACHINED	1
3	PB4A005N-1	BEARING SHELL MAIN	12
4	4A603A0D-4	DOWEL CRANK CASE 2.2L - (ID TO SUIT 7/16 THROUGH BOLTS)	10
5	PG0035N	O-RING BS112V	10
6	PE4A022A0D-1	ROLLER HYDRAULIC LIFTER (HT-2270 LU CHOU)	8
7	PG4A066N-1	O-RING MANIFOLD OIL RETURN, I.D 53, C.S 3	4
8	PG4A059N-1	O-RING 5/8 X .070	1
9	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	8
10	PH10724-2	1/4" BELLEVILLE WASHER	4
11	PG10042N-1	BS114V O RING	8
12	4A806A0D-1	GEN 4 ROLLER FOLLOWER LOCKING PLATE / ORIENTATION GUIDE	4
13	4A791B0D-2	OIL PICKUP TUBE	1
14	4A791A0D-2	OIL PICKUP ASSY - SHORT BODY	1
15	PB9942N-1	THRUST BEARING	2
16	PB9942NU-1	THRUST BEARING HALF UPPER	2
17	4586064-4	MOUNT ADAPTOR 3/4" TUBE	1
18	4A743A1D-2	MACHINED CAST MANIFOLD OIL RETURN INT ORING	4
19	4A816B0D-1	2210 LONG STUD BOLT 3/8-UNF	4
20	4A816C0D-1	2210 SHORT STUD BOLT 3/8-UNF	2

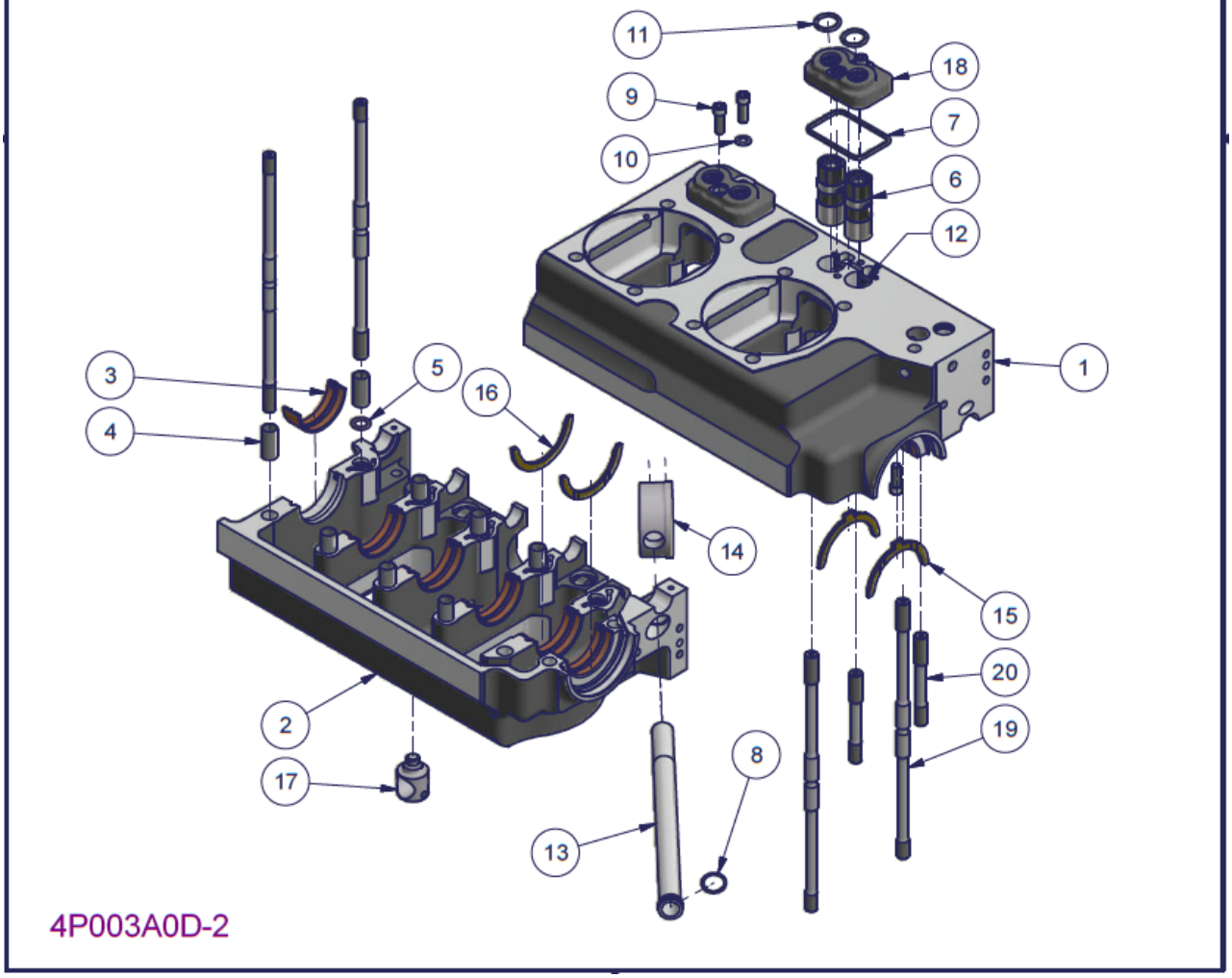


Figure 8 - 2200 Crankcase subassembly parts list

4.1.2 3300 Crankcase subassembly – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4A412A0D-9	3310 CRANKCASE LS MACHINED	1
2	4A413A0D-8	3310 CRANKCASE RS MACHINED	1
3	PB4A005N-1	BEARING SHELL MAIN	16
4	PG0035N	O-RING BS112V	14
5	4A603A0D-4	DOWEL CRANK CASE 2.2L - (ID TO SUIT 7/16 THROUGH BOLTS)	14
6	PE4A022A0D-1	ROLLER HYDRAULIC LIFTER (HT-2270 LU CHOU)	12
7	4A618A0D-1	ROLLER FOLLOWER LOCKING PLATE / ORIENTATION GUIDE	3
8	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	12
9	PH10724-2	1/4" BELLEVILLE WASHER	6
10	PG10042N-1	BS114V O RING	12
11	4A743A1D-2	MACHINED CAST MANIFOLD OIL RETURN INT ORING	6
12	PG4A066N-1	O-RING MANIFOLD OIL RETURN, I.D 53, C.S 3	6
13	4A791B0D-2	OIL PICKUP TUBE	1
14	4A791A0D-2	OIL PICKUP ASSY - SHORT BODY	1
15	4586064-4	MOUNT ADAPTOR 3/4" TUBE	1
16	PB9942N-1	THRUST BEARING	2
17	PB9942NU-1	THRUST BEARING HALF UPPER	2
18	4A806A0D-1	GEN 4 ROLLER FOLLOWER LOCKING PLATE / ORIENTATION GUIDE	3
19	PG4A059N-1	O-RING 5/8 X .070	1
20	4A816B0D-1	2210 LONG STUD BOLT 3/8-UNF	4
21	4A816C0D-1	2210 SHORT STUD BOLT 3/8-UNF	2

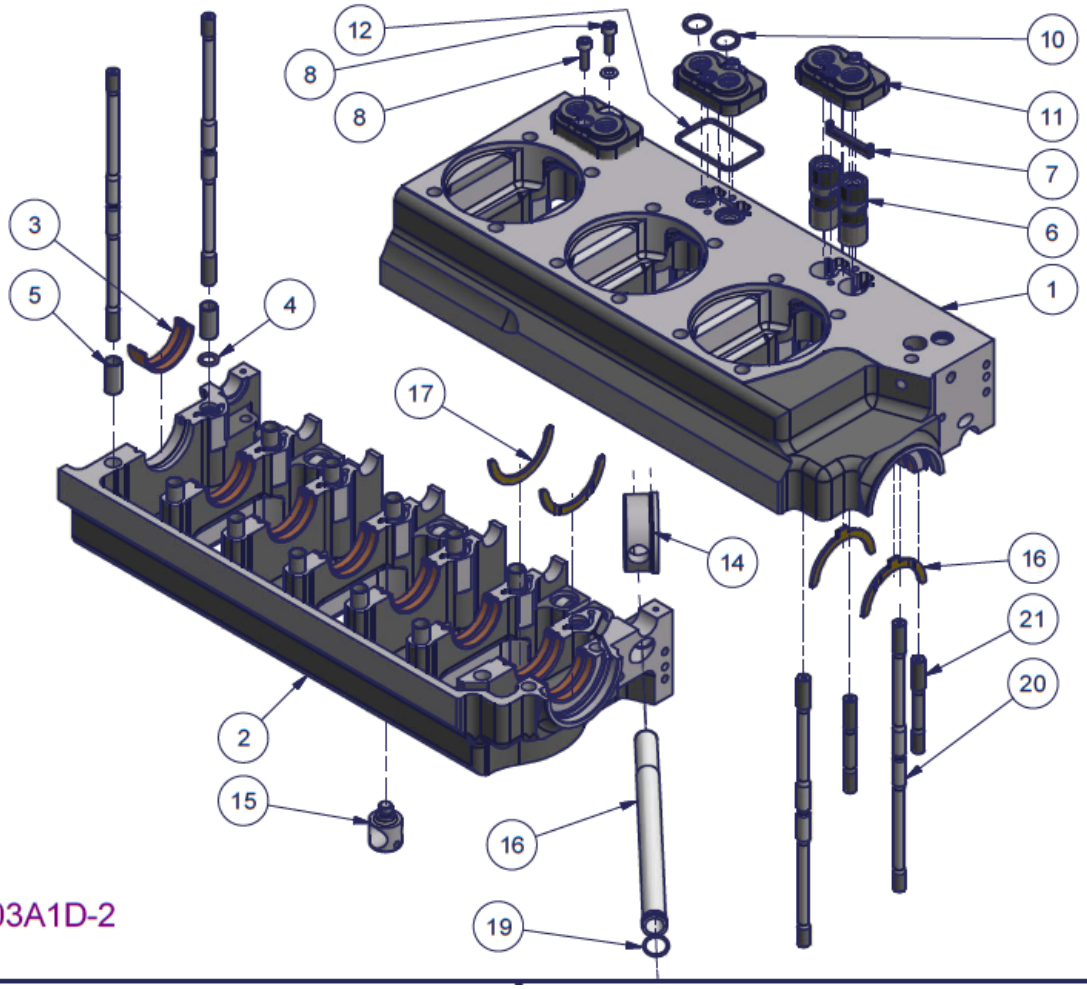


Figure 9 - 3300 Crankcase subassembly parts list

4.1.3 2200 / 3300 crankcase subassembly procedure

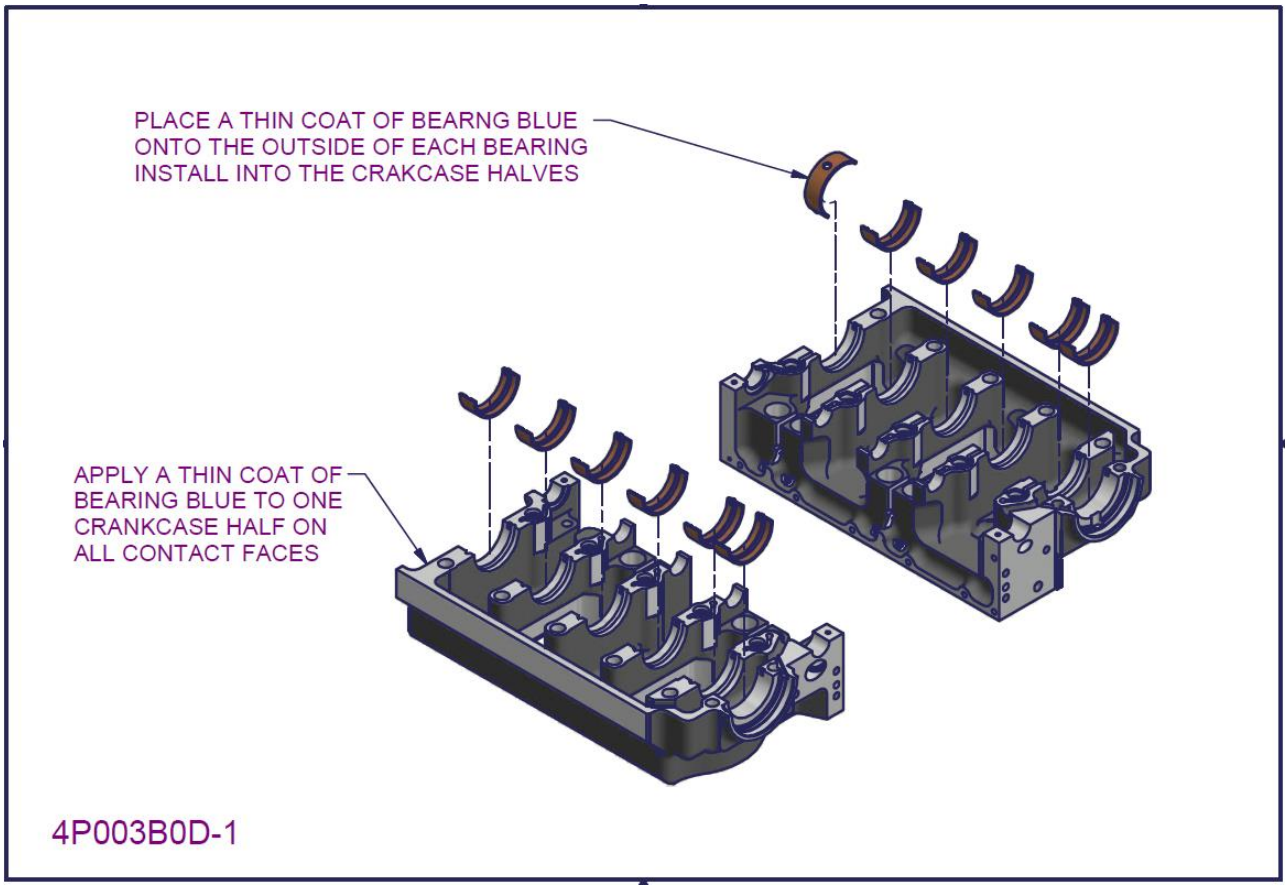


Figure 10 – 2200/3300 crankcase subassembly 1

- Check the crankcase is completely clean paying close attention that all oil galleries and threaded holes are clean and clear of debris.
  - *Record the serial number of the crankcase halves in the build log (section 6.4)*.
- Apply a thin coat of bearing blue to main bearing shells.
- Install bearing shells into the two crankcase halves ensuring that the locking tabs sit correctly in the grooves in the crankcase.
- Apply a thin coating of bearing blue to the mating faces of ONE crankcase half.

Figure 11 - Applying bearing blue to bearing shells and crankcase half

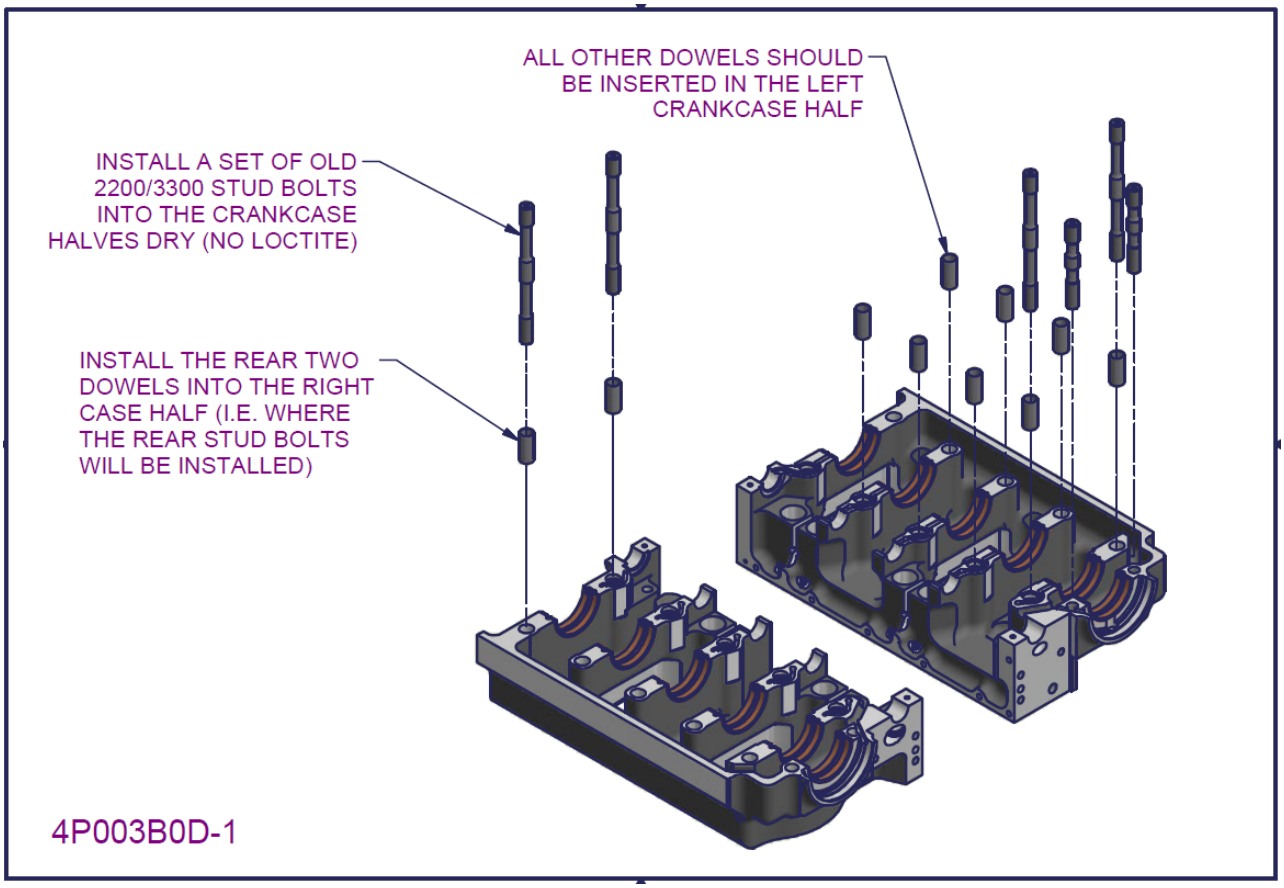


Figure 12 – 2200/330 crankcase subassembly 2

- Install hollow dowels into the left crankcase half (except two which should be placed in the right side where the stud bolts install). The fit should be a slightly firm sliding fit. Dowels can be polished using a scotch-brite wheel is the fit is too tight, Applying L90 lubricant also aids installation.
    - There exist four dowel sizes indicated by dots etched in the side of the dowel. These include 'No dot' which is the smallest and should be installed in new crankcases, up to 'three dot (with one and two dot in between) to be used for refurbished crankcases, where the dowel holes may have worn slightly.
    - A suitable dowel must be used which gives a sliding fit without being loose.
- Install an old set of Generation 3 2200/3300 stud bolts (both the long studs and short studs) into the crankcase halves.
    - The stud bolts must NOT be installed too tightly in the taped crankcase holes, they should be wound in until they just contact the bottom and no further.
- With the dowels and studs installed the two crankcase halves are pushed together (as shown below in Figure 13).

Figure 13 - Installing dowels and studs, pressing crankcase halves together

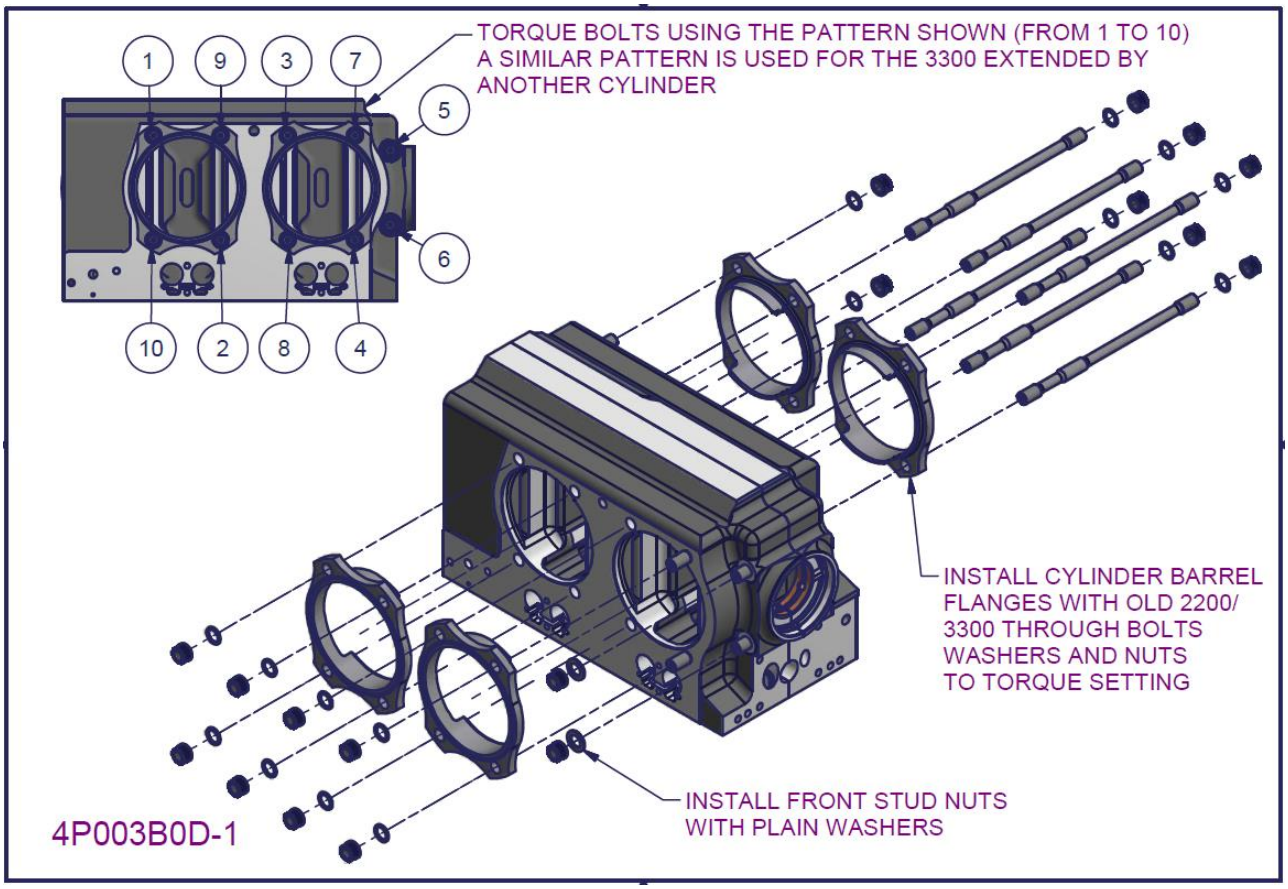


Figure 14 – 2200/330 crankcase subassembly 3

- Completely push the two crankcase halves together. This may require a soft rubber hammer to gradually tap down around each edge until the two halves come together
- Install cylinder barrel flanges into the crankcase cylinder spigots.
    - Cylinder barrel flanges can be made from old unserviceable Generation 3 2200/3300 engine cylinder barrels.
- Install old Generation 3 2200/3300 through bolts with hardened steel washers and 12 point ARP nuts (fit them dry without Loctite). Initially install the nuts finger tight only.
- Install the large flange 12 point ARP nuts with plain AN960-716 washers on the short front stud bolts (again initially only finger tight).
    - All bolt, washer and nut hardware used for this fitting should be old hardware **which must not be installed on the final engine**.
- Using the pattern shown in Figure 14, torque each nut up to 10ft.lb on both the left and right hand sides (this drawing above shows only the right hand side, the left hand side must also be torqued in the same pattern).
- Repeat the above step this time going to 20ft.lb
- Repeat again this time going directly to the prescribed torque setting (see section 0)
    - All torque settings must be obtained **while the nut is turning**.

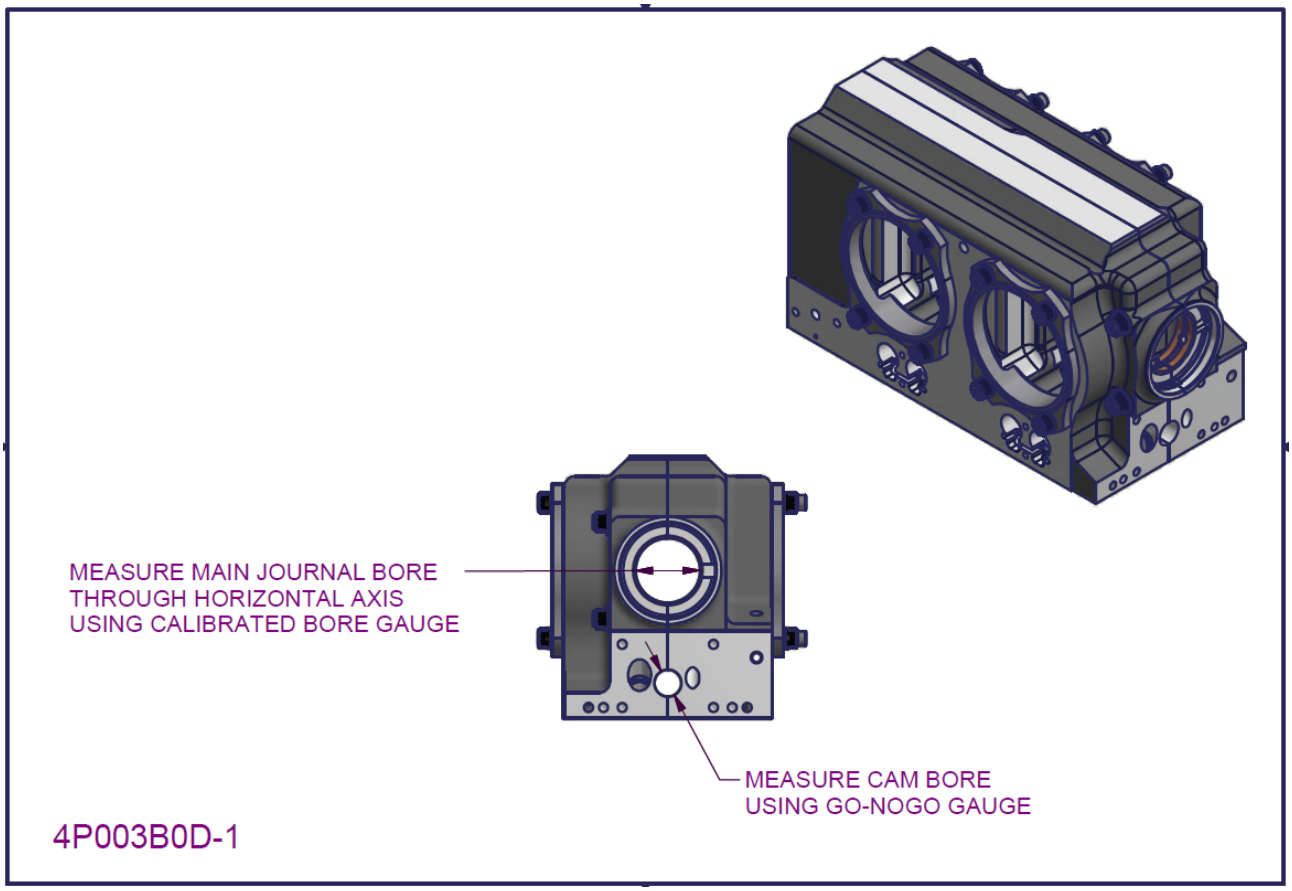


Figure 15 – 2200/330 crankcase subassembly 4

- With the crankcase halves assembled together measurements are now made:
- Measure each crankcase bearing bore using a calibrated bore gauge. Measure through the horizontal on both sides of the bearing oil groove to check they are the same. Check the measurements obtained lie within the tolerances specified in section 3.11.4.
    - *Record the crankcase bearing bore diameters in the build log (section 6.4)*
- Measure the camshaft bores using either a calibrated bore gauge or a specially machined 'Go Nogo' gauge. Again check the measurements obtained are within the required tolerance in section 3.11.4.
    - *Record the camshaft tunnel diameters in the build log (section 6.5)*
- Using the previously obtained crankshaft main journal and camshaft journal diameters, calculate the crankcase main journal and camshaft journal clearances, check they are within the tolerance in section 3.11.4.
    - *Record the camshaft and crankshaft main journal clearances in the build log (section 6.5 and 6.6)*

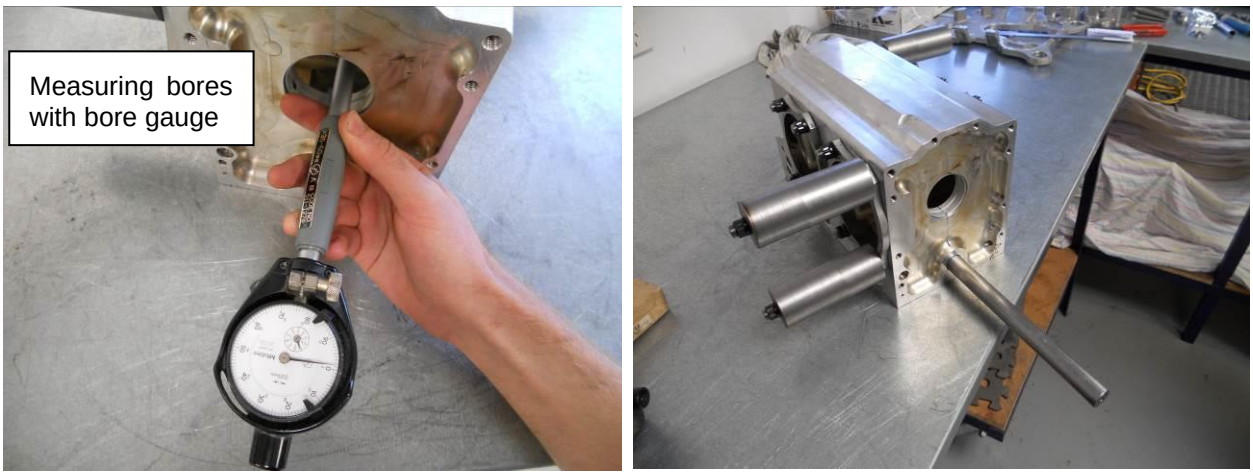


Figure 16 - Measuring Crankcase bearing and camshaft bores

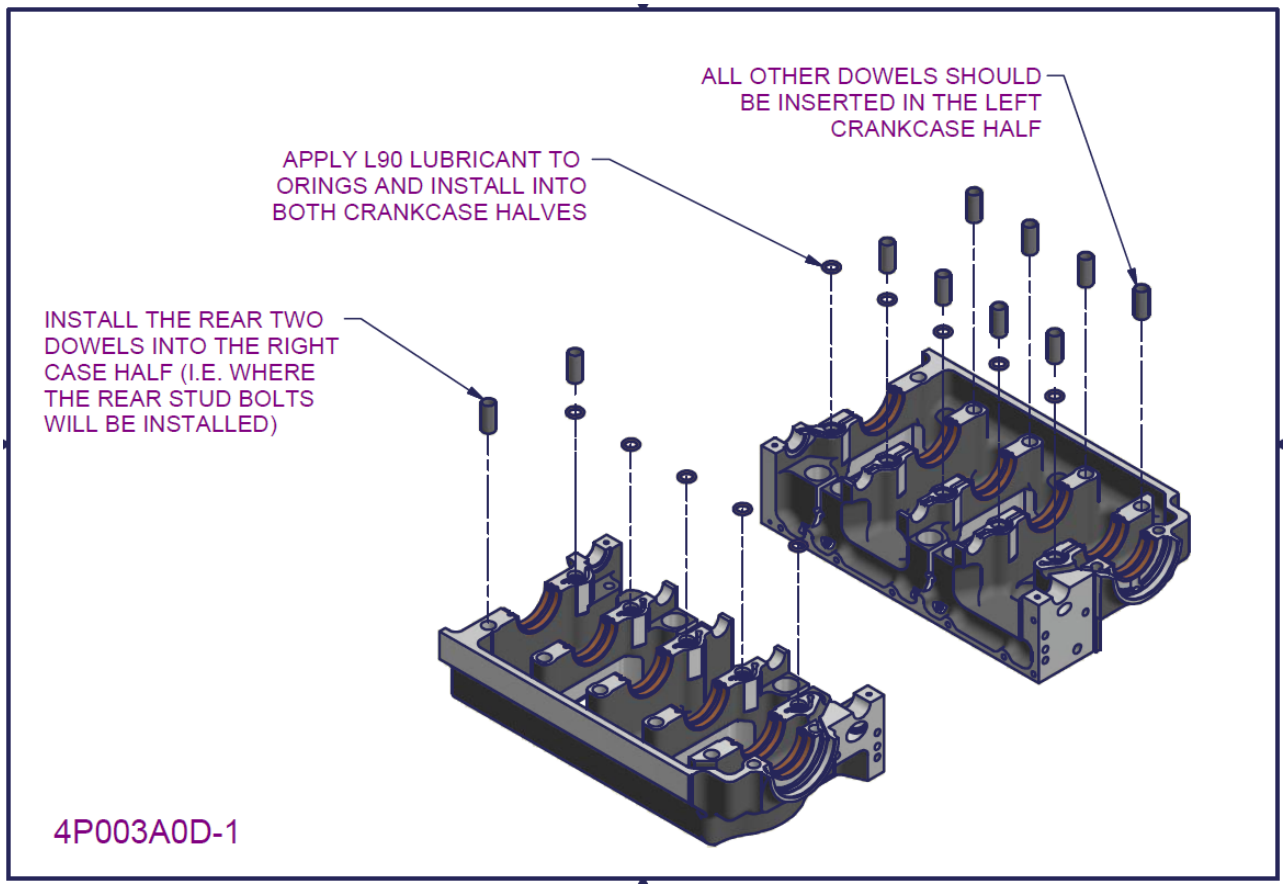


Figure 17 – 2200/330 crankcase subassembly 5

- Disassemble crankcase, removing all through bolts, stud bolts, dowels, and bearing shells (number each bearing as it is removed with a paint pen, since they must be reinstalled in the same crankcase saddle from which they were removed).
- Inspect the crankcase checking that the bearing blue from one crankcase half has transferred across to all mating faces on the other crankcase half.
- Check that bearing blue has transferred from all bearing shells onto the respective saddle.
- Completely clean all bearings and both crankcase halves of bearing blue, reinstall bearing shells.
- Apply L90 lubricant to O-rings and install into the bottom holes of BOTH crankcase halves.
- Apply L90 lubricant to the dowels and install into the left crankcase half (except two which should be placed in the right side where the stud bolts install).
    - As previously stated make sure the dowels used are of appropriate fit. It must be a sliding fit which is not loose in order to correctly locate the two crankcase halves together.

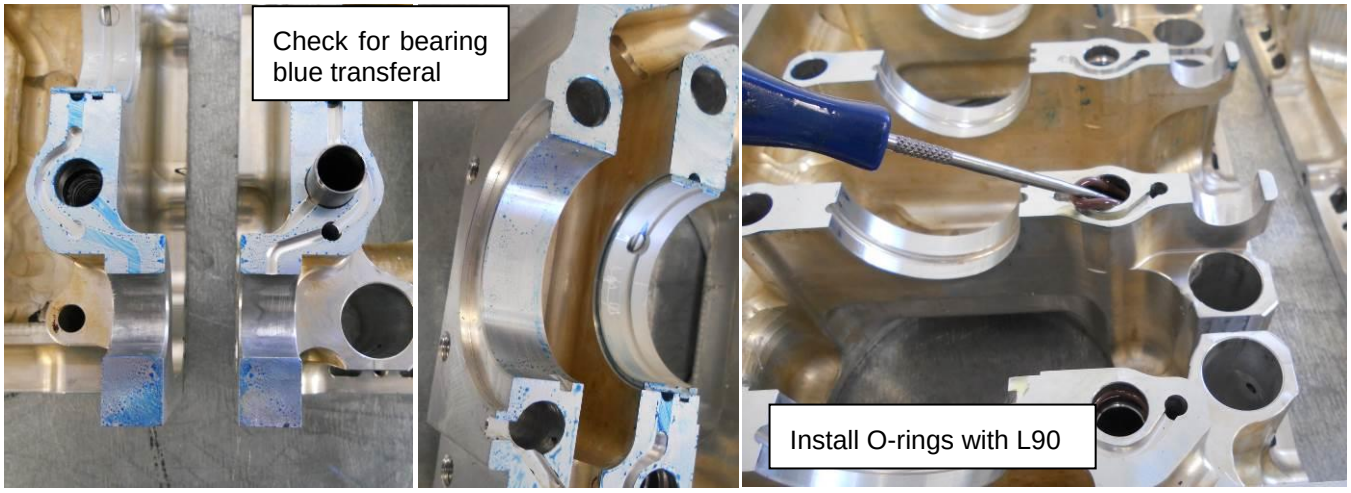


Figure 18 – Bearing blue inspection and O-ring installation

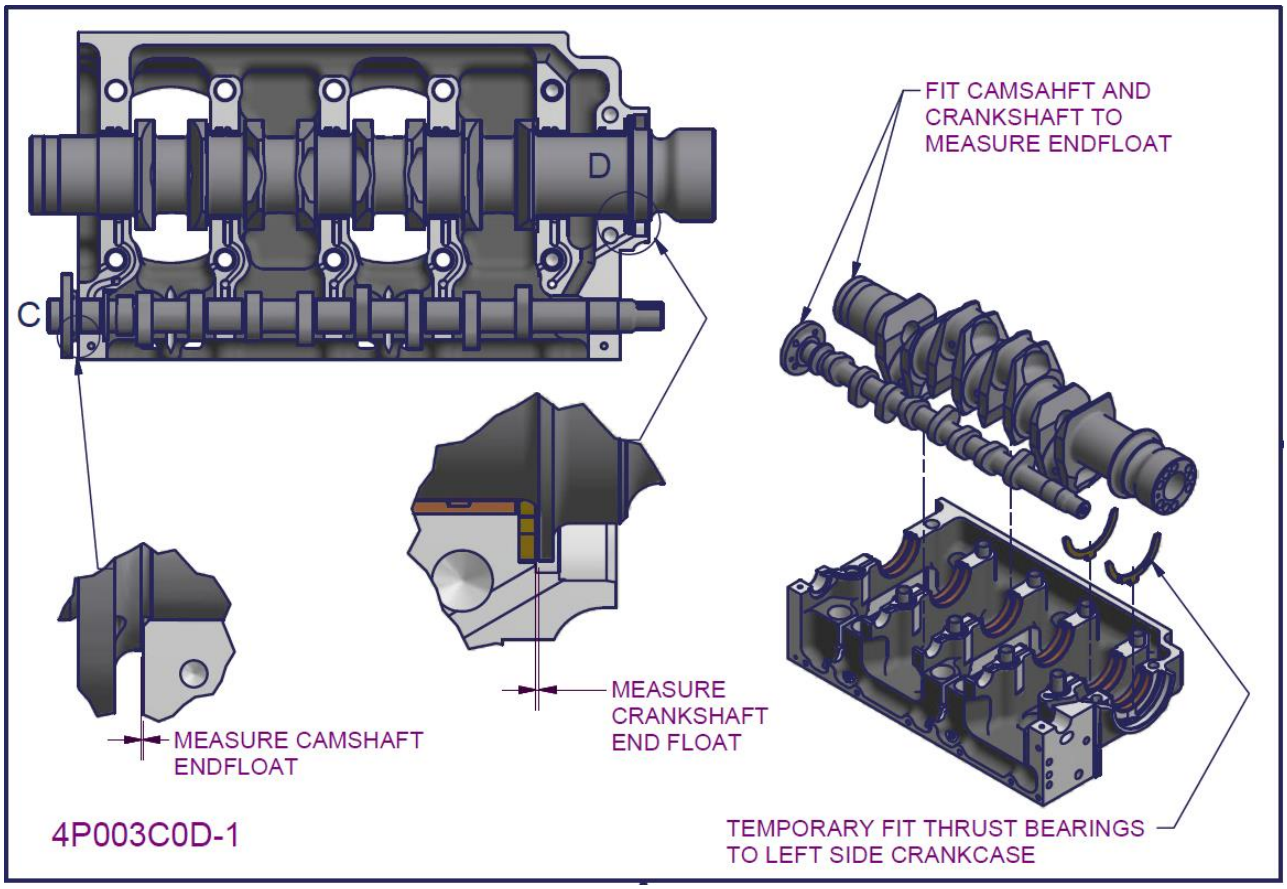


Figure 19 - 2200/330 crankcase subassembly 6

- Temporarily install thrust bearings into the left crankcase half.
  - The left side crankcase features slots in the thrust faces; therefore the bearings fitted in this side must have the appropriate tabs.
  - Ensure that the two grooves in the thrust bearings are facing outwards (i.e. NOT up against the crankcase thrust faces).
- Place the crankshaft and camshaft in the left crankcase half.
  - *Record the camshaft and crankshaft serial numbers in the appropriate sections of the build log (section 6.5 and 6.6 respectively).*
- Measure the crankshaft and camshaft end float using a feeler gauge set.
  - *Record the crankshaft and camshaft end float in the build log (section 6.4).*
- Remove the crankshaft and camshaft in order to resume crankshaft assembly.
  - The thrust bearings should also be removed since they will likely fall out whilst handling the crankcase half during subsequent assembly proceedings.

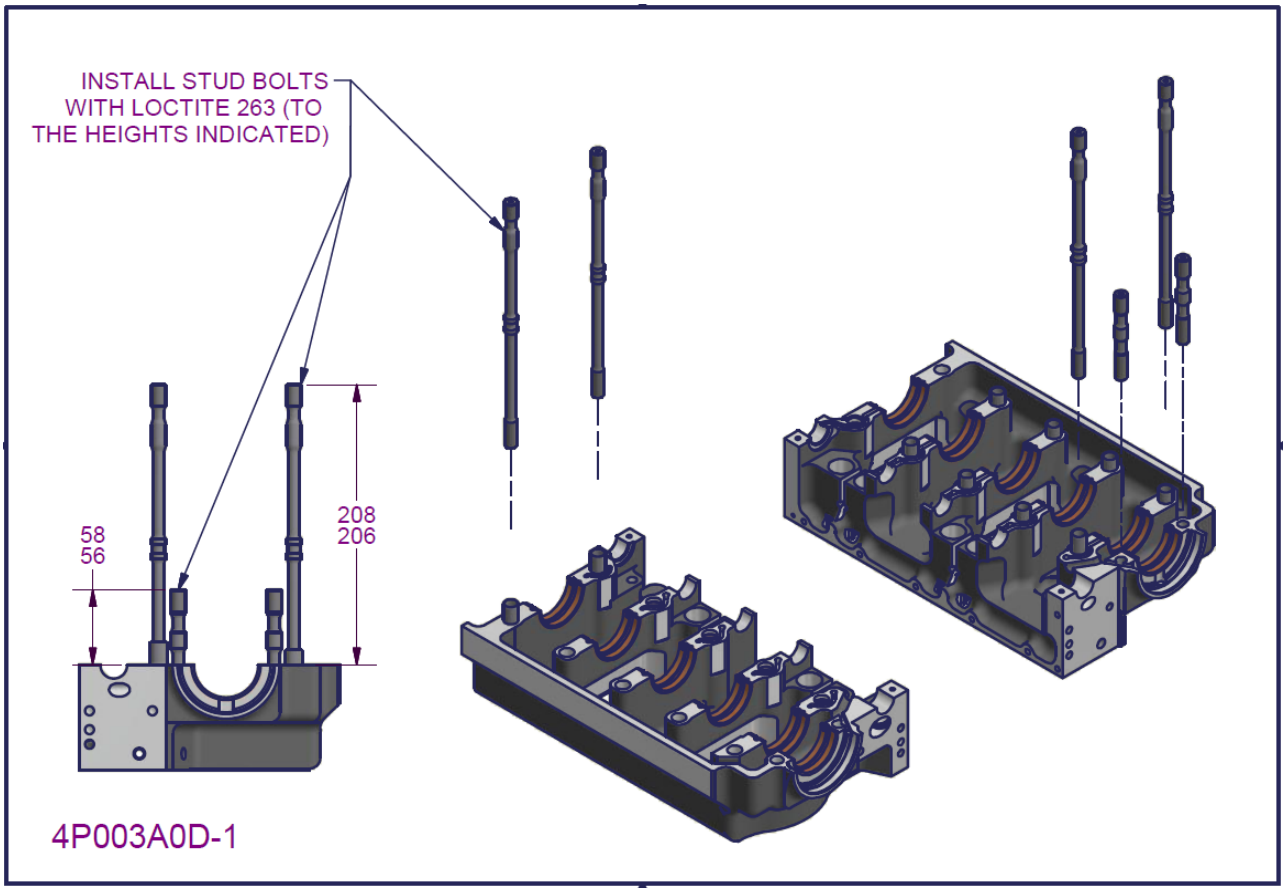


Figure 20 – 2200/330 crankcase subassembly 7

- Ensure the stud threads and the holes in the crankcase are completely clean and clear of debris.
- Prime stud-bolt holes and the stud bolt threads with Loctite 747
- Install stud-bolts (both long and short into the crankcase halves with Loctite 263
    - Loctite must be applied on the first four or five threads, making sure the compound is pressed into the root of the threads.
    - The stud-bolts should be installed into the crankcase so the exposed height above the surface of the crankcase measured as indicated in Figure 20

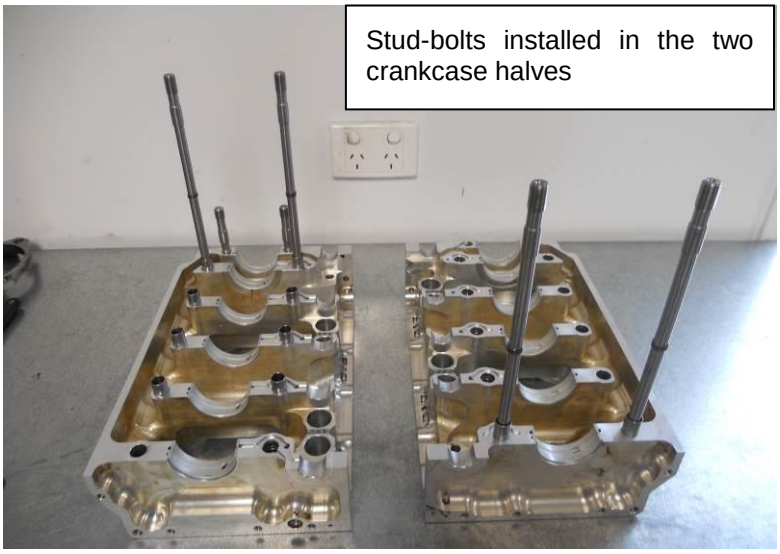


Figure 21 - Stud-bolts installed in the two crankcase halves

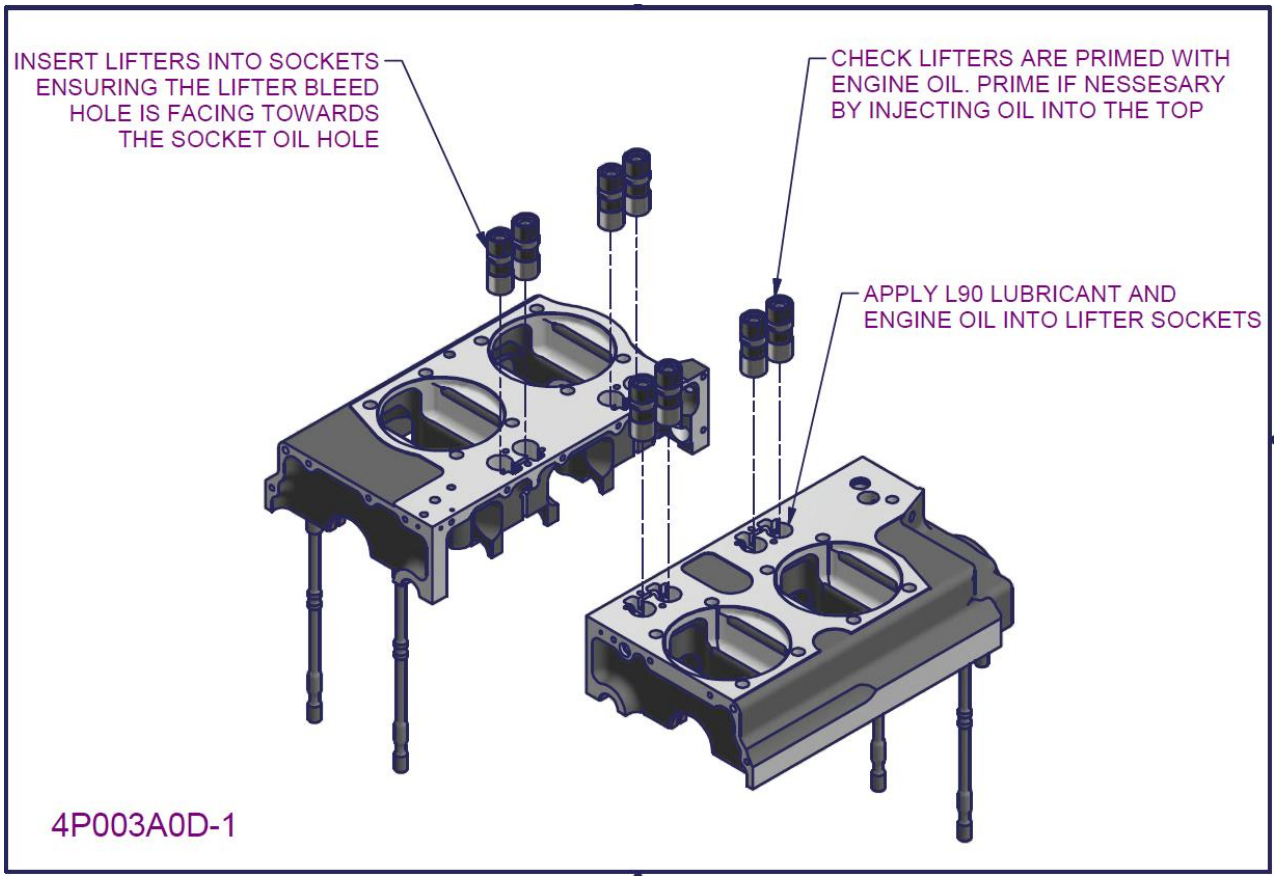


Figure 22 – 2200/330 crankcase subassembly 8

- Place strips of masking tape over the inside of each lifter socket then turn the two crankcase halves over.
- Apply a mixture of L90 lubricant and engine oil to the inside of each lifter socket.
- Prime each roller hydraulic lifter by injecting engine oil into the top of the lifter until it starts to bleed out through the side bleed hole (this may not be necessary since lifters are general supplied pre-primed)
- Install lifters into the crankcase sockets (with the rollers pointing into the crankcase)
    - The lifters must be installed with the small side bleed hole facing towards the oil hole machined in the lifter socket. The masking tape is intended to prevent the lifter falling out during case joining.

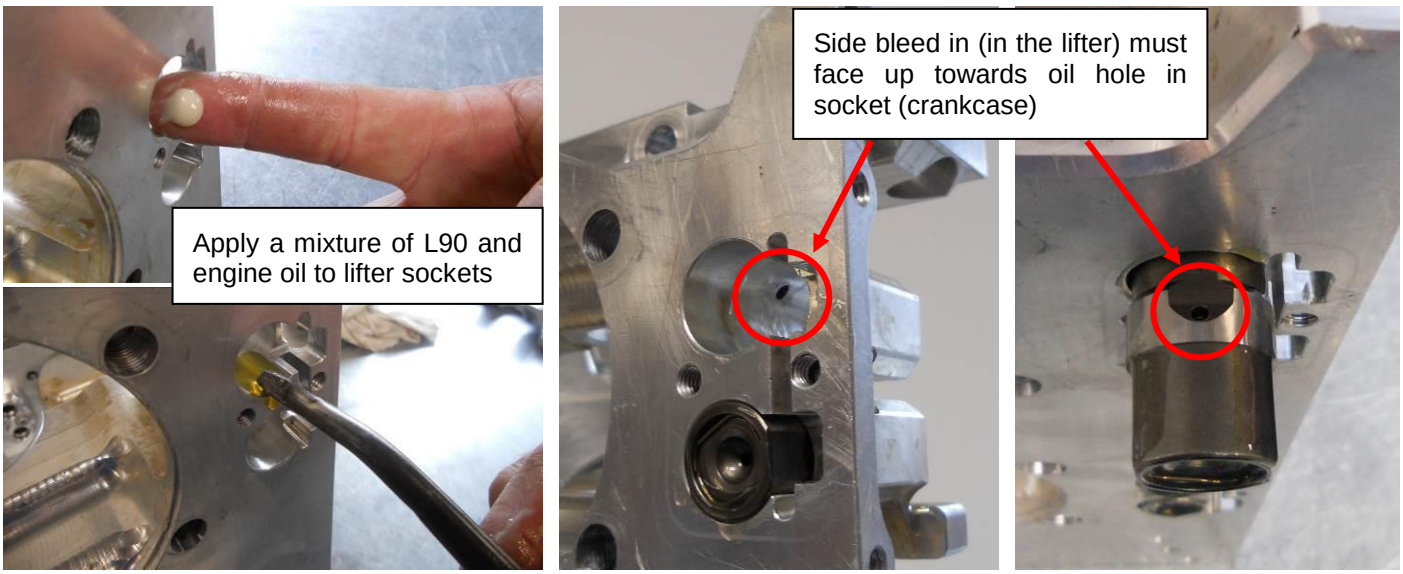


Figure 23 - Roller hydraulic lifter installation

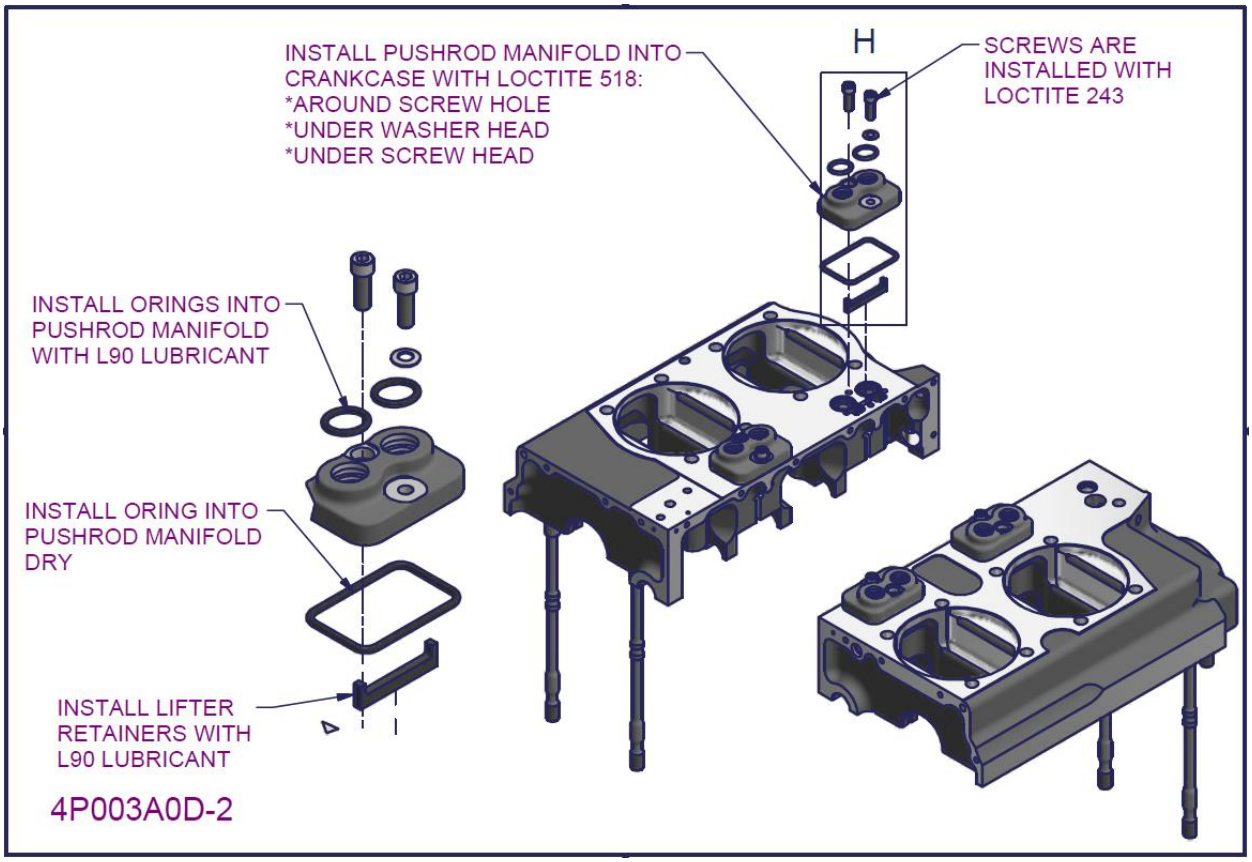
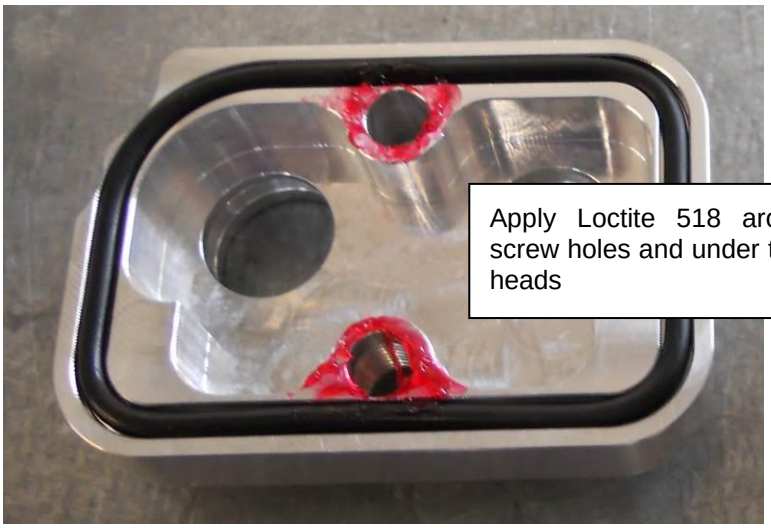
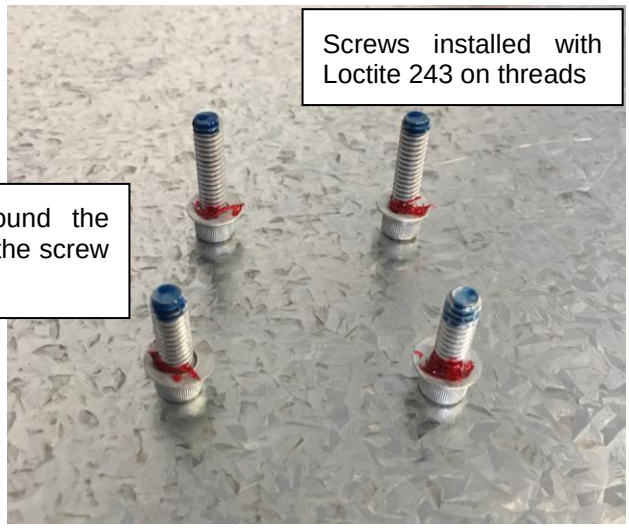


Figure 24 – 2200/330 crankcase subassembly 9

- Install roller hydraulic lifter retainers into the crankcase with L90 lubricant
  - Ensure the lifter retainer plates are installed orientating the lifter correctly as previously described (shown in Figure 23).
  - The fit of the lifter retainer plates should be a smooth sliding fit (without being loose). If the fit is too tight the retainer plates can be polished using a scotch-brite wheel or similar.
  - Check the fit of the lifter by pushing each back and forth in the socket. The fit must be smooth and not too tight.
- The pushrod manifolds must be installed with Loctite 518 sealant in the following areas:
  - Inside the manifold around the screw holes
  - Under the screw heads and washers
- Install pushrod manifold / crankcase sealing O-ring into the pushrod manifolds dry.
- Prime the crankcase holes and the screws with Loctite 747.
- Install manifold onto the crankcase with two ¼" – UNC screws and Belleville washers using Loctite 243 on the threads of the screw to the torque setting prescribed in section 0 and mark with a paint pen.
- Install pushrod tube O-rings into the pushrod tube manifolds with L90 lubricant.





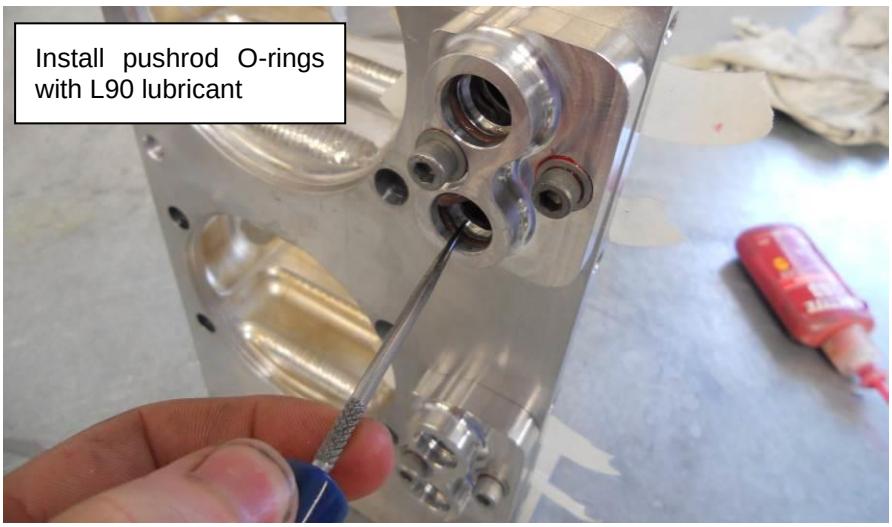


Figure 25 - pushrod manifold installation

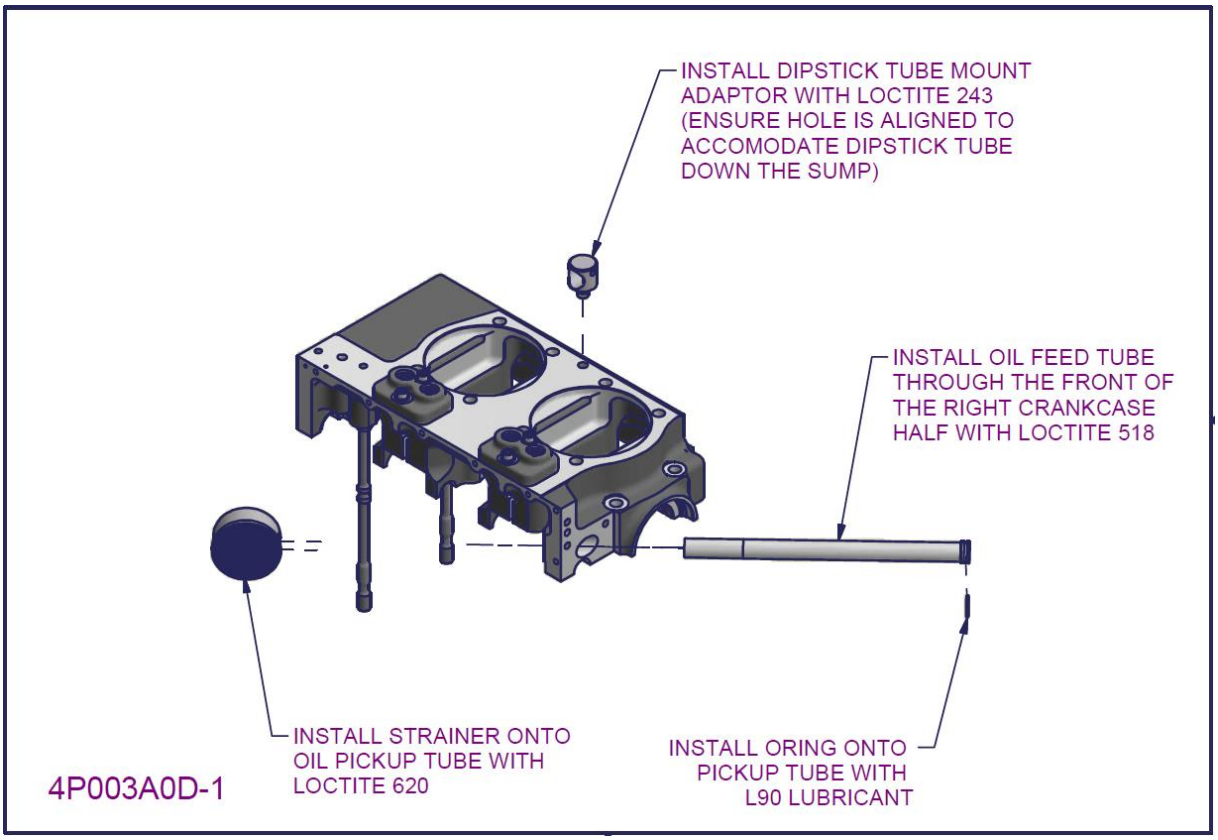


Figure 26 – 2200/330 crankcase subassembly 10

- Install Oil feed tube O-ring onto oil feed pickup tube.
- Insert the oil feed pickup tube (small diameter end first) down the front of the oil pickup hole.
  - Bond the oil pickup tube into the crankcase with Loctite 518 sealant, clean away excess.
  - Apply Loctite 290 wick in from the inside, around the oil pickup tube to seal any gaps
- Prime the oil strainer and the end of the oil pickup tube with Loctite 747.
- Install oil strainer on the oil pickup tube with Loctite 620.
  - The oil strainer will need to be tapped on with a soft rubber mallet.
  - The oil strainer must be installed with the mesh screen facing down (towards the bottom of the engine).
- Install dipstick tube mount adaptor with Loctite 243 (having primed with Loctite 747 first).
  - Make sure to align hole so dipstick tube can pass through to the sump.

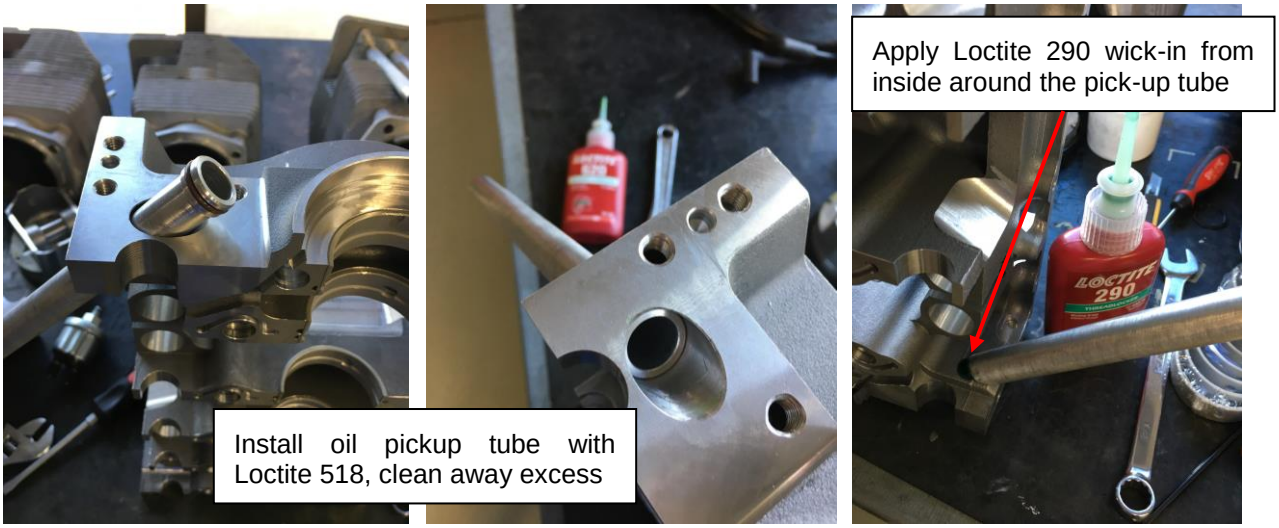


Figure 27 - Oil pickup tube installation

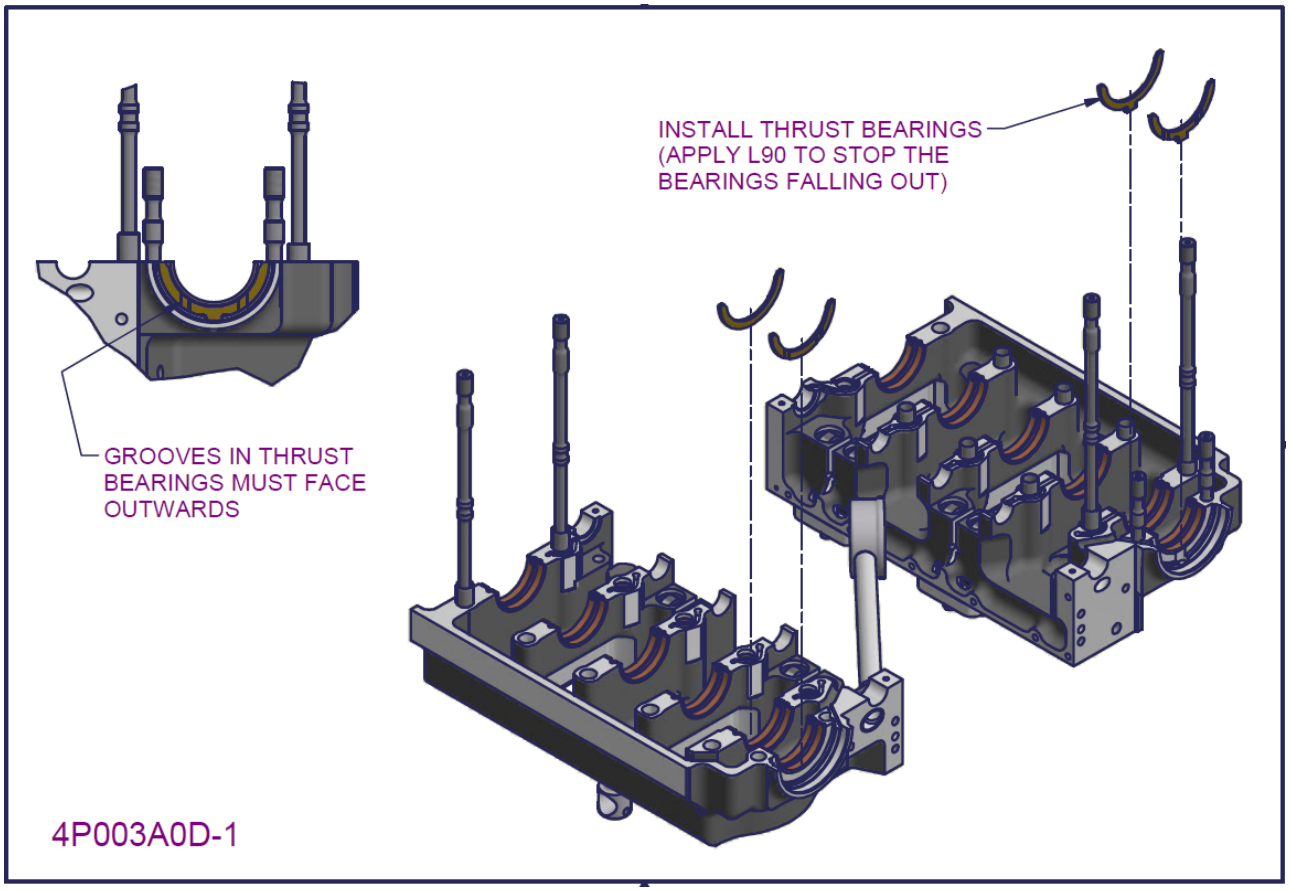


Figure 28 – 2200/330 crankcase subassembly 11

- Install thrust bearings into the crankcase halves.
  - The left side crankcase features slots in the thrust faces; therefore the bearings fitted in this side must have appropriate tabs.
  - Ensure that the two grooves in the thrust bearing are facing outwards (i.e. NOT up against the crankcase thrust faces).
  - Apply L90 to the bearings on the face which DOES contact up against the crankcase thrust faces. This acts as an adhesive preventing the bearing falling out when the engine is finally joined together.
- Give the crankcase mating faces a final clean with degreasing solvent. Apply L90 lubricant to the camshaft journals and the main bearings in preparation for joining the engine together.
- This concludes the **Crankcase subassembly**.

4.2 Camshaft subassembly

4.2.1 2200 Camshaft subassembly – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4A533A0D-3	2210 CAMSHAFT NON HANDED HEAD 28BCD/268/109 ROLLER FOLLOWER	1
2	4066123-8	GEAR CAMSHAFT INNER	1
3	4538064-5	SPACER CAM TIMING GEARS	1
4	4333054-5	DISTRIBUTOR DRIVE GEAR 2.2L	1
5	PH10724-2	1/4" BELLEVILLE WASHER	4
6	AN4-5A	BOLT	4

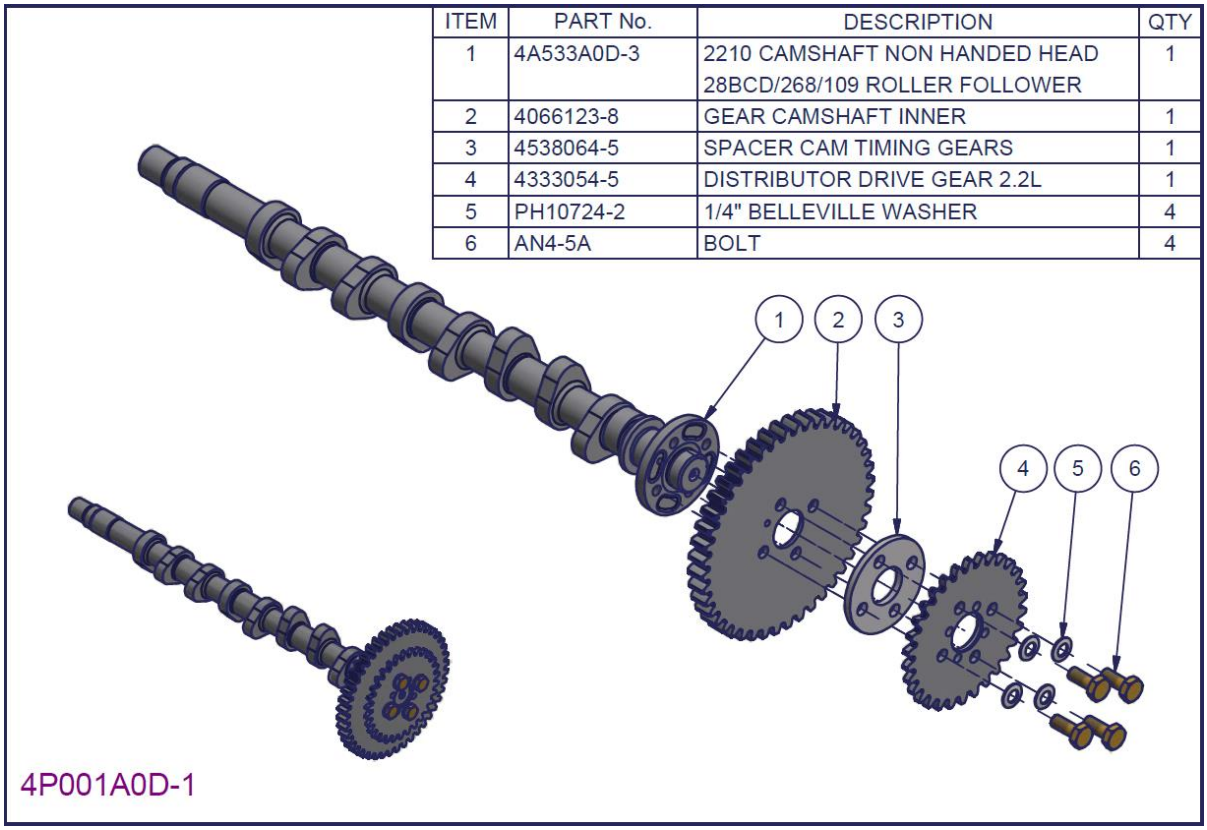


Figure 29 – 2200 Camshaft subassembly – Parts List

4.2.2 3300 Camshaft subassembly – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4A546A0D-5	CAMSHAFT 3310 268 DEG DURATION 109 DEG CTRS 28 BCD ROLLER FOLLOWER	1
2	4066123-8	GEAR CAMSHAFT INNER	1
3	4538064-5	SPACER CAM TIMING GEARS	1
4	4333054-5	DISTRIBUTOR DRIVE GEAR 2.2L	1
5	PH10724-2	1/4" BELLEVILLE WASHER	4
6	AN4-5A	BOLT	4

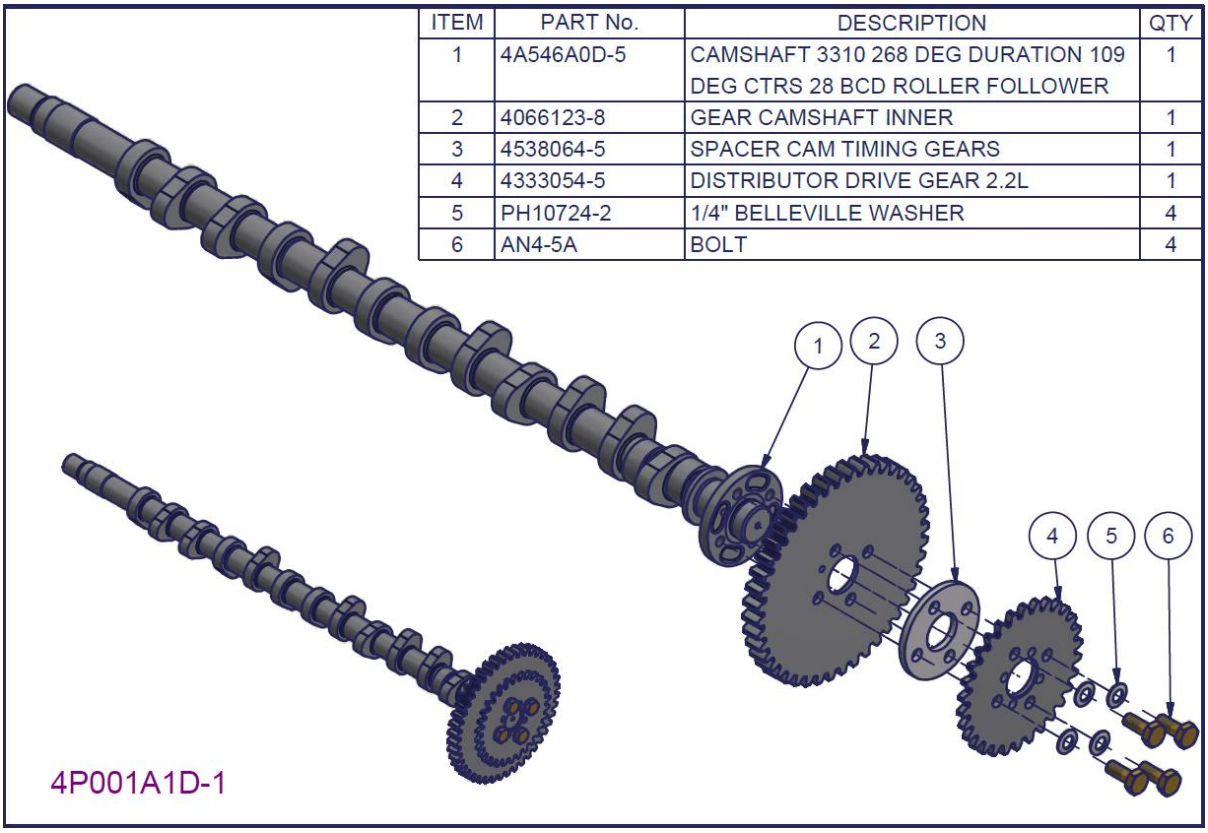


Figure 30 – 3300 Camshaft subassembly – Parts List

4.2.3 2200 / 3300 camshaft subassembly procedure

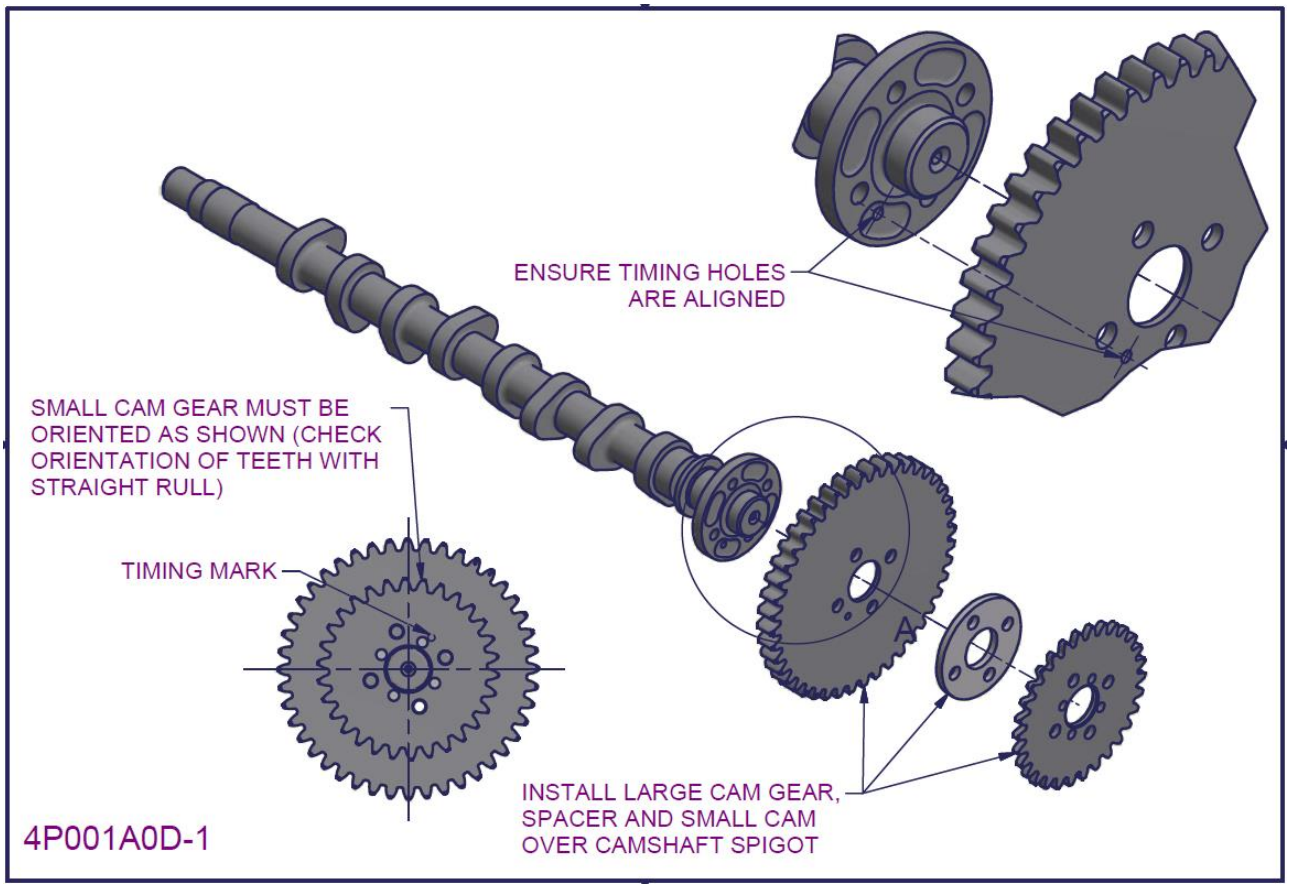


Figure 31 – 2200/3300 camshaft subassembly 1

- Measure the camshaft journals with a calibrated micrometre in two perpendicular axes to check for roundness. Check the diameters measured are within the tolerance specified in section 3.11.4.
  - *Record the camshaft journal diameters in the engine built log (section 6.5)*
- Place the cam shaft in a soft rubber jawed vice (shown in Figure 32)
- Install the large cam gear, aluminium spacer plate and small cam gear over the camshaft spigot.
  - *Record the large and small cam gear serial numbers in the engine build log (section 6.5)*
- Ensure that the timing hole on the large cam gear is aligned with the timing hole on the camshaft
- Ensure the small cam gear is correctly oriented as shown in Figure 31.

Figure 32 - Camshaft restrained in soft rubber jawed vice

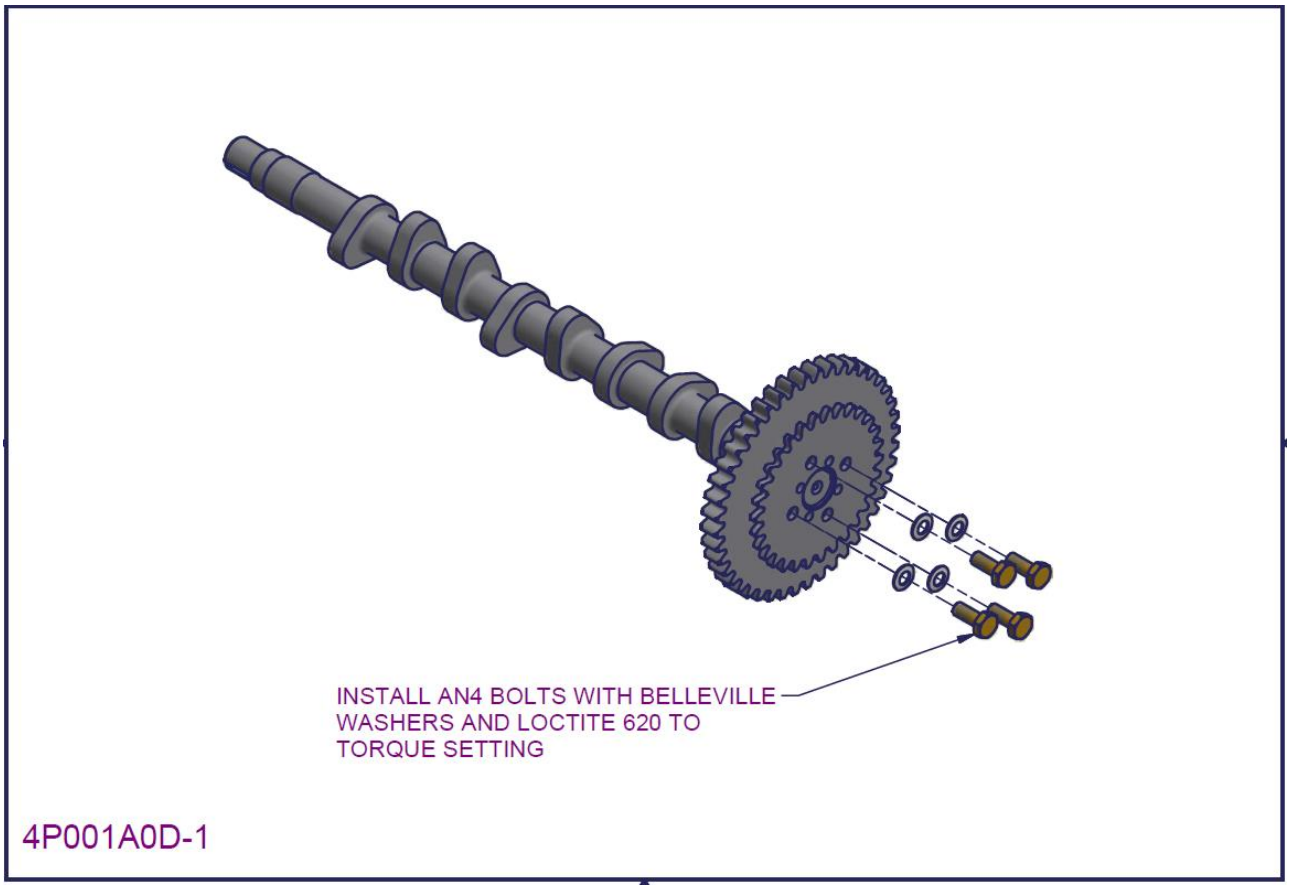


Figure 33 – 2200/3300 camshaft subassembly 2

- Prime the camshaft holes and four AN4 bolts with Loctite 747
- Install four AN4 bolts with ¼" Belleville washer using Loctite 620 to the torque setting prescribed in section 0 and mark with a paint pen.
- Apply torque seal or a paint pen mark to indicate that bolts have been torqued to the required setting
- This completes the **Camshaft subassembly**.

4.3 Crankshaft subassembly

4.3.1 2200 Crankshaft subassembly – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4A591A0D-10	CRANKSHAFT 2.2L 3/8 FLYWHEEL SCREWS	1
2	PH0646N	WELSH PLUG 7/8" DIA	2
3	PH9912N	WELSH PLUG 28 DIA	1
4	4651183-8	CONROD MACHINED STEEL	4
5	4651284-6	CAP CONROD - STEEL	4
6	PB4A006N-1	BEARING SHELL CONROD	8
7	PB0045N-1	ROLLER 3 DIA X 14	8
8	PH72E24-1	SOCKET HD SCREW 5/16 UNF X 1. UNBRAKO OR BRIGHON BEST GRADE 1960	8

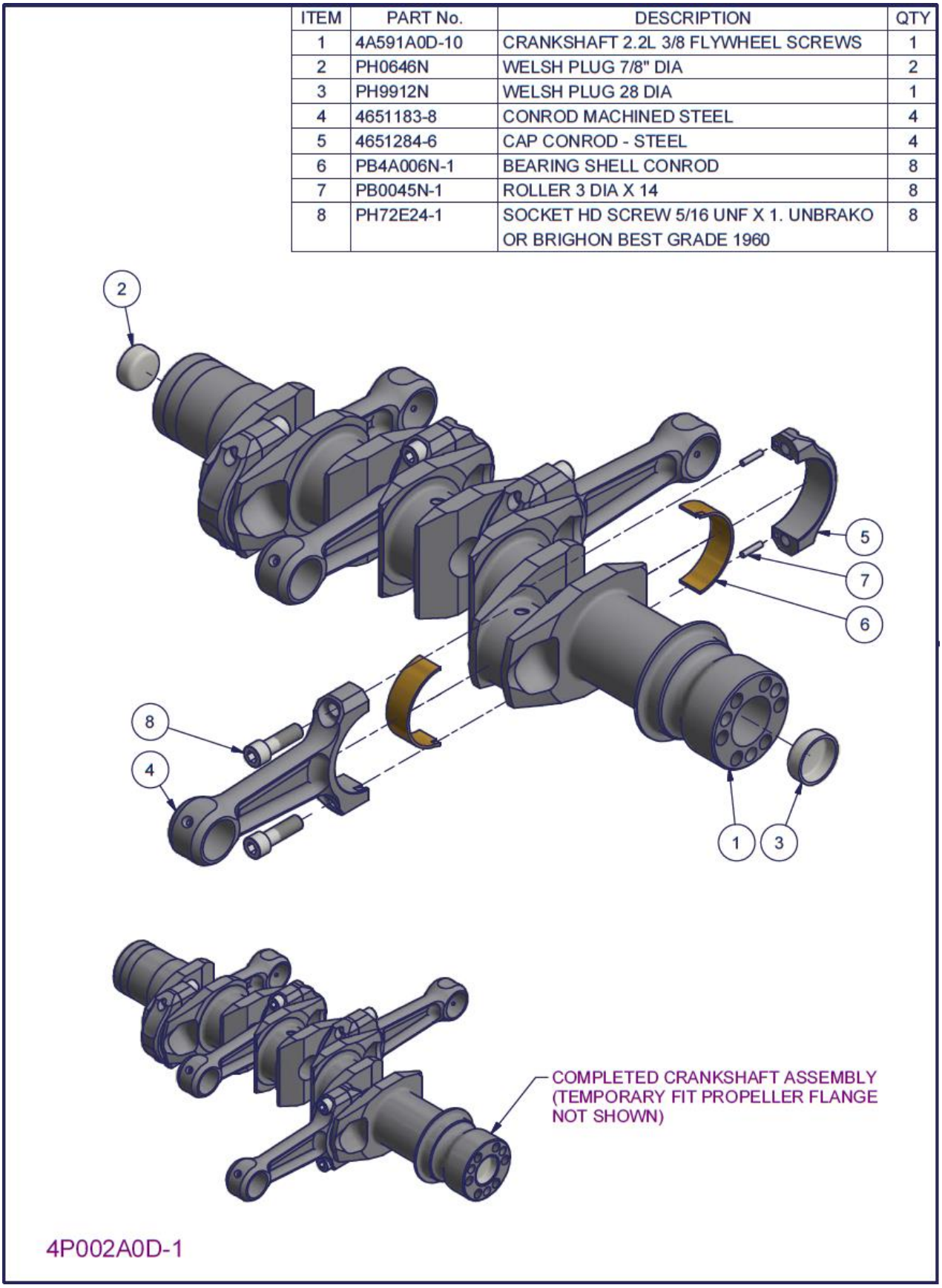


Figure 34 – Crankshaft subassembly – Parts List

4.3.2 3300 Crankshaft subassembly – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	PH0646N	WELSH PLUG 7/8" DIA	2
2	PH9912N	WELSH PLUG 28 DIA	1
3	4651183-8	CONROD MACHINED STEEL	6
4	4651284-6	CAP CONROD - STEEL	6
5	PB4A006N-1	BEARING SHELL CONROD	12
6	PB0045N-1	ROLLER 3 DIA X 14	12
7	PH72E24-1	SOCKET HD SCREW 5/16 UNF X 1. UNBRAKO OR BRIGHON BEST GRADE 1960	12
8	4A592A0D-11	CRANKSHAFT 3.3L 3/8 FLYWHEEL SCREWS	1

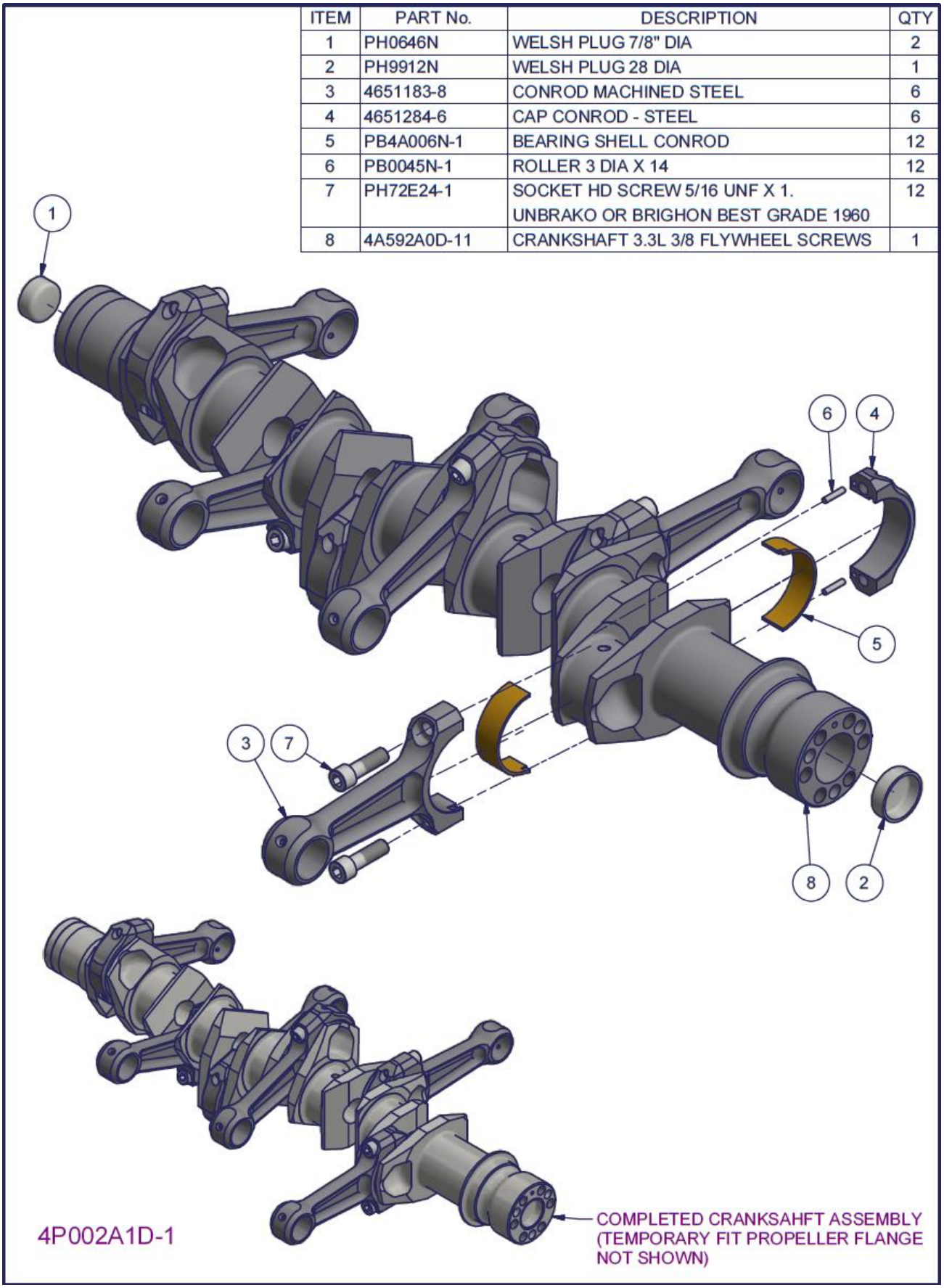


Figure 35 – 3300 Crankshaft subassembly – Parts List

4.3.3 2200 / 3300 crankshaft subassembly procedure

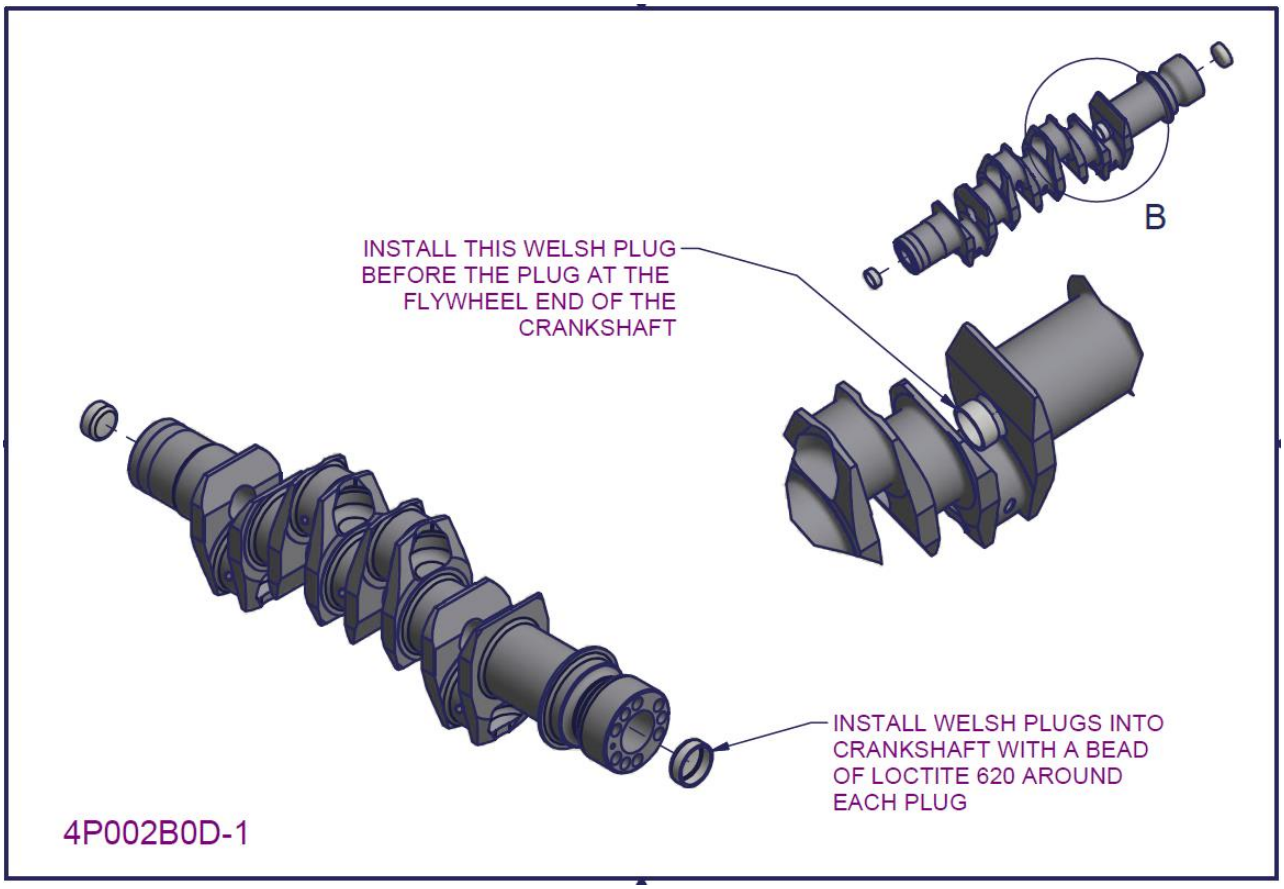


Figure 36 – 2200/3300 crankshaft subassembly 1

- Ensure crankshaft is clean, in particular check the oil gallery holes are completely clear and the dowel holes and bolts holes in the propeller and flywheel ends are completely clean.
- Measure each of the main bearing journals and conrod bearing journals using a calibrated micrometre. Measure each journal in two perpendicular axes to check each journal is round. Check that each journal diameter measures within the tolerance prescribed in section 3.11.4.
    - *Record main journal diameters and conrod journal diameters in the engine build log (section 6.6)*
- Place crankshaft in soft rubber jawed vice.
- Prime welsh plugs and prime the holes in the prop end, flywheel end and behind the thrust faces with Loctite 747.
- Apply a bead of Loctite 620 around the entire perimeter of each of the three welsh plugs.
- Install the first welsh plug in the hole behind the thrust faces (as shown in Figure 36). Using a long steel driving bar inserted through from the flywheel end and driving the plug home into the hole with a hammer.
- Now install the plugs into the flywheel end and propeller end of the crank shaft again driving the plug in using a steel driving bar and hammer.
- Ensure the plugs are driven in enough that they do not sit proud of the surface of each hole.
- Wipe away excess Loctite after the plugs have been installed.

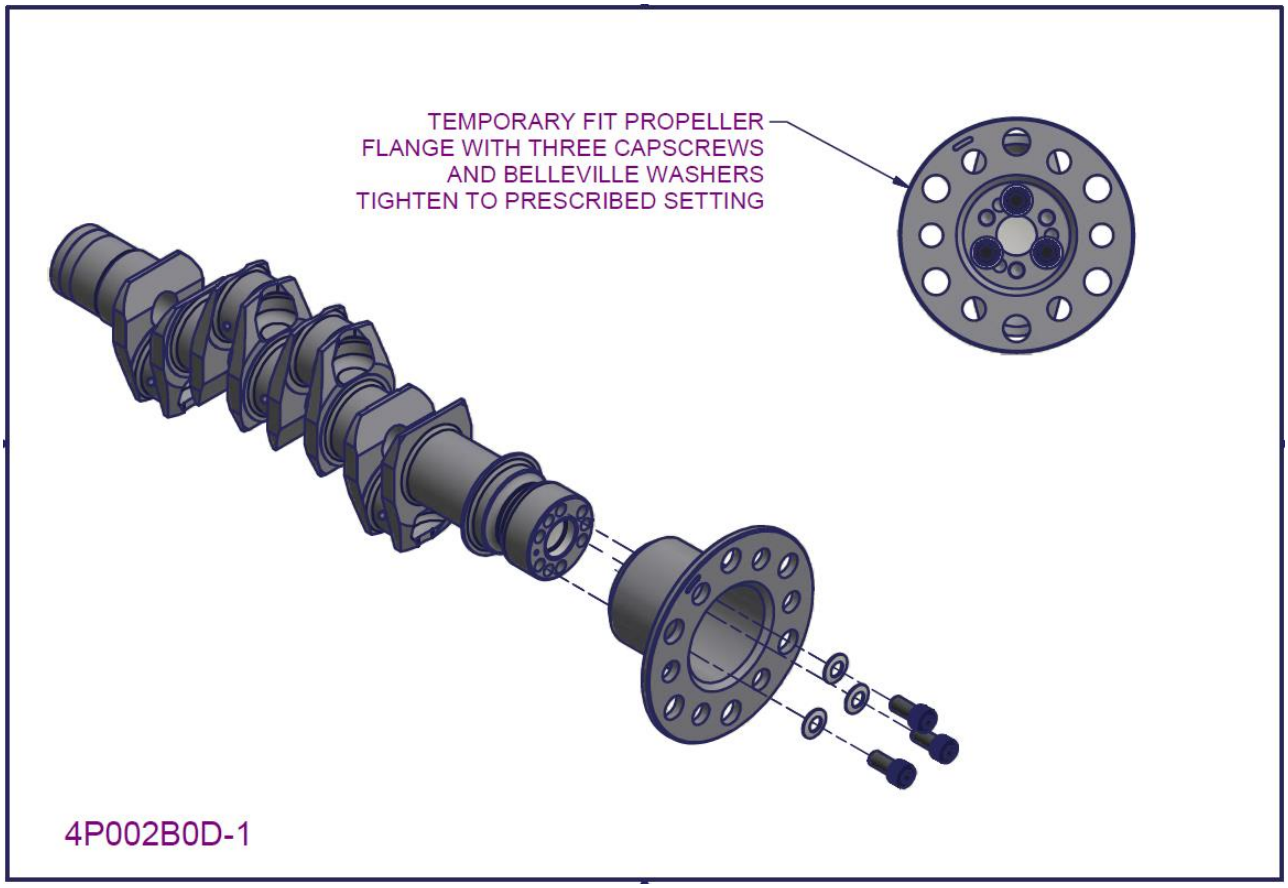
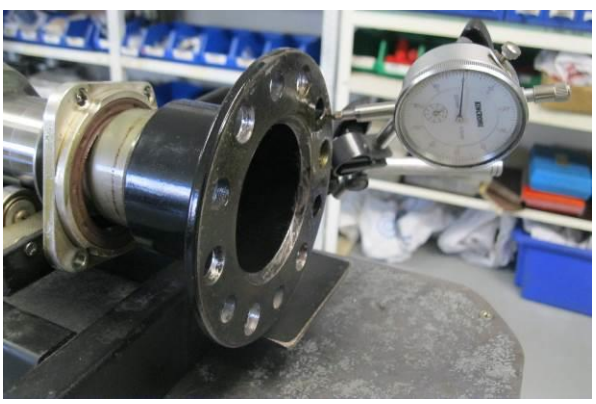


Figure 37 - 2200/3300 crankshaft subassembly 2

- Place propeller flange over the propeller mount face
- Install three capscrews with Belleville washers to retain propeller flange in place. Torque screws to the prescribed torque setting (section 0). Ensuring that the propeller flange is pulled down onto the crankshaft evenly.
- Place crankshaft propeller flange assembly on runout measuring bed
- Setup dial gauge to measure propeller flange runout
- Rotate crankshaft on bed and note the maximum displacement of the gauge. This is the propeller flange runout.
    - *Record propeller flange runout in the engine build log (section 6.6)*
- Setup dial gauge to measure crankshaft runout
- Rotate crankshaft on bed and note the maximum displacement of the gauge. This is the crankshaft runout.
    - *Record crankshaft runout in the engine build log (section 6.6)*



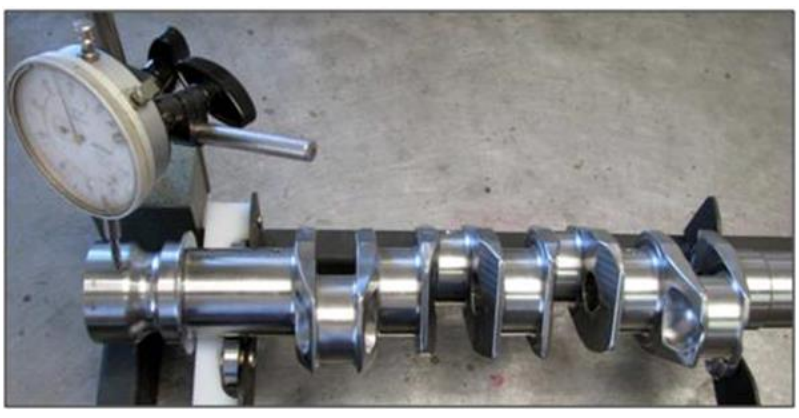


Figure 38 - Measuring propeller flange and crankshaft runout

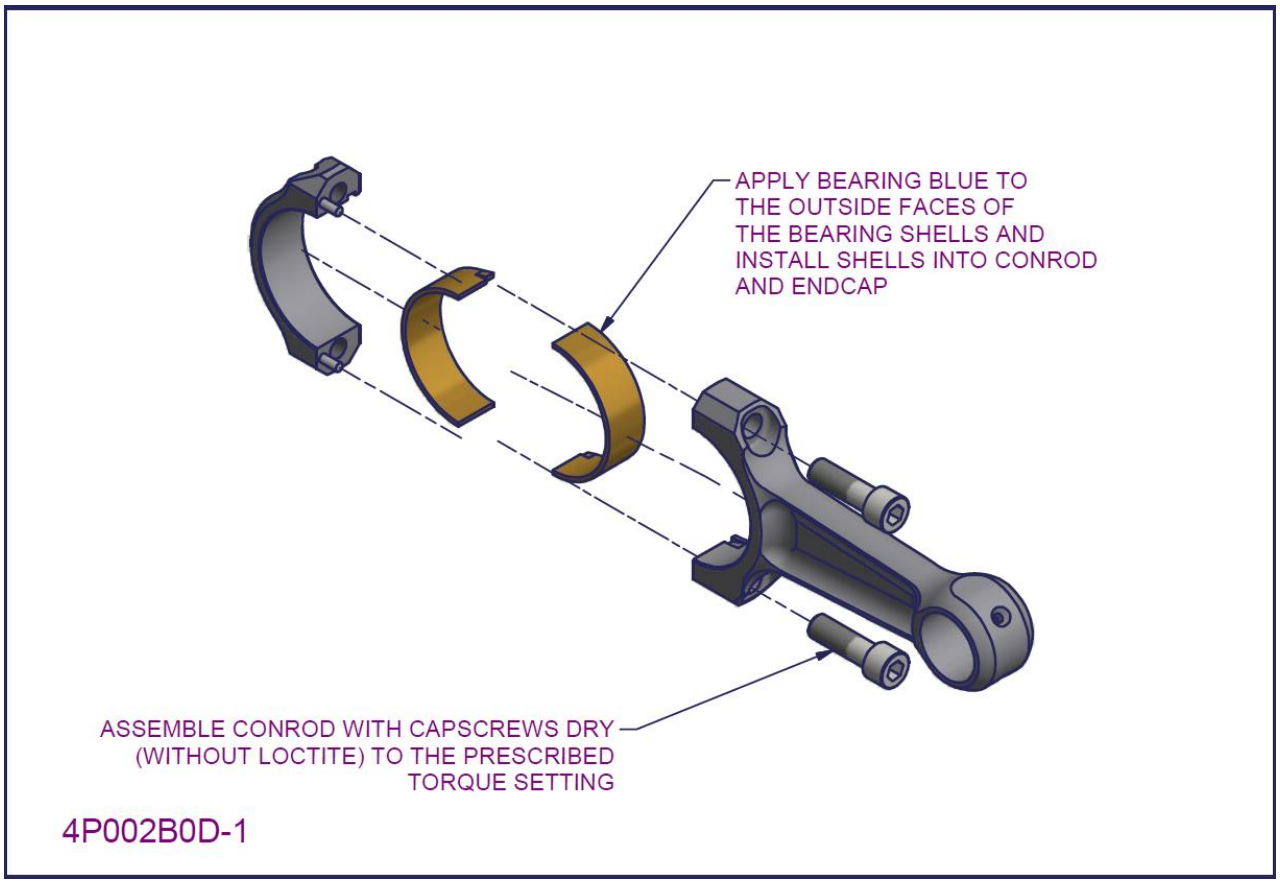


Figure 39 - 2200/3300 crankshaft subassembly 3

- If the conrods to be installed are assembled together in the box then remove the included capscrews and pull the conrod and end cap apart. The included capscrews must be discarded and genuine Unbrako or equivalent grade capscrews used.
- Check the threads in the end-cap are clean.
- Take a pair of bearing shells and apply a thin coating of bearing blue to the entire outside face.
- Install the bearing shells into the conrod and end cap, ensuring the tabs on the bearing sit inside the respective groove in the conrod and end cap.
- Insert the end cap into the conrod using the locating dowel pins.
- Fit capscrews dry (i.e. without Loctite) using the following technique:
  - Place assembly in soft jawed vice (as shown in Figure 40 below)
  - Install both screws to contact with a T-bar.
  - Torque both screws directly to the prescribed torque setting in section 0.
  - Check off each screw a second time to the prescribed torque setting.

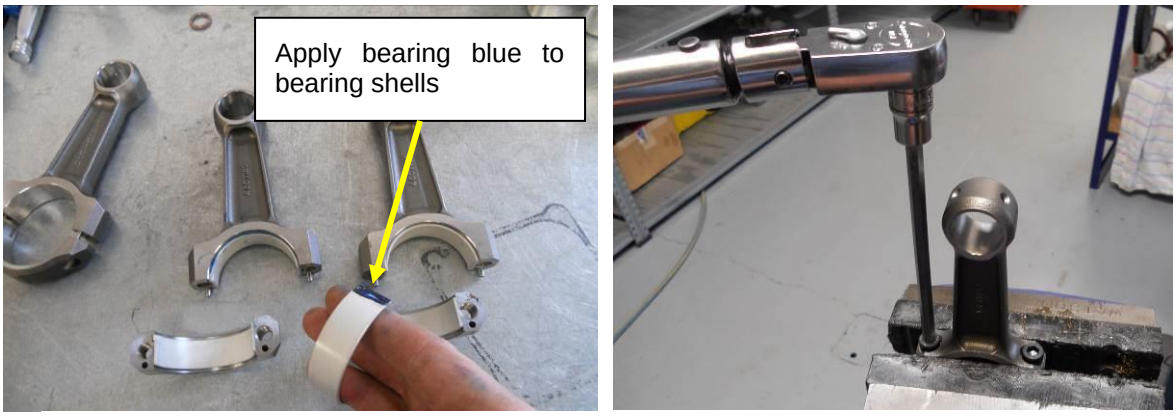


Figure 40 - Conrod assembly

- Note: The capscrew torque setting for forged and billet machined connecting rods is significantly different from one another and MUST be adhered to. Figure 41 shows the difference between the two components. The two different torque settings are provided in section 0.

Figure 41 - Forged conrods vs Billet machined conrods

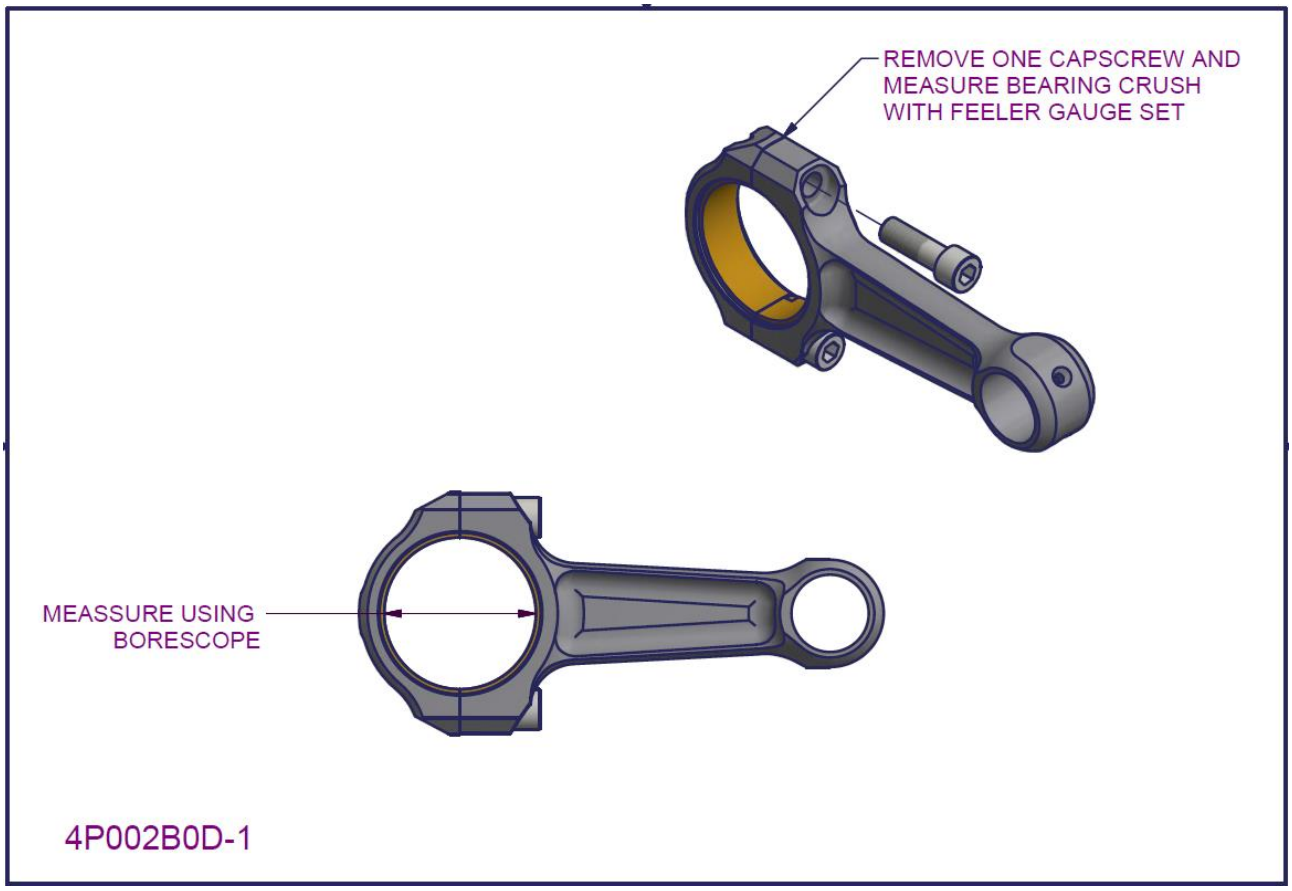


Figure 42 - 2200/3300 crankshaft subassembly 4

- While all conrods are assembled together, number each of them 1 to 4 or 1 to 6 (2200 and 3300 respectively) with a paint pen (this is the allocated position on the crankshaft). Measure the big end bore diameter using a borescope. Measure through the axis indicated in Figure 42 axes to check the bore of the conrod big end (with bearings installed) falls within the specified build tolerance (section 3.11.4).
    - *Record big end diameters (with bearings) measurements in the engine build log (section 6.6)*
    - *Calculate and record the conrod big end clearance (Big end diameter minus the crankshaft conrod journal diameter)*
- Loosen or completely remove ONE capscrew from each conrod. Measure the bearing crush using a set of feeler gauges (i.e. the gap between the conrod and the end cap on the side from which the capscrew was removed) and check it is within specified build tolerance (section 3.11.4).
    - *Record conrod bearing crush measurements in the engine build log (section 6.6)*

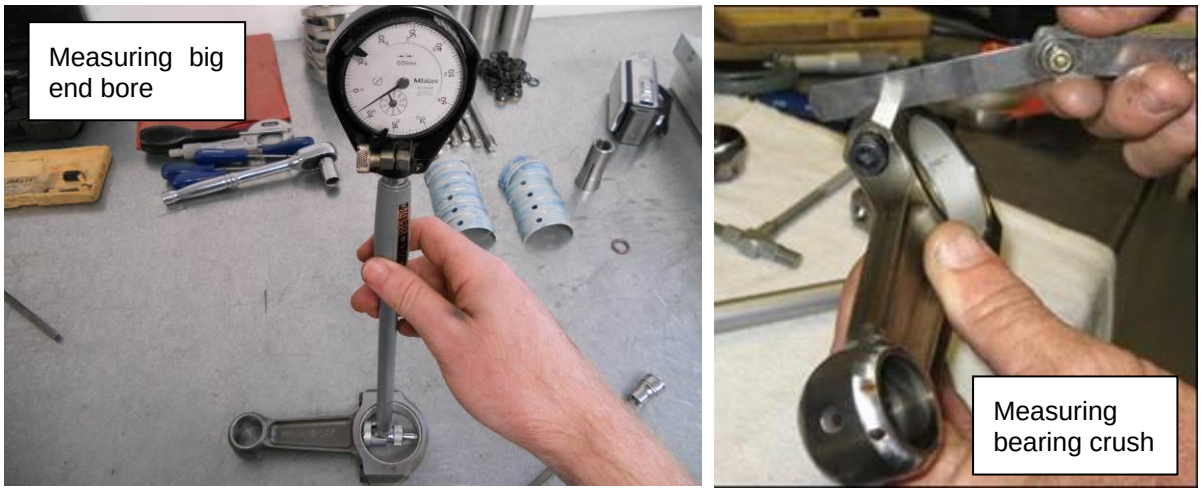


Figure 43 - Conrod measurements

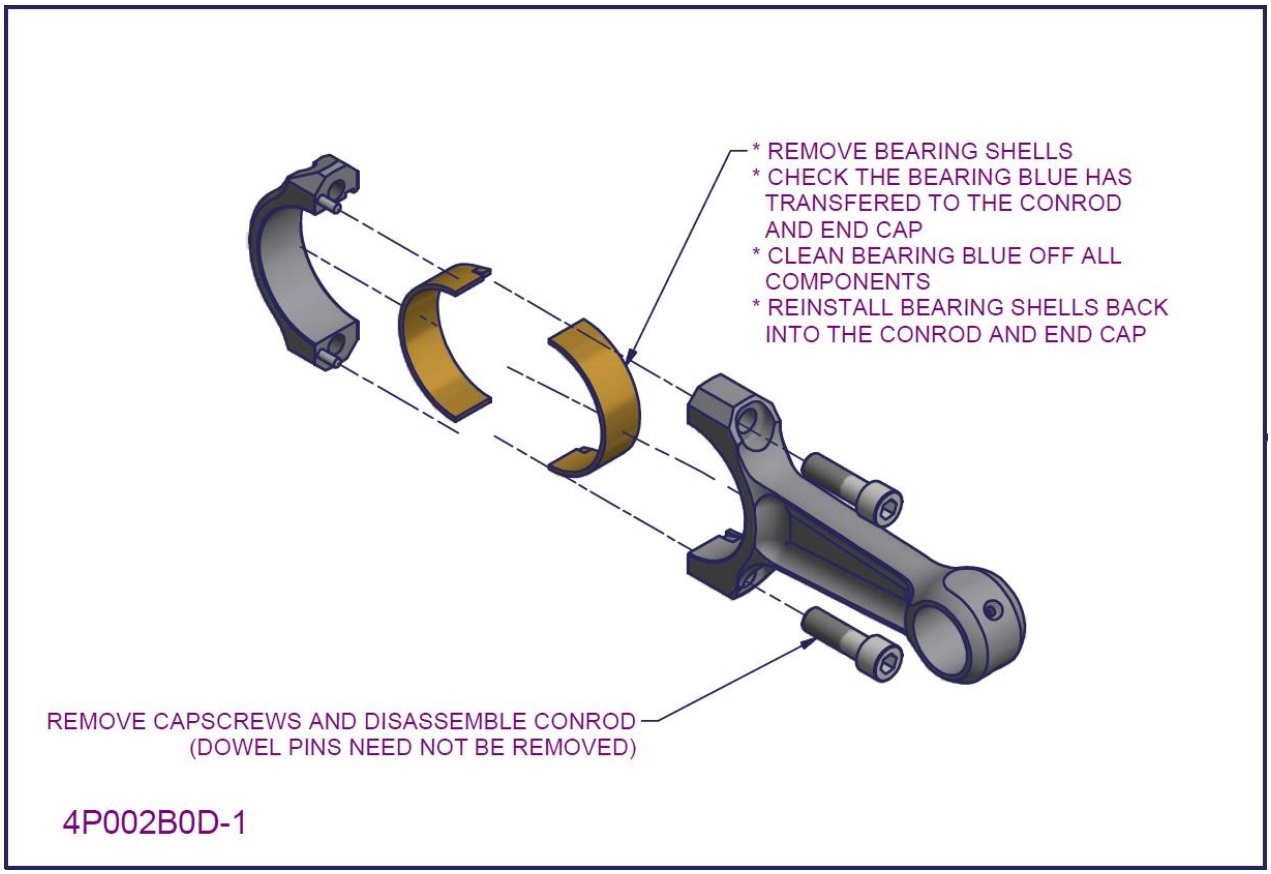


Figure 44 – 2200/3300 crankshaft subassembly 5

- Remove capscrews from each conrod assembly
- Pull the conrod and end cap apart (the dowel pin need not be removed)
- Remove the bearing shells and check that bearing blue has transferred across to the conrod and the end cap (as shown in Figure 45)
- Clean bearing blue off all conrods, end-caps and bearing shells
- Reinstall the bearing shells beck into the conrods and end caps (make sure to install each bearing back in the same conrod of end-cap from which it was removed).

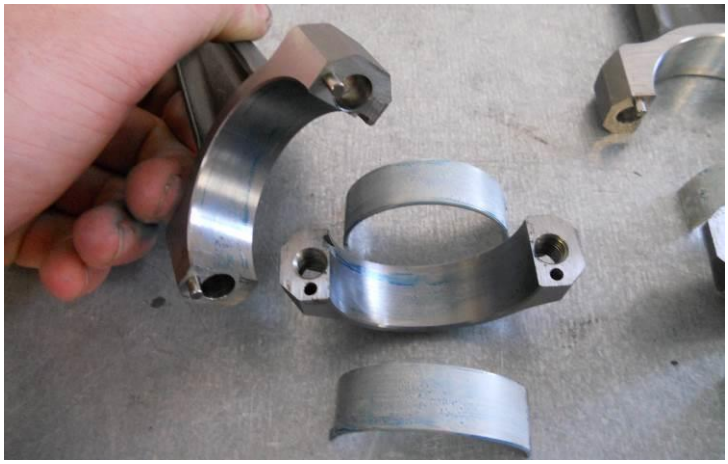


Figure 45 - Check for bearing blue transferal

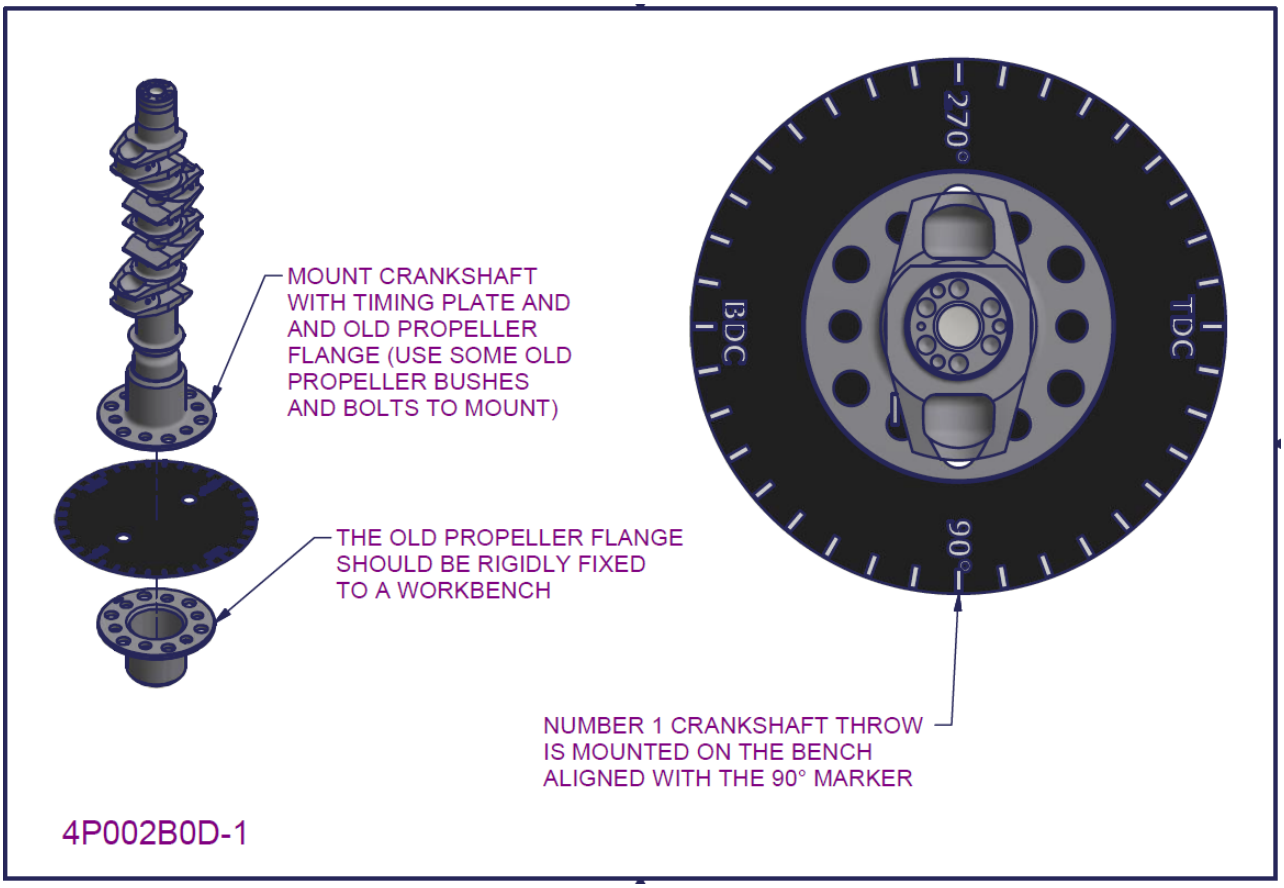


Figure 46 – 2200/3300 crankshaft subassembly 6

- Install the crankshaft onto an old propeller flange which is mounted onto the workbench
- A timing plate must also be mounted between the crankshaft and the old propeller flange for use later on in correctly timing the engine
- The crankshaft should be mounted in relation to the timing plate with the number 1 crankshaft throw aligned with the 90º marker on the timing plate (this should be done for both 2200 and 3300 engines)
- Use a pair of propeller drive bushes and bolts and nuts to affix the crankshaft and timing plate to the bench mounted old propeller flange.

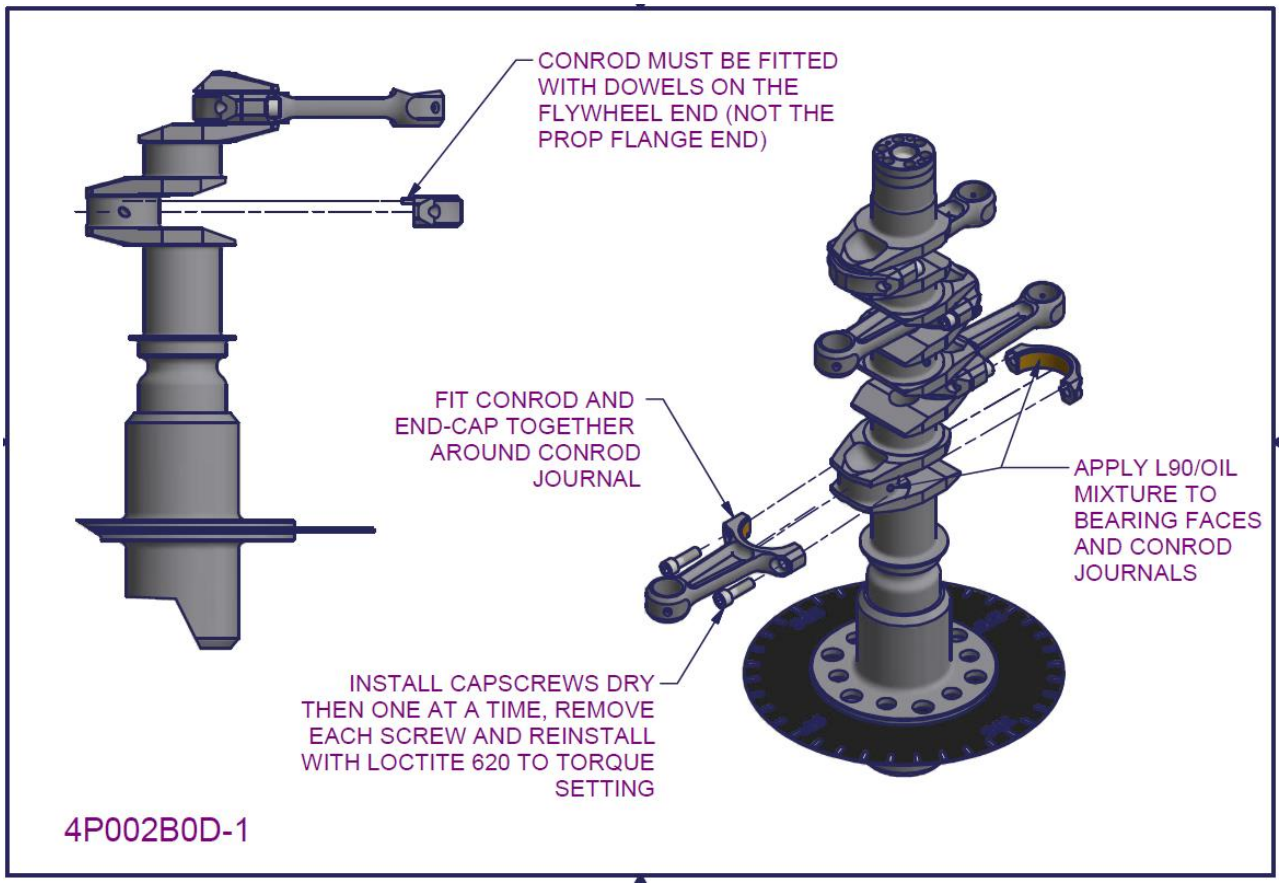


Figure 47 – 2200/3300 crankshaft subassembly 7

- Apply a mixture of L90 lubricant and engine oil generously to each of the conrod journals on the crankshaft.
- Apply L90 lubricant to the bearing shells on both the conrod and end-cap
- Fit the conrod and end-cap together around each conrod journal.
    - When fitting ensure that the dowel pins are facing up (i.e. the dowel pins are on the flywheel end NOT the propeller end).
- Fit both capscrews dry (without Loctite) to the prescribed torque setting (see section 0)
- Remove ONE capscrew, prime the hole and the screw with Loctite 747 and apply Loctite 620 to the first four threads of the screw. Install screw to prescribed torque setting and mark with a paint pen.
- Repeat with the second screw.
    - *Record the serial number of each conrod assembly and the cylinder upon which they were installed in the engine build log (section 6.6)*
- This completes the **Crankshaft subassembly**

NOTE

It is very important to dry fit the conrod capscrews first. This ensures that the conrod and end-cap are pulled up tightly together so that when a screw with Loctite is installed, excess Loctite cannot spread through a gap between the conrod and end-cap to cure between the journal and bearing.

4.4 Cylinder subassembly

4.4.1 2200 / 3300 cylinder subassembly External O-rings Current – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4A755A0D-10	2210 CYLINDER ASSY - EXT ORINGS THREADED BARREL TO HEAD	1
2	4596074-6	EXHAUST VALVE DIA 33 SYM HEAD (2.2L)	1
3	4595074-6	INLET VALVE DIA 41 SYM HEAD (2.2L)	1
4	4A716B0D-1	DOUBLE VALVE SPRING - BOTTOM WASHER	2
5	4A716D0D-3	DOUBLE VALVE SPRING - OUTER SPRING	2
6	4A716E0D-1	DOUBLE VALVE SPRING - INNER SPRING	2
7	PG0188N-1	ORING BS015V	2
8	4594074-9	ROCKER SHAFT - SYM HEAD (2.2L)	1
9	PG4A061N-1	0-RING 7 X 2.5 (ROCKER SHAFT)	2
10	4A520C0N-3	ROCKER ARM HOLLOW PUSHROD #1 REAR (RATIO 1.35, MACHINED)	1
11	4A520A0D-3	ROCKER ARM HOLLOW PUSHROD #1 FRONT (RATIO 1.35, MACHINED)	1
12	PG121415F-1	BUSH - ROCKER SHAFT	2
13	PH10724-2	1/4" BELLEVILLE WASHER	1
14	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	1
15	4A738B0D-3	PISTON 97.53 DIA, VALVE RELIEF, SLOTTED SKIRT (RIGHT) NOTE: PISTONS ARE HANDED (RIGHT HAND SHOWN) IF LEFT - USE 4A738C0D-2	1
16	PG02400-1B	RING SET	1
17	PH4A047N-1	CIRCLIP INT 25 DIA	1
18	4299064-3	GUDGEON PIN 57.5 LONG (2.2L)	1
19	4A654A0D-2	HOLLOW PUSHROD ASSY ROLLER FOLLOWER 28 BCD 2210	2
20	4A716C0D-4	DOUBLE VALVE SPRING - TOP SPRING WASHER	2
21	4605074-6	VALVE COLLET - MULTI GROOVE STEM	4
22	PH72624	SOCKET HD SCREW 1/4 UNC X 5/8	1
23	4A826A0D-1	PUSHROD COVER EXT ORING	2
24	4A839A0D-1	2210 CHT PROBE POST - 1/4-UNC MALE	1
25	PH0219N	WASHER 1/4 X 5/8 FLAT Z/P	1

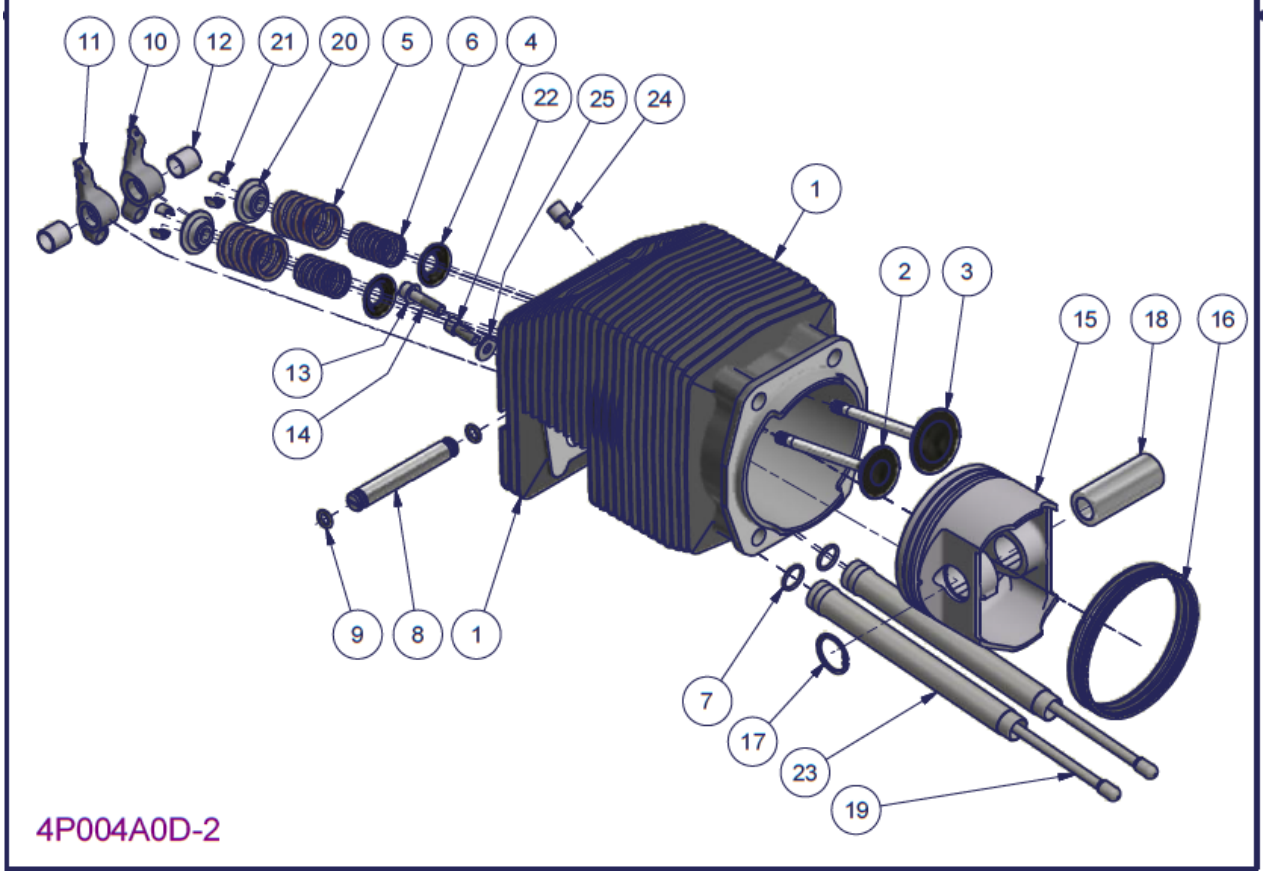


Figure 48 - 2200/3300 Cylinder subassembly - Parts list

4.4.2 2200 / 3300 cylinder subassembly Internal O-ring groove – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4596074-6	EXHAUST VALVE DIA 33 SYM HEAD (2.2L)	1
2	4595074-6	INLET VALVE DIA 41 SYM HEAD (2.2L)	1
3	4A716B0D-1	DOUBLE VALVE SPRING - BOTTOM WASHER	2
4	4A716D0D-3	DOUBLE VALVE SPRING - OUTER SPRING	2
5	4A716E0D-1	DOUBLE VALVE SPRING - INNER SPRING	2
6	PG10042N-1	BS114V O RING	2
7	PH0515N	CIRCLIP 20MM INT	2
8	4594074-9	ROCKER SHAFT - SYM HEAD (2.2L)	1
9	PG4A061N-1	0-RING 7 X 2.5 (ROCKER SHAFT)	2
10	4A520C0N-3	ROCKER ARM HOLLOW PUSHROD #1 REAR (RATIO 1.35, MACHINED)	1
11	4A520A0D-3	ROCKER ARM HOLLOW PUSHROD #1 FRONT (RATIO 1.35, MACHINED)	1
12	PG121415F-1	BUSH - ROCKER SHAFT	2
13	PH10724-2	1/4" BELLEVILLE WASHER	1
14	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	1
15	4A738B0D-3	PISTON 97.53 DIA, VALVE RELIEF, SLOTTED SKIRT (RIGHT) NOTE: PISTONS ARE HANDED (RIGHT HAND SHOWN) IF LEFT - USE 4A738C0D-2	1
16	PG02400-1B	RING SET	1
17	PH4A047N-1	CIRCLIP INT 25 DIA	1
18	4299064-3	GUDGEON PIN 57.5 LONG (2.2L)	1
19	4A654A0D-2	HOLLOW PUSHROD ASSY ROLLER FOLLOWER 28 BCD 2210	2
20	4A755A1D-6	2210 CYLINDER ASSY - INT ORINGS THREADED BARREL TO HEAD	1
21	4A631A0D-2	PUSHROD COVER TUBE 2200/3300 ENGINE ROLLER FOLLOWER, 4A617 ADAPTOR.	2
22	4A716C0D-4	DOUBLE VALVE SPRING - TOP SPRING WASHER	2
23	4605074-6	VALVE COLLET - MULTI GROOVE STEM	4

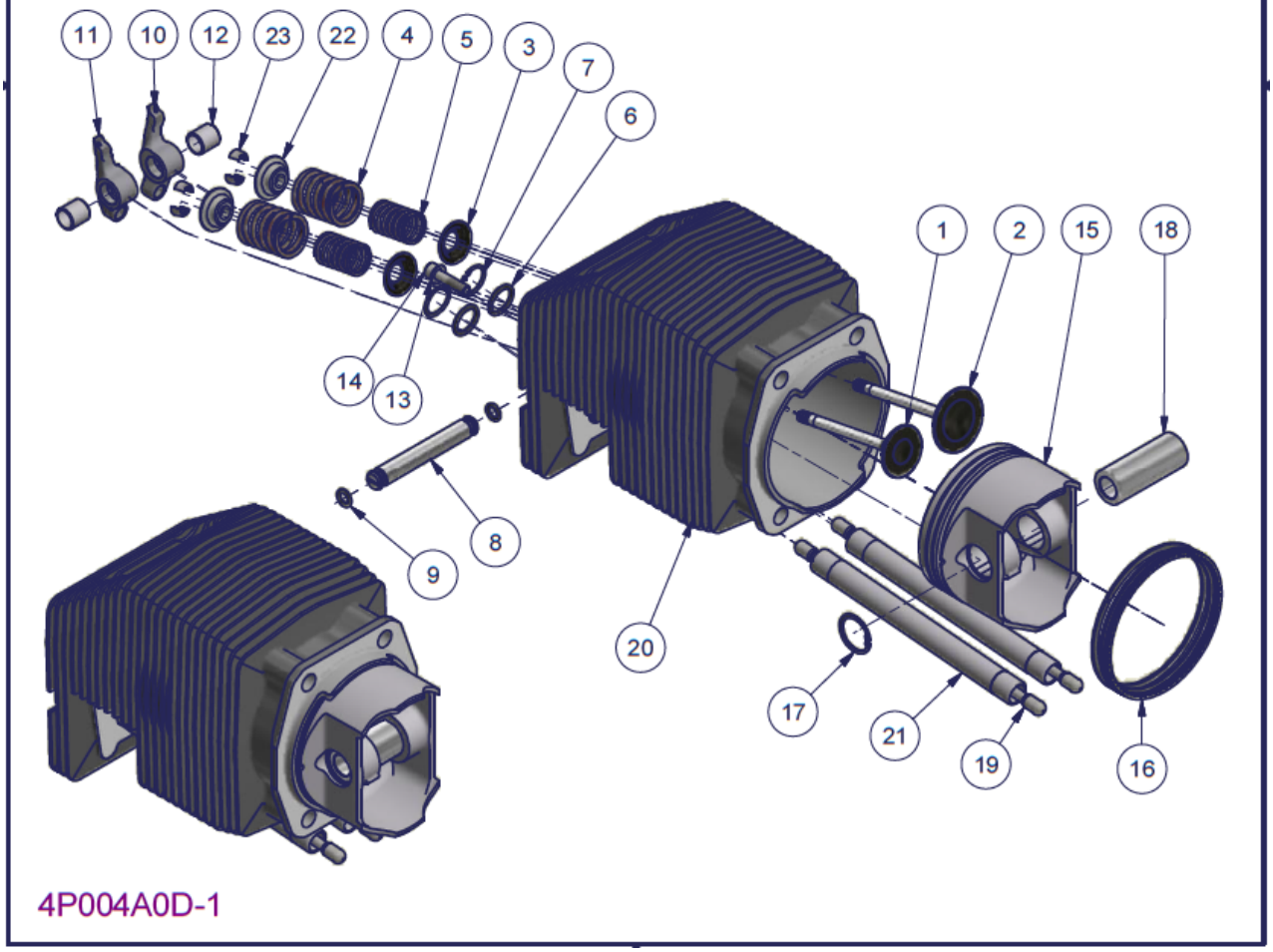


Figure 49 - 2200/3300 Cylinder subassembly - Parts list

4.4.3 Checking Cylinder head type before assembly

- There are two types of cylinder heads used on Jabiru Gen4 engines.
  - At the time of this writing the most current cylinder head design features an **external O-ring groove** for the pushrod tubes (i.e. the O-rings goes on the pushrod tube itself)
  - Prior to this configuration was the **internal O-ring groove cylinder** the O-ring was installed inside the cylinder head and the pushrod tube inserted.
  - The two designs are interchangeable and external O-ring groove cylinder can replace internal O-ring groove cylinder at overhaul. However the pushrod tube must also be replaced. Check the parts list provided (Figure 48, Figure 49) for the relevant part numbers.
  - The procedure for assembling cylinder head is largely the same. Differing procedures are presented where differences arise. Cylinders of both types should be assembled using these procedure in the order it is presented.

4.4.4 2200 / 3300 Cylinder subassembly procedure

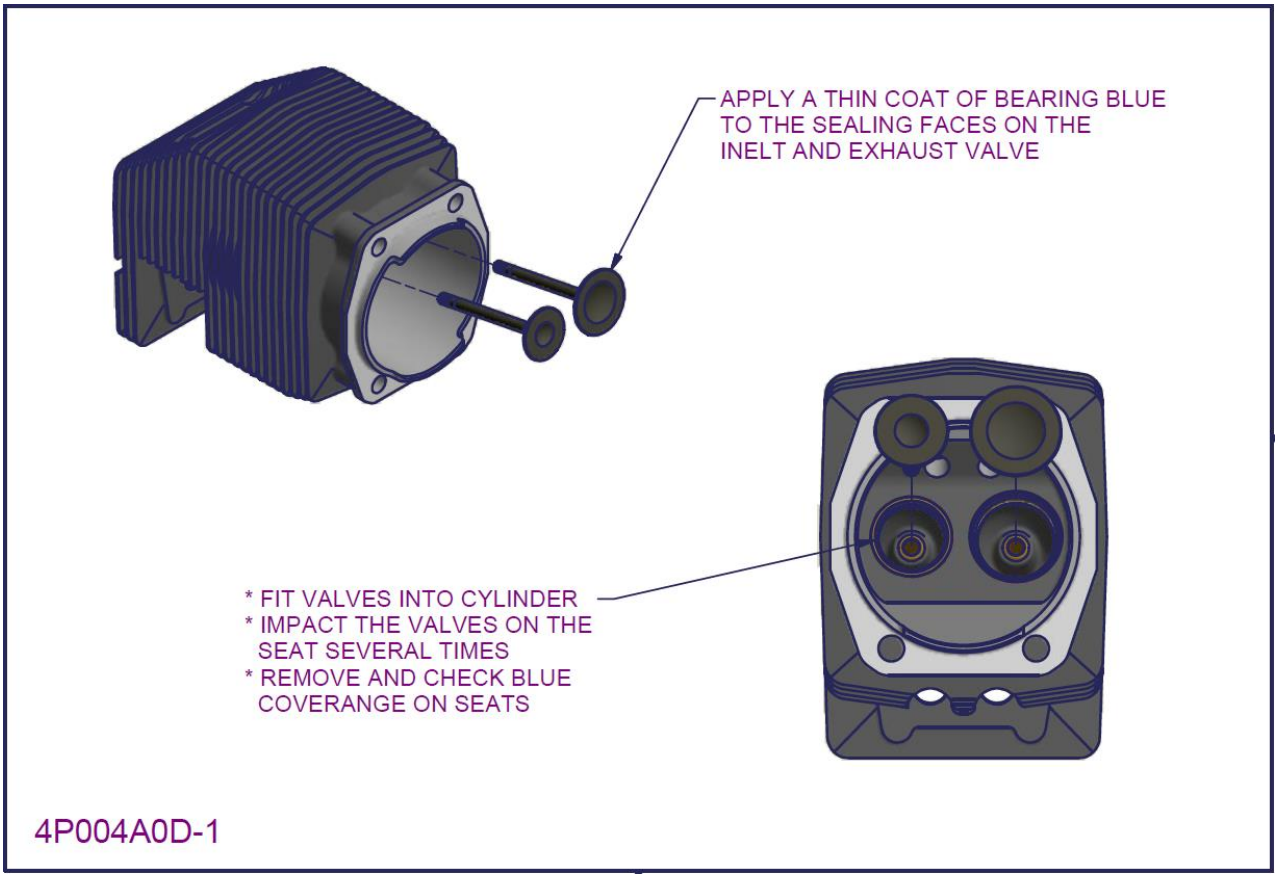


Figure 50 – 2200/3300 cylinder assembly 1

- Apply bearing blue to the sealing faces of each exhaust and inlet valve.
- Fit each valve into the cylinder head. Pop the valve in and out so the valve impact on the seat.
  - Rotate the valve a quarter turn between each impacting action.
- Remove the valves and inspect the valve seats. Check that each valve seat has an unbroken blue ring.
- Completely clean cylinder heads and valves.
  - It is very important that the bearing blue indicates a fully sealing face of the valve on the seat; incomplete sealing will lead to problems with the engine in service.

Figure 51 - checking valve sealing with bearing blue

- Check the seal of the inlet and exhaust valves using a vacuum gauge testing device.
    - Establish what maximum valve the vacuum testing device will deliver by placing a thumb over the suction cup and recording vacuum measured as the device vacuum is engaged.
    - *Record the maximum device vacuum in the build log (section 6.7).*
    - With the inlet and exhaust valves fitted (clean, dry and without oil) attach the suction cup to the inlet valve port using an induction O-ring to seal.
    - Engage the vacuum device and record the highest vacuum reading observed.
    - Repeat for the exhaust valve (again using an induction O-ring to seal.
    - *Record the vacuum measured for the inlet and exhaust valve in the build log (section 6.7).*
    - Repeat for the other cylinders
- Once vacuum measurements have been made, check the inlet and exhaust valve vacuum is within the prescribed tolerance of the maximum device vacuum.
    - For example if the device vacuum recorded is 28 inHg and the valve sealing vacuum is 27 inHg the difference is 1 inHg. (which is acceptable since this lies within the limiting tolerance stated in section 3.11.4).

Figure 52 - Using a vacuum check to assess the valve sealing quality

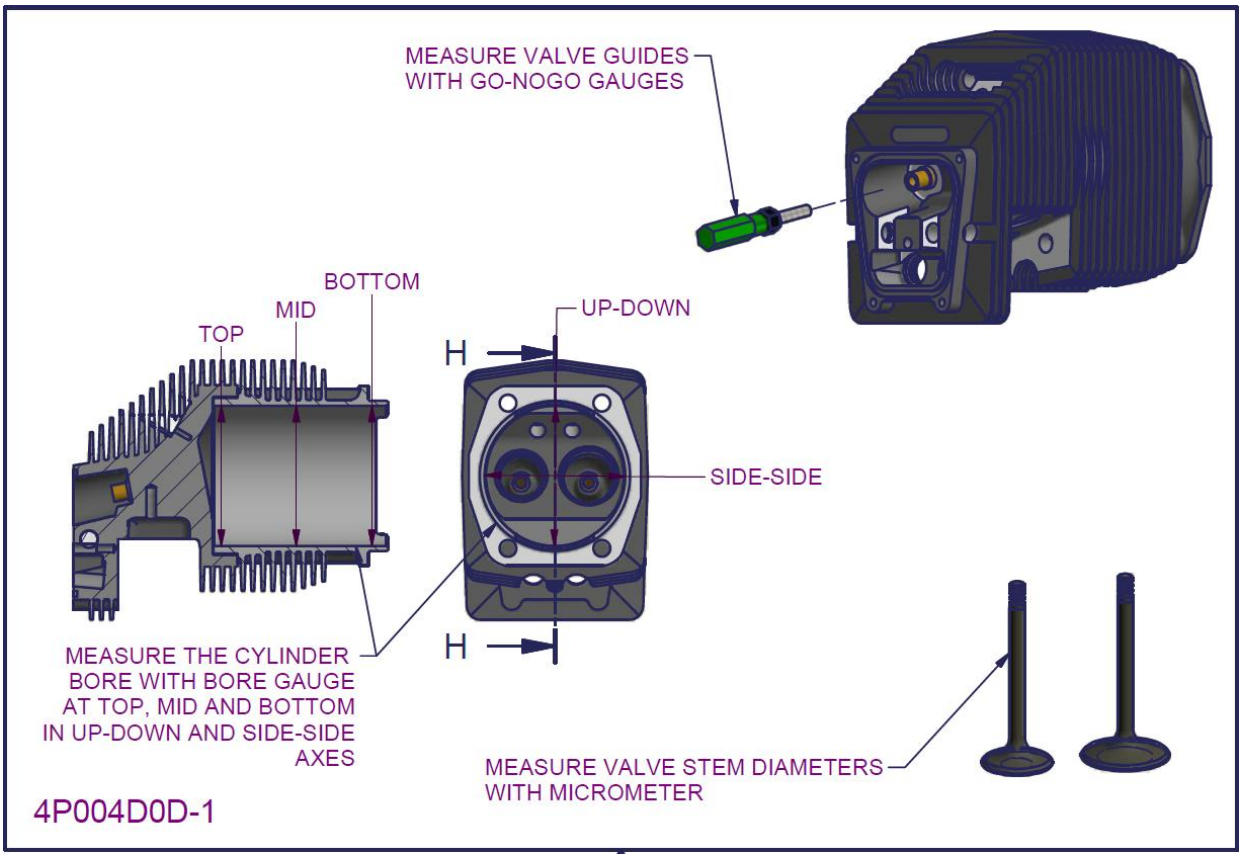


Figure 53 – 2200/3300 cylinder assembly 2

- At this stage each cylinder head assembly should be allocated a position on the engine. Number each cylinder head from one to four (one to six for the 3300 engine) with a permanent marker pen.
- Draw an arrow on the top of each cylinder head which points towards the propeller flange. The directions will be opposite for cylinder head mounted on the left (i.e. heads #2, #4 and #6) versus the right side of the engine (i.e. heads #1, #3 and #5).
    - *Record cylinder serial numbers as allocated to each cylinder position in the build log (section 6.7).*
- Measure the valve stems (both inlet and exhaust with a micrometre checking they are within the allowable tolerance prescribed in section 3.11.4.
    - *Record inlet and exhaust valve diameters in the build log (section 6.7).*
- Measure the valve guide bore using a set of 'Go-Nogo' gauges, checking they are within the tolerance prescribed in section 3.11.4.
    - *Record the valve guide bores in the build log (section 6.7).*
- Calculate the valve clearance (simply the valve stem diameter subtracted from the valve guide bore). Check it lies within the allowable valve clearance tolerance prescribed in section 3.11.4.
    - *Record the valve clearances in the build log (section 6.7).*
- Using a calibrated bore gauge measure the cylinder bore at three stages along the bore length and in two axes. Check the cylinder bore is within the limits of diameter and out of roundness as prescribed in section 3.11.4.
    - Measure at the Top, Mid-plane and Bottom of the cylinder.
    - Measure in the Up-Down and Side-Side axis
    - A total of six measurements should be taken
    - *Record the cylinder bore measurements in the build log (section 6.7.1).*
    - Determine the minimum, maximum and maximum out of-of-roundness values (the out of roundness is calculated by finding the difference between the Up-Down and Side-Side measurements **in the same plane** (e.g. TOP (Up-Down) minus TOP (side-side), **NOT** TOP(Up-Down) minus BOTTOM (Side-Side))
    - *Record the cylinder bore maximum, minimum and maximum out-of-round values in the build log (section 6.7.1).*

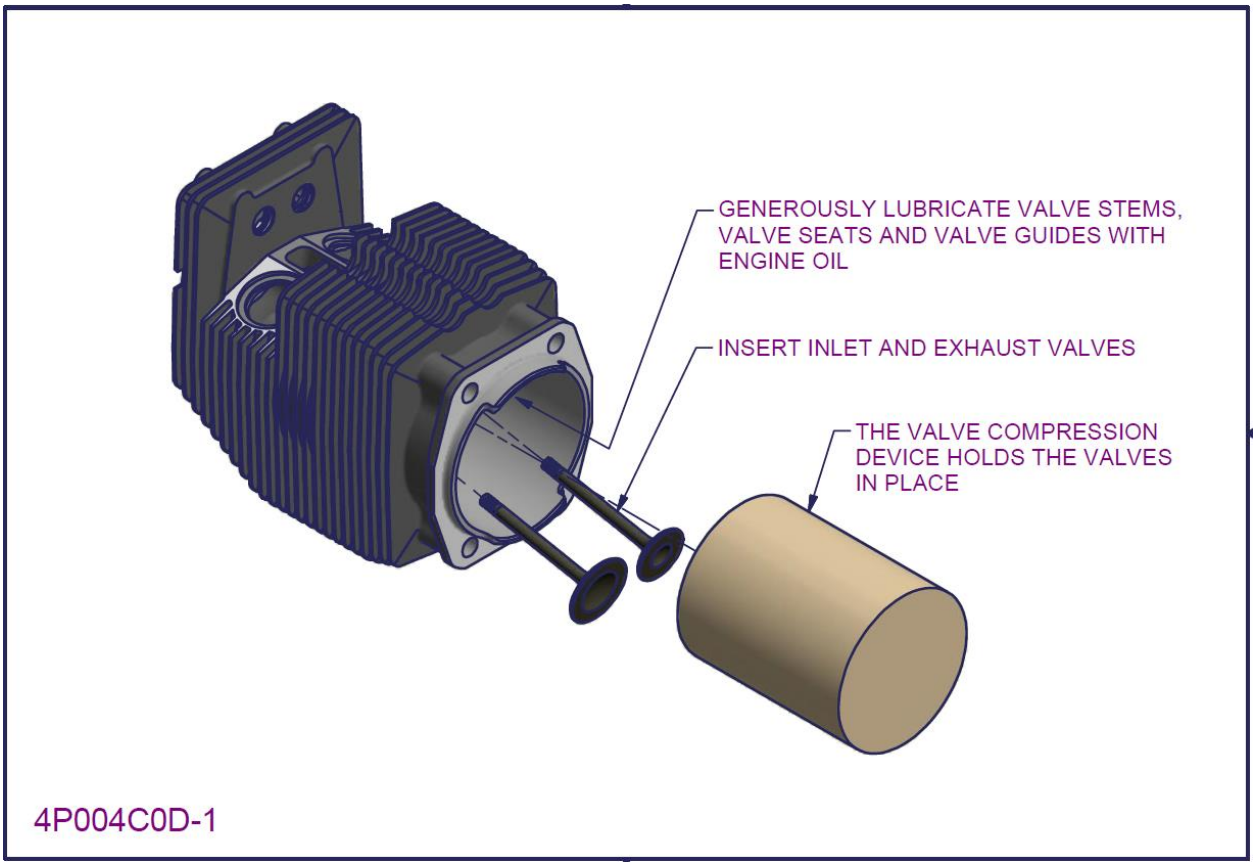


Figure 54 – 2200/3300 cylinder assembly 3

- Generously apply engine oil to the cylinder head valve guides and seats; also apply engine oil to the valve stem itself.
- Install the inlet and exhaust valves into the cylinder heads.
    - Make sure to install the valves in the corresponding heads from which they were removed (during the bearing blue seal checking stage).
- Run the valve back and forth several times in the valve guide to ensure that it moves smoothly without resistance (but is not loose in the guide).
- Insert cylinder onto a valve spring compressing device such as that shown below in Figure 55. The valve spring compressing tool uses a piston with rubber lining to hold the valves in place while the valve springs are compressed.

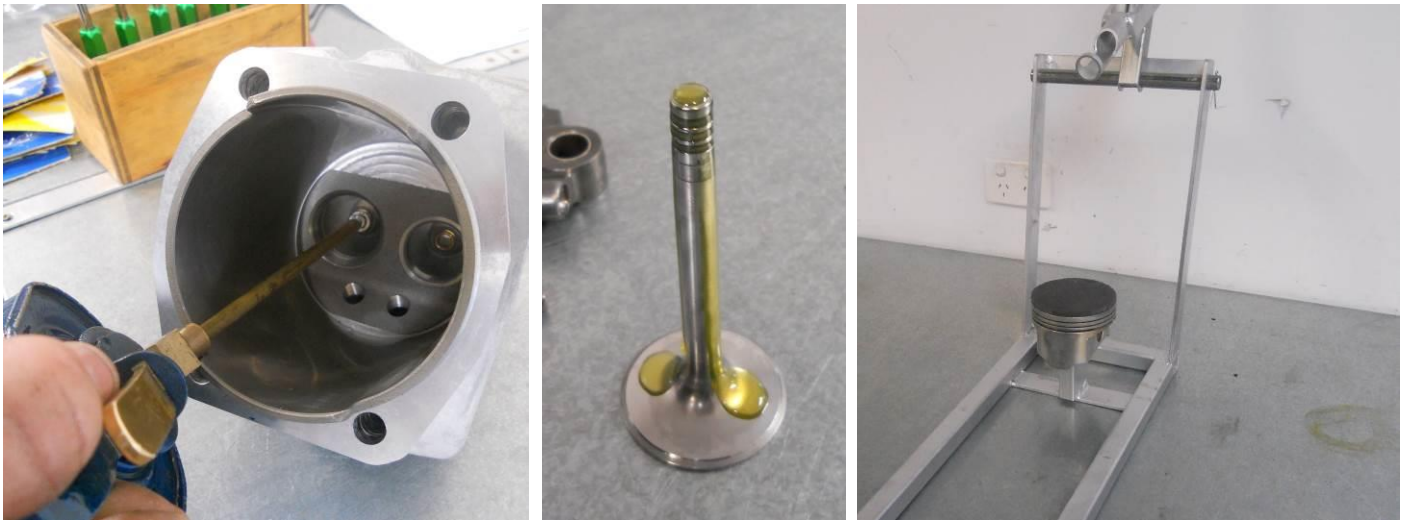


Figure 55 - Lubricating valves, seats and guides

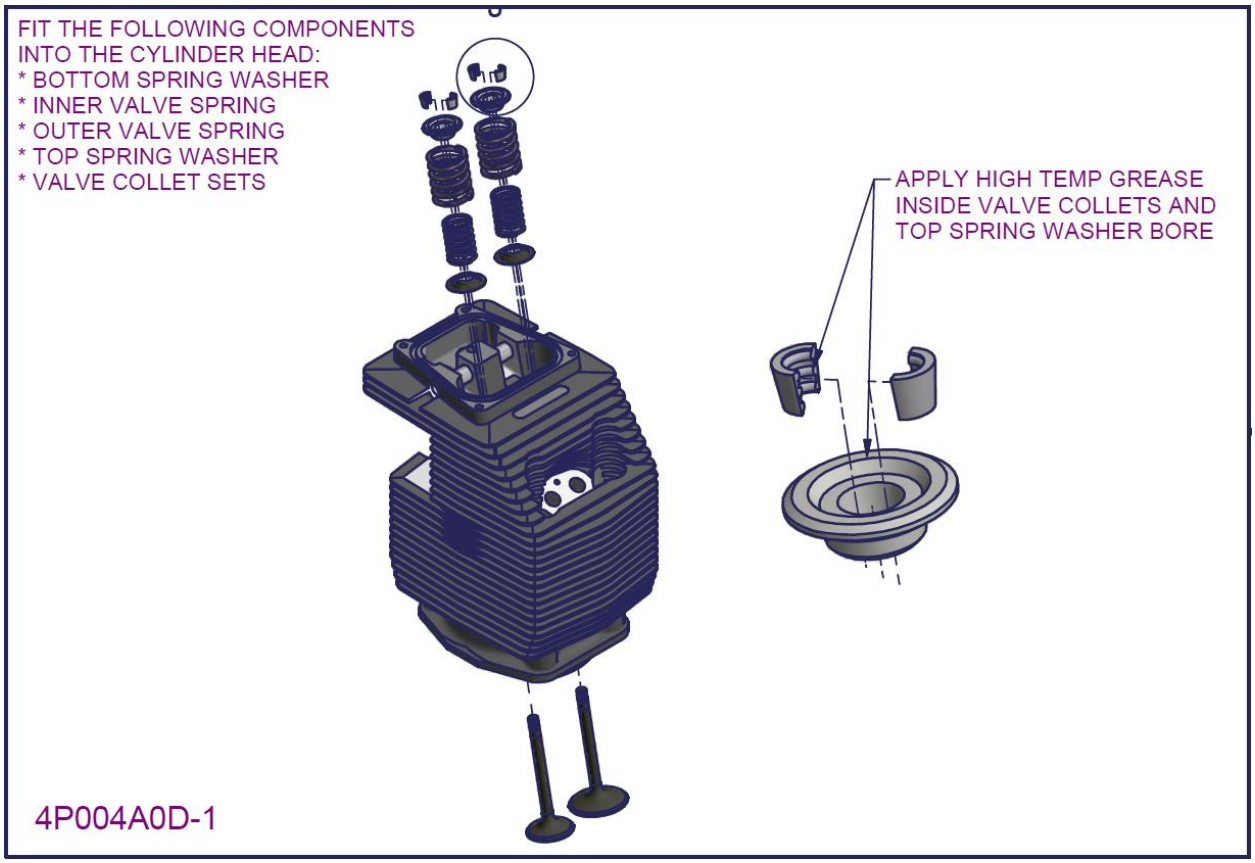


Figure 56 – 2200/3300 cylinder assembly 4

- Install the bottom spring washer, inner valve spring, outer valve spring, top spring washer and valve collets into the cylinder head. This requires a special valve spring compressing device as previously stated.
    - Each Valve (both inlet and exhaust), top spring washer and pair of valve collets are provided as a pre-fitted complete kit. It is **absolutely essential** that the supplied valve collets and top spring washer are fitted to the corresponding valve.
    - **Never mix and match valves, collets and top-spring washers between different kits!**
    - A small amount of high temperature grease must be applied inside the valve collets and inside the bore of the top spring washer.

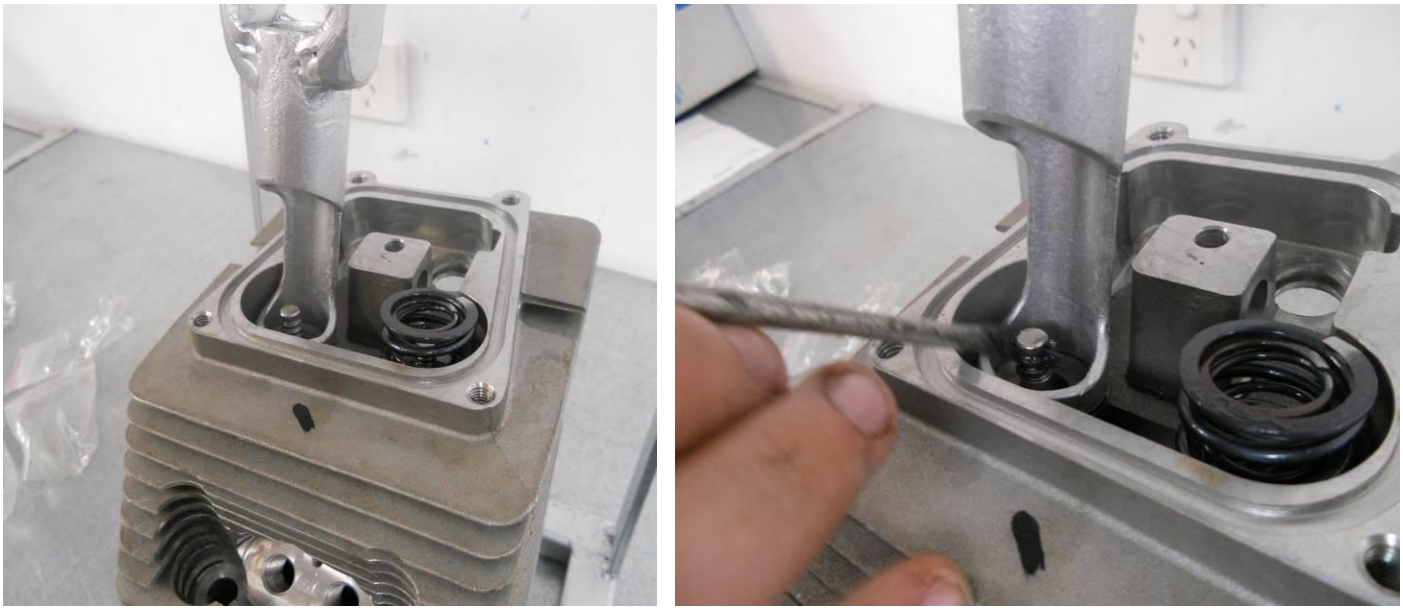


Figure 57 - Installing valve gear into the cylinder heads

4.4.1 External O-ring groove cylinder head – Install retaining washer

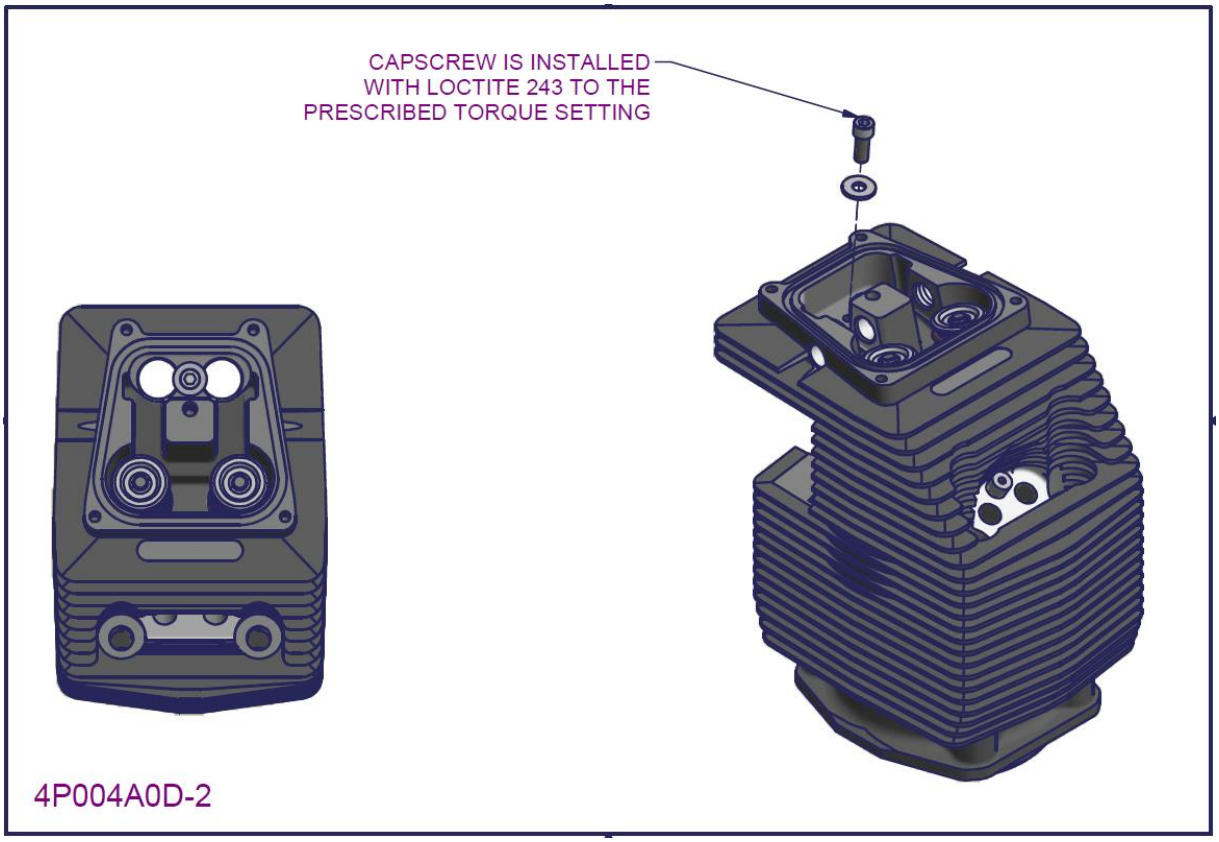


Figure 58 - 2200/3300 cylinder assembly 5a (external O-ring groove cylinder head)

- Prime the 1/4-UNC capscrew and tapped hole (between the two pushrod tube holes) with Loctite 747.
- Install capscrew with a wide zinc washer using Loctite 243. Install to the torque setting prescribed in section 0 and mark with a paint pen.

4.4.2 Internal O-ring groove cylinder head – Install circlips and O-rings

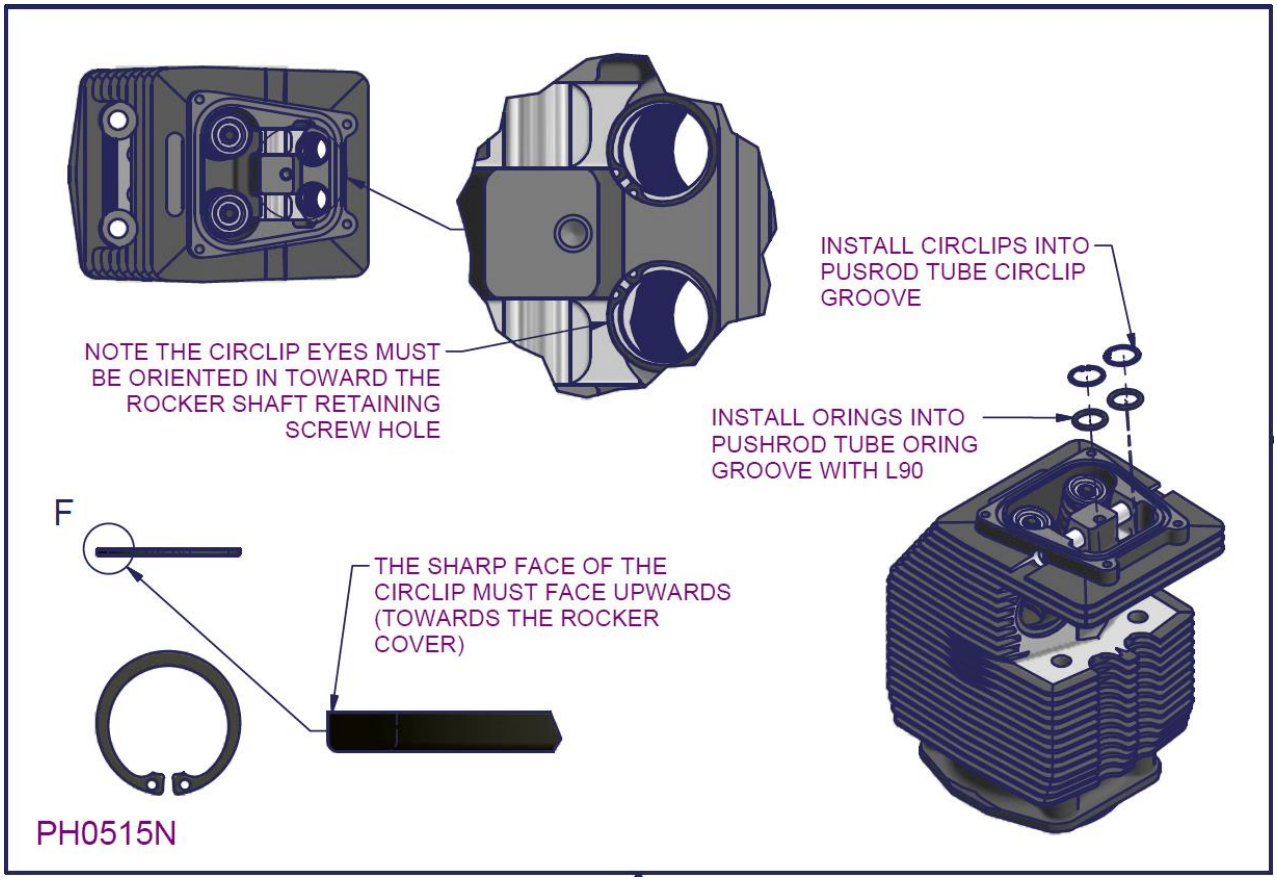


Figure 59 – 2200/3300 cylinder assembly 5b (Internal O-ring groove cylinder head)

- Install the pushrod tube O-rings into the pushrod tube O-ring grooves with L90 lubricant.
- Install circlips in the pushrod tube circlip grooves with circlip pliers, there are several important aspects to note when installing these circlips
    - Due to the manufacturing process circlips have two distinct faces, a sharp edged face and a slightly curved edge face. It is of **extreme importance** that the circlips are installed with the **sharp edged face pointing upwards** (towards the rocker cover).
    - The circlips must also be installed with the pair of eyes pointing in towards the rocker shaft retaining screw hole as pictured.
    - In general circlip installation can be tricky. The circlip must not be over compressed or it will not hold pressure on the circlip groove. One must also ensure that the circlip seats correctly in the entire groove and is not being held halfway out of the groove.
    - To this end once the circlip is installed grab one eye with the circlip pliars and try to pull it around in the groove (do not apply excessive force). If the circlip clicks it has now seated itself completely in the circlip groove.

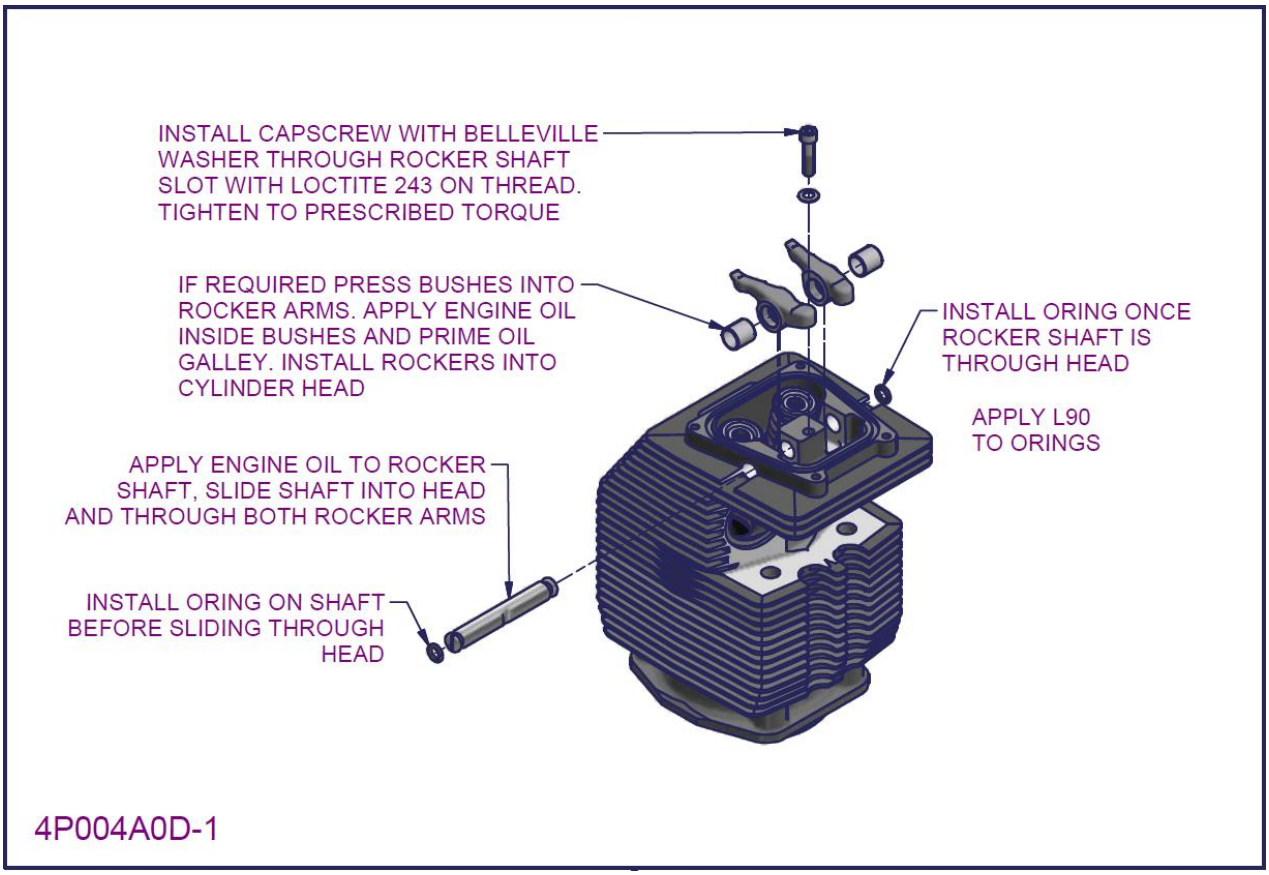


Figure 60 – 2200/3300 cylinder assembly 6

- Check the oil gallery through each rocker shaft is completely clean and clear or any debris.
- Press rocker bushes into the left and right side rocker arms.
  - This must be done with a shop press or similar. **Not a hammer.**
  - The split joint in the rocker bush must be installed at the top of the rocker arm.
  - This step may not be necessary since rockers are supplied with bushes already installed
- Apply engine oil inside rocker arms bushes and rocker shafts, test fit rocker arm onto shaft, check the fit is smooth and the rocker arms are free to rotate without being loose. Remove rocker arms from shaft.
- Prime the rocker by injecting oil into the oil galley hole inside the pushrod bearing surface. The rocker is fully primed once oil is seen to come out at the other end (at the valve bearing surface)
- Insert rocker arms into the head making sure to install the correct arm in the left side and right side (the two arms are different).
- Install one O-ring onto the trailing rocker shaft end with L90 lubricant.
- Insert the rocker shaft through the head so that rocker shaft O-ring groove just pokes out other side of head.
- Fit second O-ring onto rocker shaft with L90 and push the shaft back through the head to central position.
- Use a flat headed screw driver to keep the vertical indentation on rocker shaft vertical and the slot facing back (away from the valve springs).
- Prime the shaft retaining hole and a ¼" UNC capscrew with Loctite 747.
- Install capscrew with Belleville washer using Loctite 243. Install to the torque setting prescribed in section 0 and mark with a paint pen.

Figure 61 - Piston ring installation and measurement

- Take a piston ring set and install the TOP ring (the difference between the TOP and SECOND rings are detailed in Figure 63) into each numbered cylinder barrel using the following action:
  - Place ring in perpendicular to the cylinder bore axis with the ring gap facing up wards.
  - Turn the ring so it now sits concentric to the cylinder barrel bore, it should be about 20mm from the bottom end of the cylinder barrel.
  - Take a piston and use it as a plunger to push the piston ring up the barrel until the edge of the piston skirts are aligned with the edge of the barrel skirts.
  - Remove piston.
- With the piston ring fitted, measure the piston ring gap using a set or feeler gauges
  - *Record the piston ring gap measurement in the build log (section 6.7.2).*
- Remove the TOP ring and repeat the installation and measurement process with the SECOND ring (the oil scraper ring does not need to be measured in this way.

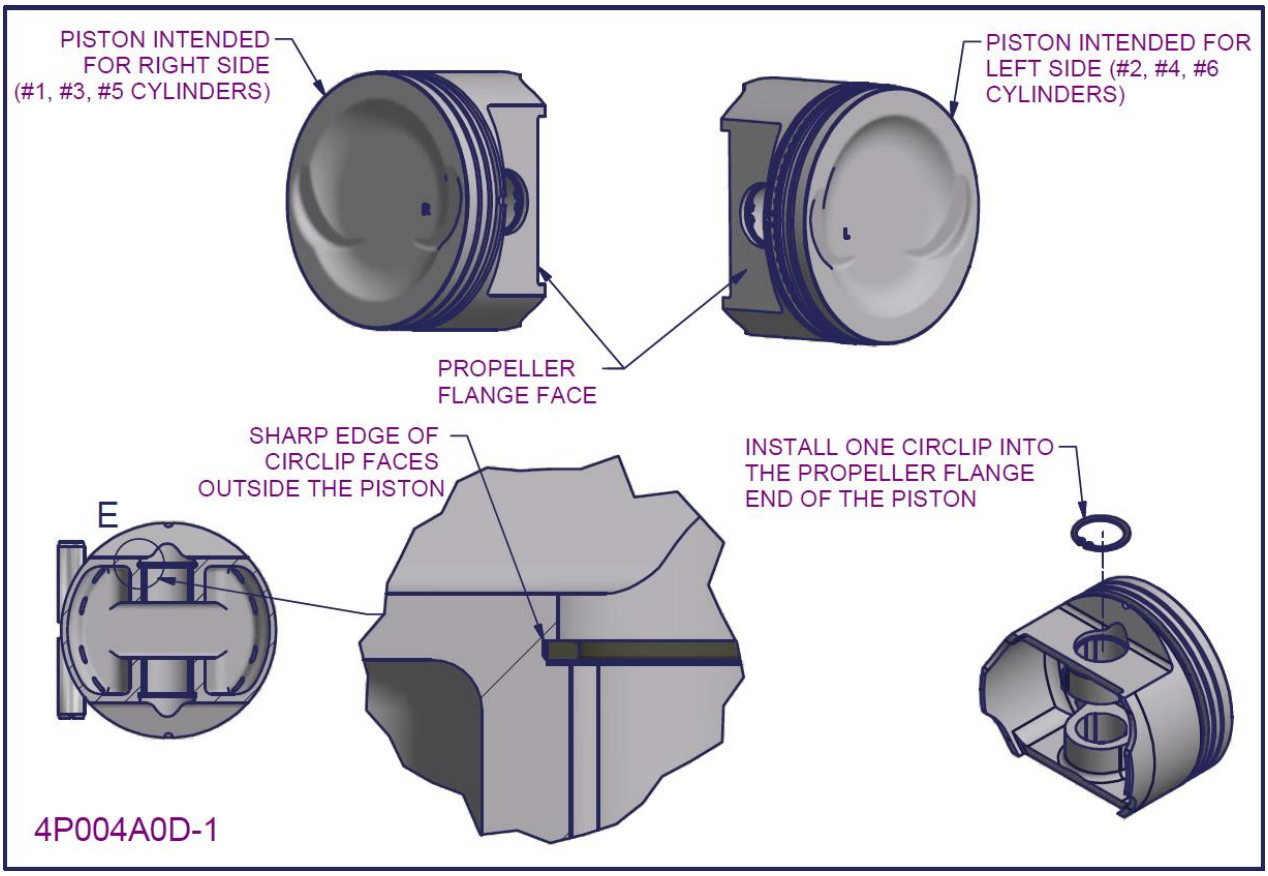


Figure 62 – 2200/3300 cylinder assembly 7

- Identify the orientation of installation for each piston using the following criteria:
  - Both left and right side pistons must be installed into the engine with the valve reliefs in the crown forming a 'smiley face' (not a frowning face). Based on this orientation the Propeller flange faces of the piston (i.e. the end of the piston which must be installed closest to the propeller flange) are indicated in Figure 62.
- With the correct side and orientation established number the pistons from one to four (one to six for the 3300 engine) and draw an arrow indicating the direction of the propeller flange in permanent marker.
- Ensure before installing pistons that they are of **all the same weight**. Pistons will have the weight in grams written on the crown in permanent marker.
  - *Record the weight of each piston in the build log (section 6.7.2).*
- Measure the diameter across the skirt of the piston in the position shown in Figure 63 using a micrometre
  - *Record the skirt diameter of each piston in the build log (section 6.7.2).*
- Calculate the piston to cylinder bore clearance. This is done by subtracting the piston skirt diameter from the smallest of either the cylinder bore at mid-plane of bottom in the up-down axis (refer to Figure 53 for bore position designations).
  - For example in the Up down axis the cylinder mid-plane bore = 97.60, the bottom bore = 97.61 and the piston skirt diameter = 97.50. Therefore clearance = 97.60 – 97.50 = 0.10mm.
  - *Record the piston clearance calculated for each cylinder in the build log (section 6.7.2).*
- Apply oil to the supplied gudgeon pin and test fit the pin through the piston bore. Slide it back and forth ensuring the pin slides without being loose. Remove the gudgeon pin.
- Now install ONE circlip in the Propeller flange end of each piston. Ensuring the circlip is installed correctly:
  - A drop of Loctite 620 is first applied between the circlip and the outside of the piston circlip groove **(do not allow Loctite to come between the circlip and gudgeon pin)**
  - Ensure the circlip is not over compressed during installation
  - Ensure the circlip is completely seated in the circlip groove
  - Ensure the circlip is installed with the sharp edged face pointing to the outside of the piston as shown in Figure 62.
  - The circlip must be installed with the 'eyes' at the bottom of the piston as shown in Figure 63.

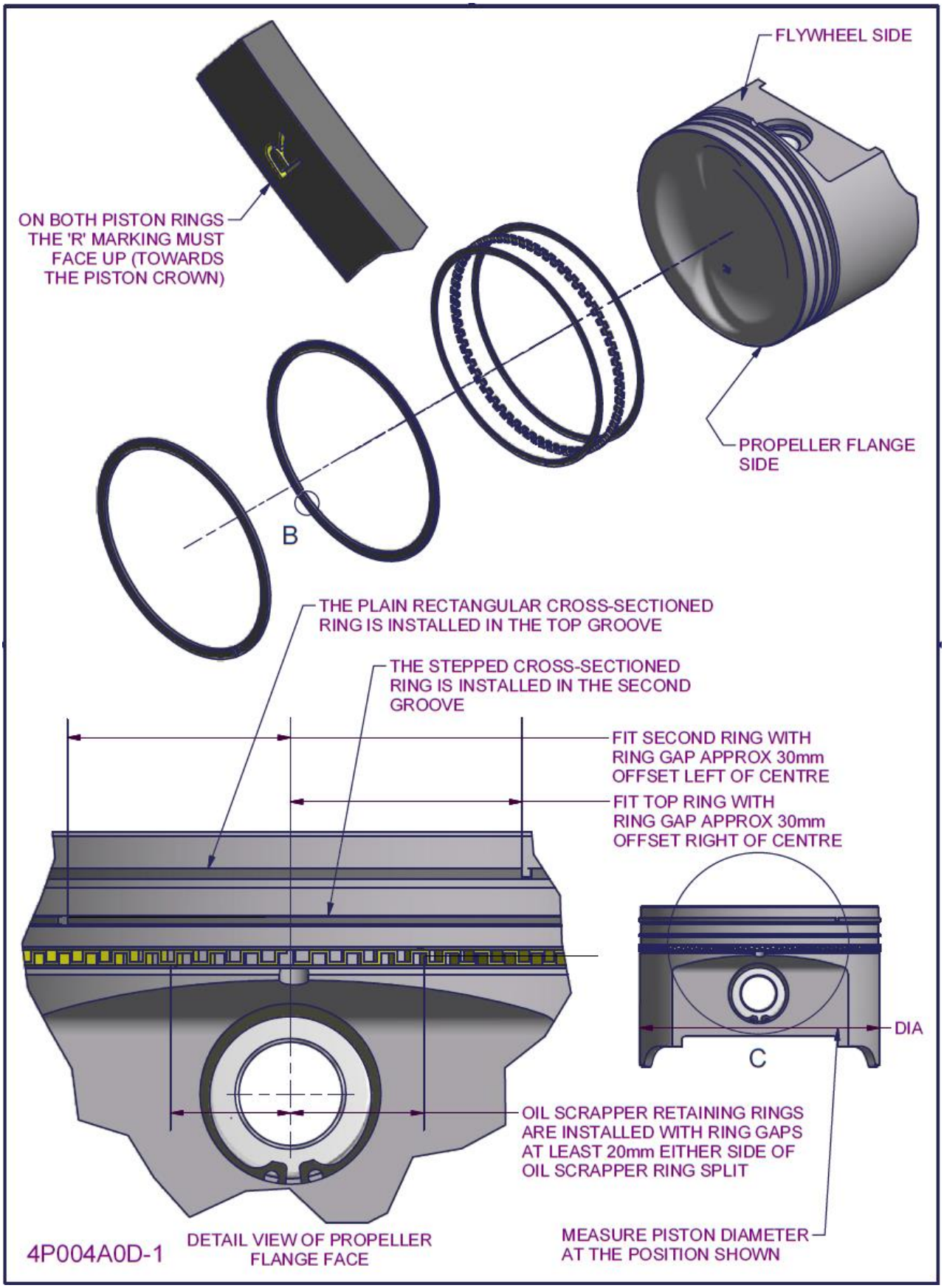


Figure 63 – 2200/3300 cylinder assembly 8

- Fit the OIL SCRAPPER RING into the bottom ring groove along with the two thin oil scraper retaining rings.
    - The oil scraper ring gap (i.e. split in the ring) must be oriented in the centre when the piston is viewed from the Propeller Flange face.
    - The two retaining ring gaps must be oriented at least 20mm either side of the centre. (i.e. the top retaining ring should be oriented 20mm to the right of centre and the bottom ring 20mm left of centre)
- Fit the SECOND from top piston ring.
    - Ensure you have the correct ring fitted in the SECOND from top groove. **It must be the ring with the 'stepped' cross-sectional profile**.
    - Ensure the ring is fitted in the correct orientation. A small letter 'R' is indented in this piston ring. **This letter R must be facing up towards the piston crown**.
    - The piston ring gap must be offset approximately 30mm to the **right of centre** (when the piston is viewed from the propeller flange face).
- Fit the TOP piston ring
    - Ensure you have the correct ring fitted in the TOP groove. **It must be the ring with the 'rectangular' cross-sectional profile**.
    - Ensure the ring is fitted in the correct orientation. A small letter 'R' is indented in this piston ring. **This letter R must be facing up towards the piston crown**.
    - The piston ring gap must be offset approximately 30mm to the **left of centre** (when the piston is viewed from the propeller flange face).
- Inject engine oil into all three piston ring grooves, ensuring that oil percolates through the entire oil scrapper ring.

Figure 64 - Piston ring installation and oiling

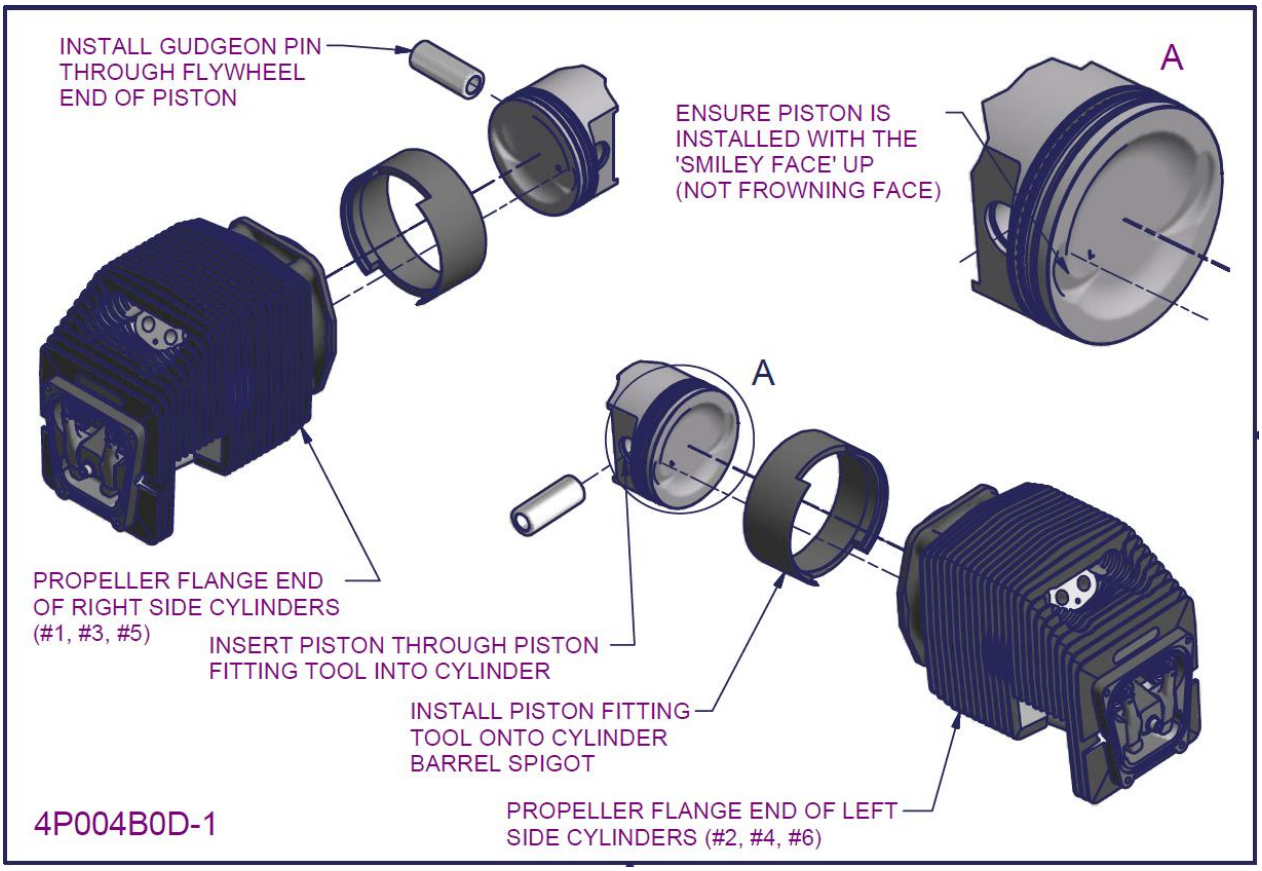


Figure 65 – 2200/3300 cylinder assembly 9

- Install piston fitting tool into the cylinder barrel skirts, apply engine oil inside the piston fitting tool and the barrel to lubricate.
- Install each piston (as previously numbered) into the respectively numbered cylinder head/barrel assemblies aided by the piston fitting tool.
    - Ensure the pistons are fitted into their correct barrels. They should already have been allocated numbers previously, make sure not to mix and match pre-allocated pistons and cylinder head/barrel assemblies.
    - Ensure each piston is inserted in the correct orientation. For both left and right side pistons the piston must be inserted so that the valve relief pockets present a smiling face (not a frowning face). The orientation is shown above in Figure 65.
    - While installing each piston through the piston fitting tool, be careful the rings do no snag on the tool or the barrel.
    - The piston need only be fitted far enough that all three rings are inside the barrel. The gudgeon pin hole must be left exposed out the bottom of the barrel
- Check the gudgeon pin is adequately oiled and install it through the flywheel end hole. It should only be installed through the first piston hole.

Figure 66 – Piston installation into the cylinder barrel

4.4.1 External O-ring groove cylinder head – Install pushrod tubes, O-rings and pushrods

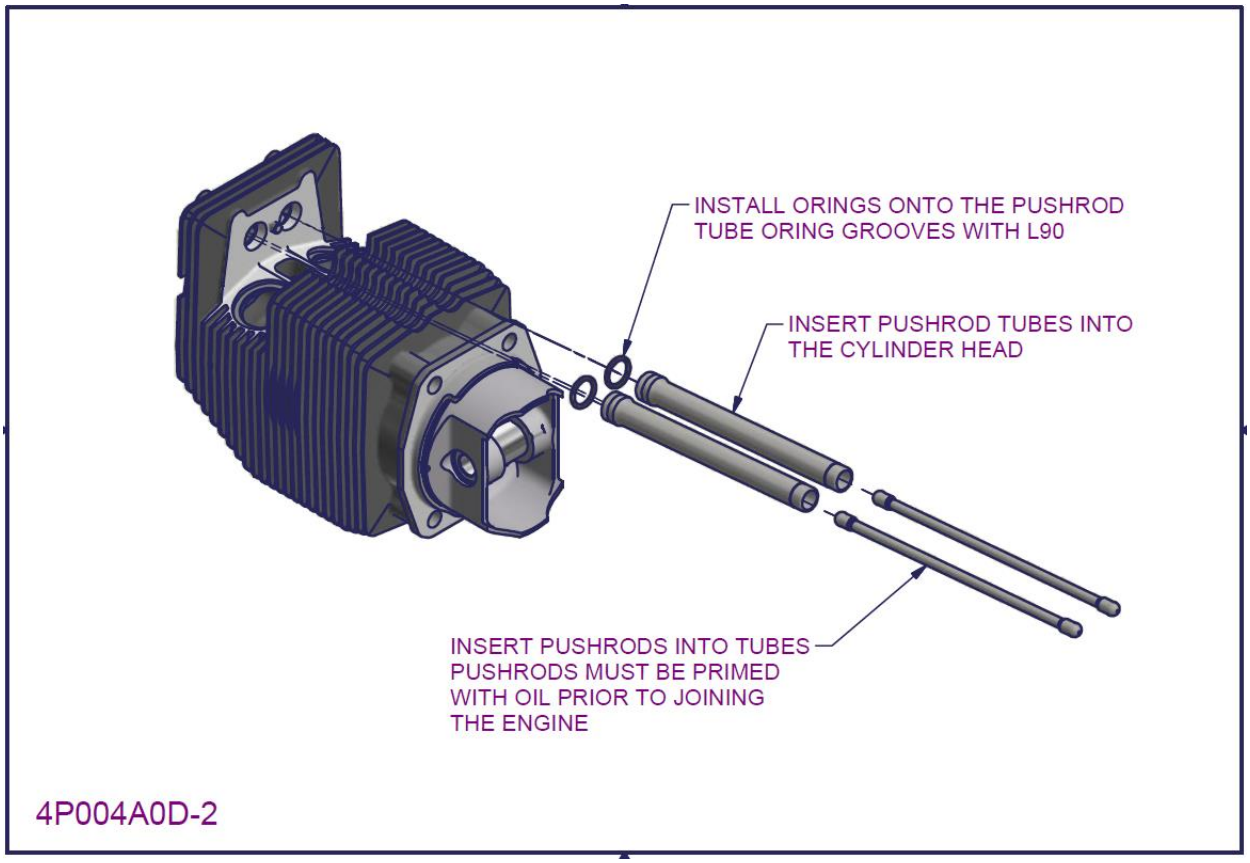


Figure 67 - 2200/3300 cylinder assembly 10a (external O-ring groove cylinder head)

- Apply L90 to the O-rings and fit them onto the O-ring grooves on the pushrod tubes
- Insert the pushrod tubes into the cylinder head. The tubes should be pushed in until they contact the retaining washer previously installed.
- Insert pushrods into the pushrod tubes
    - Pushrods must be primed with engine oil, by injecting oil in one end until it emerges out the other end.
    - Alternatively the pushrods may be left in a bottle of engine oil. This is option is better if the engine is not to be joined immediately after the cylinder heads have been assembled.
- This concludes the procedure for **Cylinder assembly.**
- In assembling a full set of cylinder (four for the 2200 and six for the 3300 engine) it is recommended to complete each step in an assembly line fashion.

4.4.2 Internal O-ring groove cylinder head – Install pushrod tubes and pushrods

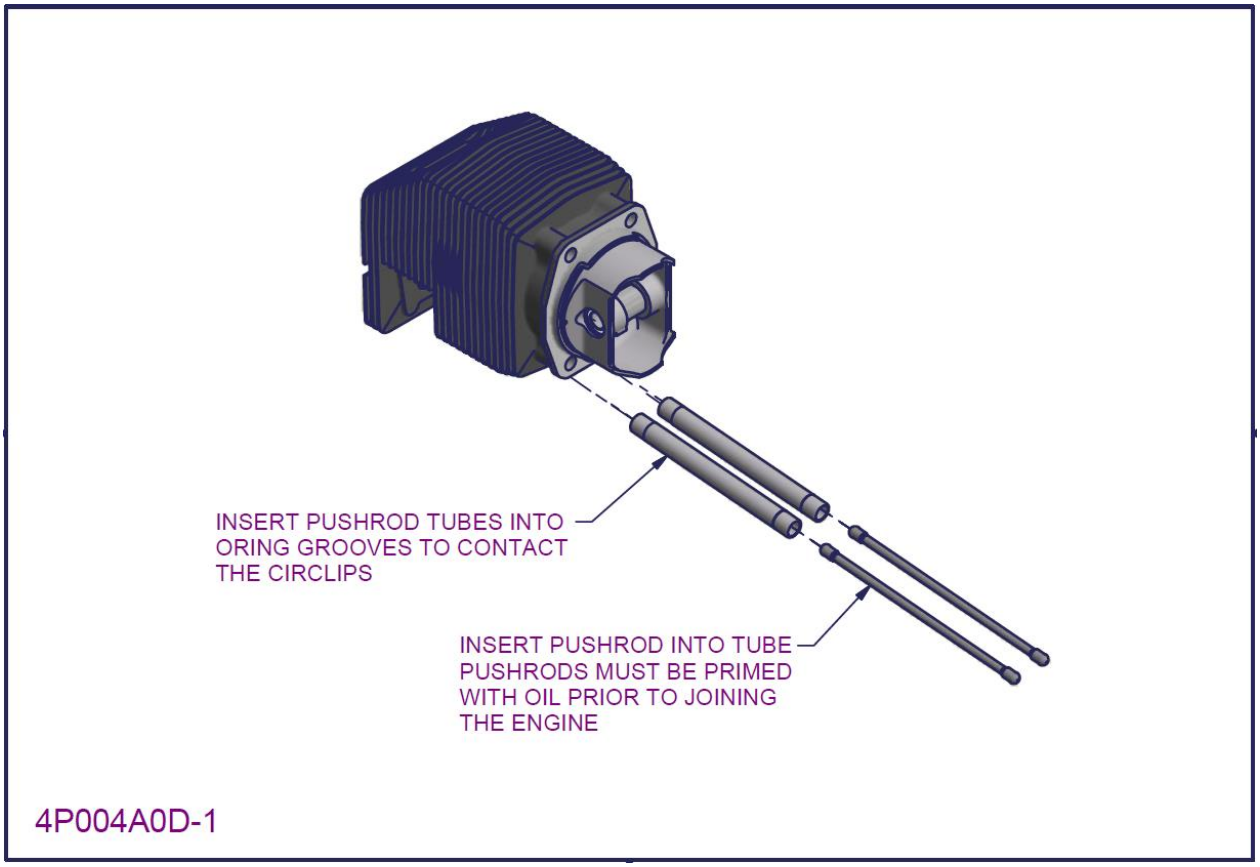


Figure 68 - 2200/3300 cylinder assembly 10b (Internal O-ring groove cylinder head)

- Fit the pushrod tubes into the cylinder head O-rings. The tubes should be pushed in until they contact the circlip previously installed.
- Insert pushrods into the pushrod tubes
  - Pushrods must be primed with engine oil, by injecting oil in one end until it emerges out the other end.
  - Alternatively the pushrods may be left in a bottle of engine oil. This is option is better if the engine is not to be joined immediately after the cylinder heads have been assembled.
- This concludes the procedure for **Cylinder assembly.**
- In assembling a full set of cylinder (four for the 2200 and six for the 3300 engine) it is recommended to complete each step in an assembly line fashion.

4.5 Distributor gearbox subassembly

4.5.1 2200 Distributor gearbox subassembly – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4A530A0D-1	2210 GEAR CASE REAR MACHINED	1
2	PB4A014N	DISTRIBUTER SHAFT BUSH 2210 - SKF PCM 151712E	4
3	PG10622N-1	SEAL DISTRIBUTOR SHAFT 15 X 24 X 7	2
5	PG4A037N	SEAL 50 x 65 x 8	1
6	PH10724-2	1/4" BELLEVILLE WASHER	4
7	4332154-11	DISTRIBUTOR DRIVE SHAFT (2.2L)	2
8	4333054-5	DISTRIBUTOR DRIVE GEAR 2.2L	2
9	73MS6-4	POP RIVET	8
10	PI10632N	ROTOR BUTTON	2
11	PH72624	SOCKET HD SCREW 1/4 UNC X 5/8	4
14	4334054-7	DISTRIBUTOR CAP MOUNT PLATE 2.2L	2

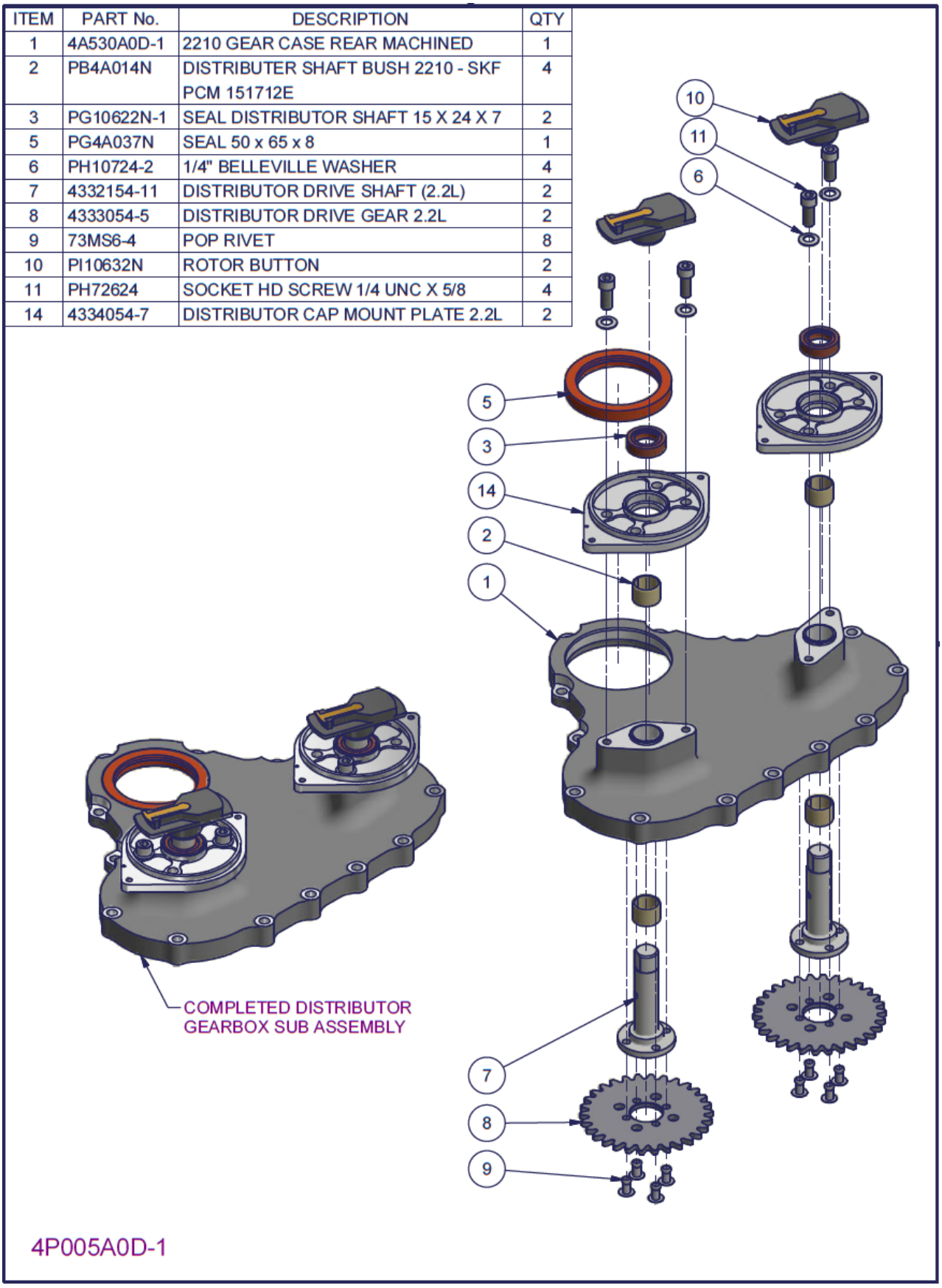


Figure 69 - 2200 Distributor gearbox subassembly - Parts list

4.5.2 3300 Distributor gearbox subassembly – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4A530A0D-1	2210 GEAR CASE REAR MACHINED	1
2	PB4A014N	DISTRIBUTER SHAFT BUSH 2210 - SKF PCM 151712E	4
3	PG10622N-1	SEAL DISTRIBUTOR SHAFT 15 X 24 X 7	2
4	PG4A037N	SEAL 50 x 65 x 8	1
5	PH10724-2	1/4" BELLEVILLE WASHER	4
6	4333054-5	DISTRIBUTOR DRIVE GEAR 2.2L	2
7	73MS6-4	POP RIVET	8
8	PH72624	SOCKET HD SCREW 1/4 UNC X 5/8	4
9	PI10633N	ROTOR BUTTON (BH74)	2
10	4656084-6	DISTRIBUTOR CAP MOUNT PLATE 3.3L	2
11	4653184-10	DISTRIBUTOR DRIVE SHAFT (3.3L)	2

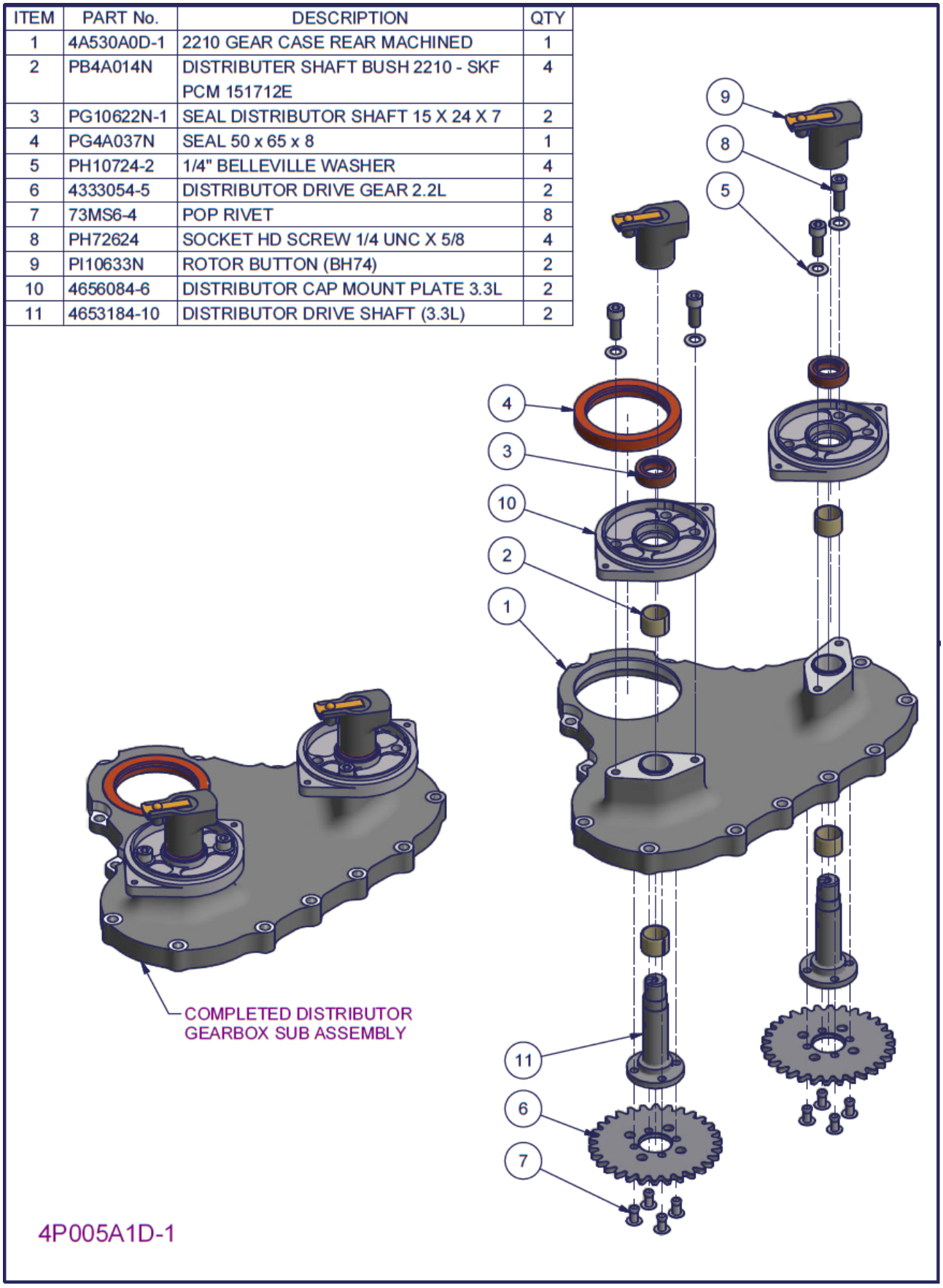


Figure 70 - 3300 Distributor gearbox subassembly - Parts list

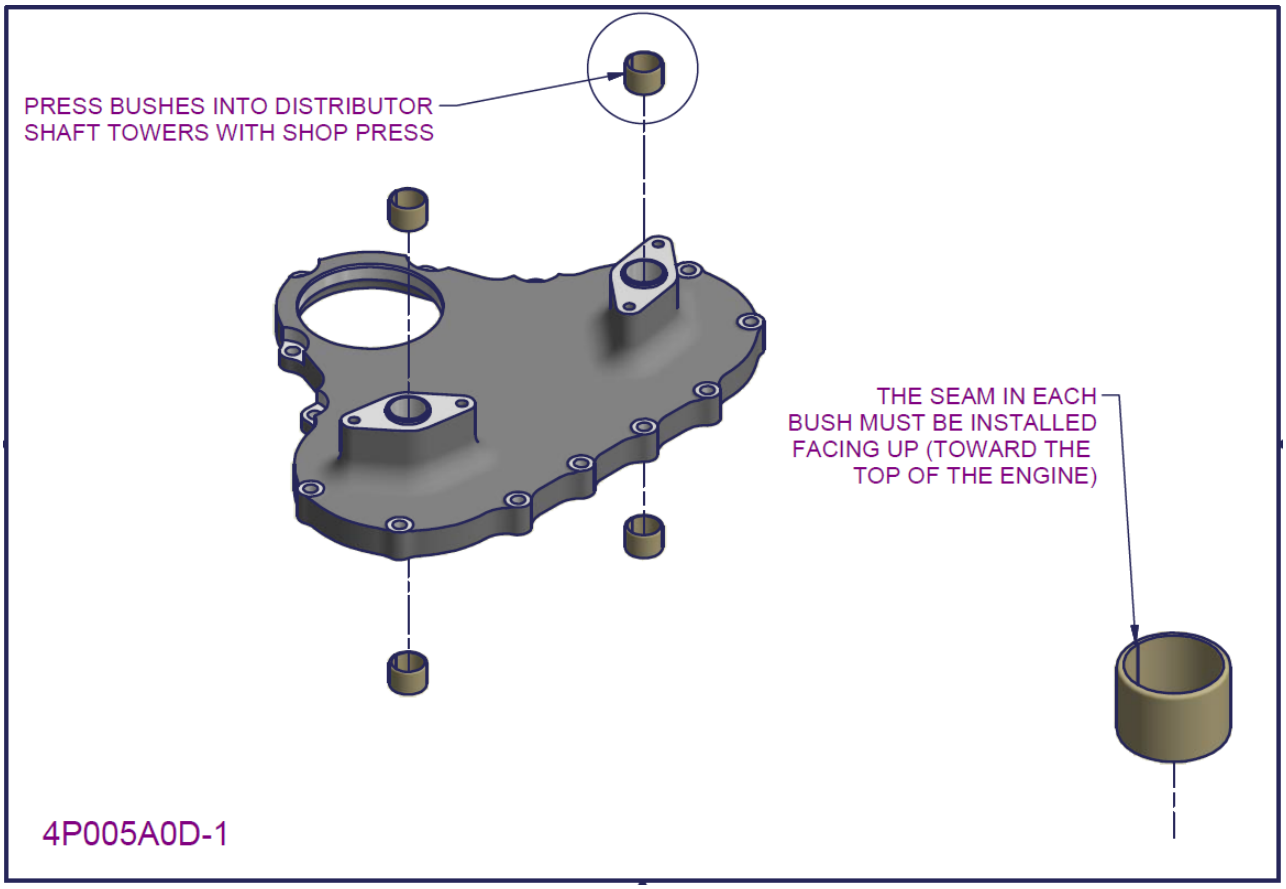


Figure 71 – 2200/3300 Distributor gearbox subassembly 1

- Ensure gearbox cover is completely clean and clear or any debris in the distributor shaft towers, rear seal, bolts holes and all mating faces.
- Press four bushes into the distributor shaft towers (one through the top and bottom of each tower) with a shop press.
    - Do Not use a hammer or damage to the bush will result.
    - Apply a small amount of L90 lubricant to the leading edge on the bush to aid installation.
    - The bushes must be installed with the seam facing up towards the top of the engine.

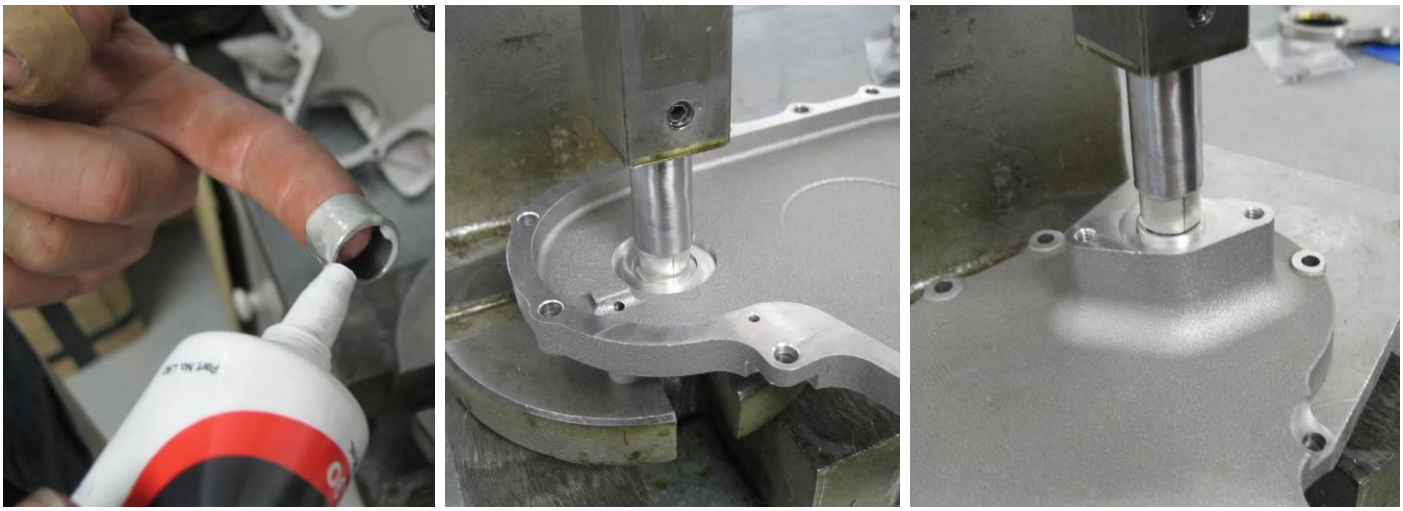


Figure 72 - Distributor shaft bush installation

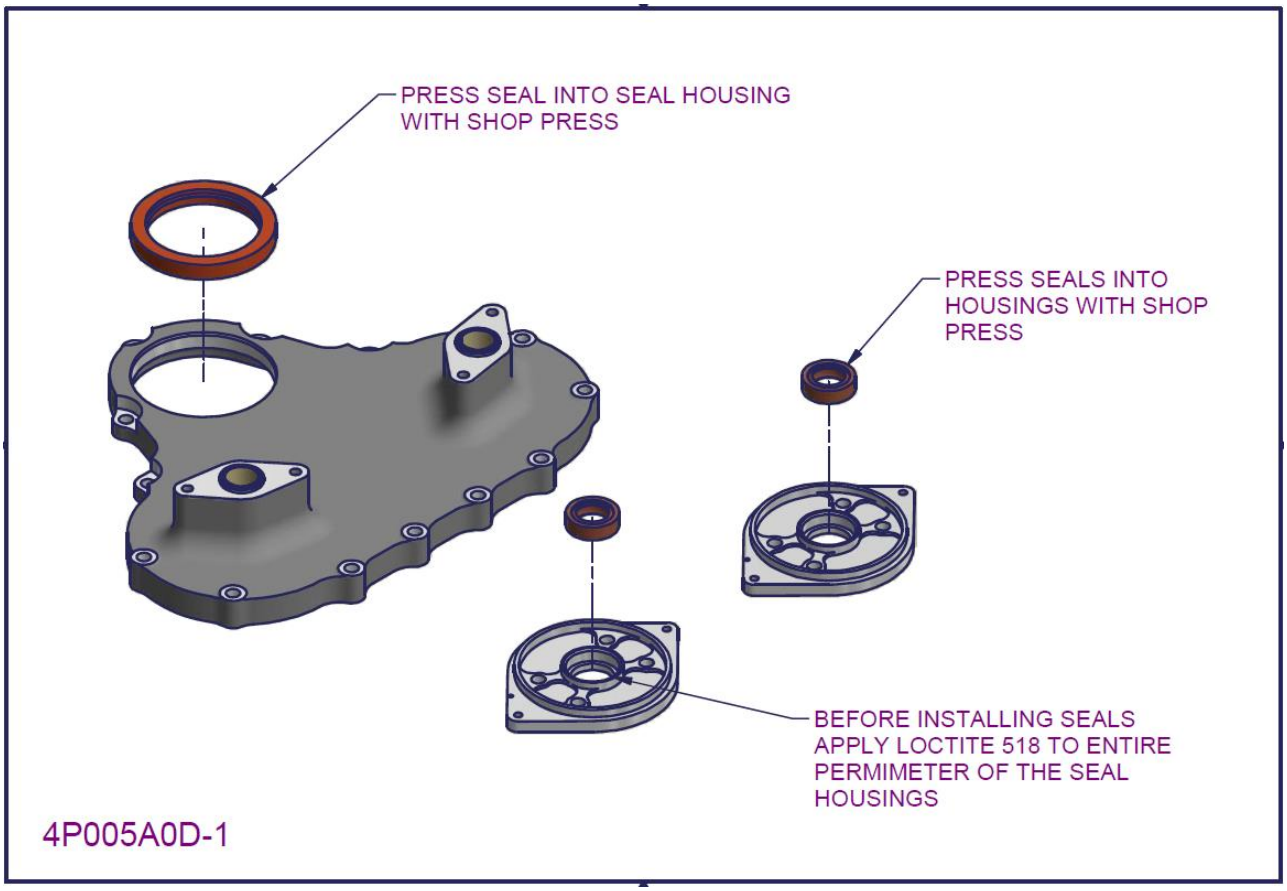


Figure 73 – 2200/3300 Distributor gearbox subassembly 2

- Apply Loctite 518 around the entire perimeter of the rear seal housing and the two distributor mount plates.
- Press the small distributor shaft seals into the two distributor mount plates using a shop press.
- Press the large rear seal into the gearbox seal housing.
    - Unlike the distributor mount plates, the gearbox seal housing does not have a machined step at the bottom to correctly seat the seal. Ensure that the rear seal is installed so the top is completely flush with the top of the gearbox cover **and no further**.
    - Ensure that the seal are installed in the correct orientation. Both seals must have the internal springs facing downwards.
- Clean off excess Loctite 518.

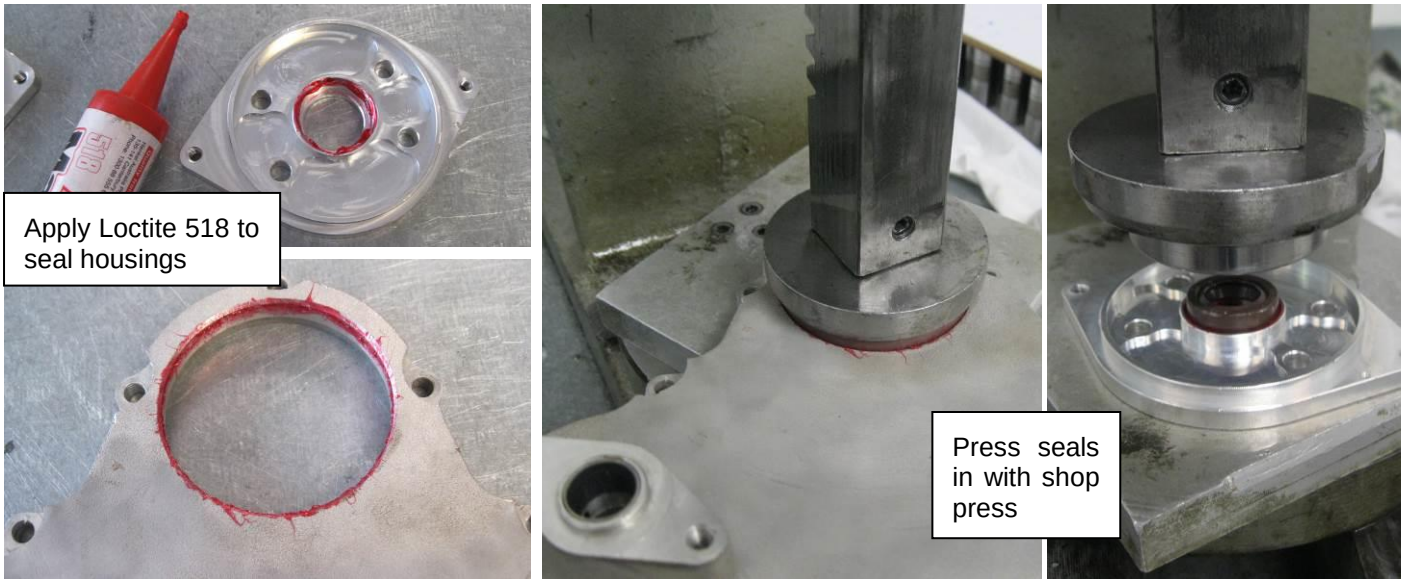


Figure 74 - Distributor gearbox seal installation

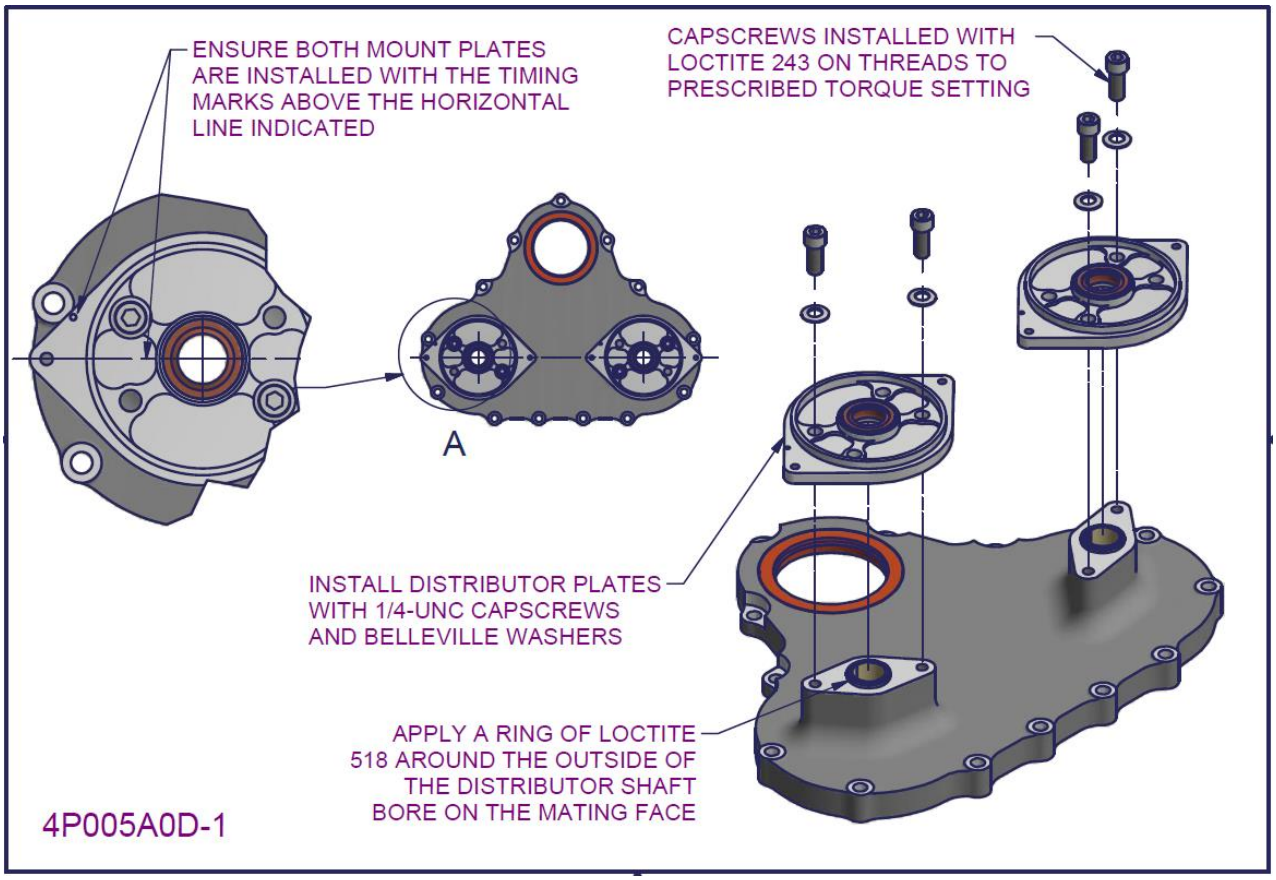


Figure 75 – 2200/3300 Distributor gearbox subassembly 3

- Apply a ring of Loctite 518 around the perimeter of the mating faces of the two distributor shaft towers.
- Prime the taped holes and ¼-UNC capscrews with Loctite 747.
- Install the two distributor mount plate onto the distributor shaft towers with two ¼-UNC capscrews and Belleville washers for each distributor mount plate.
    - Capscrews are installed with Loctite 243 on the threads to the torque setting prescribed in section 0 and marked with a paint pen.
    - Ensure that the mount plates are installed in the correct orientation. The timing marks must be above the imaginary horizontal line drawn through both distributor shaft axes (as shown in Figure 75).

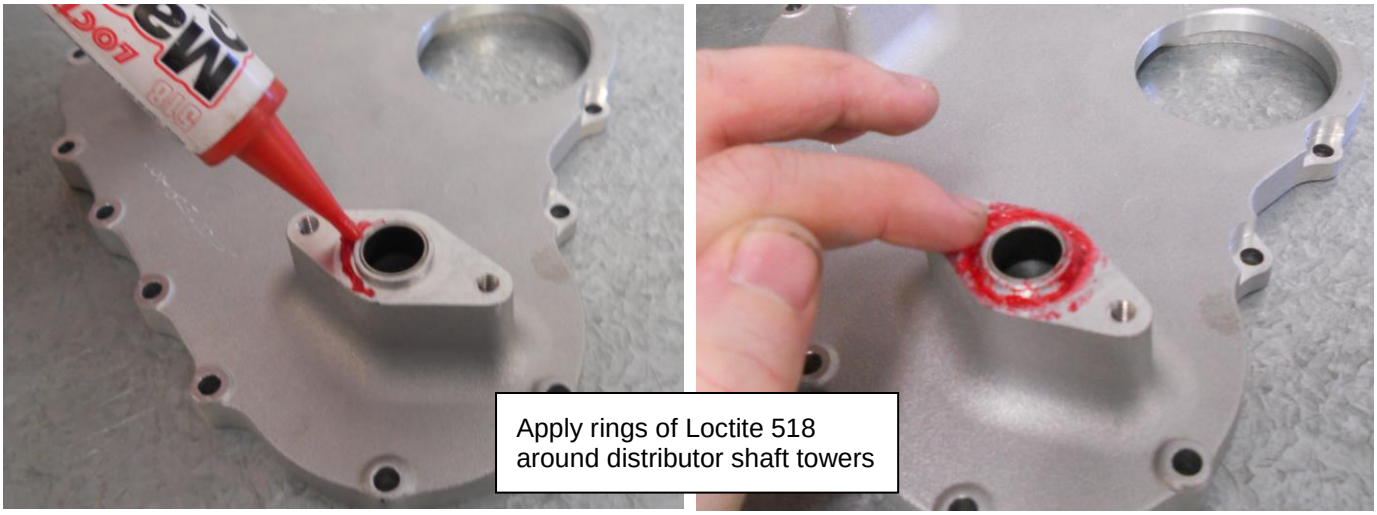


Figure 76 - Distributor mount plate installation

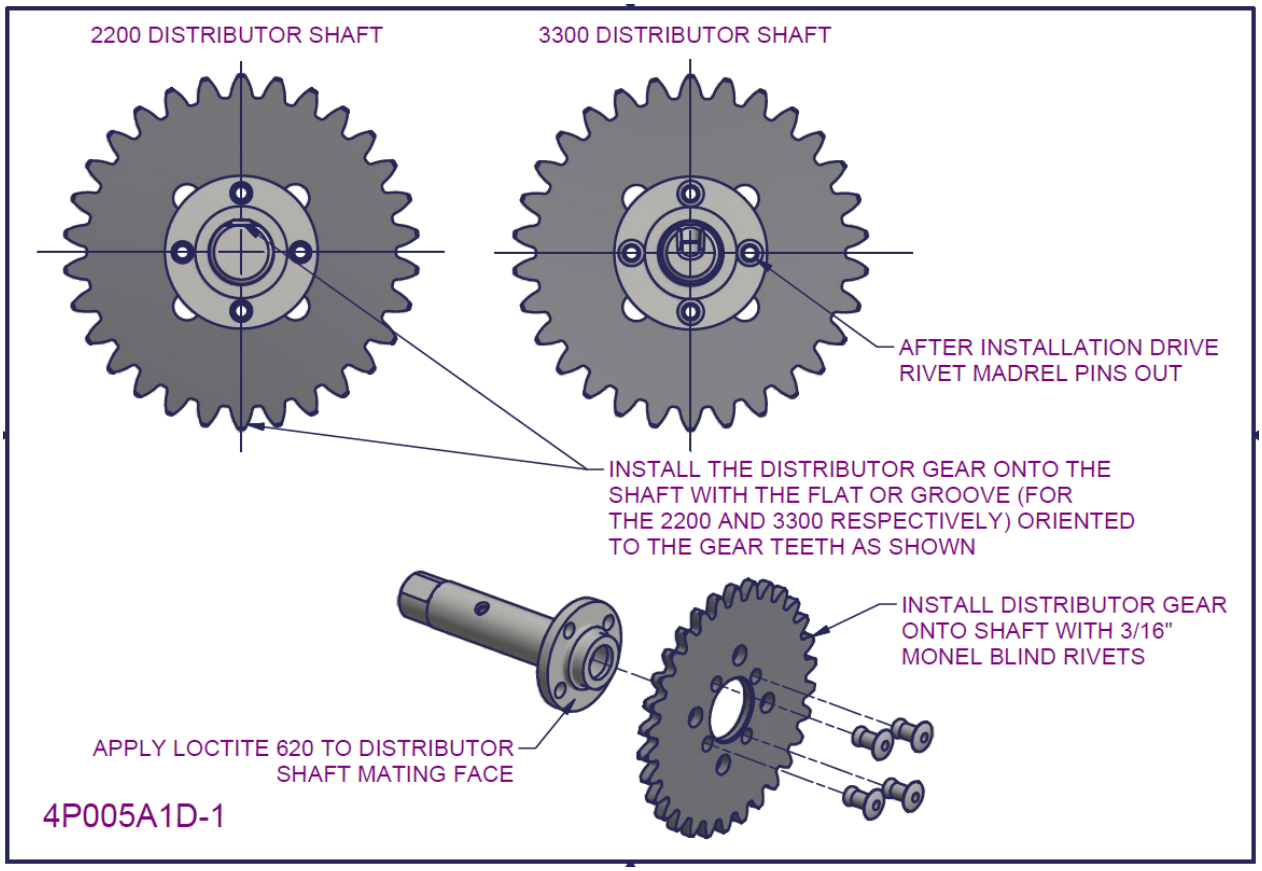


Figure 77 – 2200/3300 Distributor gearbox subassembly 4

- The two distributor shafts are now assembled.
  - *Record the Serial numbers of the Distributor shafts used in the build log (section 6.8).*
  - *Record the Serial numbers of the Gears used in the build log (section 6.8).*
- Prime mating faces with Loctite 747 and apply Loctite 620 to the distributor shaft mating face.
- Insert the distributor gear onto the distributor shaft spigot.
  - The flat face or machined groove (for the 2200 and 3300 respectively) on the distributor shaft must be aligned with the teeth of the gear as shown in Figure 77.
- Install four 3/16” monel blind rivets from behind the distributor gear with a rivet gun.
  - All rivets should be inserted first to correctly locate the gear, then each rivet is pulled using a pneumatic rivet gun in a diagonal pattern
  - After installation the rivet mandrel pins must be driven out of each rivet.

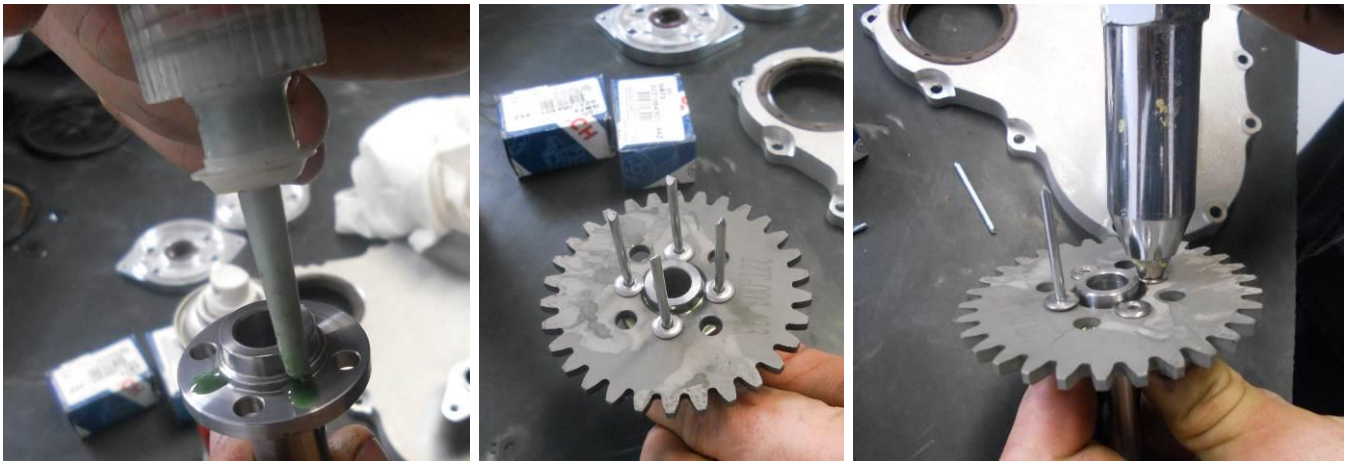


Figure 78 - Rotor shaft assembly

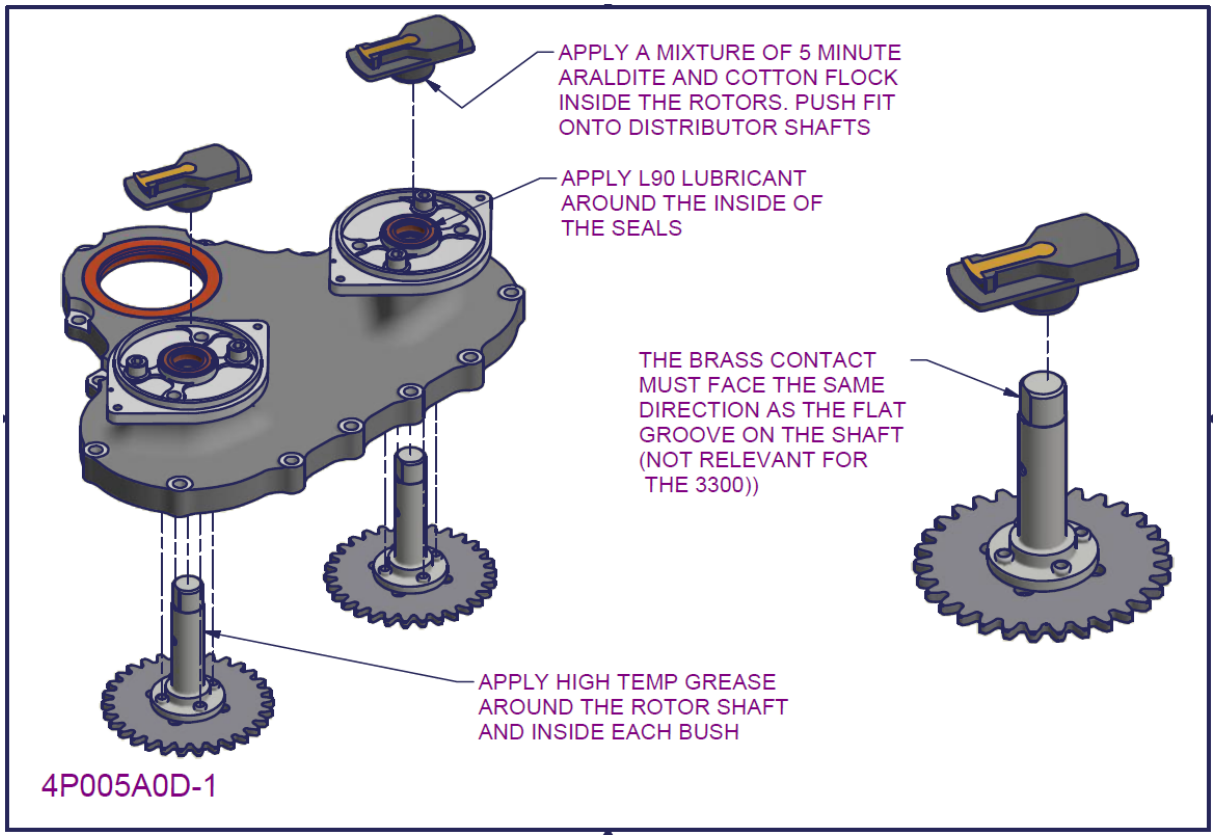


Figure 79 – 2200/3300 Distributor gearbox subassembly 5

- Apply L90 lubricant around the distributor shafts and inside the distributor mount plate seal and bushes.
- Insert the distributor shaft assembly into the gear cover from the back. Rotate each shaft back and forth to distribute lubricant and check that the shaft rotates freely.
- Wipe the top of the distributor shafts completely clean of lubricant (i.e. where the flat face or machined groove on the shaft is located)
- Mix a small batch of 5 minute araldite with cotton flock to thicken to a gluey consistency. Apply mixture to the inside of the rotor and push fit each rotor onto the distributor shafts.
    - Ensure that the rotor is fitted on the distributor shaft with the flat face or machined groove and the brass contact plate pointing in the same direction (shown above in Figure 79)
- Wipe away excess 5 minute araldite.
- This concludes the **Distributor gearbox sub assembly**.

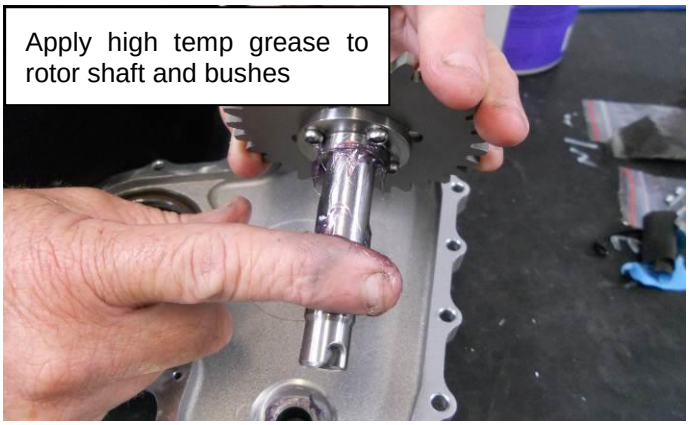


Figure 80 - Lubricating rotor shaft

4.6 Cast Flywheel subassembly

4.6.1 2200 Cast flywheel (bolted aluminium cross piece) subassembly – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4A788A0D-2	FLYWHEEL MACHINED 4 CYL SOLID CONNECTION	1
2	4A739A0D-1	LAMINATE POLE PLATE OUTER ASSY	2
3	4A740A0D-1	LAMINATE POLE PLATE CENTRE ASSY	2
4	MS35206-246	SCREW 8-32 X 5/8	8
5	PM0065N-1	MAGNET 15 DIA X 7 RARE EARTH	18
6	4A714D0D-2	MAGNET RETAINER – SOLID CONNECTION GEN-4 FLYWHEEL	1
7	4A783A0D-1	4 CYL FLYWHEEL DRIVE PLATE SOLID 3/8" 23 DEG	1
8	4A714F0D-1	STARTER RING GEAR 101T 2M PRESS FIT	1
9	AN960-416L	1/4" FLAT WASHER	8
10	PH10724-2	1/4" BELLEVILLE WASHER	4
11	MS21045-4	1/4" HIGH-TEMP LOCK NUT	4
12	AN4-6A	BOLT	4
13	NAS1096-2-6	HEX HEAD 8-32 .375 IN	2
14	4A714E0D-3	TACHO PICKUP - SOLID CONNECTION GEN-4 FLYWHEEL	2

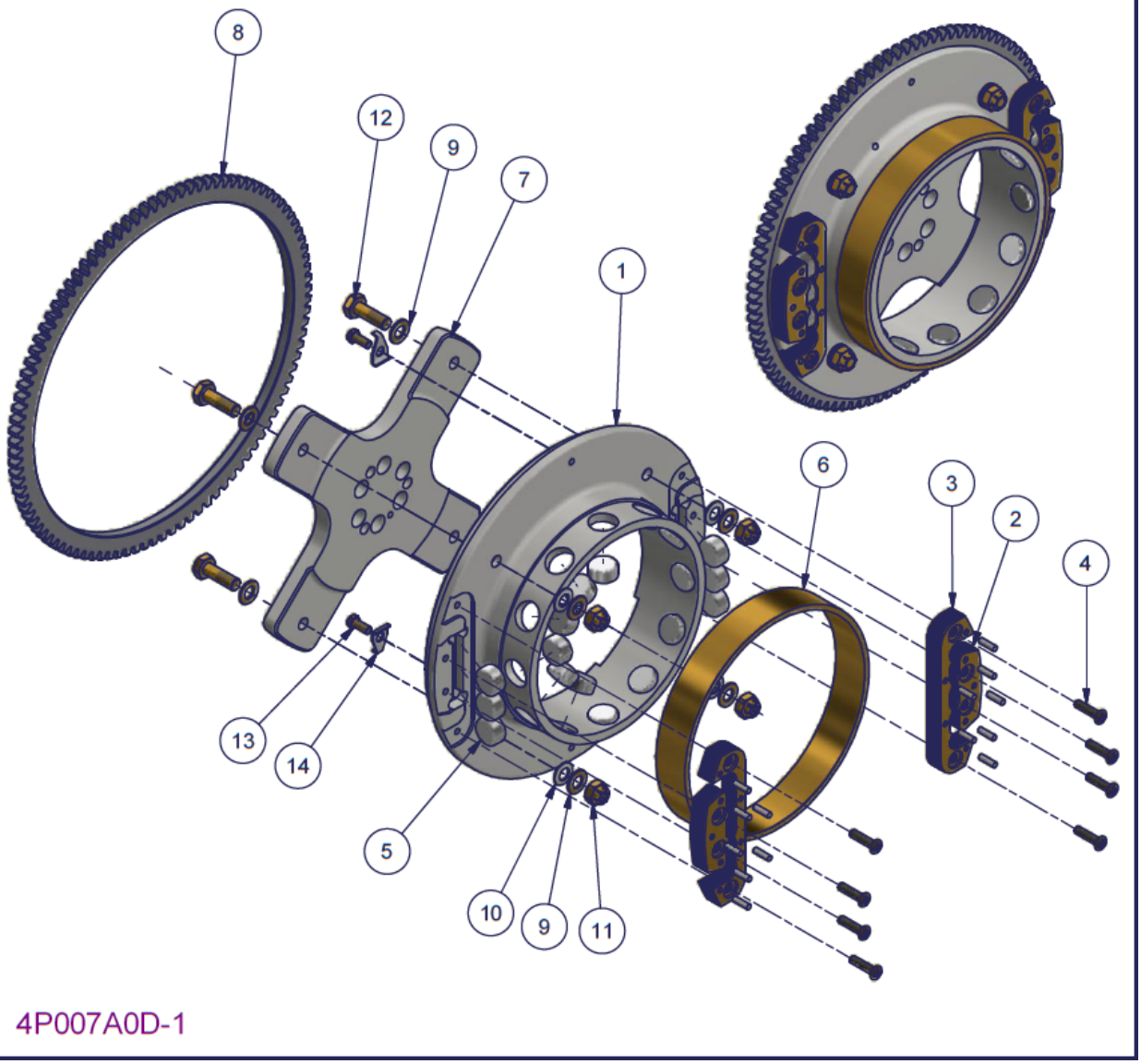


Figure 81 - 2200 Flywheel subassembly (aluminium cross piece) - Parts list

4.6.2 2200 Cast flywheel (integral cast centre) subassembly – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4A809A0D-2	MACHINED CAST FLYWHEEL 4 CYL 3/8" BOLTS (FROM 4A807A0D CASTING)	1
2	4A739A0D-1	LAMINATE POLE PLATE OUTER ASSY	2
3	4A740A0D-1	LAMINATE POLE PLATE CENTRE ASSY	2
4	MS35206-246	SCREW 8-32 X 5/8	8
5	PM0065N-1	MAGNET 15 DIA X 7 RARE EARTH	18
6	4A714D0D-2	MAGNET RETAINER – SOLID CONNECTION GEN-4 FLYWHEEL	1
7	4A714F0D-1	STARTER RING GEAR 101T 2M PRESS FIT	1
9	4A714E0D-2	TACHO PICKUP - SOLID CONNECTION GEN-4 FLYWHEEL	2
8	NAS1096-2-6	HEX HEAD 8-32 .375 IN	2

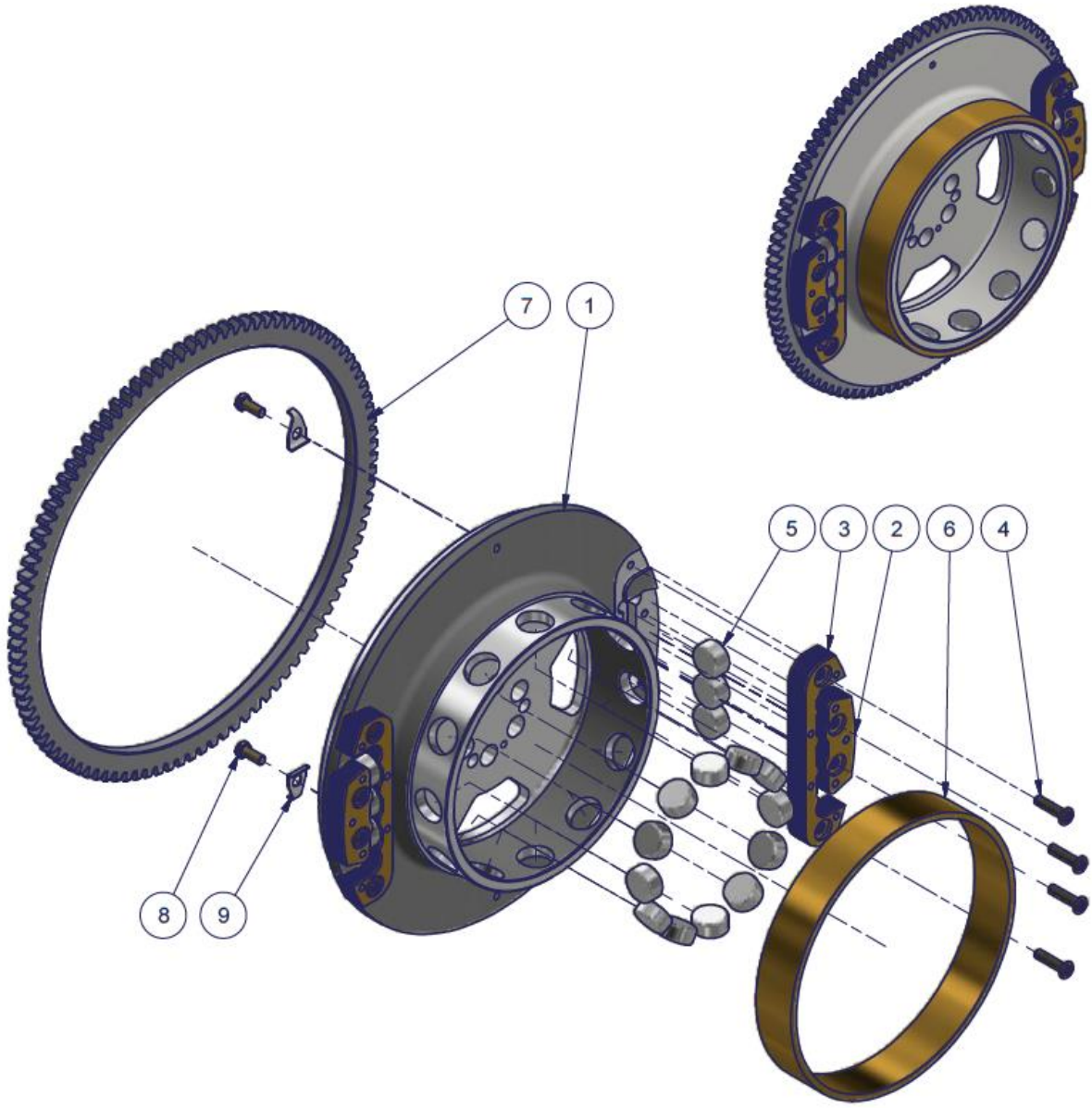


Figure 82 - 2200 Flywheel subassembly (integral cast centre) - Parts list

4.6.3 3300 Cast flywheel (aluminium cross piece) subassembly – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4A784A0D-2	6 CYL FLYWHEEL CAST MACHINED - ALUM CENTRE SOLID CONNECTION	1
2	4A785A0D-1	6 CYL FLYWHEEL DRIVE PLATE SOLID 3/8" 23 DEG	1
3	AN960-416L	1/4" FLAT WASHER	12
4	AN4-6A	BOLT	6
5	PH10724-2	1/4" BELLEVILLE WASHER	6
6	MS21045-4	1/4" HIGH-TEMP LOCK NUT	6
7	4A714D0D-2	MAGNET RETAINER – SOLID CONNECTION GEN-4 FLYWHEEL	1
8	PM0065N-1	MAGNET 15 DIA X 7 RARE EARTH	21
9	4A739A0D-1	LAMINATE POLE PLATE OUTER ASSY	3
10	4A740A0D-1	LAMINATE POLE PLATE CENTRE ASSY	3
11	MS35206-246	SCREW 8-32 X 5/8	12
12	4A714F0D-1	STARTER RING GEAR 101T 2M PRESS FIT	1
13	NAS1096-2-6	HEX HEAD 8-32 .375 IN	2
14	4A714E0D-3	TACHO PICKUP - SOLID CONNECTION GEN-4 FLYWHEEL	2

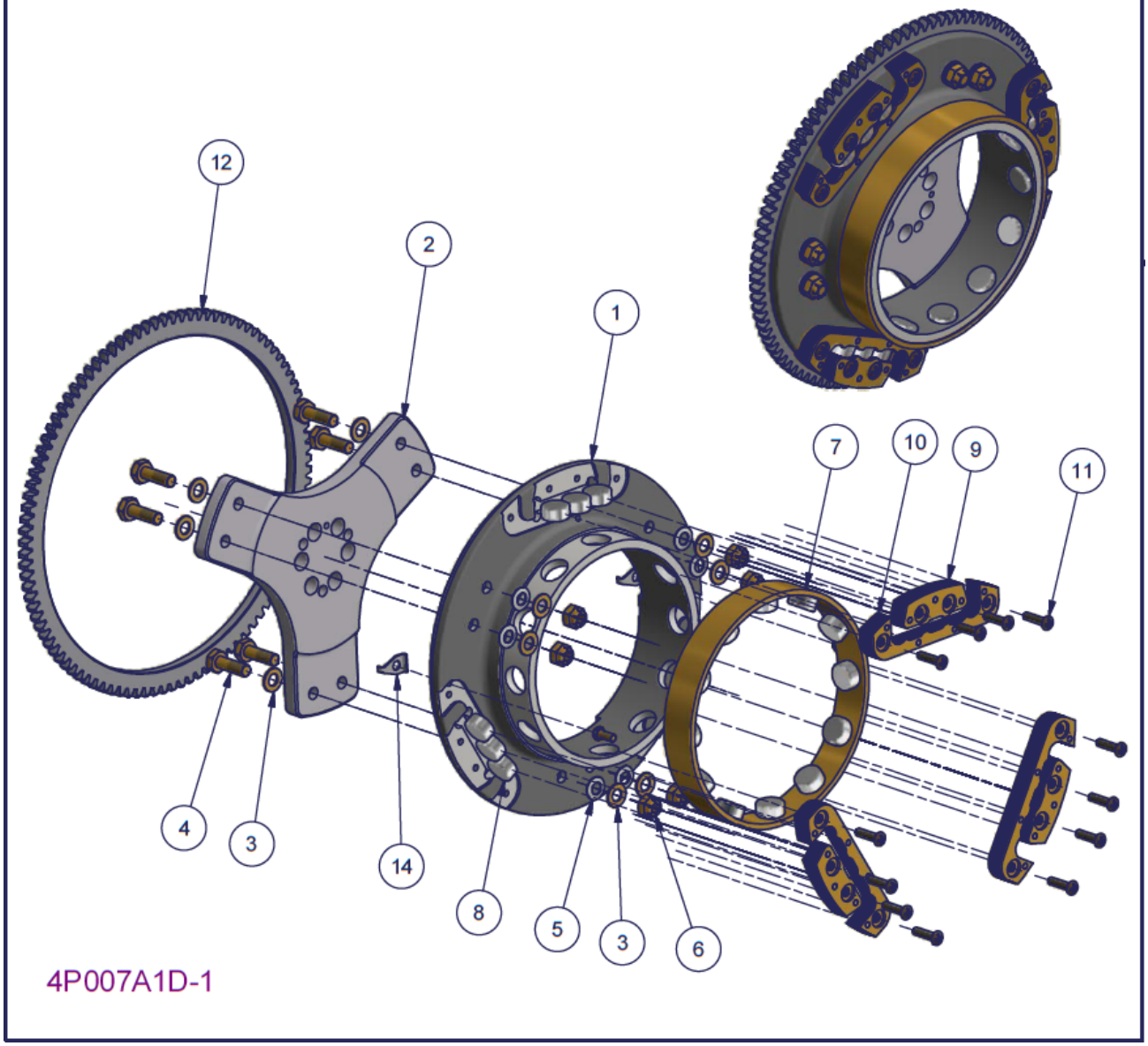


Figure 83 - 3300 flywheel subassembly (aluminium cross piece) - Parts list

4.6.4 3300 Cast flywheel (integral cast centre) subassembly – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4A808A0D-2	MACHINED CAST FLYWHEEL 6 CYL 3/8" BOLTS (FROM 4A807A0D CASTING)	1
8	4A714D0D-2	MAGNET RETAINER – SOLID CONNECTION GEN-4 FLYWHEEL	1
9	PM0065N-1	MAGNET 15 DIA X 7 RARE EARTH	21
10	4A739A0D-1	LAMINATE POLE PLATE OUTER ASSY	3
11	4A740A0D-1	LAMINATE POLE PLATE CENTRE ASSY	3
12	MS35206-246	SCREW 8-32 X 5/8	12
13	4A714F0D-1	STARTER RING GEAR 101T 2M PRESS FIT	1
15	MS35207-259	SCREW 10-32 X 1/4	2
14	4A714E0D-2	TACHO PICKUP - SOLID CONNECTION GEN-4 FLYWHEEL	2

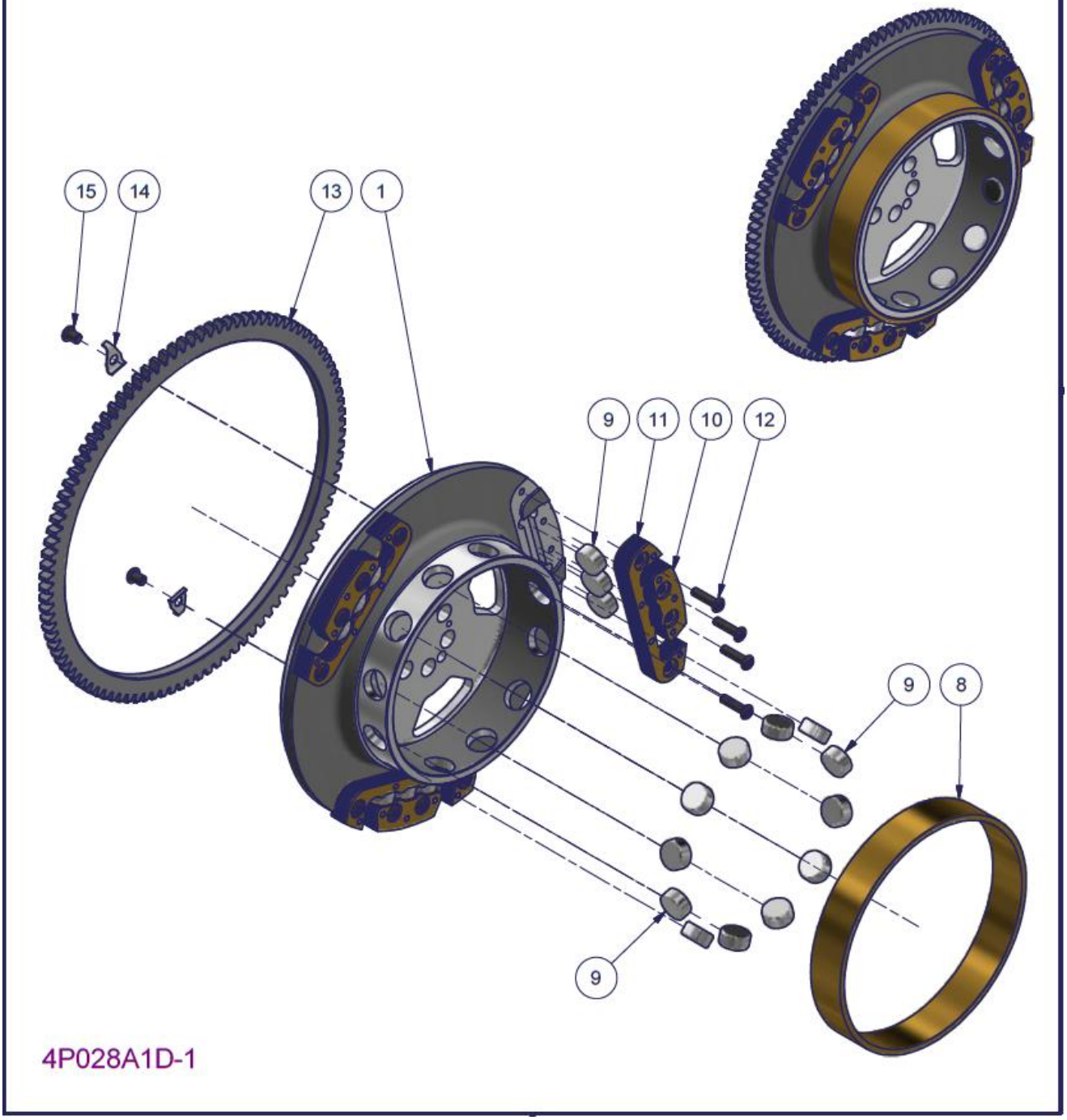


Figure 84 - 3300 Flywheel subassembly (integral cast centre) - Parts list

4.6.5 2200/3300 Flywheel (aluminium cross piece and Integral cast centre) subassembly procedure

- Both the 'Aluminium cross piece' and 'Cast integral centre' flywheels use the same subassembly procedure, detailed as follows:

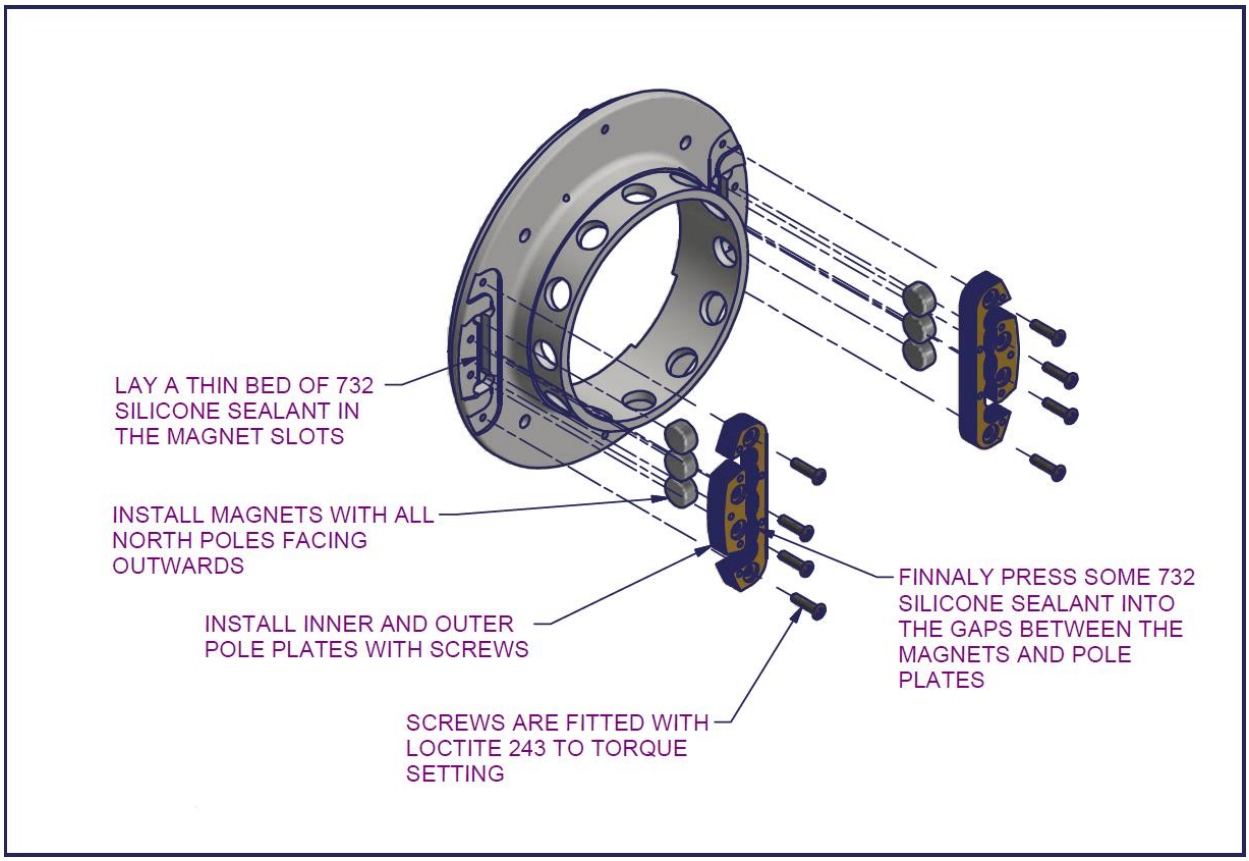


Figure 85 – 2200/3300 Flywheel subassembly (aluminium cross piece) 1

  - *Record the Serial number of the Flywheel used in the build log (section 6.9).*
- Lay a thin bed of 732 silicone sealant in the bottom of each ignition magnet retaining groove on the flywheel
- Install sets of three magnets into the magnet retaining grooves
- Install the inner and outer poles plates into the respective grooves
  - Installation is made simplest by inserting each magnet between the two pole plates first and then installing the whole thing into the respective groove
  - Ensure that all three magnets have the north poles facing outwards. Use a magnet of known polarity to determine which face is the north pole and mark using a paint pen the letter 'N' to indicate north
  - Ensure the pole plates are fitted with the counter bore facing outwards
- Prime the taped threads and screws with Loctite 747 and install screws with Loctite 243 to the torque setting prescribed in section 0 and marked with a paint pen.
- Finally press some 732 silicone sealant into the gaps between the magnets and pole plates. Clean away any excess silicone.

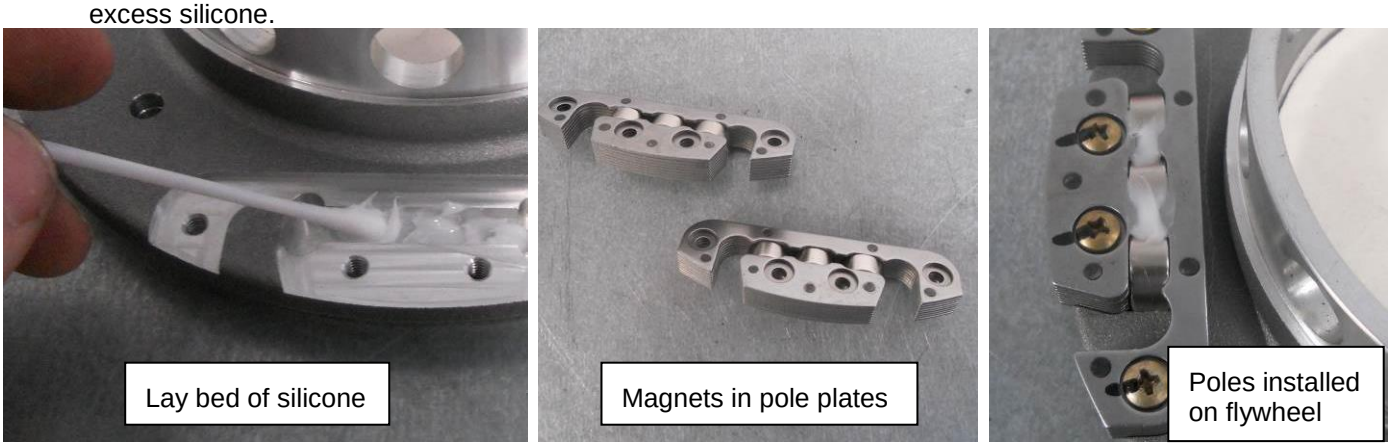


Figure 86 - Flywheel ignition magnets and pole plate installation

Figure 87 - 2200/3300 Flywheel subassembly (aluminium cross piece) 2

- *Record the Serial number of the Ring gear used in the build log (section 6.9).*

- Clean and prime the contact faces of the flywheel alternator retaining ring with Loctite 747.
- Apply Loctite 620 around the circumference of the flywheel at the top and in spots between the magnet holes
- Press the alternator retaining ring onto the flywheel using a shop press. Ensure the ring is inserted until it bottoms out on the flywheel land.

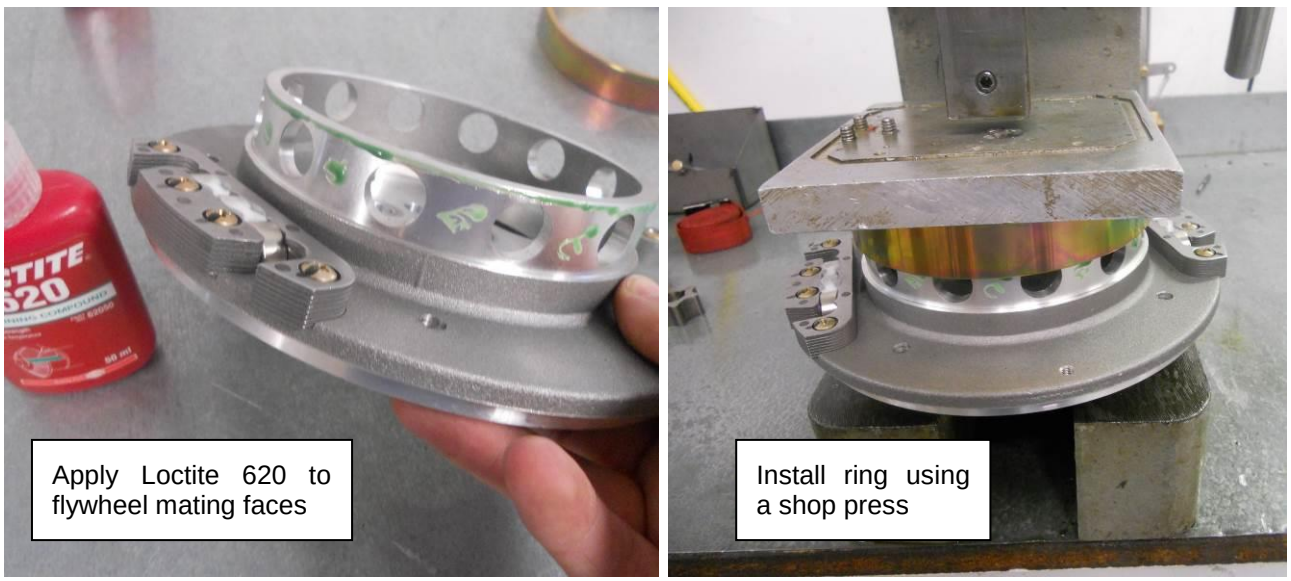


Figure 88 - Alternator magnet ring installation

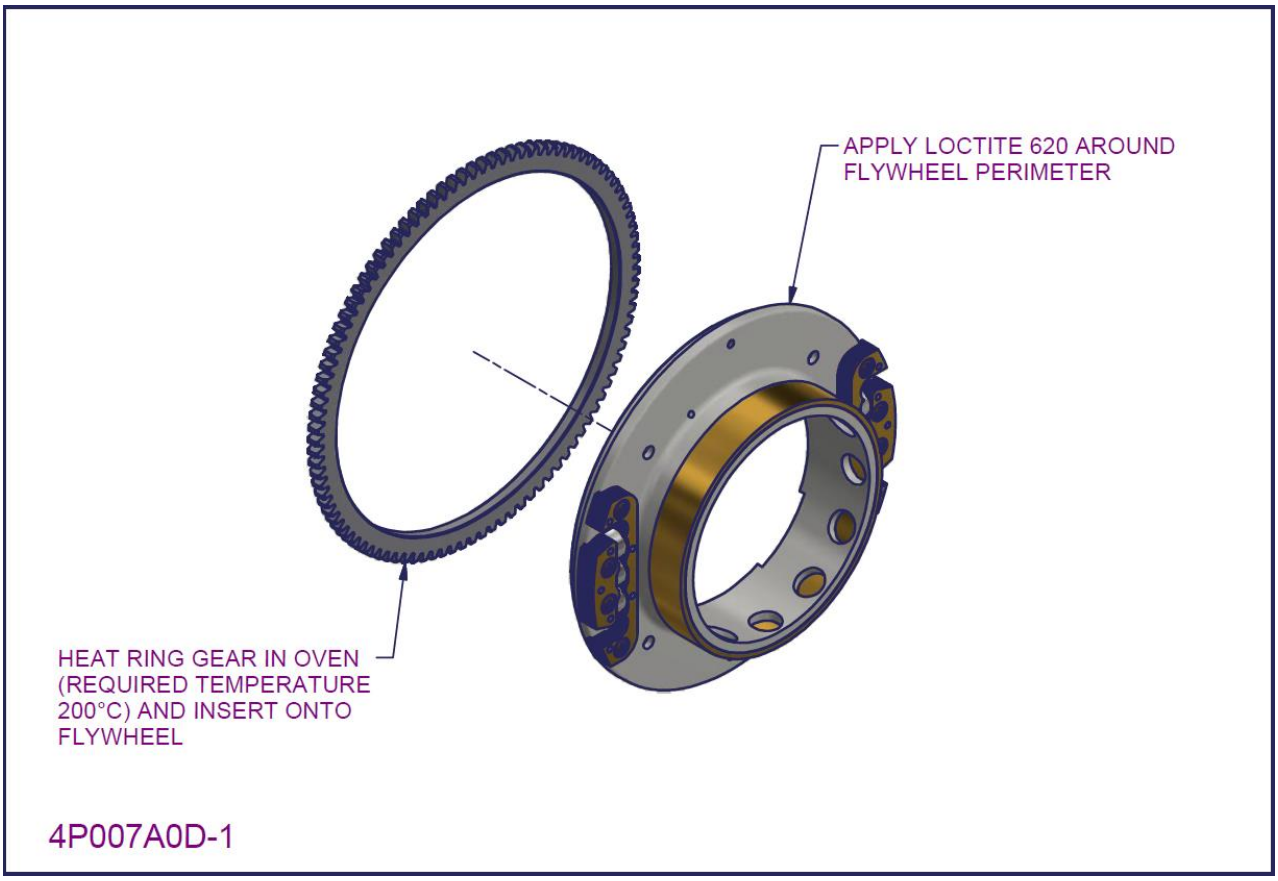


Figure 89 – 2200/3300 Flywheel subassembly (aluminium cross piece) 3

- *Record the Serial number of the Ring gear used in the build log (section 6.9).*

- Clean and prime the contact faces of the starter ring gear with Loctite 747. Then place the ring gear in an oven for 10 minutes.
  - Oven temperature **must be 200ºC.** Use an external thermometer to monitor temperature (i.e. don't rely on the oven temperature settings alone). **Do not overheat ring gear.** Place as far away from oven element as possible within oven. Discard gear ring if unusual or uneven discolouring occurs.
- Whilst the gear is heating up, prepare the flywheel bonding surfaces by cleaning and priming with Loctite 747. Apply Loctite 620 around the perimeter.
- With the flywheel placed on a flat benchtop. Remove starter ring gear from oven (with welder's gloves) and position on flywheel. The ignition magnets will pull the ring gear down to seat correctly on the flywheel land.
  - The starter ring gear may have a larger chamfer on one edge than the other, install the gear so the larger chamfer is facing IN TOWARDS the flywheel.
- Allow assembly to cool to room temp before continuing.
  - **Do not quench flywheel or accelerate cooling down in any other way.**

Figure 90 - Starter ring gear installation

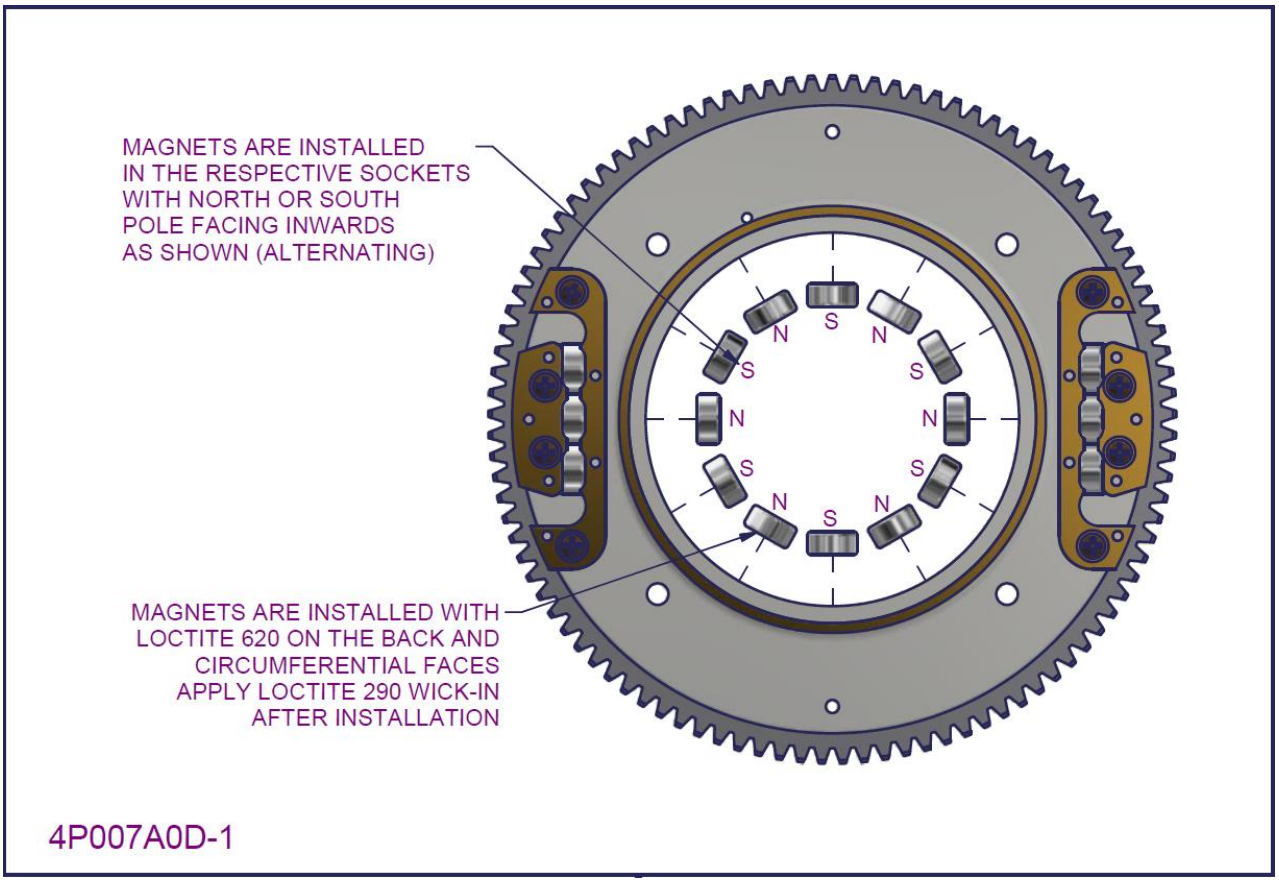


Figure 91 - 2200/3300 Flywheel subassembly (aluminium cross piece) 3

- Using a magnet of known polarity determine the north pole of six magnets and mark the letter ‘N’ to indicated this. Do the same to another six magnet, this time determining the south pole and mark the letter ‘S’
- Clean and prime the twelve magnet retaining sockets and the twelve magnets with Loctite 747
- Install the twelve magnets with the inward facing pole alternating between north and south as shown in Figure 91.

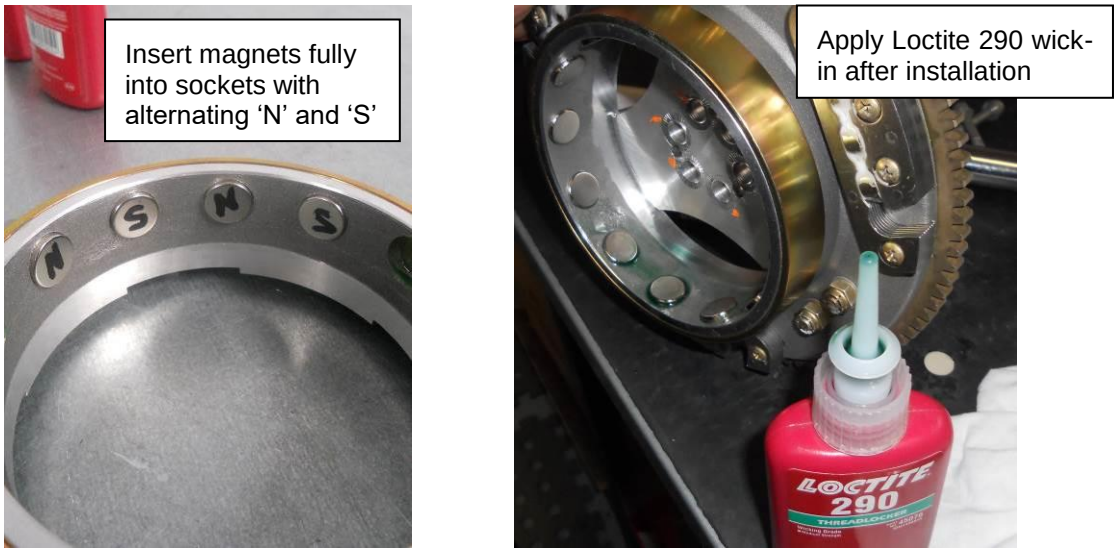


Figure 92 - Alternator magnet installation

4.6.6 Install hub centre (Aluminium cross piece flywheel only)

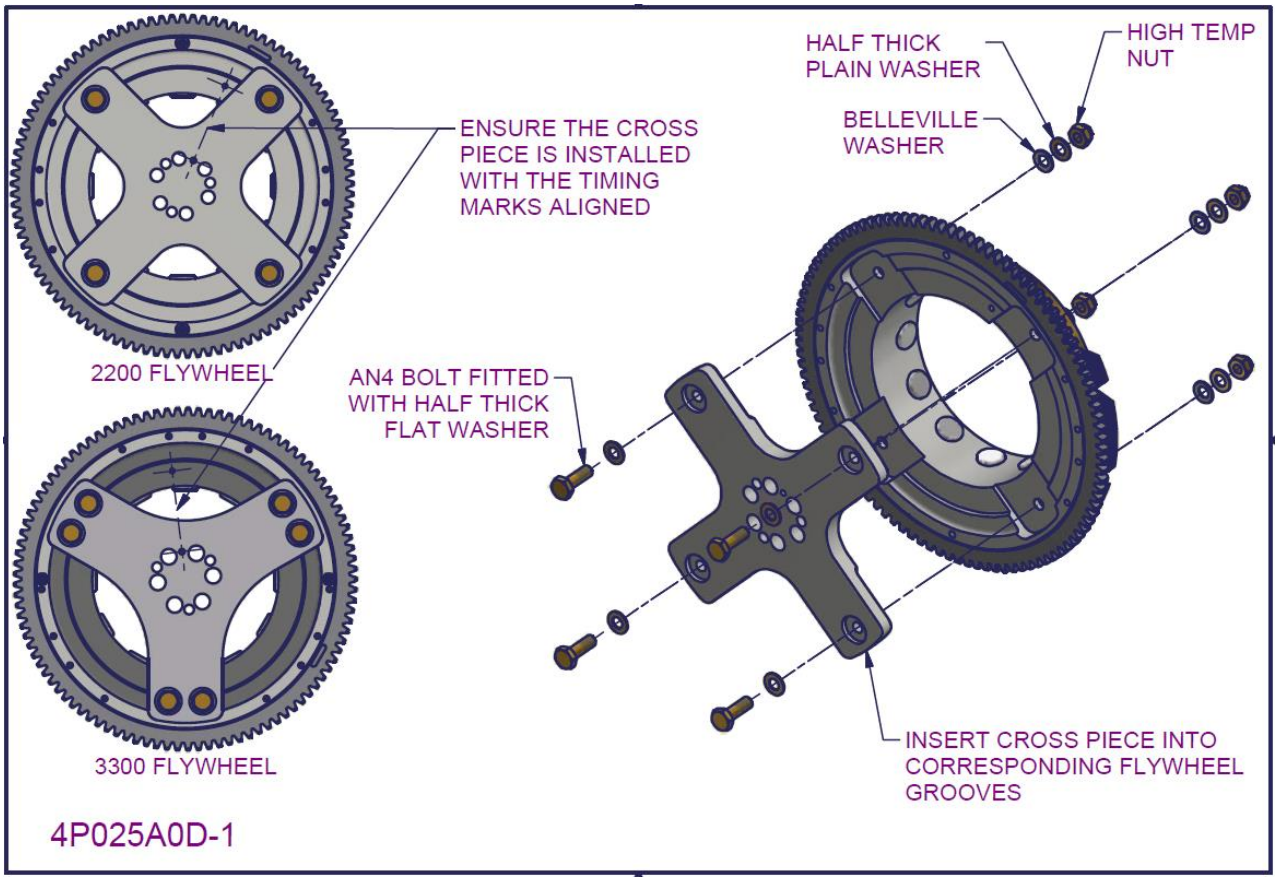


Figure 93 - 2200/3300 Flywheel subassembly (aluminium cross piece) 4

- *Record the Serial number of the Inner hub used in the build log (section 6.9).*

- Insert cross piece inner hub into the respective machined grooves of the flywheel. A soft mallet may be used to assist.
  - Ensure the contact faces are completely clean of any dirt or oil
  - Ensure that the cross piece is install with the two timing holes correctly aligned as shown in Figure 93
- Fix cross piece in place using AN4 bolts washers and high temperature nuts
  - Bolts are fitted from the cross piece side with a single half thickness flat washers under the bolt head
  - High temperature nuts are fitted with a Belleville washer and full thickness plain washer (in that order) under the nut
  - All bolts should be first tightened to contact then tightened to the prescribed torque setting in section 0 using a diagonal tightening pattern and marked with a paint pen.

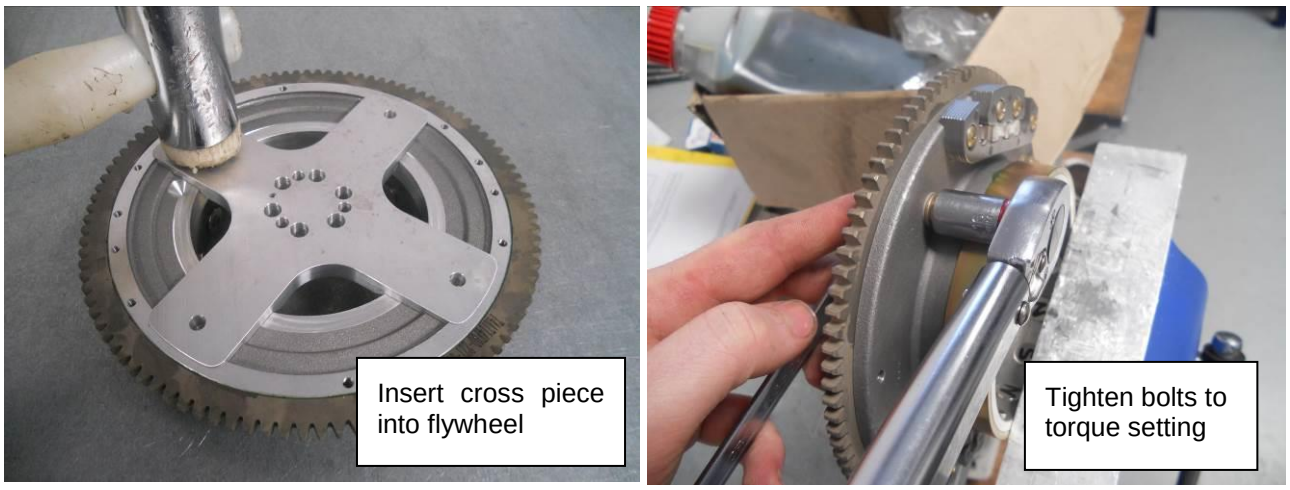


Figure 94 - Inner hub cross piece installation

4.6.7 Flywheel Pole plate skimming procedure

In finishing the flywheel assembly the flywheel must be turned in a metal working lathe to skim the outer edge of the ignition pole plates so the pole plates run concentric to the ignition coil when later installed on the engine.

WARNING

This task requires special tools equipment and training. DO NOT attempt this procedure unless sufficiently trained and equipped to do so

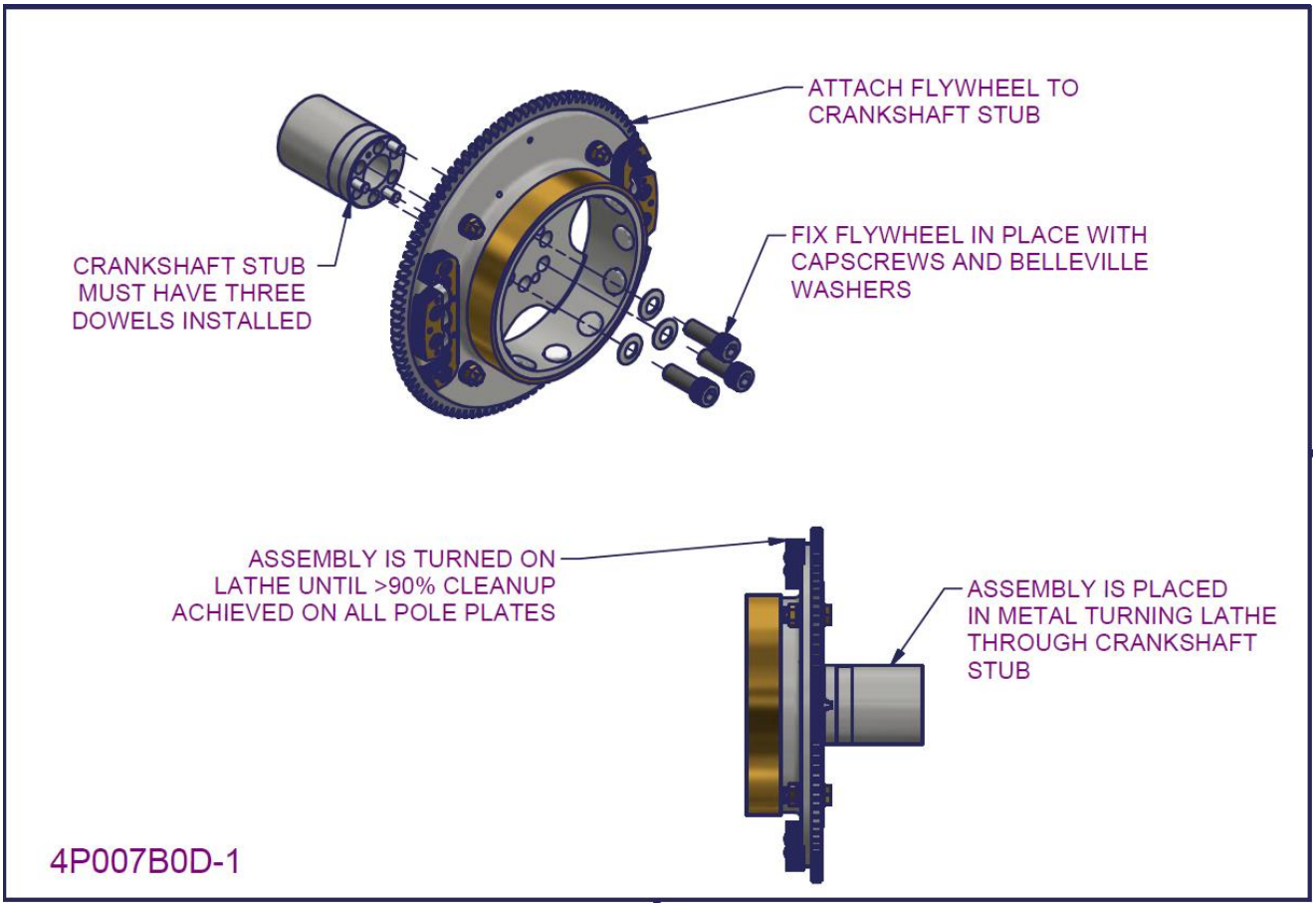
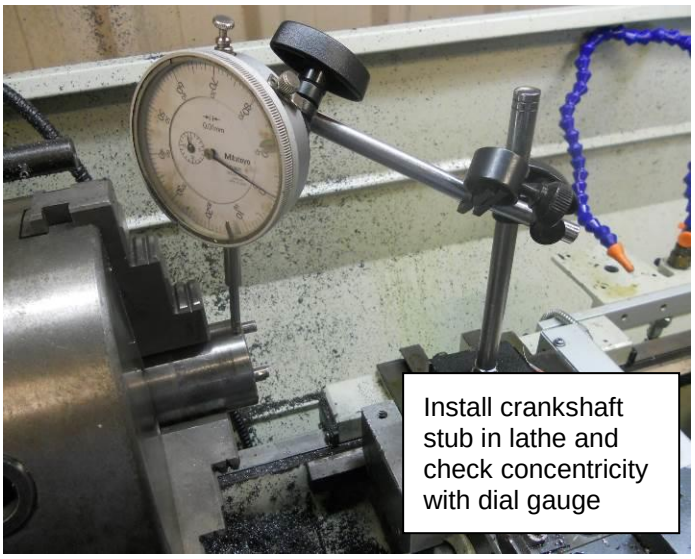
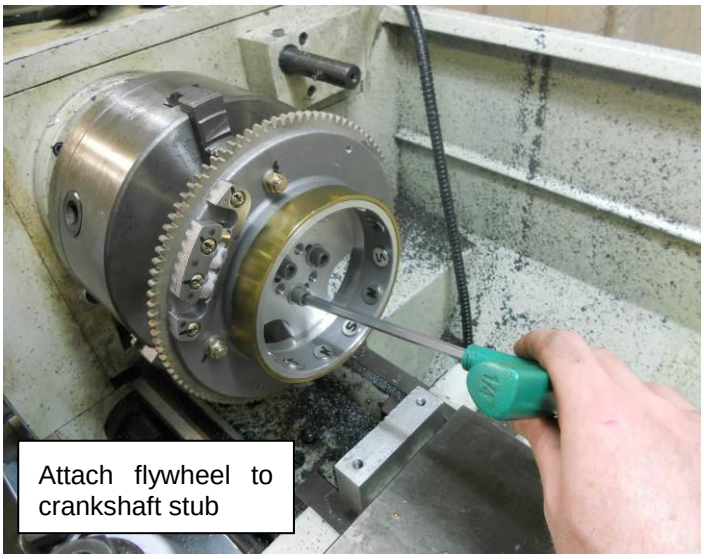
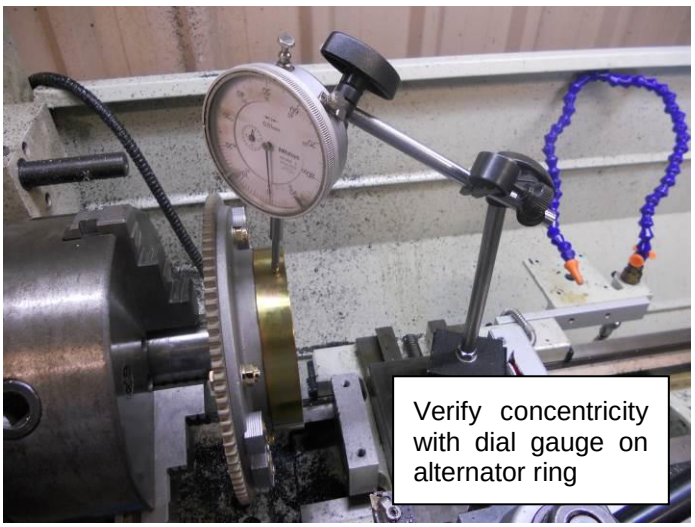


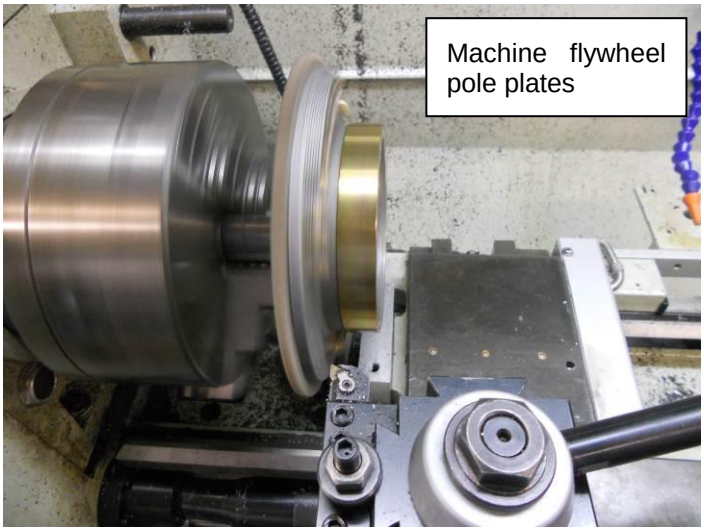
Figure 95 - 2200/3300 Flywheel subassembly (aluminium cross piece) 6

- Fit a crankshaft stub into lathe chuck and check concentricity with dial gauge (must be within 0.10mm).
  - The lathe must have sufficient room over the bed to swing the relatively large diameter of the flywheel.
- While the stub remains in the lathe chuck, install flywheel onto stub using three capscrews with Belleville washers.
  - The crankshaft stub must include three dowel to correctly locate the flywheel
  - The flywheel should be pulled down over the dowels by progressively winding each capscrew in
  - Tighten each screw to 20ft.lb. torque setting
  - These screws **must not** be used on the final engine assembly.
- The flywheel concentricity to the lathe must be checked using a dial gauge mounted on the lathe and gauged off the alternator retainer ring. Concentricity must be within 0.10mm.
- The pole plates are now machined on the lathe so that all inner and outer pole plates clean up **at least 90%**
  - Use small radial cut increments (0.10mm typically) to ensure that the minimum amount of material is removed before all pole plate sets are sufficiently cleaned up.
- Once sufficient pole plate clean-up is achieved the flywheel is removed from lathe and unbolted from the crankshaft stub
- Clean the metal swarf away from the poles using a compressed air gun.
- After machining apply a clear acrylic spray varnish to each pole as an anti-corrosion layer.









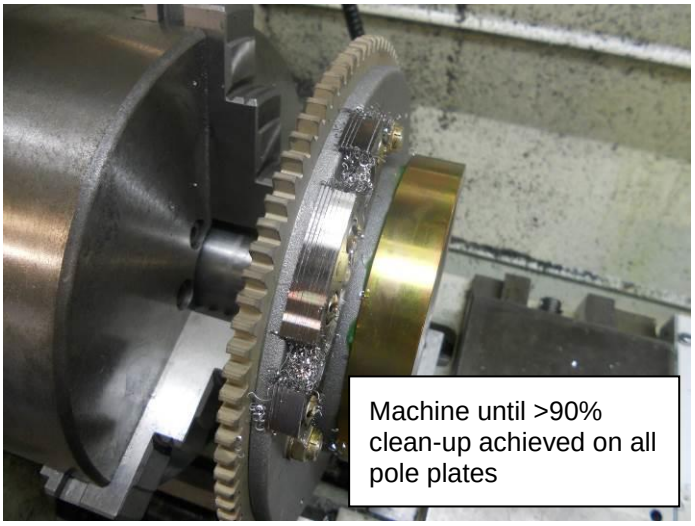


Figure 96 - Flywheel pole plate skimming

4.6.8 Tacho tag installation

As a final step after pole plate skimming the tacho tags should be installed as follows.

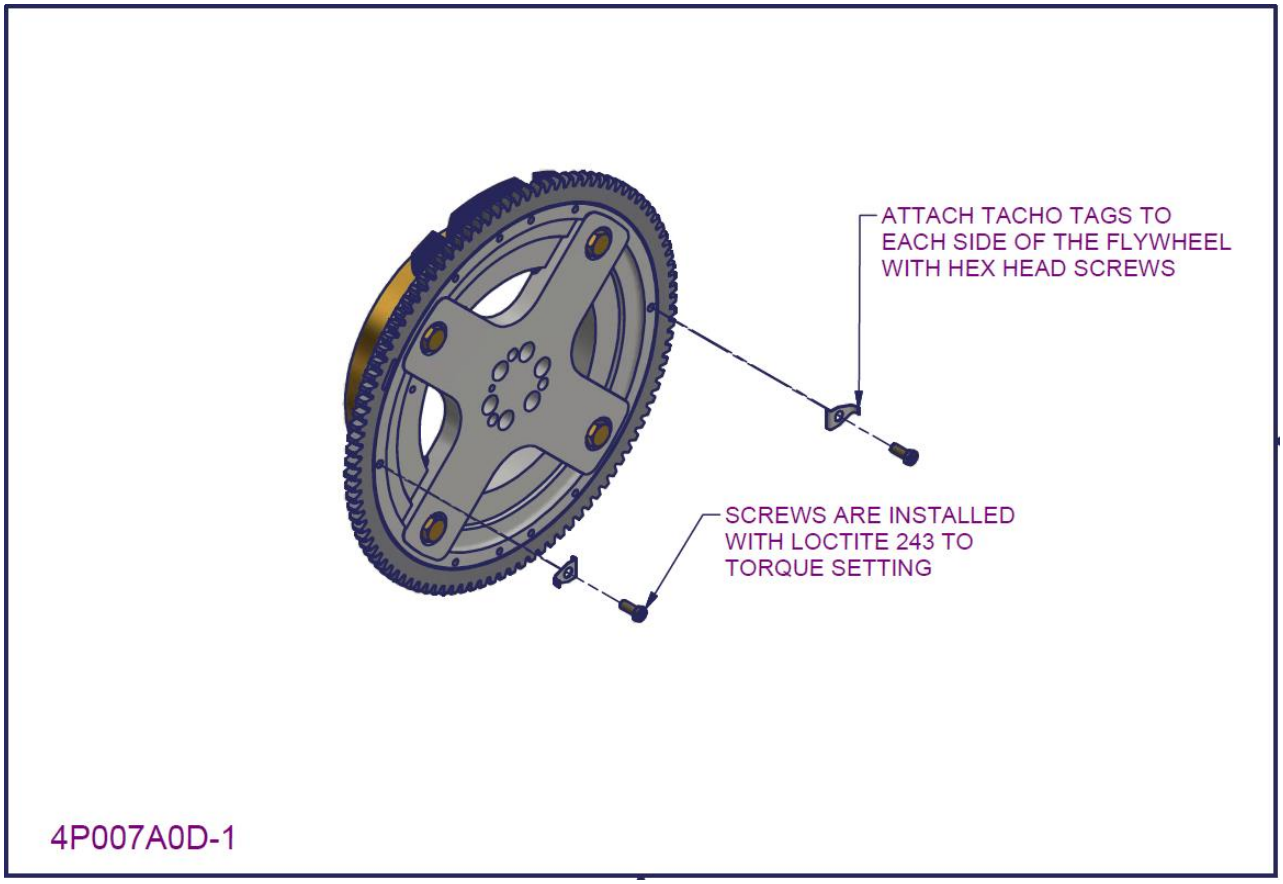


Figure 97 - 2200/3300 Flywheel subassembly (aluminium cross piece) 5

- Prime the taped holes and screws with Loctite 747.
- Install tacho tags with screws.
    - Screws are installed with Loctite 243 to the torque setting prescribed in section 0 and marked with a paint pen.
    - Ensure the tacho tags are installed pointing straight outwards, with the hole exactly concentric to the screw.
- This concludes the **Cast Flywheel subassembly**

4.7 Alternator stator assembly

4.7.1 2200/3300 alternator stator subassembly – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4A534A0D-5	2210 ALTERNATOR MOUNT MACHINED	1
2	4A753A0D-2	STATOR ASSY 12 POLE SERIES (22 COILS)	1
3	PG9862	ROLL PIN 5/32 X 3/8	4
4	MS27039-1-10	STRUCTURAL SCREW	4

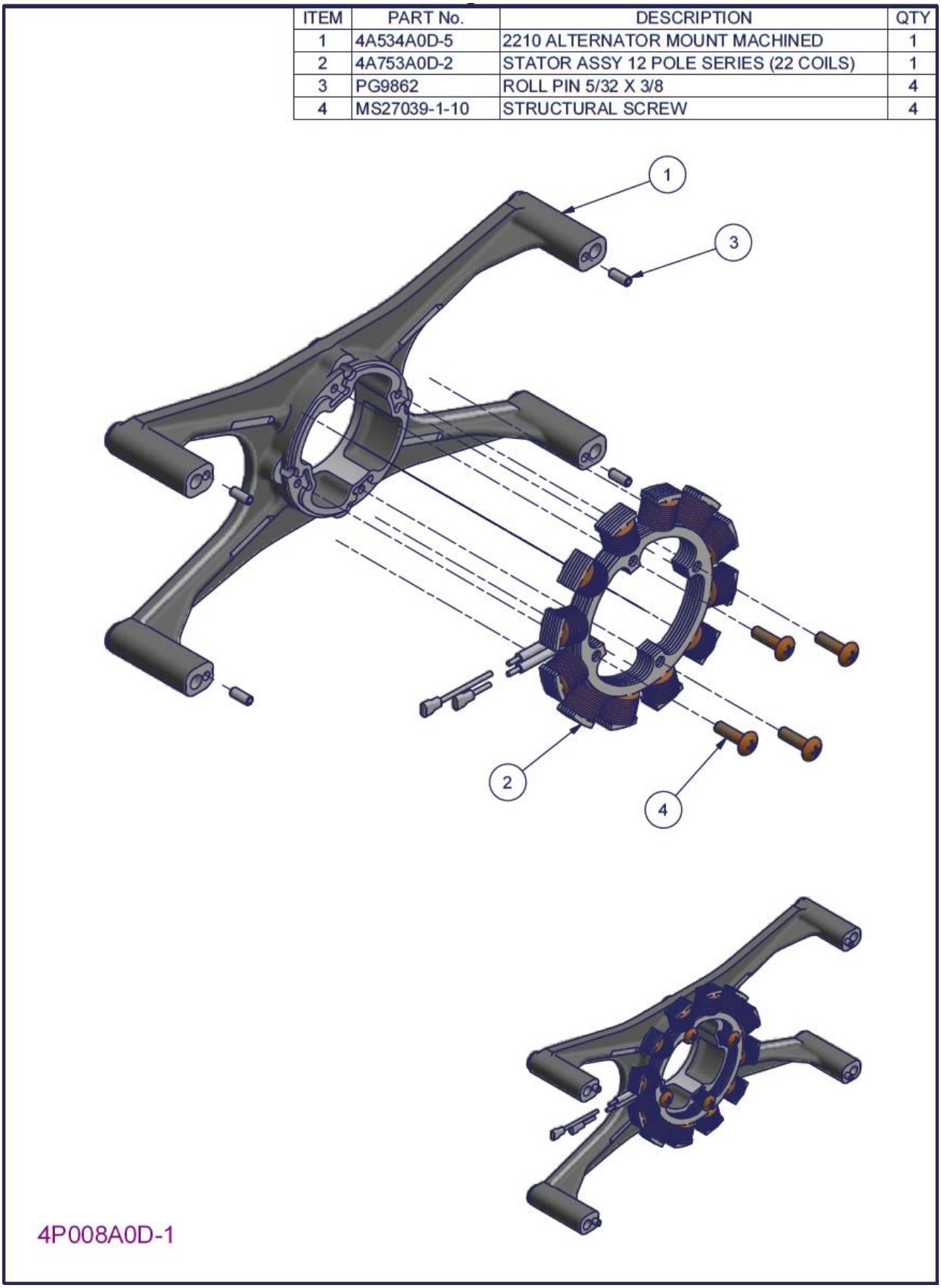


Figure 98 – 2200/3300 alternator stator subassembly – Parts list

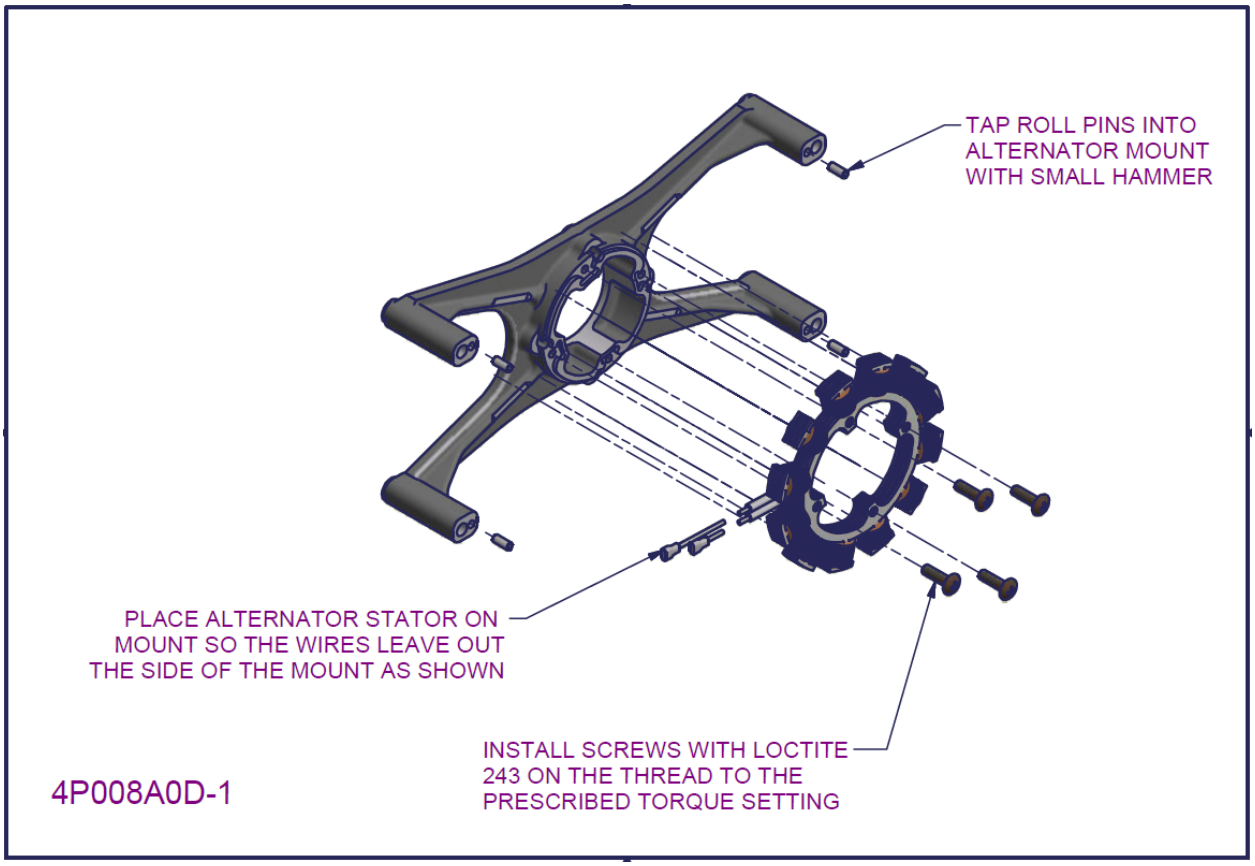


Figure 99 – 2200/ 3300 alternator stator subassembly 1

- Install roll pins in the stator mount using a small hammer to tap them in.
    - The stator mount should be fully supported under the leg to prevent damage to the mount during installation.
- Place alternator stator on mount with the wire orientated with relief (as pictured in Figure 99) when later mounted on the engine.
- Fix stator in place with four screws.
    - Screws are installed with Loctite 243 on the threads to the torque setting prescribed in section 0. and marked with a paint pen
- Inspect the assembly to check none of the stator wire coils contact the stator mount.
- This concludes the **Alternator stator subassembly.**

4.8 Joining the Engine

4.8.1 2200 Joint Engine – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P001A0D-1	2210 ROLLER CAMSHAFT ASSY	1
2	4P002A0D-1	2210 CRANKSHAFT ASSY	1
3	4P003A0D-2	2210 CRANKCASE ASSY	1
4	4P004A0D-2	2210/3310 CYLINDER ASSY	4
5	PH4A047N-1	CIRCLIP INT 25 DIA	4
6	PG4A028N	ORING VITON BS238V	4
7	4A610A0D-2	ROCKER COVER MACHINED 2210 ENGINE	4
8	AN960-416	1/4" FLAT WASHER	16
9	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	16
10	4A590A0D-5	GEAR CRANKSHAFT 22T 10DP 3/8 BOLTS 52 DIA SEAL	1
11	4A838A0D-1	THROUGH BOLT WASHER MS - 2210 (3/8")	8
12	4A816A0D-1	2210 THRU BOLT 3/8-UNF	6
13	PH10224-2	3/8" BELLEVILLE WASHER	20
14	PH4A068N-1	12-POINT NUT ARP 3/8-24 (SUIT 1/2" SOCKET; 300-8372)	18
15	PG0127N	O-RING BS011V 5/16 X 7/16 0.070 SECT	16

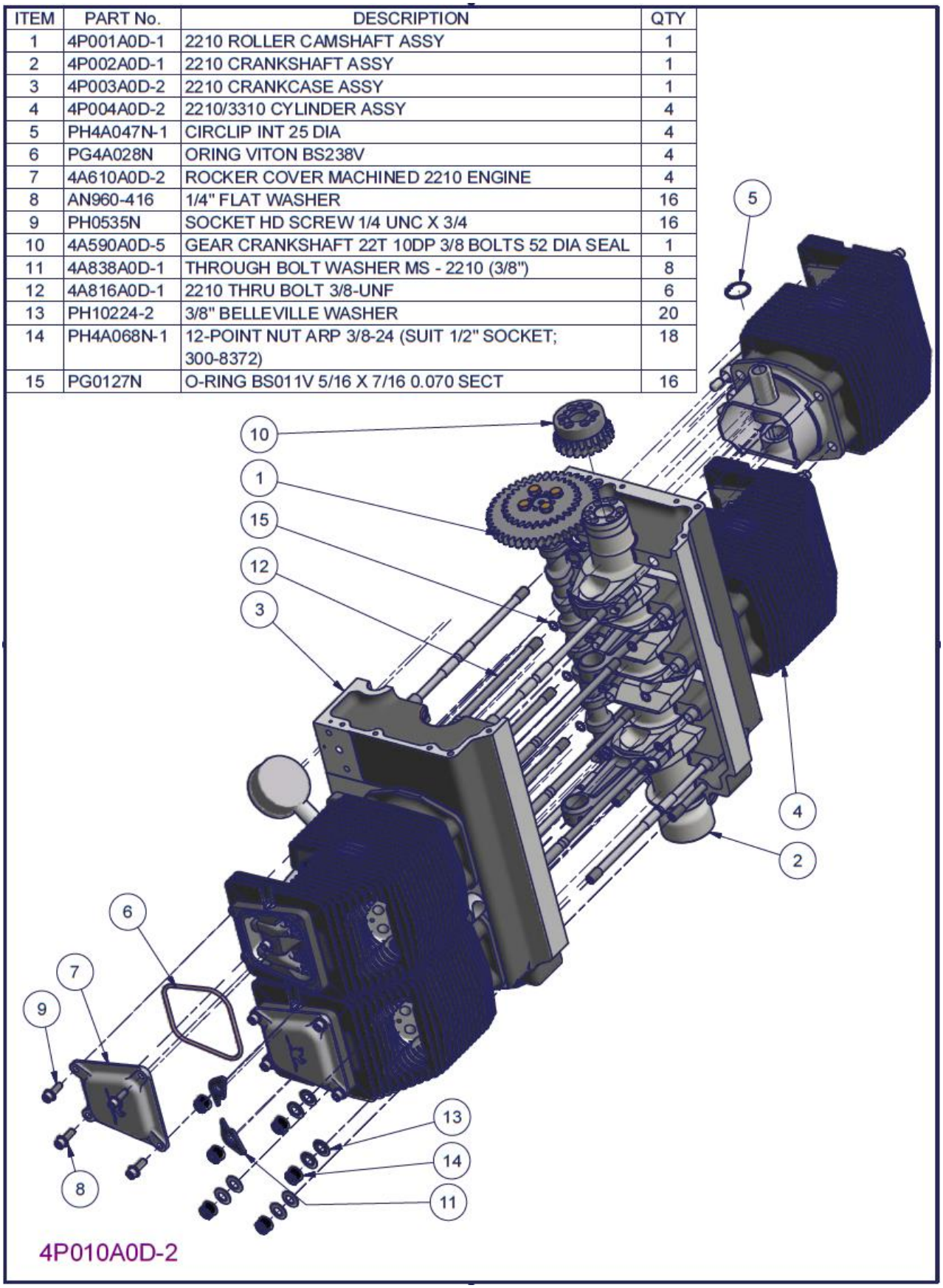


Figure 100 – 2200 Joint engine – Parts list

4.8.2 3300 Joint Engine – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P001A1D-1	3310 ROLLER CAMSHAFT ASSY	1
2	4P002A1D-1	3310 CRANKSHAFT ASSY	1
3	4P003A1D-2	3310 CRANKCASE ASSY	1
4	4P004A0D-2	2210/3310 CYLINDER ASSY	6
5	PH4A047N-1	CIRCLIP INT 25 DIA	6
6	PG4A028N	ORING VITON BS238V	6
7	4A610A0D-2	ROCKER COVER MACHINED 2210 ENGINE	6
8	AN960-416	1/4" FLAT WASHER	24
9	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	24
10	4A590A0D-5	GEAR CRANKSHAFT 22T 10DP 3/8 BOLTS 52 DIA SEAL	1
11	4A816A0D-1	2210 THRU BOLT 3/8-UNF	10
12	PH4A068N-1	12-POINT NUT ARP 3/8-24 (SUIT 1/2" SOCKET; 300-8372)	26
13	PG0127N	O-RING BS011V 5/16 X 7/16 0.070 SECT	25
14	PH10224-2	3/8" BELLEVILLE WASHER	28
15	4A838A0D-1	THROUGH BOLT WASHER MS - 2210 (3/8")	12

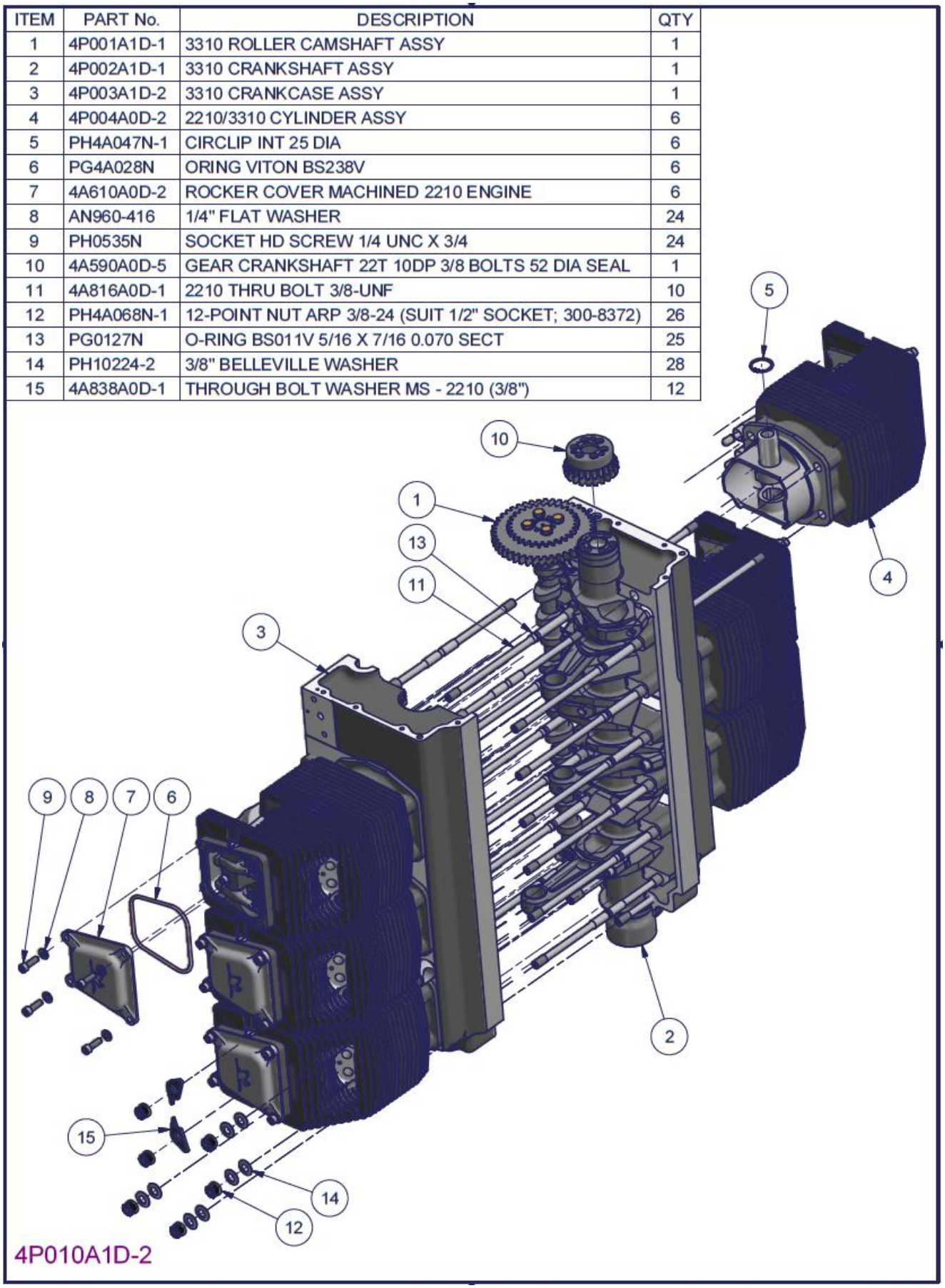


Figure 101 – 3300 joint engine – Parts List

4.8.3 2200/3300 Engine joining – preliminary preparation

Joining the 2200 and 3300 configuration engines contain substantially more tasks then older Jabiru configuration engines. This is mainly due to the fact that the case halves are bonded together at the same time as the cylinders and pistons are installed. All of which requires diligence and consistency in the process used. Before attempting to join the engine check the following:

- Without a doubt **TWO PERSONS** are required to complete this stage of the engine build. The number of assemblages which must be brought together simultaneously makes it impossible for a single pair of hands to complete. **Never attempt to join a 2200 or 3300 configuration engine alone.**
- Ensure both persons have thoroughly read the engine joining instructions described in this manual in full before joining the engine. You should also pre plan exactly whom will complete the various tasks as encountered to ensure nothing gets missed.
- **Work quickly!** Joining the engine broadly includes joining the two case halves and all cylinders with through bolts to the required torque setting before the bonding adhesive begins to set. This gives only about 30 minutes of working time.
- Ensure the following preparations have been made before joining the engine
    - Have all the major assemblages laid out and correctly labelled.
    - Have all assembly hardware laid out and on hand.
    - Have all required tools laid out within easy reach of the workbench.
    - Check all bonding faces are completely clean of dirt and oils. This primarily includes the crankcase mating faces and cylinder barrel mating faces.
    - Check all journals and bearings are adequately lubricated. A mixture of L90 and engine oil should be applied to the crankshaft and crankcase main journals, Camshaft and Cam bore journals. Piston bore and gudgeon pin.
    - The pistons should be installed in the cylinders with the gudgeon pin installed through one piston bore only, from the flywheel end.
    - Check the pushrods are primed with engine oil and inserted in the pushrod tubes.
    - Remove the masking tape holding the lifters inside the crankcase lifter sockets.
    - Check there is sufficient Three-Bond sealant to do the job.

Figure 102 - Engine assemblages, hardware and tools laid out ready to join the engine

4.8.4 2200/3300 Engine joining procedure

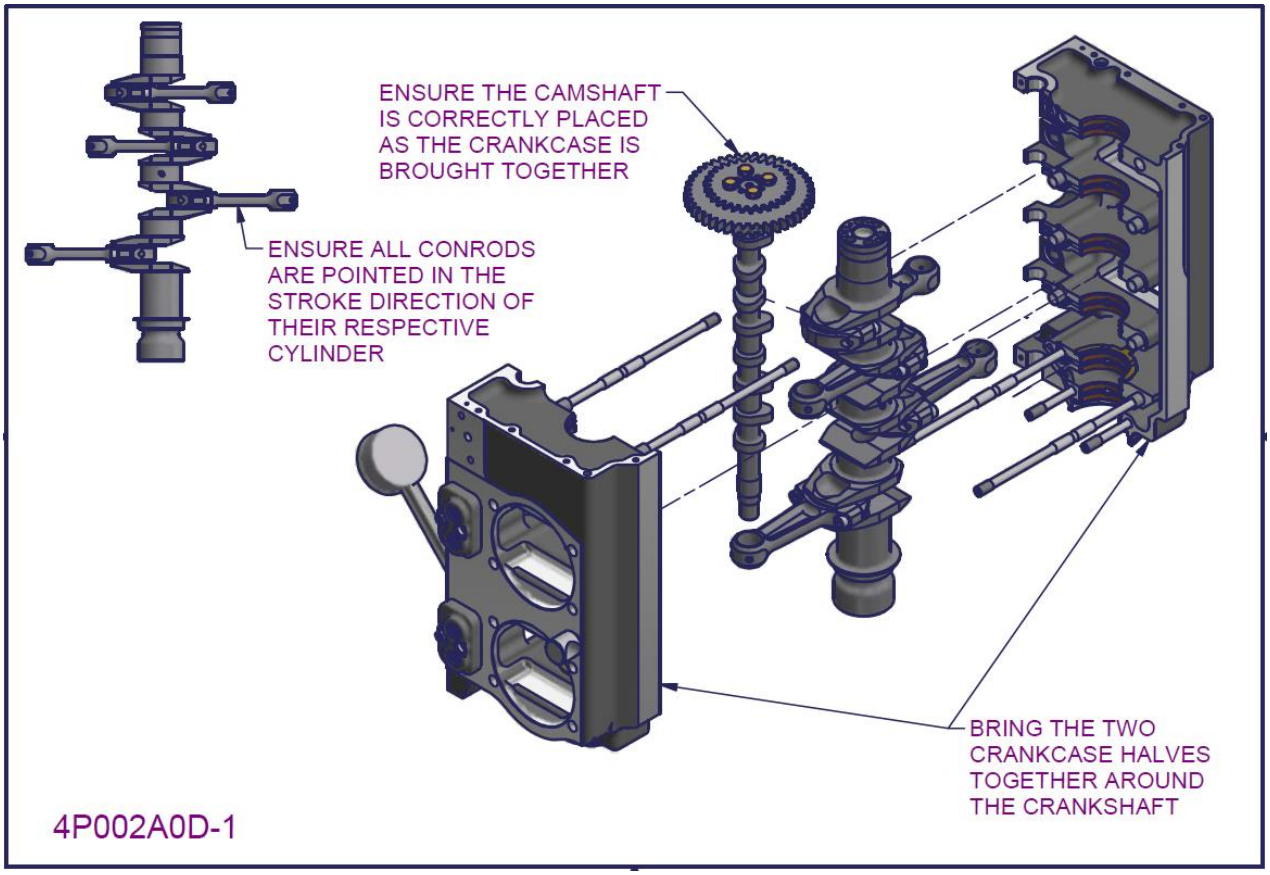


Figure 103 - 2200/3300 Joint engine assembly 1

- Apply Three bond sealant to ONE crankcase half mating face.
  - The sealant should be applied with a dabbing action to create small peaks.
  - Fingers should be used for most of the application with cotton buds useful for more detailed areas
  - Ensure the oil galleries are completely clean of sealant. Clean excess away with cotton buds
- Place the camshaft in one crankcase half
- Check the conrods are all point in the stroke direction of their respective cylinder
- Bring the two crankcase halves together around the crankshaft using the stud bolts to guide them
  - To push the halves over the dowels tap one crankcase half with a soft mallet, while a second person holds the other half rigidly up against the crankshaft.
  - Make sure the thrust bearings have not fallen out as the two halves were brought together.

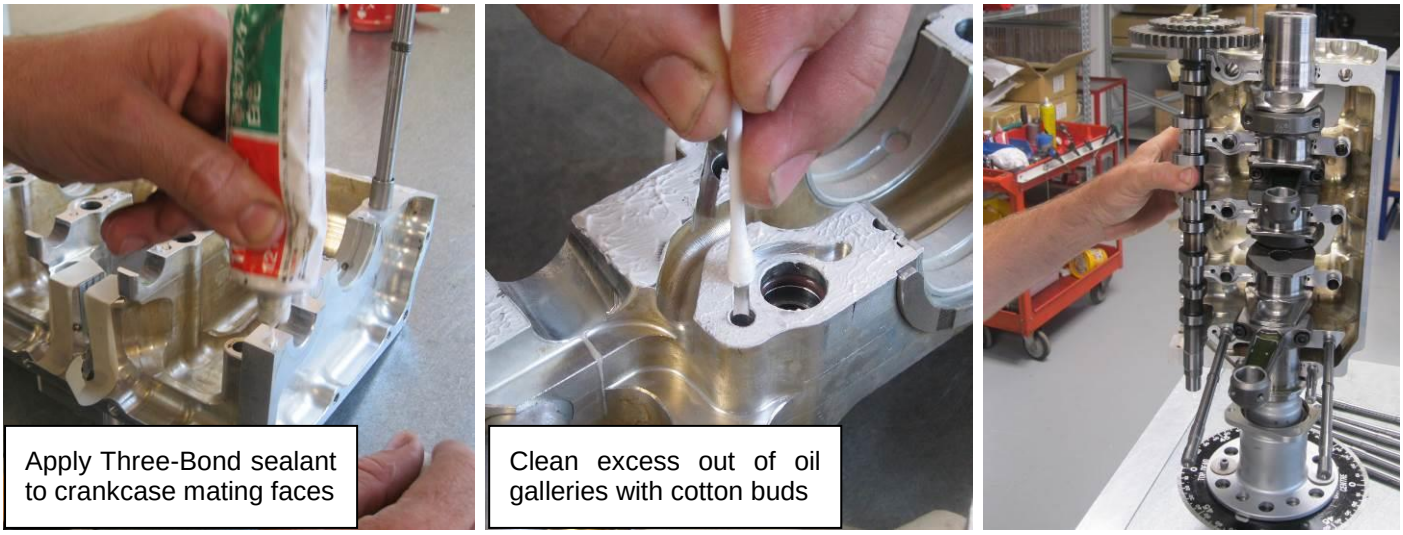


Figure 104 - Appling Three-bond to crankcase halves

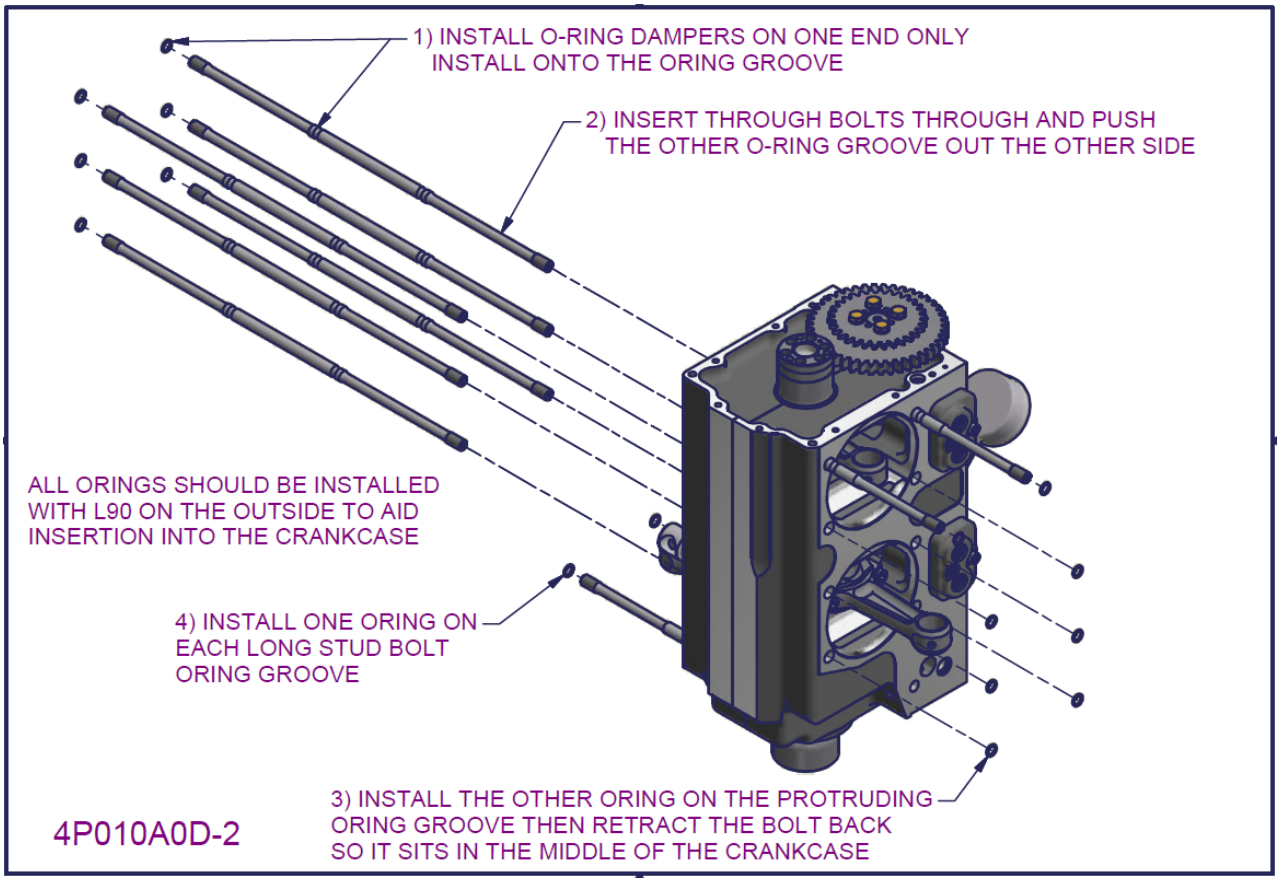


Figure 105 - 2200/3300 Joint engine assembly 2

- Install a vibration damping O-ring on ONE end of each through bolt.
  - The O-ring sits in the O-ring groove machined in the shank section of the bolts.
  - Apply L90 lubricant to the outside of the O-ring.
- Insert the through bolts through the crankcase.
  - The other end (i.e. the end which does not have an O-ring on it must be inserted first
  - Insert the through bolt through so the damping O-ring goes inside the crankcase and the other O-ring groove comes out the other side
- Install a second O-ring on the exposed O-ring groove
- Push this end of the bolt back through the crankcase so that both O-rings are inside the crankcase and the through bolt sits in the middle.
- Install a vibration damping O-ring on each O-ring groove of the long stud bolts (i.e. just above the surface of the crankcase.

Note

Vibration dampening O-rings must be installed on the respective O-ring grooves and should never be neglected or discarded.

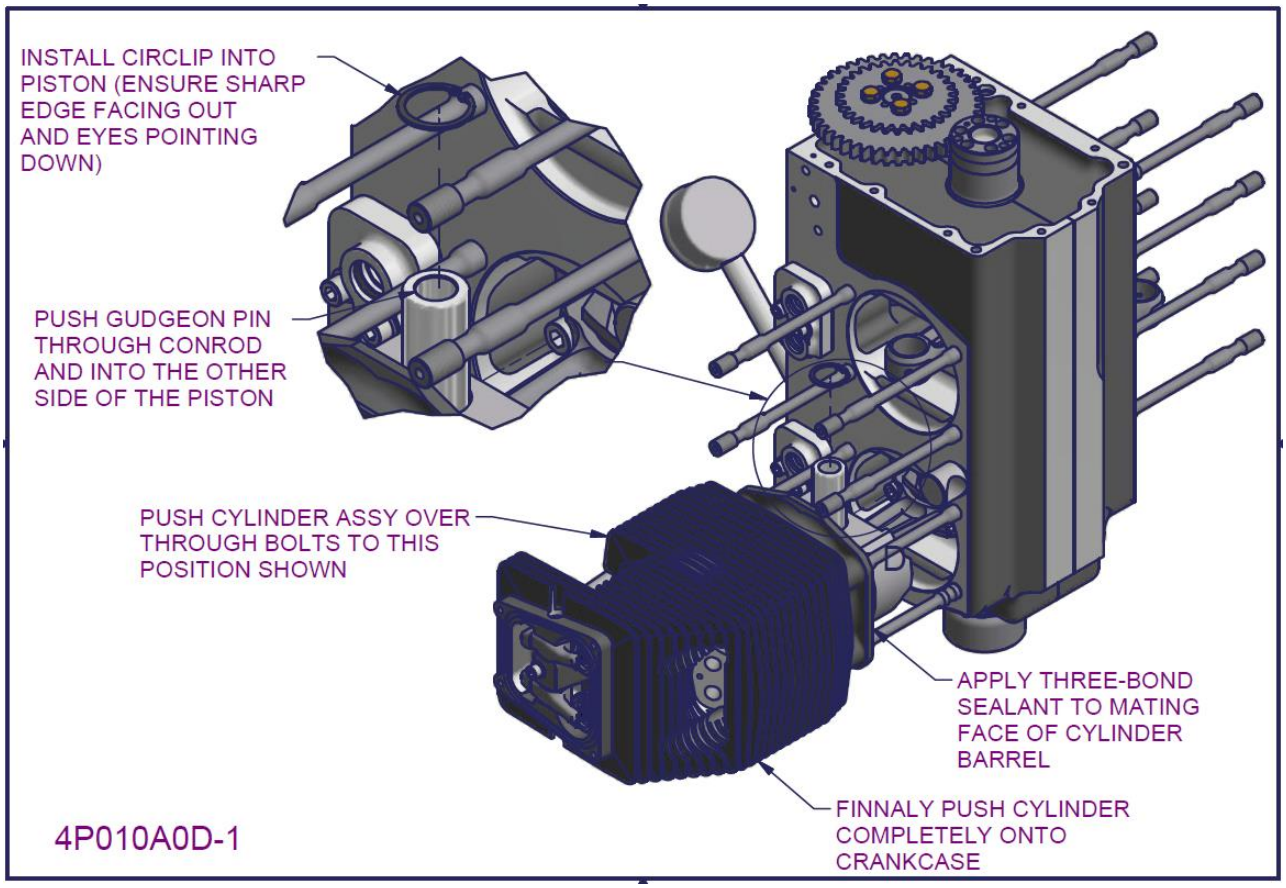


Figure 106 - 2200/3300 Joint engine assembly 3

- When installing cylinders always start with Cylinder #1 and work progressively up the engine (2, 3, 4 etc).
- Apply Three-bond sealant to the mating faces on the cylinder barrel
  - The sealant should be applied with a dabbing action to create small peaks.
- Slide the cylinder onto the engine guided by the through bolts until the piston gudgeon pin lines up with the conrod small end.
- Push the gudgeon pin through the conrod and into the other side of the piston
- Install a circlip into the flywheel end piston circlip groove. **Ensure the circlip is fully seated with the eyes pointed down and the sharp edge facing outwards (see Figure 62 and Figure 63)**
  - A drop of Loctite 620 is first applied between the circlip and the outside of the piston circlip groove **(do not allow Loctite to come between the circlip and gudgeon pin)**
- Push the cylinder fully home onto the crankcase mating face.
- Repeat these steps for the other cylinders until all are installed.

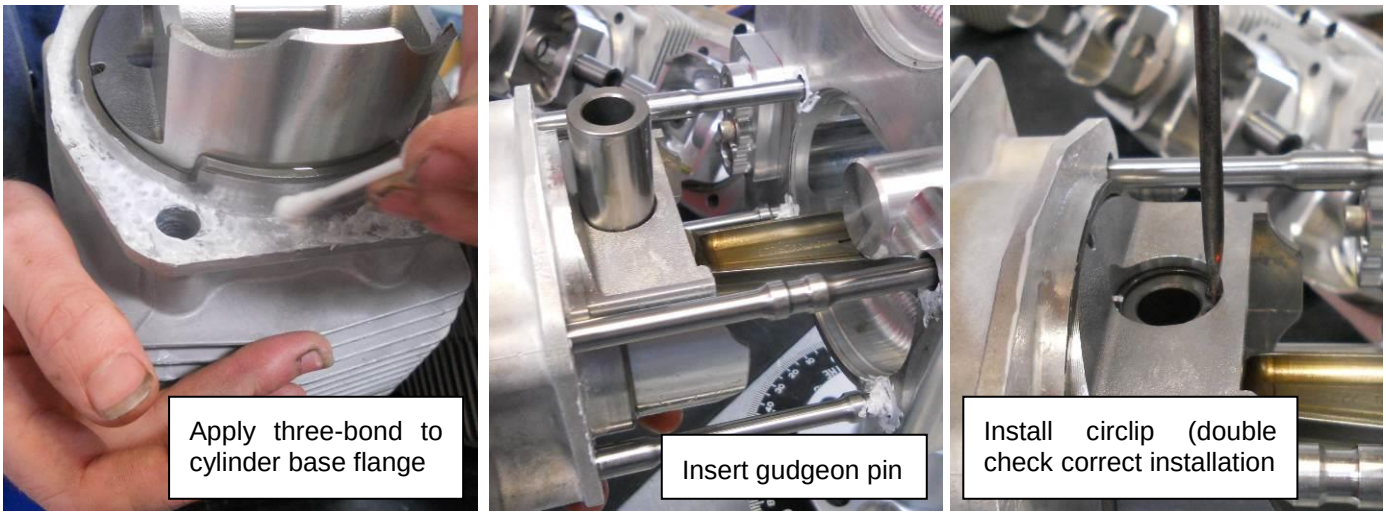


Figure 107 - Cylinder installation

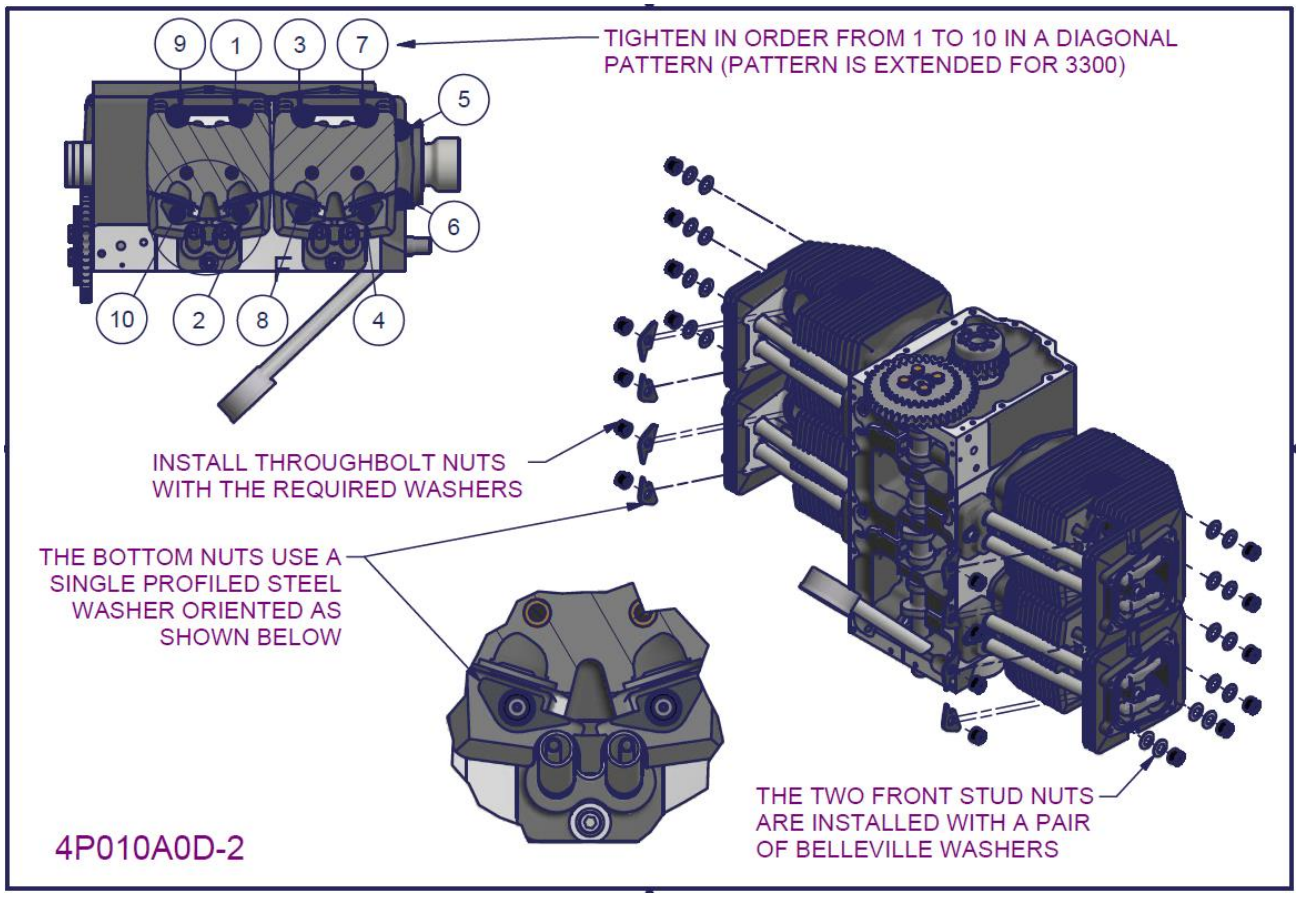


Figure 108 - 2200/3300 Joint engine assembly 4

- Install the 12 point nuts with the correct designated washers to contact
  - The bottom through bolts and bottom long stud bolts (i.e. adjacent to the induction and exhaust ports) use a single specially profiled steel washer.
  - The top through bolts and bottom long stud bolts (i.e. adjacent to the spark plugs) use two 3/8" Belleville washers stacked to tessellate (i.e. not opposing each other).
  - The two front short studs also use two 3/8" Belleville washers stacked to tessellate.
- Torque all nuts to 20ft.lb using a diagonal tightening pattern such at that shown in Figure 108.
- Torque all nuts to the prescribed torque setting in section 0 using the same tightening pattern.
- Mark nuts with a paint pen or torque seal as they are torqued to the final prescribed setting.
  - Nut must be torqued on the left side followed by the right side using equivalent tightening patterns.
  - Using such a pattern will require quick changes of tools. From a socket to a crows foot and back again. Make sure you are using the correct torque setting for the crows' foot tool as opposed to the socket.
  - Refer to the table in section 3.11.2 for guidance on using a crow's foot attachment on a torque wrench.

Note

Ensure the correct torque setting in section 3.11.2 is used for the particular type of through bolt. There are two types (3/8" UNF and 7/16" UNF) with different torque requirements.

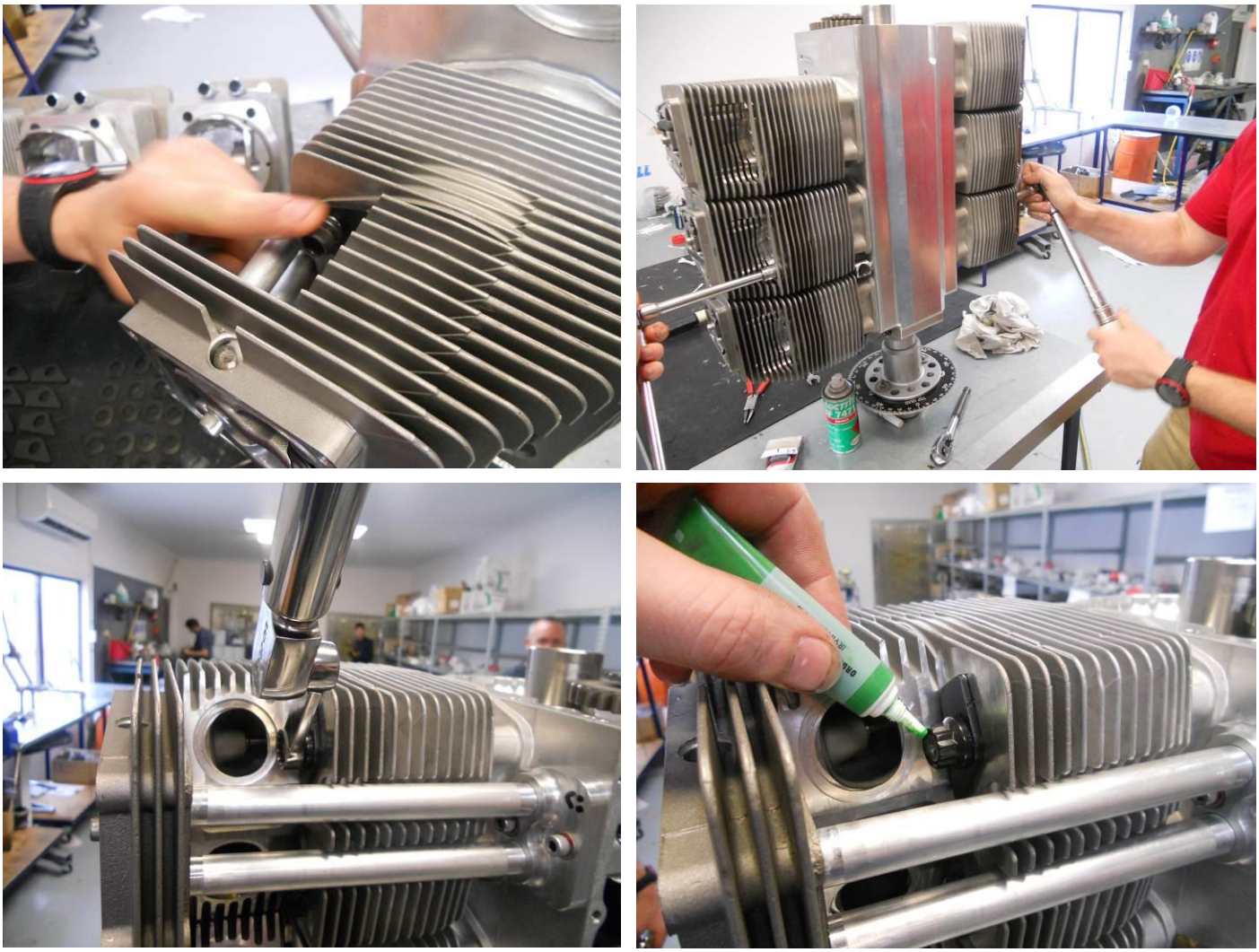


Figure 109 - Installing washers, nuts and tightening to torque

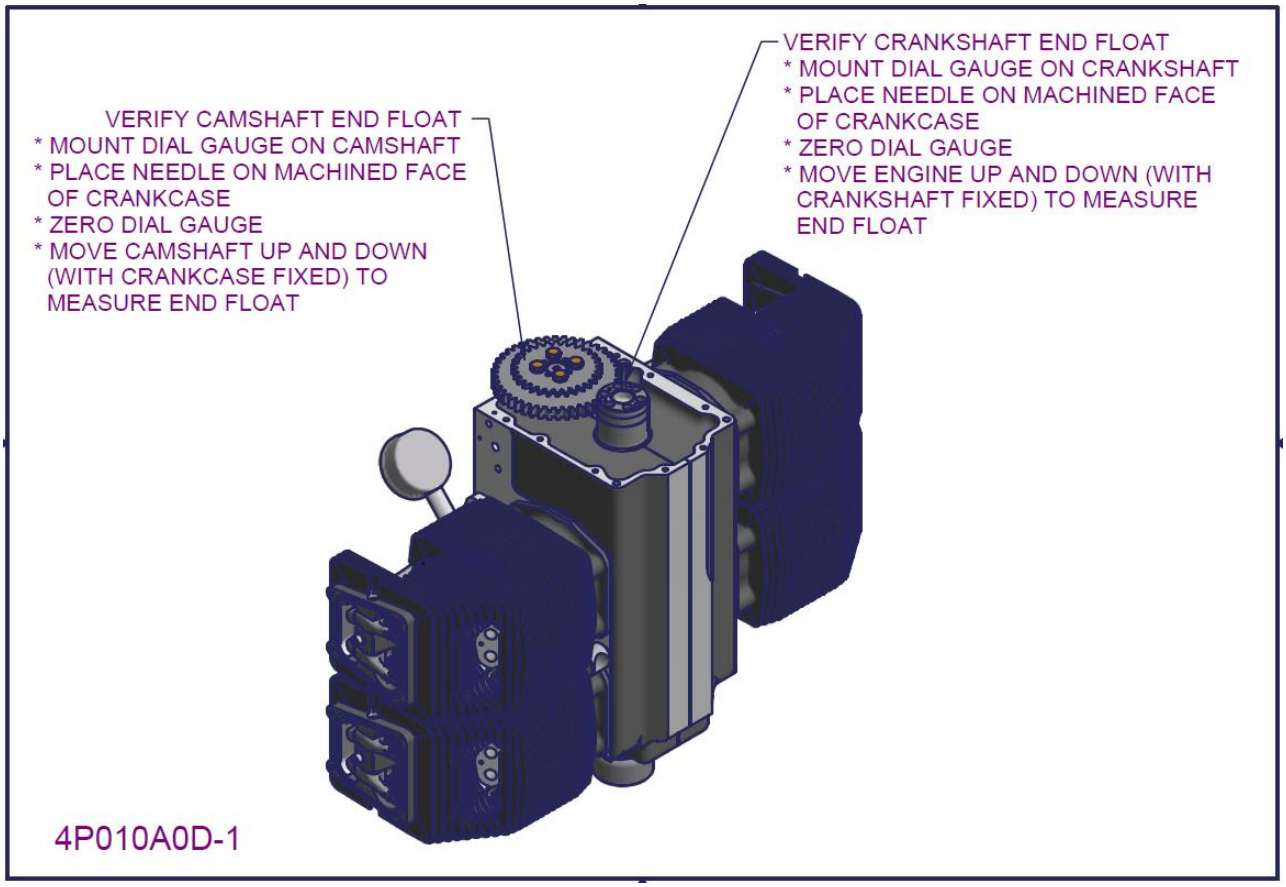


Figure 110 - 2200/3300 Joint engine assembly 5

- Before proceeding with all ancillary installations the crankshaft and camshaft end float must now be verified now that the engine is joined
- Check the crankshaft end float relative to the crankcase
  - Mount a dial gauge on the flywheel end of the crankshaft
  - Place the needle on a machined face of the crankcase (i.e. where the back plate will seal onto
  - Zero dial gauge and move crankcase up and down (with the crankshaft fixed to the bench) to measure crankshaft end float. Check the verified end float is within the limits of section 3.11.4.
  - *Record the verified crankshaft end float in the build log (section 6.4).*
- Repeat the same for the camshaft (by mounting the dial gauge on the camshaft and moving the camshaft up and down to measure end float). Again check end float is within limits
  - *Record the verified camshaft end float in the build log (section 6.4).*

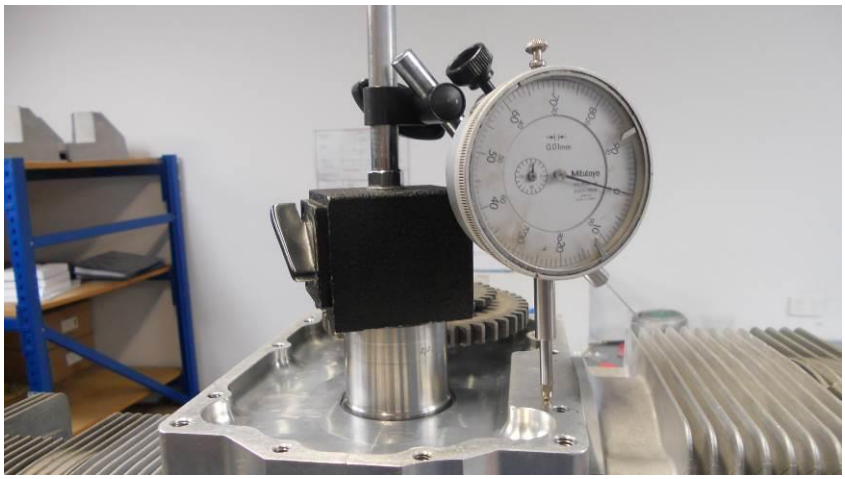


Figure 111 - Verifying end float using a dial gauge

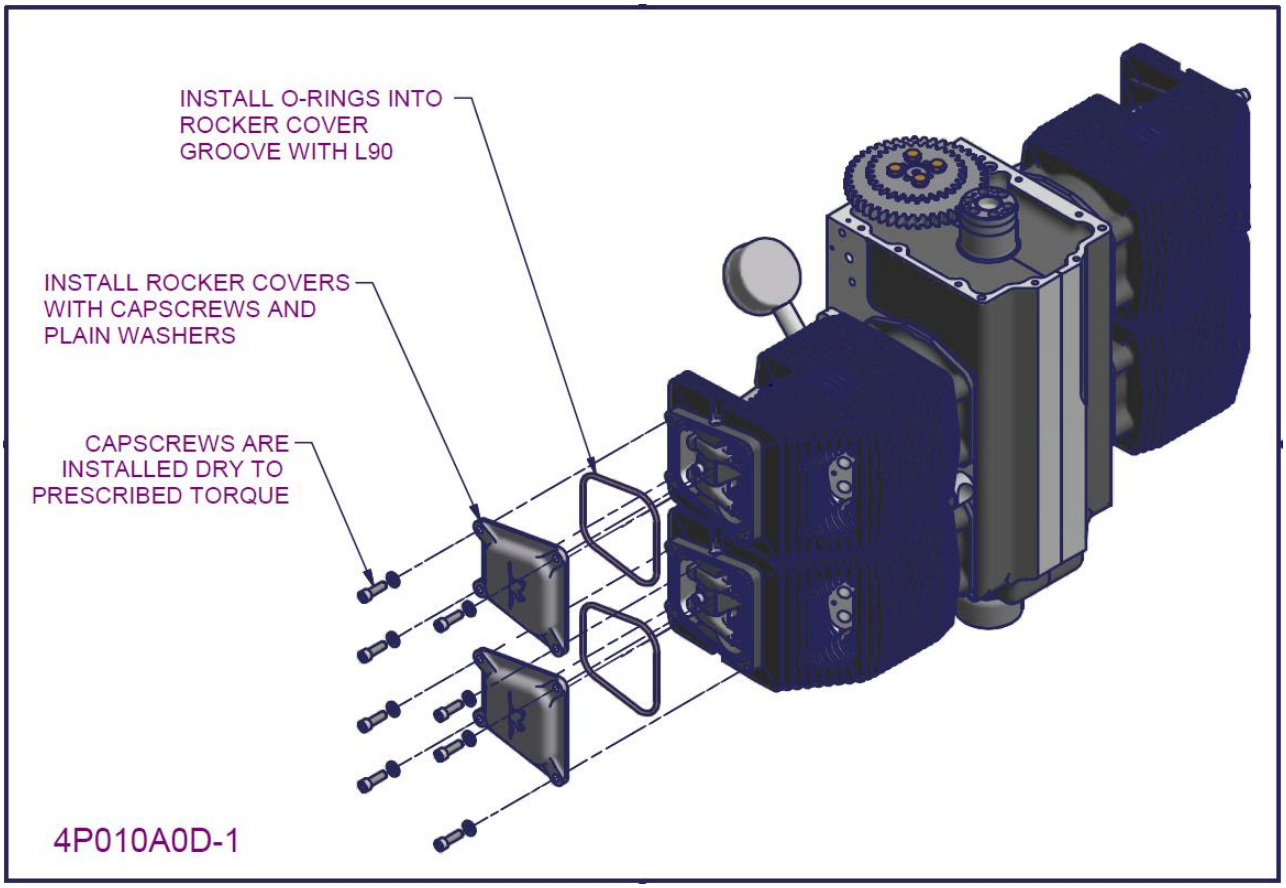


Figure 112 - 2200/3300 Joint engine assembly 6

- Apply L90 lubricant and install O-rings into rocker cover grooves
- Install rocker covers onto cylinder heads with capscrews and a single AN plain washer under each.
    - Screws are installed DRY (without Loctite) to the torque setting prescribed in section 0.
    - The rocker cover on number 1 cylinder should be left off in order to check the camshaft timing (see section 4.9).

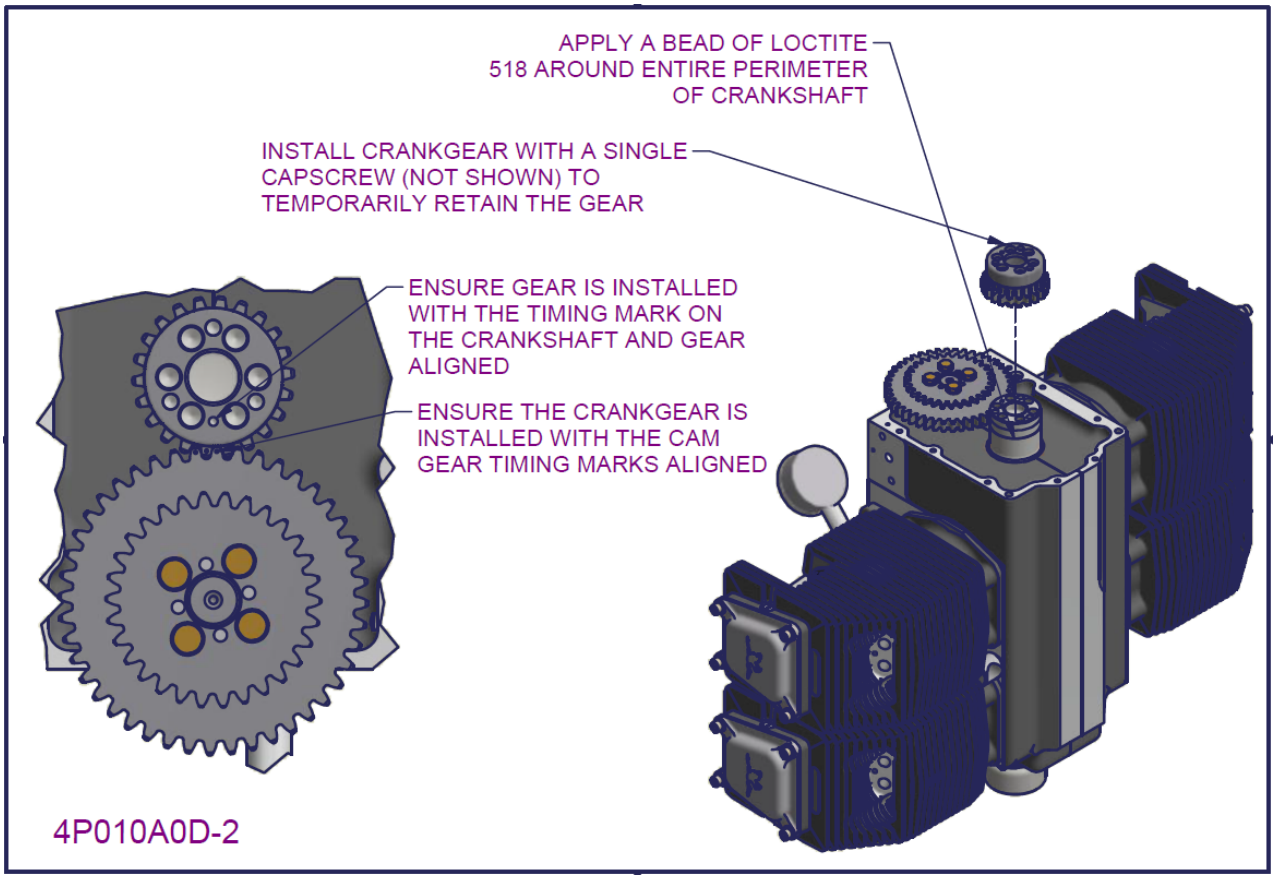


Figure 113 – 2200/3300 Joint engine assembly 7

- Ensure the flywheel end of the crankshaft is completely clean and dry and check the crank gear itself is also completely dry and clean

WARNING

It cannot be overstated enough how important is a perfectly dry crank gear to crankshaft connection. Oils in this connection reduce the friction capacity of this joint and can cause flywheel screw failure.

- Apply a bead of Loctite 518 around the entire perimeter of the crankshaft
  - Ensure the bead is continuous and un-broken
  - The bead should be applied **22mm** down from the flywheel attachment face.

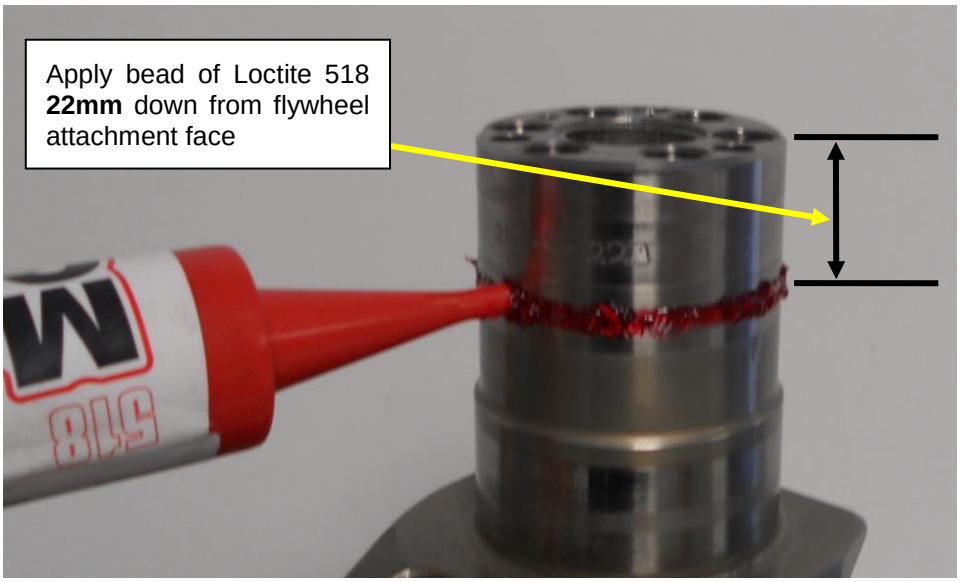


Figure 114 - Apply bead of Loctite 518 around perimeter of crank-gear

- Install the crank gear on the crankshaft. Use one capscrew to temporarily retain the crank gear in place
  - *Record the serial number of the crank-gear in the build log (section 6.6)*
  - The crank gear must be installed with the timing hole in the gear aligned with the timing hole in the crankshaft.
  - The crank gear must be installed so the timing mark on the crank gear tooth sits between the two timing marks on the large cam gear.
- This concludes the **Joint Engine assembly.**

4.9 Check camshaft timing

- It is important that the camshaft timing is verified as being correct before continuing with further assembly. This section describes the procedure used for checking timing.
- The timing of the camshaft is verified by inspection of the exhaust lobe on number 1 cylinder head (this applies for both 4 and 6 cylinder engines.

4.9.1 Finding top dead centre (TDC)

- Remove the rocker cover of number one cylinder head if not already done so.
- Install an arrow indicator either on two temporarily fitted front seal capscrews or under one of the front through bolts nuts. (A length of wire will also suffice).
- For the 2200 and 3300 configurations engine a spark plug dial gauge must be used to indicate the piston position and therefore find top dead centre. Install the spark plug dial gauge into one of the spark plug holes in number 1 cylinder head.
- Rotate the engine to **approximate TDC on compression stroke**.
    - The compression stroke of the engine will have both valves CLOSED.
    - Approximate TDC can be judged by the point at which the dial gauge indicates the turning point (i.e. when the piston begins to descend.
- Zero the dial gauge at this point
- Move the arrow indicator (or piece of wire) to point at the TDC position on the timing plate.

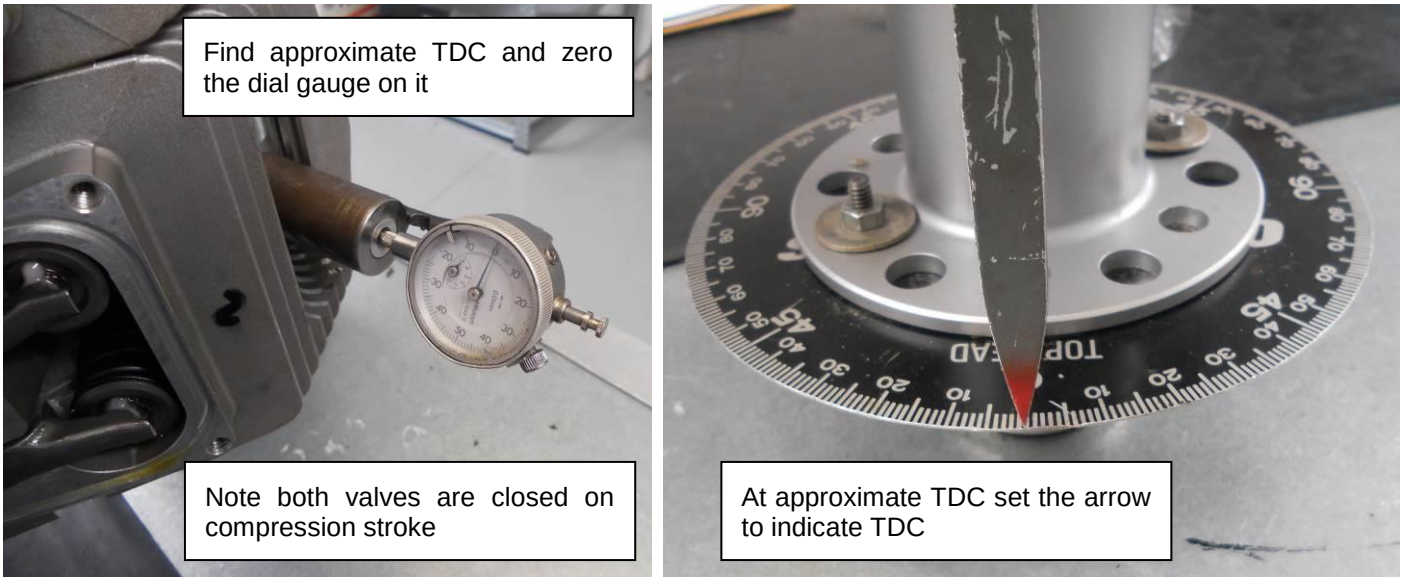


Figure 115 - set dial gauge and arrow indicator at approximate TDC

- Now rotate the engine clockwise (when viewed from the flywheel) until the dial gauge indicates 0.5mm below approximate TDC. Note the angle which the arrow indicator points toward.
- Now rotate the engine anticlockwise until the dial gauge goes through approximate TDC and indicates slightly below 0.5mm below TDC then bring the engine back slightly clockwise until it come up to 0.5mm below TDC. Note the angle which the arrow indicator is pointing to.
- The top dead centre position lies equidistant between the two 0.5mm angles indicated by the arrow gauge. Move the arrow gauge the necessary amount so the arrow gauge indicates the position of exact TDC.
    - For example. If the first indicated angle at 0.5mm is 9 degrees right and the second indicated angle at 0.5mm below is 7 degrees left, then true TDC will be 1 degree right of approximate TDC and the indicating arrow should be adjusted as such.
    - Once true TDC is found DO NOT MOVE THE ARROW. Or it will have to be found again
- Repeat the process to verify that true TDC has been found.

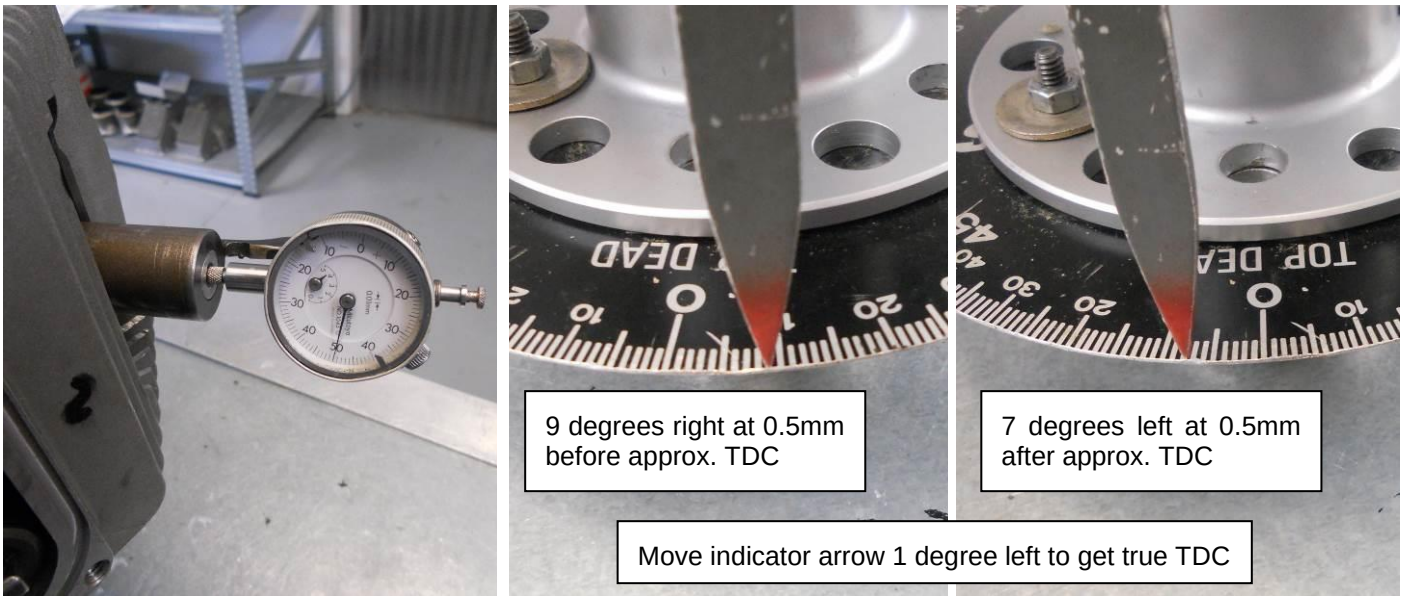


Figure 116 - Locating true TDC

4.9.2 Checking Cam timing

- With true TDC found as indicated by the indicating arrow, the cam timing is now checked using number one cylinder head on the exhaust lobe.
- Install a steel plate on one of the rocker cover screw holes on cylinder number one.
- Set up a magnetic base dial gauge on the steel plate so the dial pointer rests on the pushrod end of the exhaust valve rocker arm.

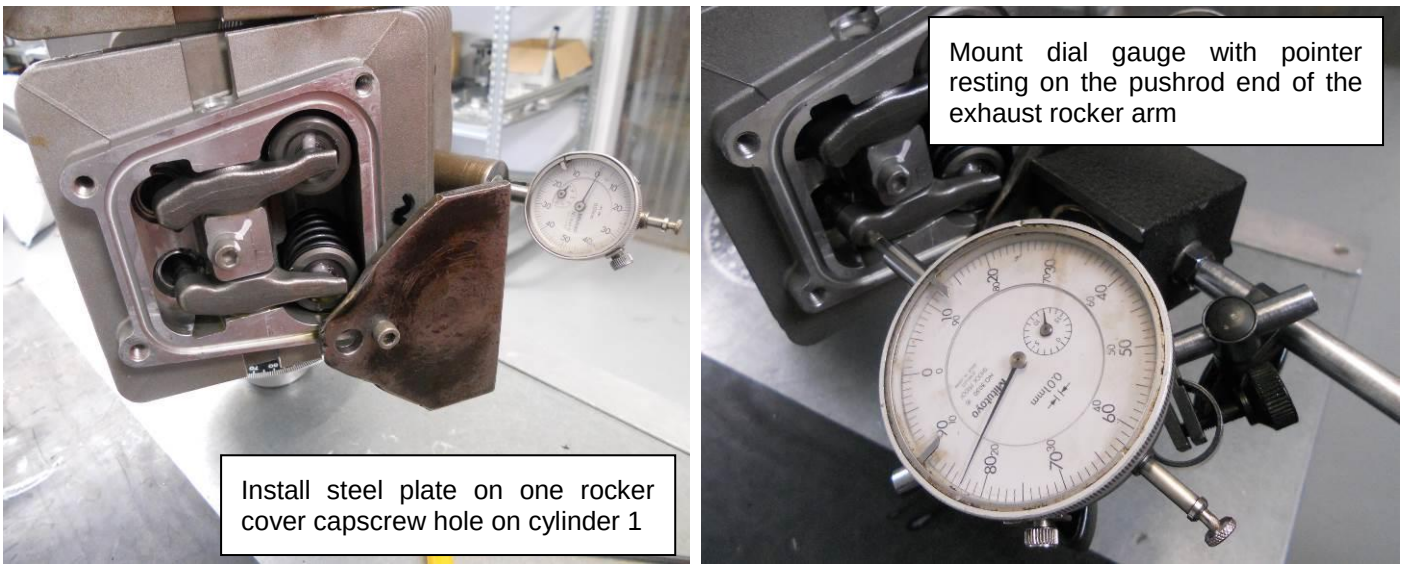


Figure 117 – setup dial gauge on number 1 exhaust rocker arm

- Rotate the engine anticlockwise (when view from the flywheel end) to point at 70 degrees after Bottom Dead Centre (BDC).
- By viewing inside the engine it should be observed that the number one exhaust lobe is on approximate maximum lift. This is used as the starting point for measuring camshaft timing.
- Wait a short time for the lifter to bleed down (the lifter will be fully bled down when the dial gauge arrow stops moving). Then zero the dial gauge.

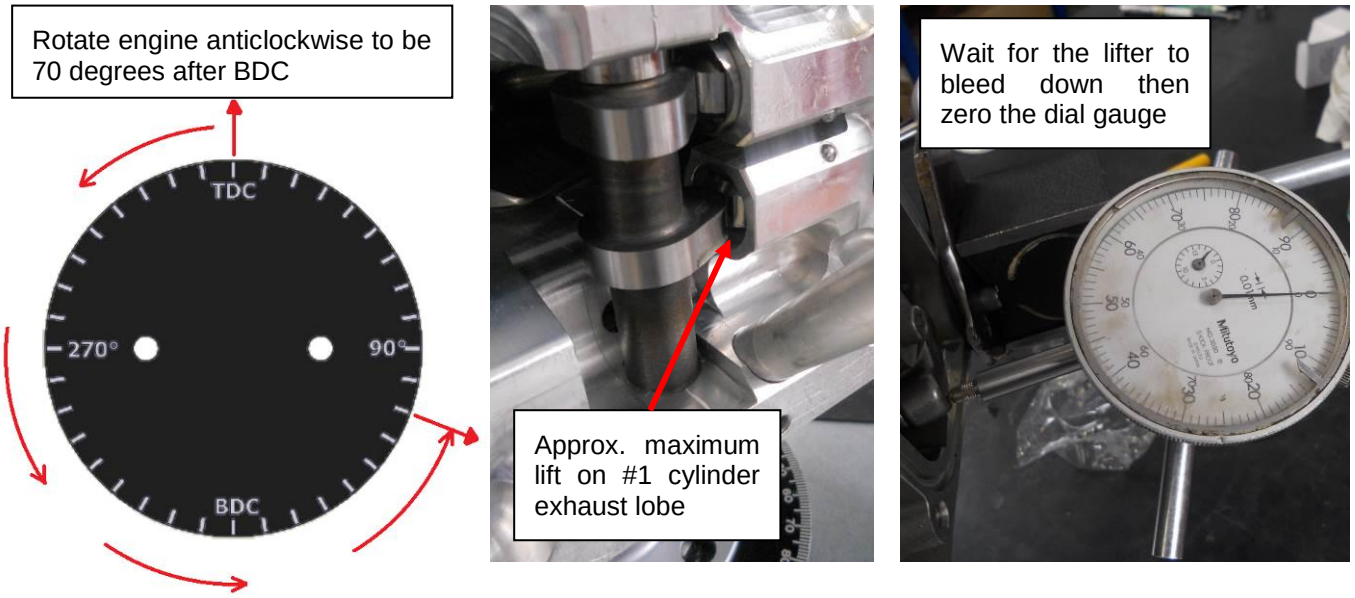


Figure 118 – setting zero on the dial gauge at approximate maximum lift (exhaust #1)

- From this position rotate the engine clockwise until the dial gauge indicates 0.5mm before maximum lift. Note the angle indicated by the arrow.
- Now rotate the engine anticlockwise past 0.5mm after maximum lift and rotate the engine clockwise again onto the 0.5mm after maximum lift position as indicated by the dial gauge. Note the angle indicated.

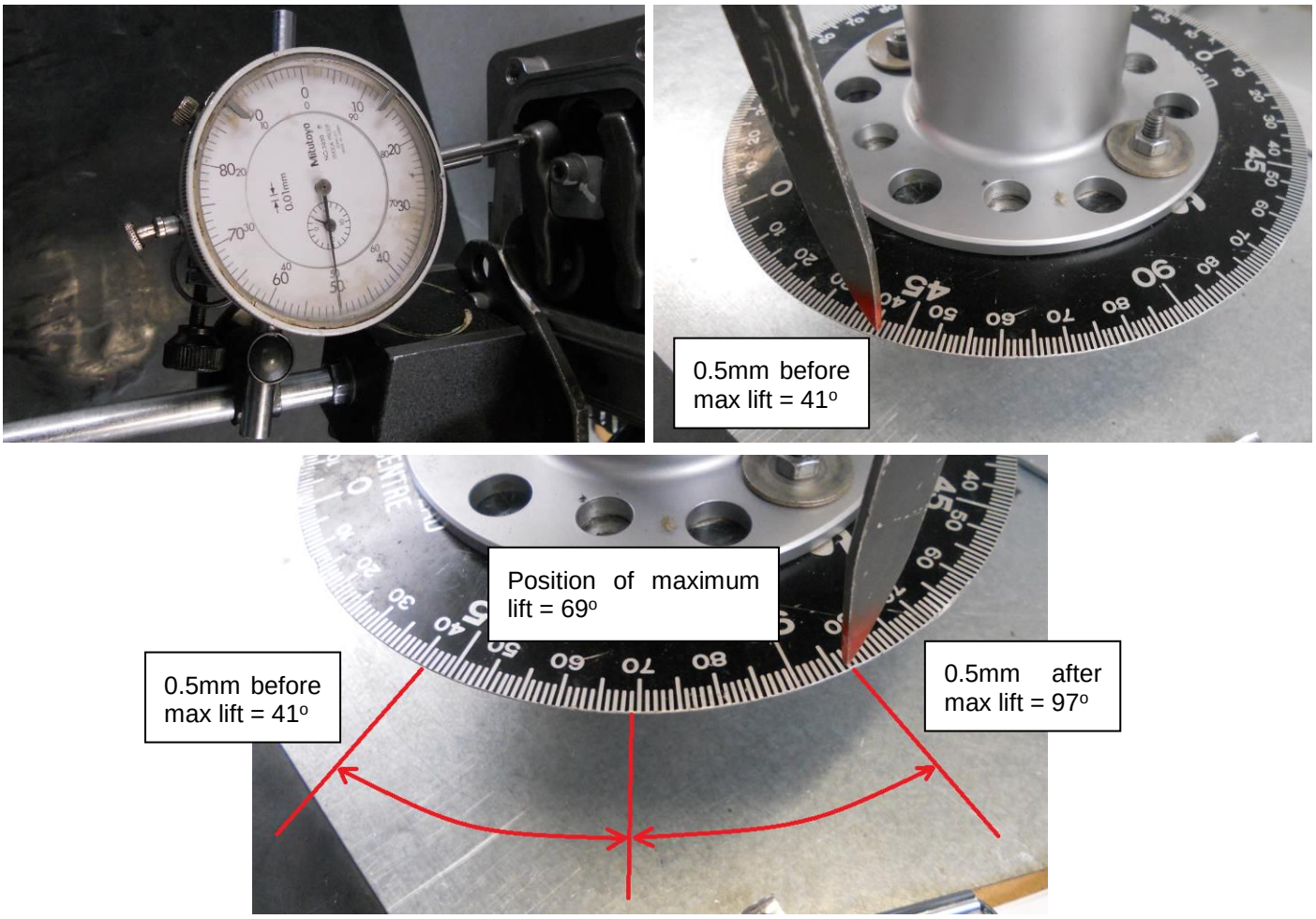


Figure 119 - Locating the position of maximum lift for the exhaust lobe on number 1 cylinder

- The position of maximum lift is equidistant between the two angles indicated at 0.50mm before and after maximum lift. Figure 119 shows an example.
    - At 0.50mm before maximum lift the angle is 41^{o}
    - At 0.50mm after maximum lift the angle is 97^{o}
    - The angle equidistant is calculated by finding the average of these two angles
    - Angle of maximum lift = (41^{o}+97^{o}) ÷ 2 = 69^{o}
    - *Record the angle of maximum lift for exhaust lobe #1 in the engine build log (section 6.12).*

- Check the recorded angle of maximum lift for exhaust lobe #1 lies within the tolerance prescribed in section 3.11.4.
- This completes **checking the camshaft timing.**

4.10 Sump installation

4.10.1 2200 Sump installation (cast integral plenum) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P010A0D-1	2210 JOINT ENGINE ASSY	1
2	4A652A0D-4	SUMP 2210 MACHINED WITH INDUCTION	1
3	PG0148N-1	BS116 VITON O'RING	1
4	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	13
5	PI10172N	TEMPERATURE SENDER	1
6	PE4A006N	GASKET WASHER SUMP PLUG	1
7	PH117434-5	SUMP PLUG REWORKED	1
8	PH0636N	GRUB SCREW 1/4 UNF x 1/4	1
9	4585364-5	DROPPER TUBE SUMP BREATHER (2.2L)	1
10	4585164-3	HOUSING DIPSTICK & BREATHER (2.2L)	1
11	4585264-3	BRANCH TUBE THREADED DIPSTICK (2.2L)	1
12	4A814A0D-1	DIPSTICK ASSY 2.2L FLAT (PER POONA DWG D-AP392/S001)	1
13	PH72624	SOCKET HD SCREW 1/4 UNC X 5/8	1

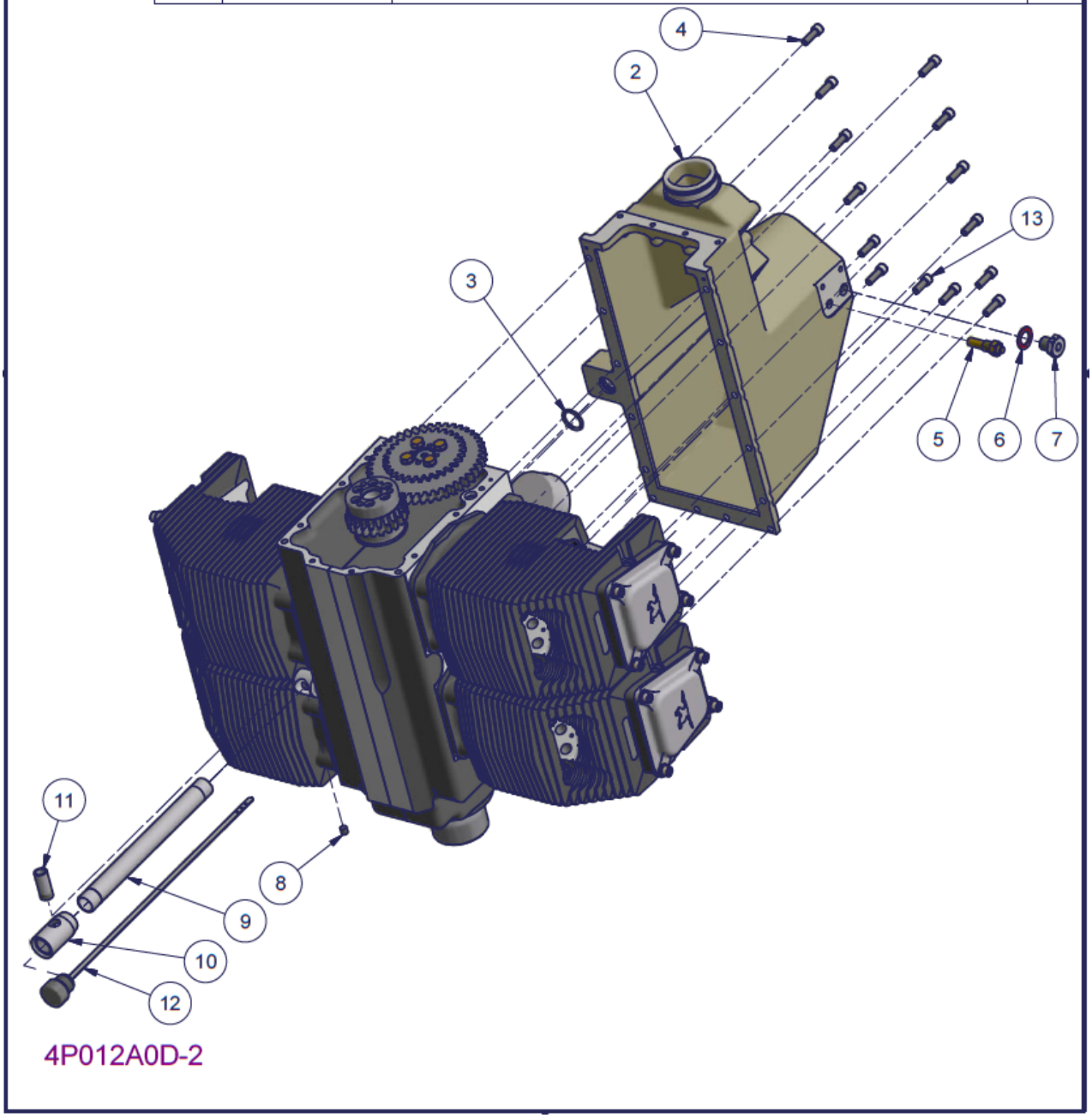


Figure 120 – 2200 Sump installation (integral plenum) – Parts List

4.10.2 2200 Sump installation (No plenum) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P010A0D-1	2210 JOINT ENGINE ASSY	1
2	PG0148N-1	BS116 VITON O'RING	1
3	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	13
4	PI10172N	TEMPERATURE SENDER	1
5	PE4A006N	GASKET WASHER SUMP PLUG	1
6	PH117434-5	SUMP PLUG REWORKED	1
7	PH0636N	GRUB SCREW 1/4 UNF x 1/4	1
8	4A298A0D-6	SUMP MACHINED LARGE CAPACITY 2.2L	1
9	4585164-3	HOUSING DIPSTICK & BREATHER (2.2L)	1
10	4585264-3	BRANCH TUBE THREADED DIPSTICK (2.2L)	1
11	4585364-5	DROPPER TUBE SUMP BREATHER (2.2L)	1
12	4A814A0D-1	DIPSTICK ASSY 2.2L FLAT (PER POONA DWG D-AP392/S001)	1
13	PH72624	SOCKET HD SCREW 1/4 UNC X 5/8	1

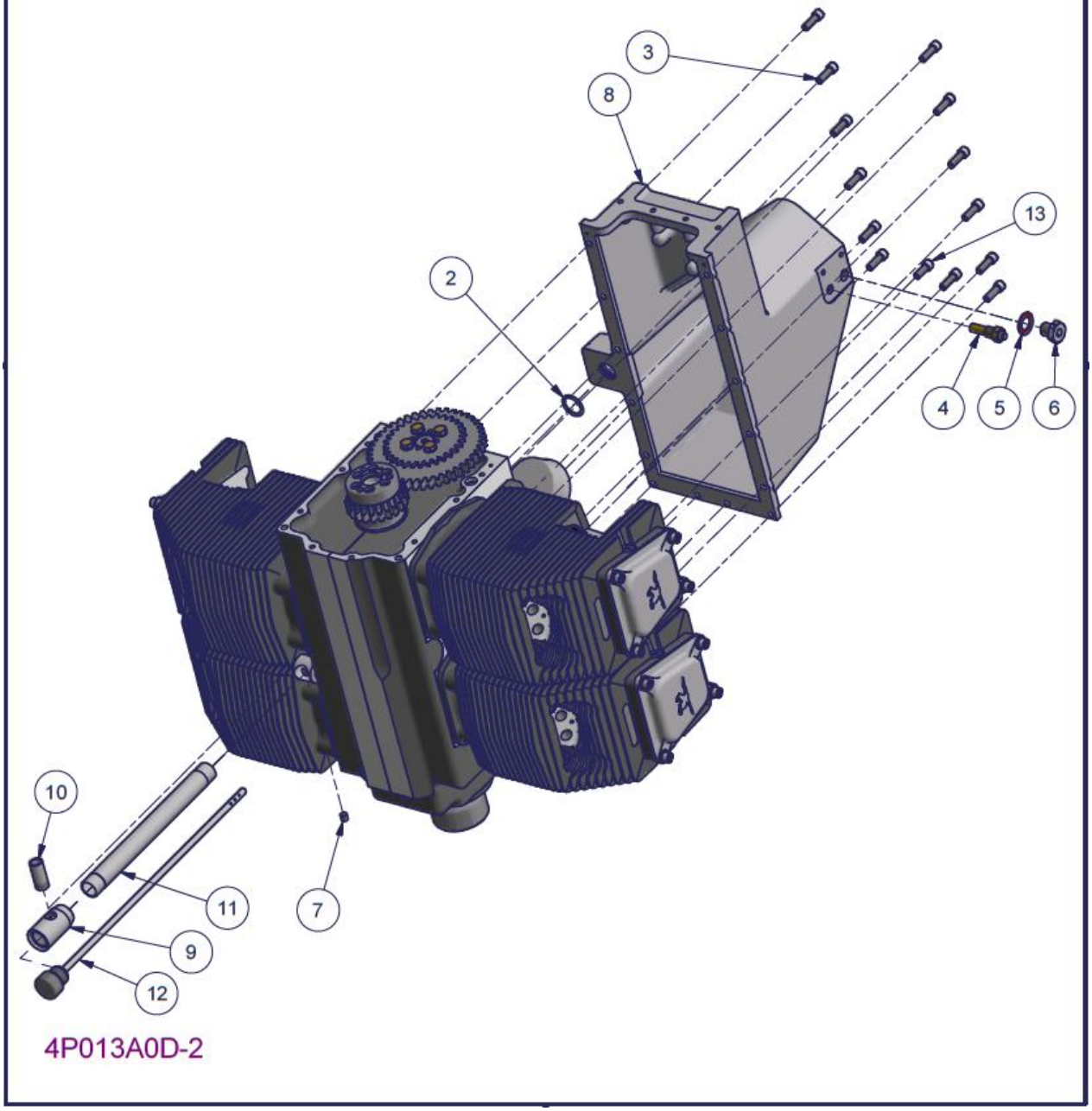


Figure 121 – 2200 Sump installation (machined plenum) – Parts List

4.10.3 3300 Sump installation (integral plenum) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P010A1D-1	3310 JOINT ENGINE ASSY	1
2	4A540A0D-7	SUMP MACHINED 3300 WITH INDUCTION	1
3	PG0148N-1	BS116 VITON O'RING	1
4	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	17
5	PI10172N	TEMPERATURE SENDER	1
6	PE4A006N	GASKET WASHER SUMP PLUG	1
7	PH117434-5	SUMP PLUG REWORKED	1
8	PH0636N	GRUB SCREW 1/4 UNF x 1/4	1
9	4585164-3	HOUSING DIPSTICK & BREATHER (2.2L)	1
10	4585264-3	BRANCH TUBE THREADED DIPSTICK (2.2L)	1
11	4585364-5	DROPPER TUBE SUMP BREATHER (2.2L)	1
12	4A815A0D-1	DIPSTICK ASSY 2.2L FLAT (PER POONA DWG D-AP392/S001)	1
20	PH72624	SOCKET HD SCREW 1/4 UNC X 5/8	1

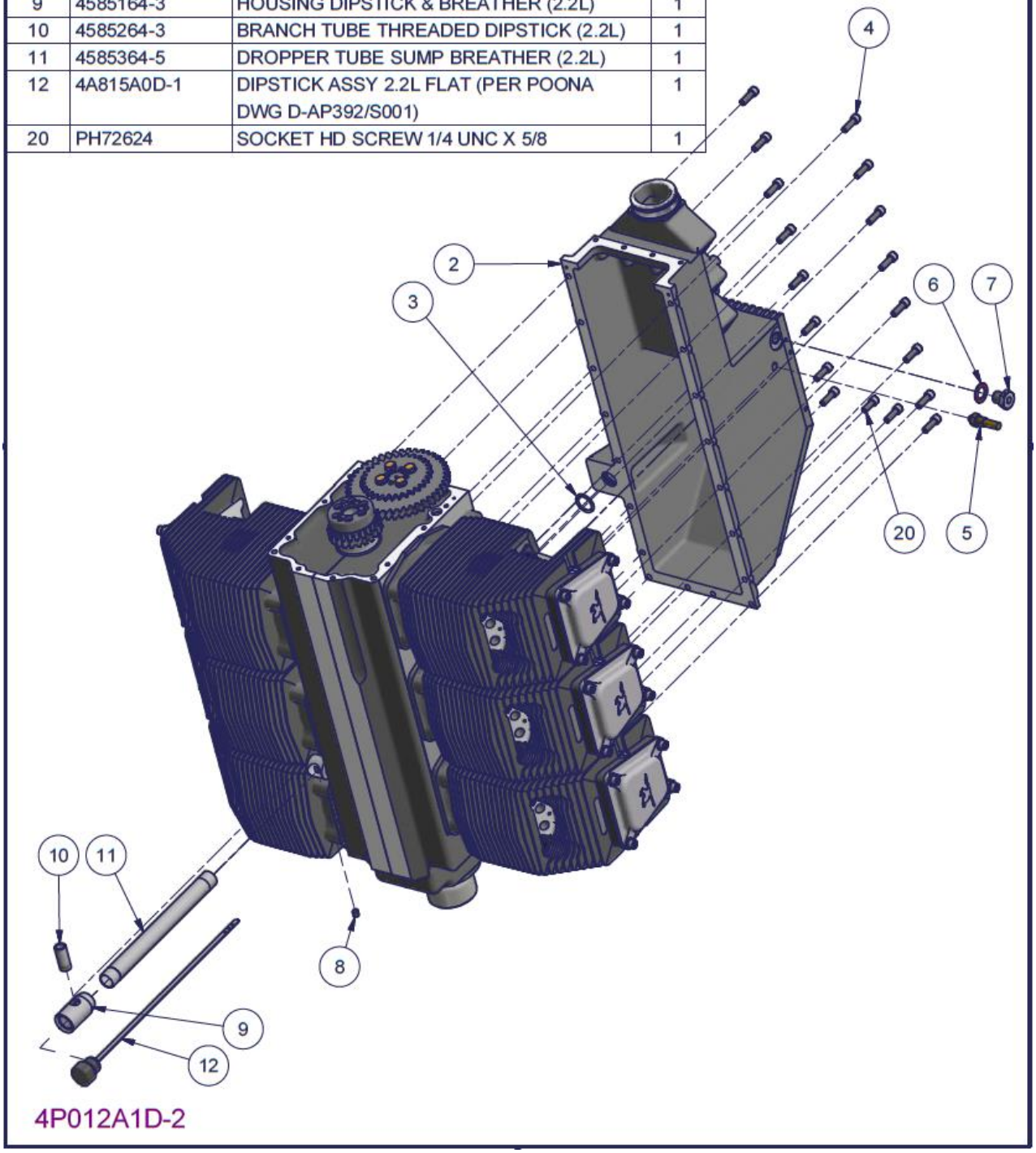


Figure 122 – 3300 Sump installation (integral plenum) – Parts List

4.10.4 3300 Sump installation (No plenum) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P010A1D-1	3310 JOINT ENGINE ASSY	1
2	PG0148N-1	BS116 VITON O'RING	1
3	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	17
4	PI10172N	TEMPERATURE SENDER	1
5	PE4A006N	GASKET WASHER SUMP PLUG	1
6	PH117434-5	SUMP PLUG REWORKED	1
7	PH0636N	GRUB SCREW 1/4 UNF x 1/4	1
8	960409X-15	SUMP 3.3L	1
9	4585364-5	DROPPER TUBE SUMP BREATHER (2.2L)	1
10	4585264-3	BRANCH TUBE THREADED DIPSTICK (2.2L)	1
11	4585164-3	HOUSING DIPSTICK & BREATHER (2.2L)	1
12	4A815A0D-1	DIPSTICK ASSY 2.2L FLAT (PER POONA DWG D-AP392/S001)	1
21	PH72624	SOCKET HD SCREW 1/4 UNC X 5/8	1

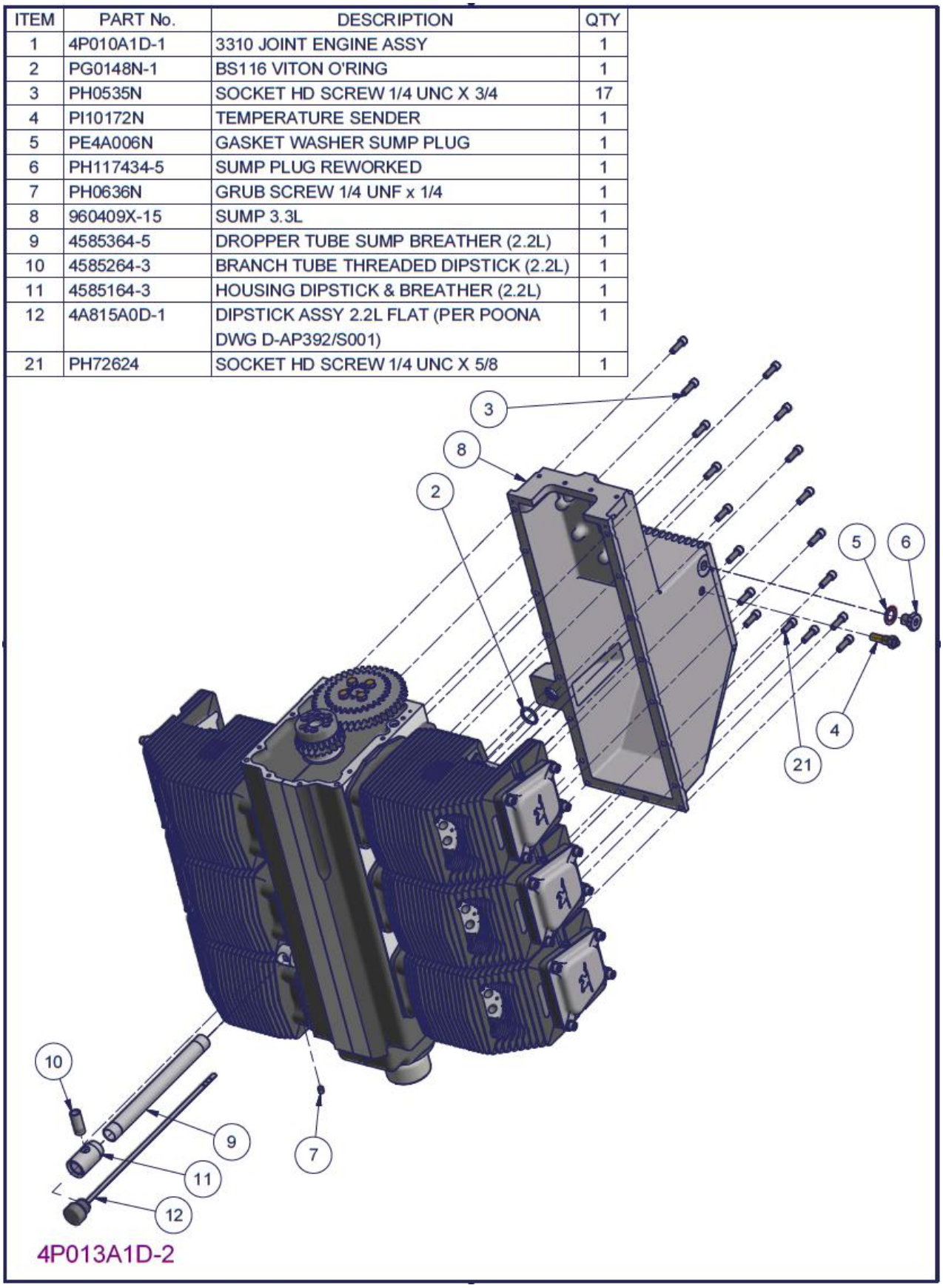


Figure 123 – 3300 Sump installation (No plenum) – Parts List

4.10.5 2200/3300 Sump installation

As the previous parts list drawings show there are several configurations or sump and plenum chamber by which an engine can be assembled. This section of the manual describes the installation of the sump and associated components; the procedure for which is identical regardless of the sump type used.

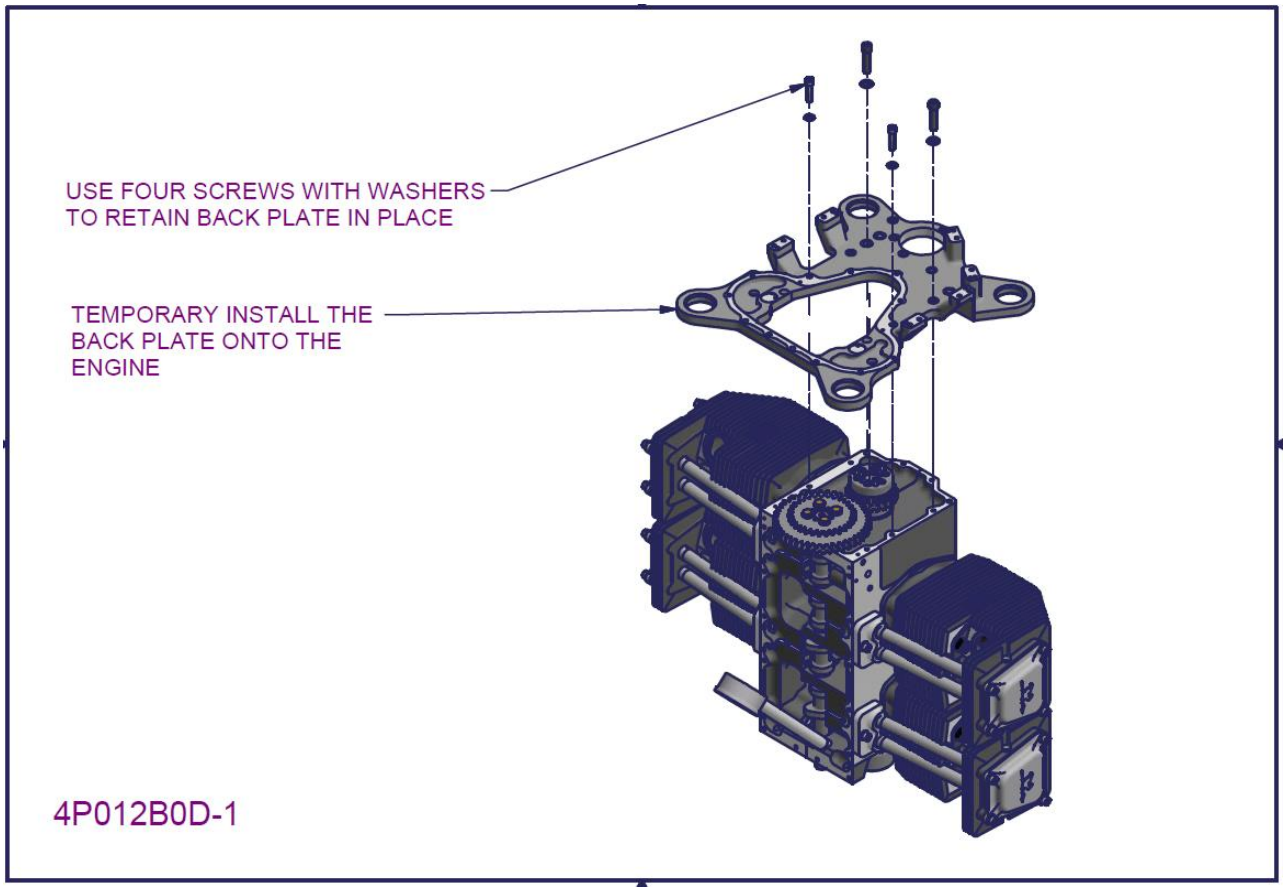


Figure 124 – 2200/3300 Sump installation 1

- Ensure all mating faces between the sump and the crankcase are clean and dry of any dirt and oils
- Fit the engine back plate temporarily using at least 4 screws with washers
    - The back plate is only temporarily fitted therefore no sealant is used, the back plate is installed dry
    - The retaining screws are also fit dry and only tight enough to prevent movement (i.e. no specific torque setting required)

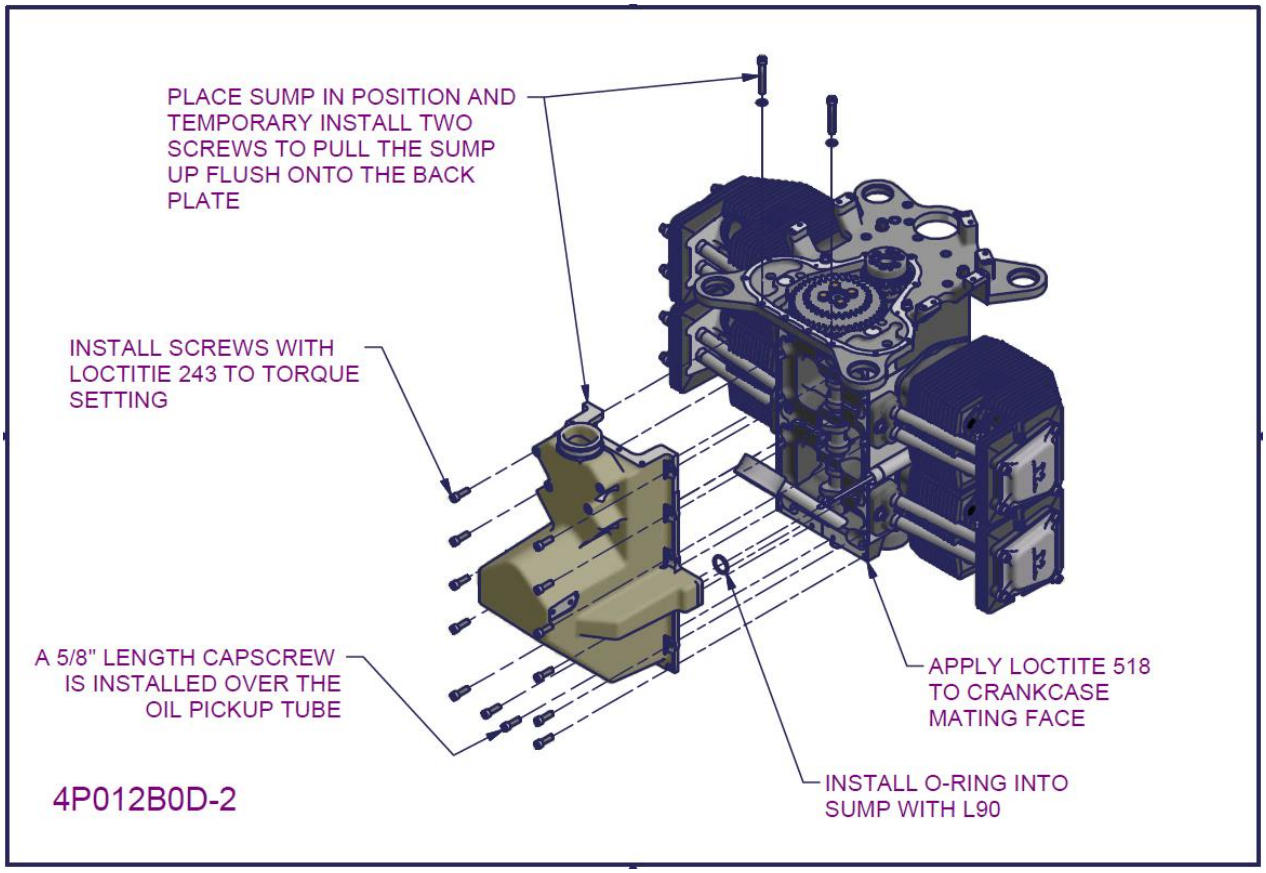


Figure 125 – 2200/3300 Sump installation 2

- Install the dipstick O-ring into the sump O-ring groove using L90 lubricant.
  - *Record the serial number of the sump in the build log (section 6.13)*
  - *Note the type of sump installed (i.e. integral cast plenum chamber or machined plenum) in the build log (section 6.13)*
- Apply Loctite 518 sealant to the crankcase mating faces using a dabbing action. Ensure the threaded holes are clear of this sealant.
- Position the sump onto the engine and install two screws through the previously fitted back plate into the sump, tighten these screws sufficiently to pull the sump hard up against the back plate mating face.
- Prime the retaining capscrews with Loctite 747 and install with Loctite 243 to the torque setting prescribed in section 0. Mark each screw with torque seal or paint pen as it is torqued.
  - Note that a shorter 5/8” capscrew is used for the hole over the oil pickup tube.

Figure 126 - Sump installation

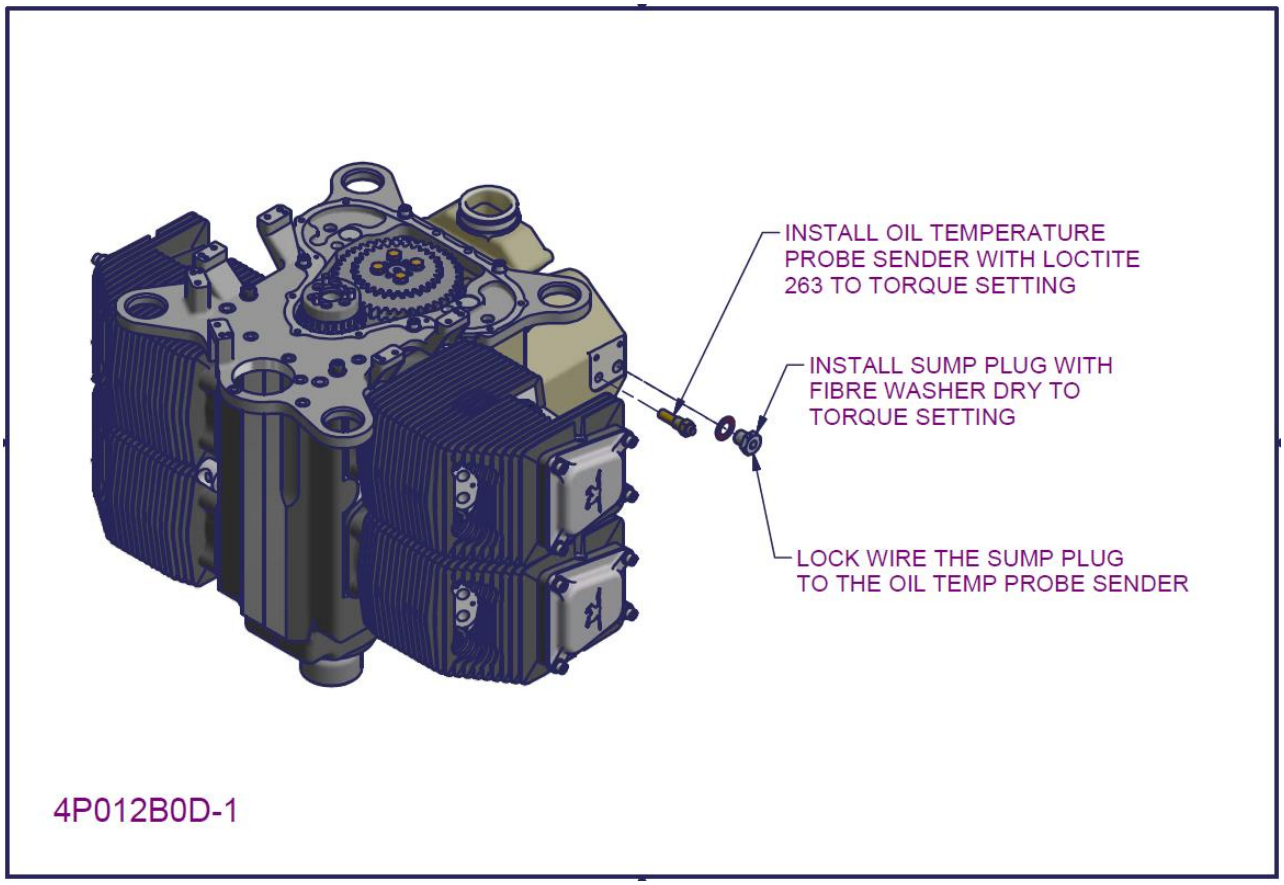


Figure 127 – 2200/3300 Sump installation 3

- Prime the thread of the oil temperature sender with Loctite 747 and install into the sump with Loctite 263 on the thread to the torque setting prescribed in section 0. Mark with paint pen.
- Install the sump plug with a fibre washer into the sump dry (i.e. without locking compound) to the torque setting prescribed in section 0.
- Lock wire the sump plug to the oil temperature sender
    - Note the orientation of the lock wire as shown in Figure 128. The lock wire must retain the plug from rotating to untighten. Wire ends must be neat.
    - The recommended wire is aircraft stainless steel wire of 0.032 thickness (0.81mm)

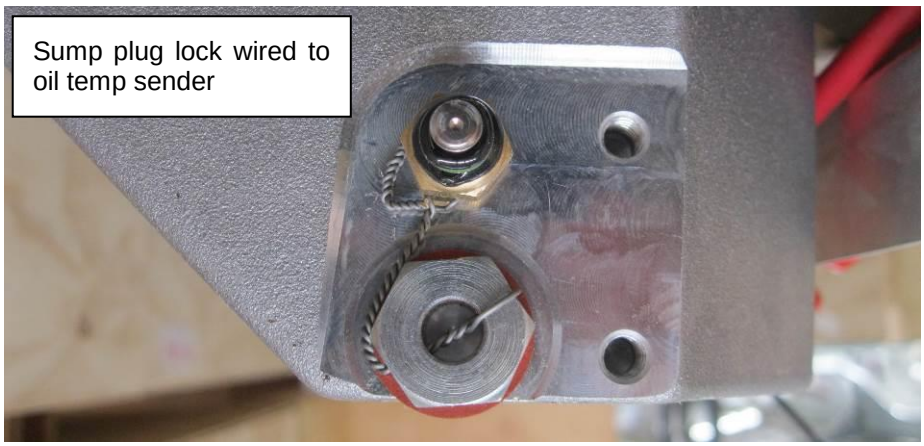


Figure 128 – Sump plug lock wiring

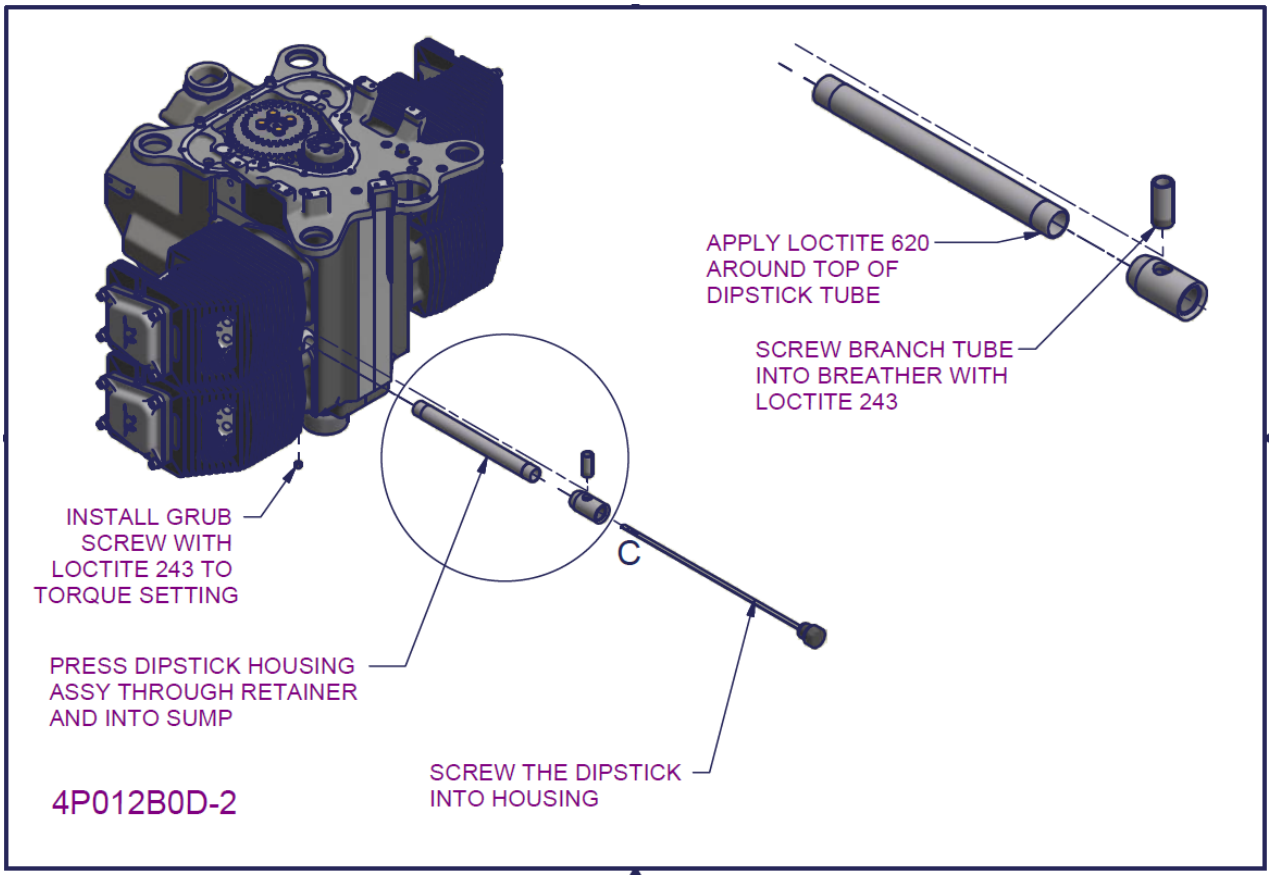


Figure 129 – 2200/3300 Sump installation 4

- Clean and prime the dipstick and housing using Loctite 747.
- Install the dipstick tube into the dipstick housing with Loctite 620 using a press or soft mallet.
  - Ensure the dipstick bottoms out on the housing or incorrect oil level readings will result.
- Apply Loctite 243 and screw the branch tube into the breather housing
- Screw the dipstick into the housing
- Fit the dipstick housing assembly through the retainer into the sump
- Install the grub screw into the dipstick retainer using Loctite 243 to the torque setting prescribed in section 0.
  - Ensure the dipstick housing breather outlet is aligned pointing directly out toward the rear of the engine before installing the grub screw.
- This completes the **sump installation** (with cast integral plenum chamber).
  - If the machined plenum chamber is installed instead the same procedure applies for the installation of the sump.

4.11 Heat shield and Plenum chamber installation

4.11.1 2200 Heat shield installation (cast integral plenum) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P012A0D-1	2210 SUMP INSTALLATION (INTERGRAL PLENUM)	1
2	4573064-8	HEAT SHIELD 2.2L	1
3	PH0219N	WASHER 1/4 X 5/8 FLAT Z/P	6
4	PH10724-2	1/4" BELLEVILLE WASHER	2
5	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	2

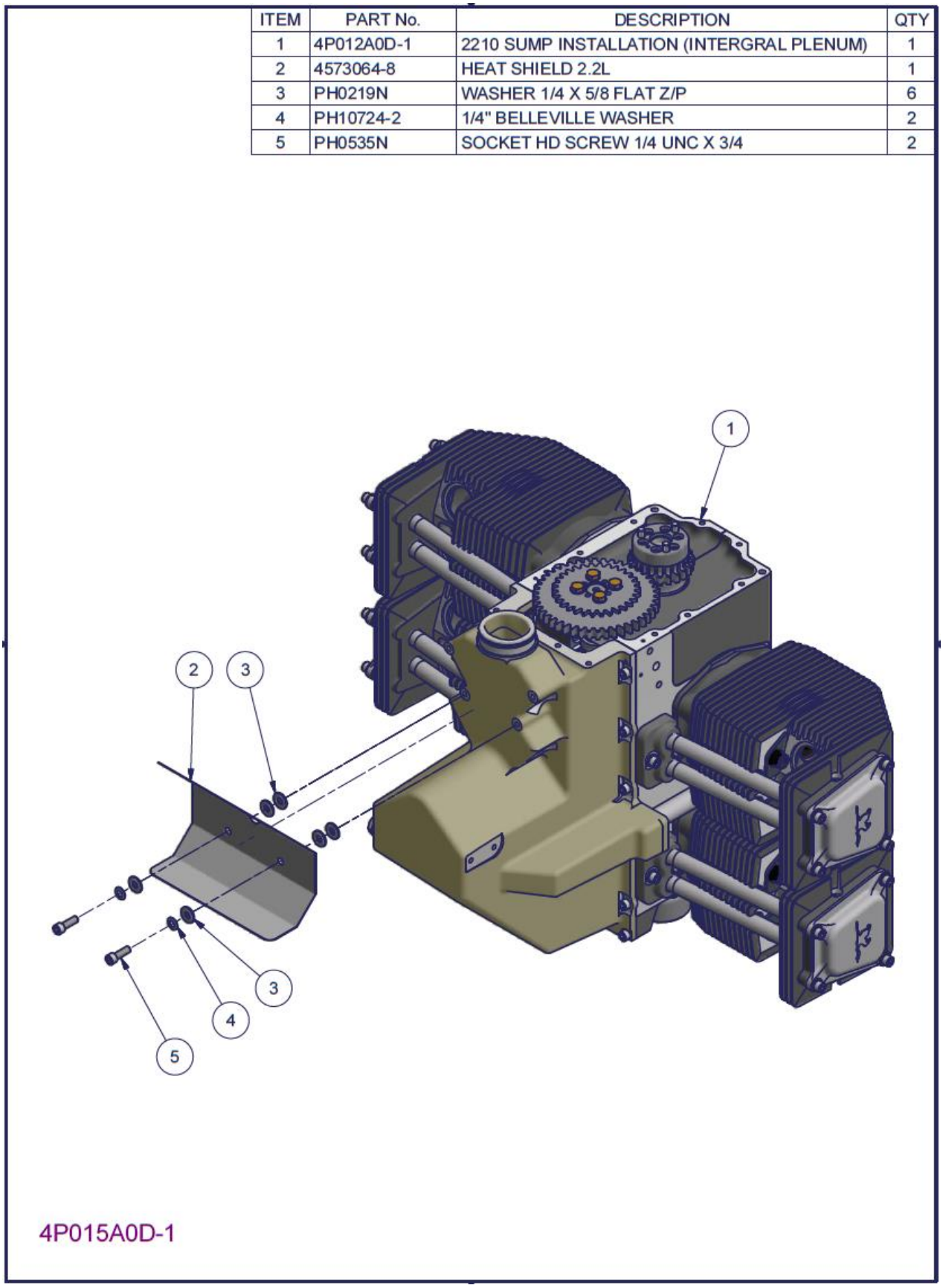


Figure 130 – Heat shield installation (integral plenum) – Parts List

4.11.2 2200 Plenum and Heat shield installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P013A0D-1	2210 SUMP INSTALLATION (NO PLENUM)	1
2	PH1033N-1	DOWEL PIN DIA 3x14	2
3	4A537D0D-1	DIFFUSER ROD SER III INDUCTION	1
4	PH72B24	SOCKET HD SCREW 10-32 X 1 1/4	2
5	PH0595N	SOCKET HD SCREW 1/4 UNC X 1 1/2	1
6	PH10724-2	1/4" BELLEVILLE WASHER	9
7	PH4A003N	3/16" BELLEVILLE WASHER	2
8	4774094-5	ADAPTOR FLANGE TO CARBY COUPLING	1
9	PH4A002	SOCKET HD SCREW 1/4 UNC X 2-1/4	4
10	PH0219N	WASHER 1/4 X 5/8 FLAT Z/P	6
11	4573064-8	HEAT SHIELD 2.2L	1
12	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	4
13	4A538A0D-2	INDUCTION BODY ASSEMBLY 2200 SER III	1

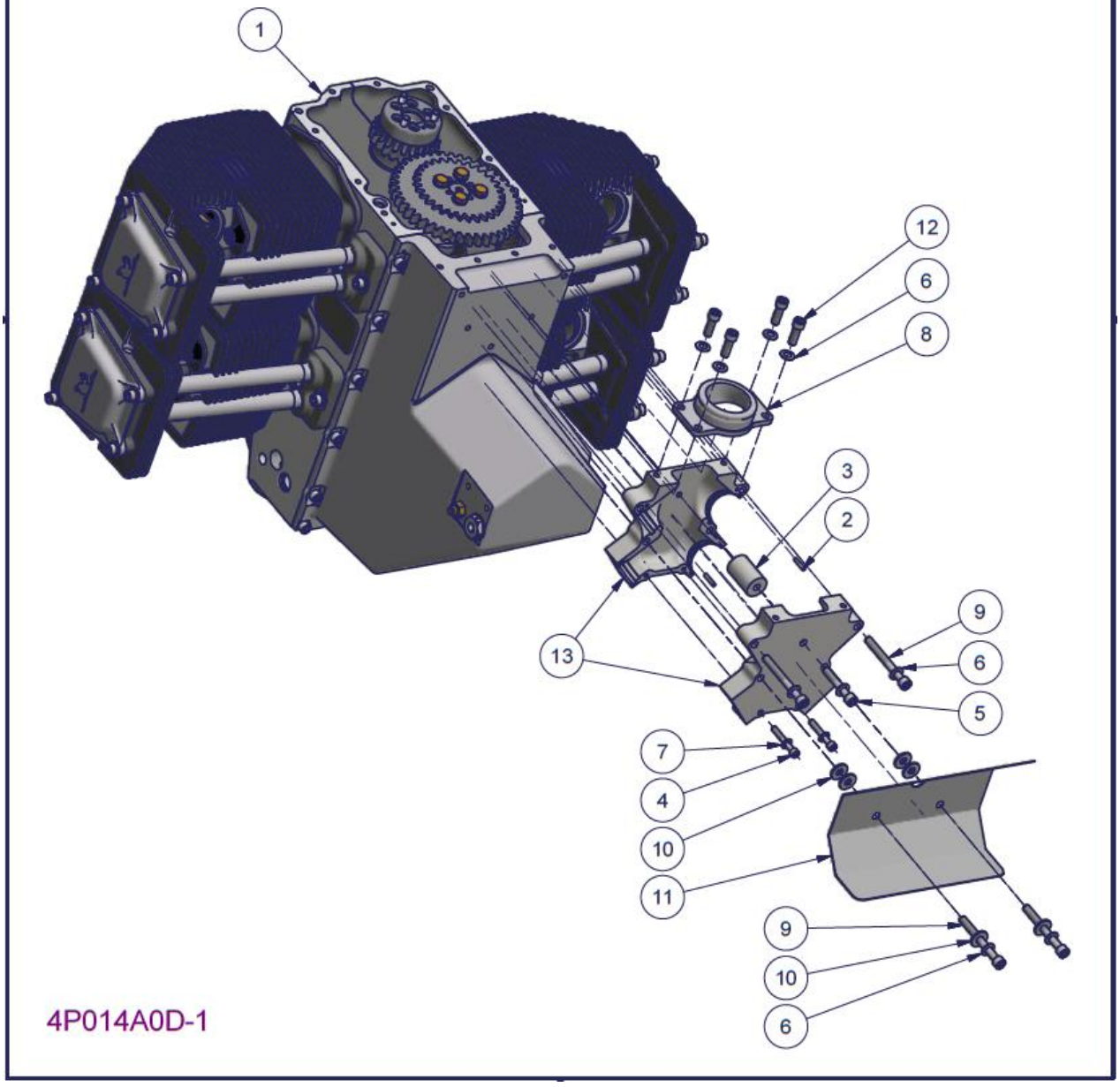


Figure 131 – Plenum and Heat shield installation – Parts List

4.11.3 3300 Heat shield installation (integral plenum) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P012A1D-1	3310 SUMP INSTALLATION (INTERGRAL PLENUM)	1
2	4690194-5	HEAT SHIELD 6 CYLINDER MUFFLER	1
3	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	4
4	PH10724-2	1/4" BELLEVILLE WASHER	4
5	PH0219N	WASHER 1/4 X 5/8 FLAT Z/P	8

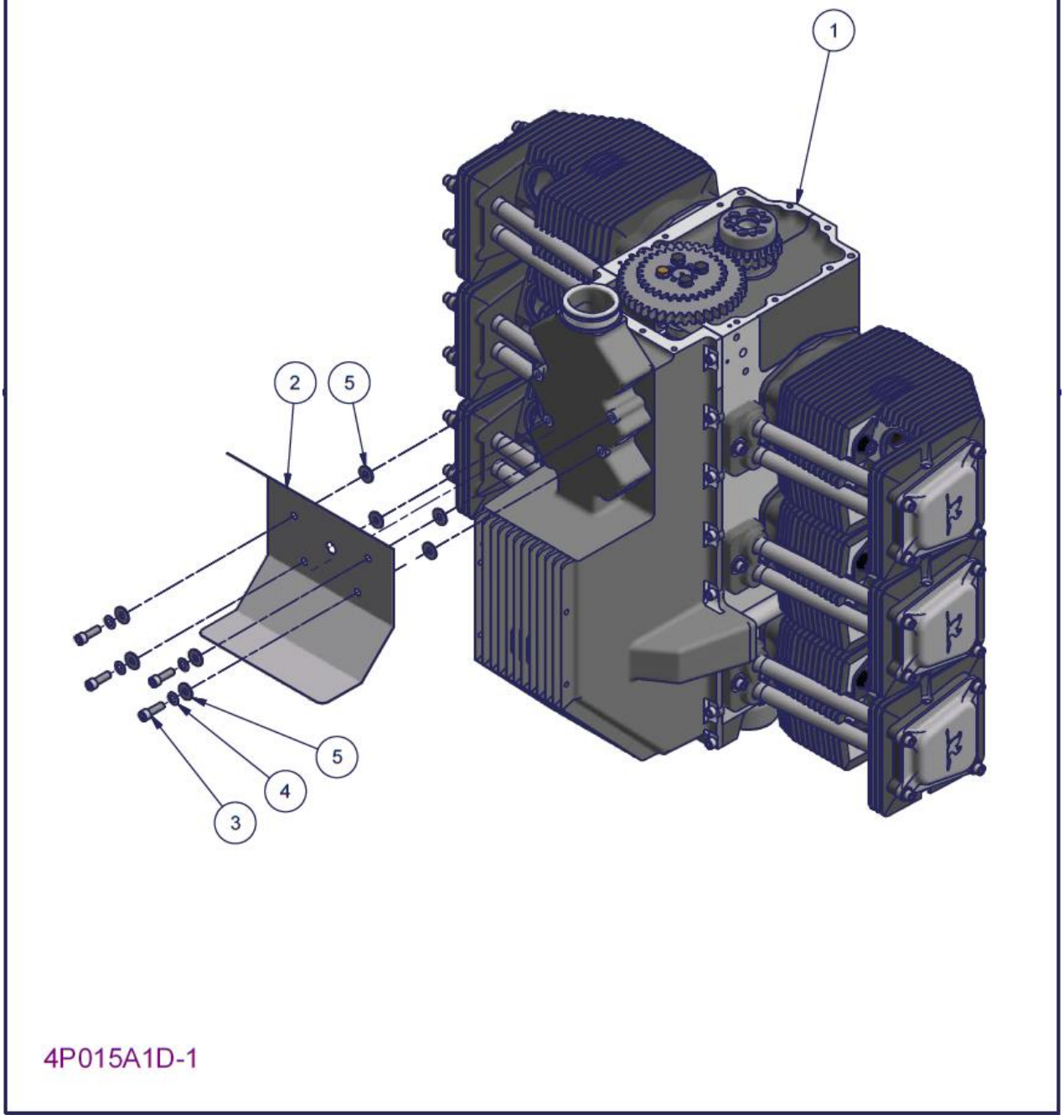


Figure 132 – 3300 Heat shield installation (integral plenum) – Parts List

4.11.4 3300 Plenum and Heat shield installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P013A1D-1	3310 SUMP INSTALLATION (NO PLENUM)	1
2	4A537A0D-4	INDUCTION BODY ASSY 3300 SER III	1
3	PB0045N-1	ROLLER 3 DIA X 14	2
4	PH72B24	SOCKET HD SCREW 10-32 X 1 1/4	4
5	PH4A003N	3/16" BELLEVILLE WASHER	4
6	4A537D0D-1	DIFFUSER ROD SER III INDUCTION	1
7	4A537E0D-1	DIFFUSER BOSS SER III INDUCTION TAPPED	1
8	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	5
9	PH10724-2	1/4" BELLEVILLE WASHER	10
10	PH4A002	SOCKET HD SCREW 1/4 UNC X 2-1/4	4
11	4690194-5	HEAT SHIELD 6 CYLINDER MUFFLER	1
12	PH0219N	WASHER 1/4 X 5/8 FLAT Z/P	8
13	PH0615N	SOCKET HD SCREW 1/4 UNC X 2	1
14	4A539A0D-1	CARBY COUPLING ADAPTOR RECTANGULAR SUITS SER III INDUCTION	1

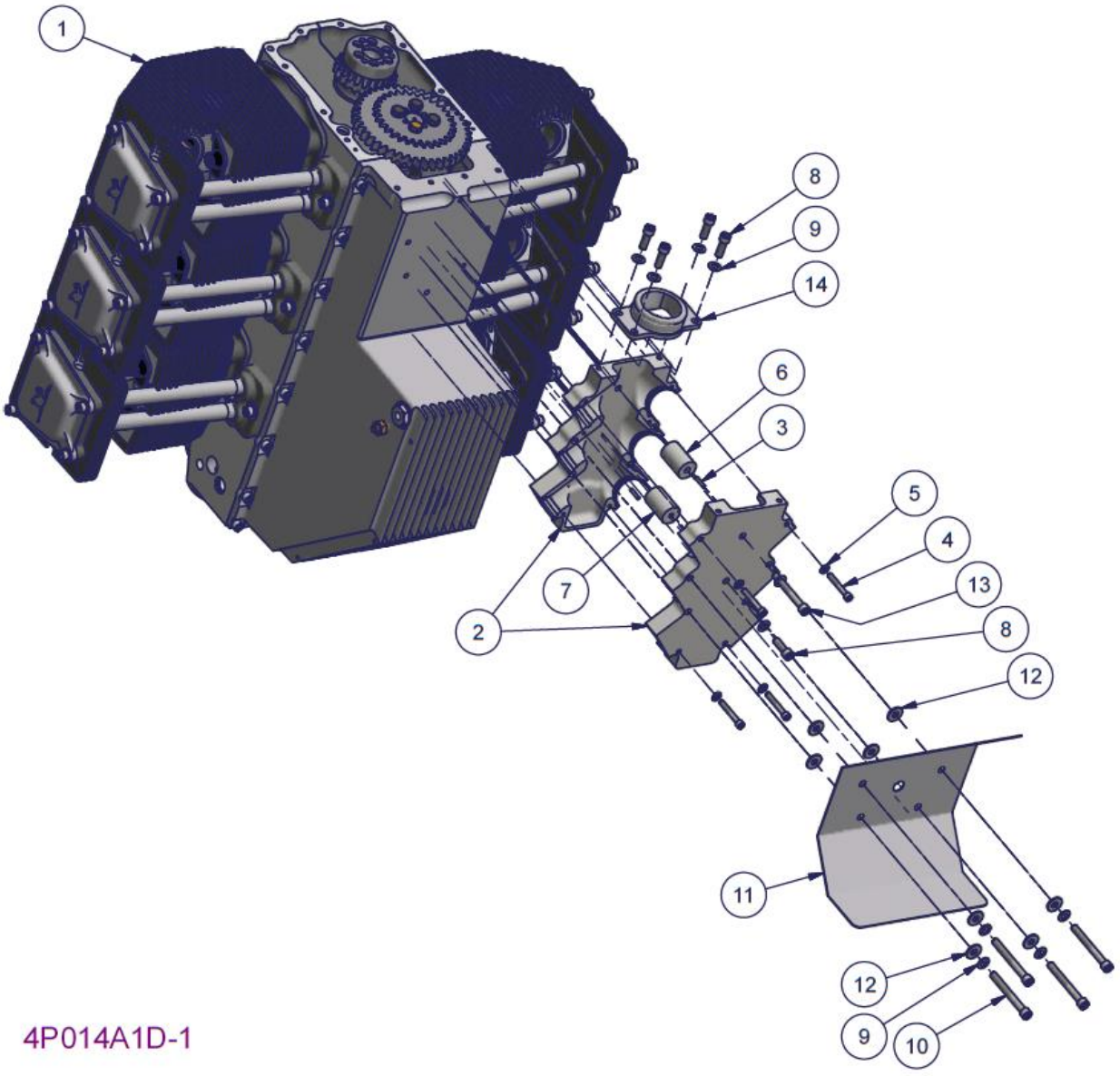


Figure 133 – 3300 Plenum and heat shield installation – Parts List

4.11.5 2200/3300 Plenum and Heat shield installation procedure

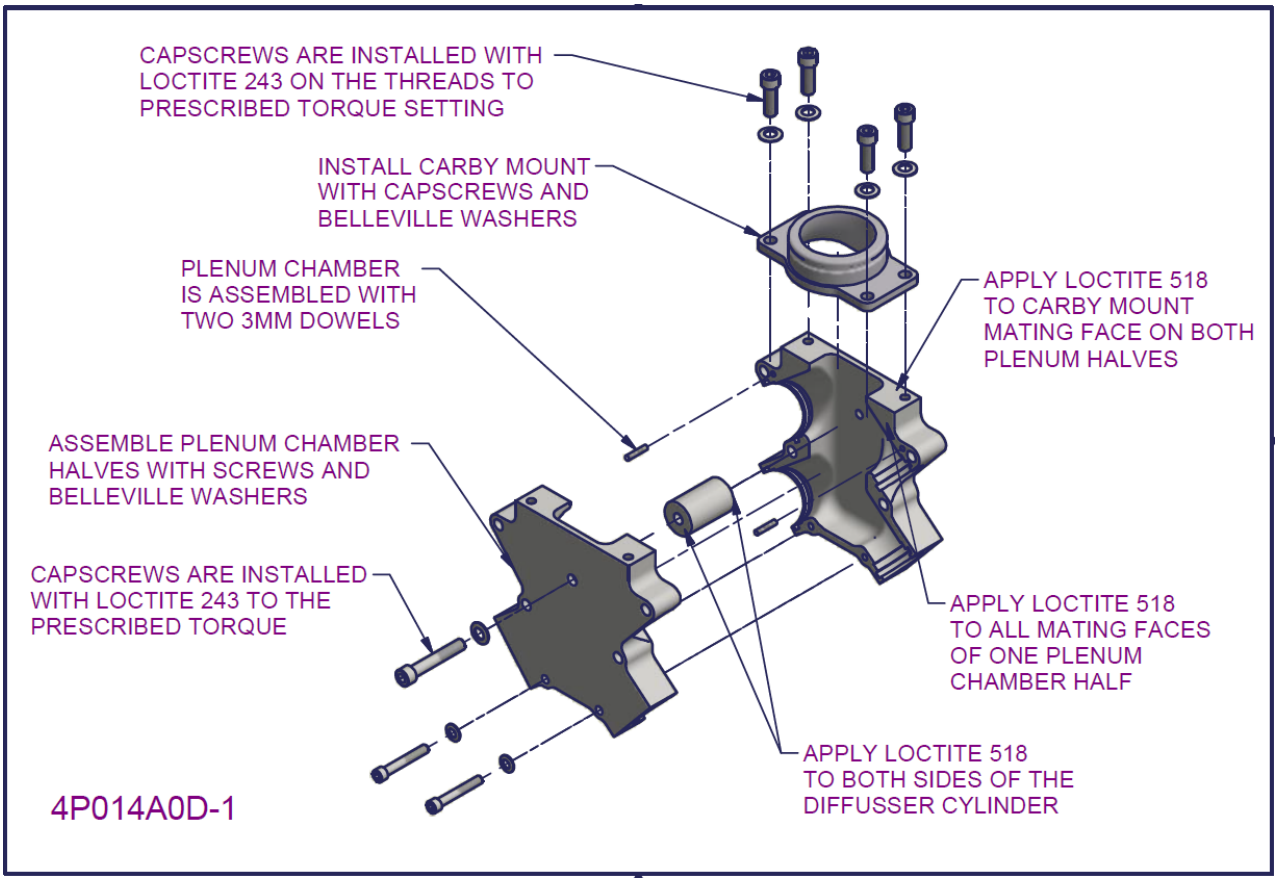


Figure 134 – 2200/3300 Plenum and Heat shield installation 1

- *Record the serial numbers of plenum chamber halves and carby mount in build log (section 6.14)*

- Ensure the plenum chamber halves and the carburettor mount are completely clean and dry.
- Apply Loctite 518 sealant to the mating faces of ONE plenum chamber half using a dabbing action.
- Apply Loctite 518 sealant to both flat faces of the diffuser cylinder again using a dabbing action.
- Assemble the two plenum chamber halves together with two 3mm dowels and the diffuser cylinder
  - The plenum chamber is retained together with two 3/16" capscrews at the back and a single ¼" capscrew through the diffuser cylinder
  - All capscrews are installed with Belleville washers and Loctite 243 on the thread. Install screws to the torque setting prescribed in section 0 and mark with a paint pen.
- Apply Loctite 518 sealant to the carburettor mount mating face and install the carburettor mount
  - Again the capscrews are installed with Loctite 243 on the threads to the torque setting prescribed in section 0 and mark with a paint pen.

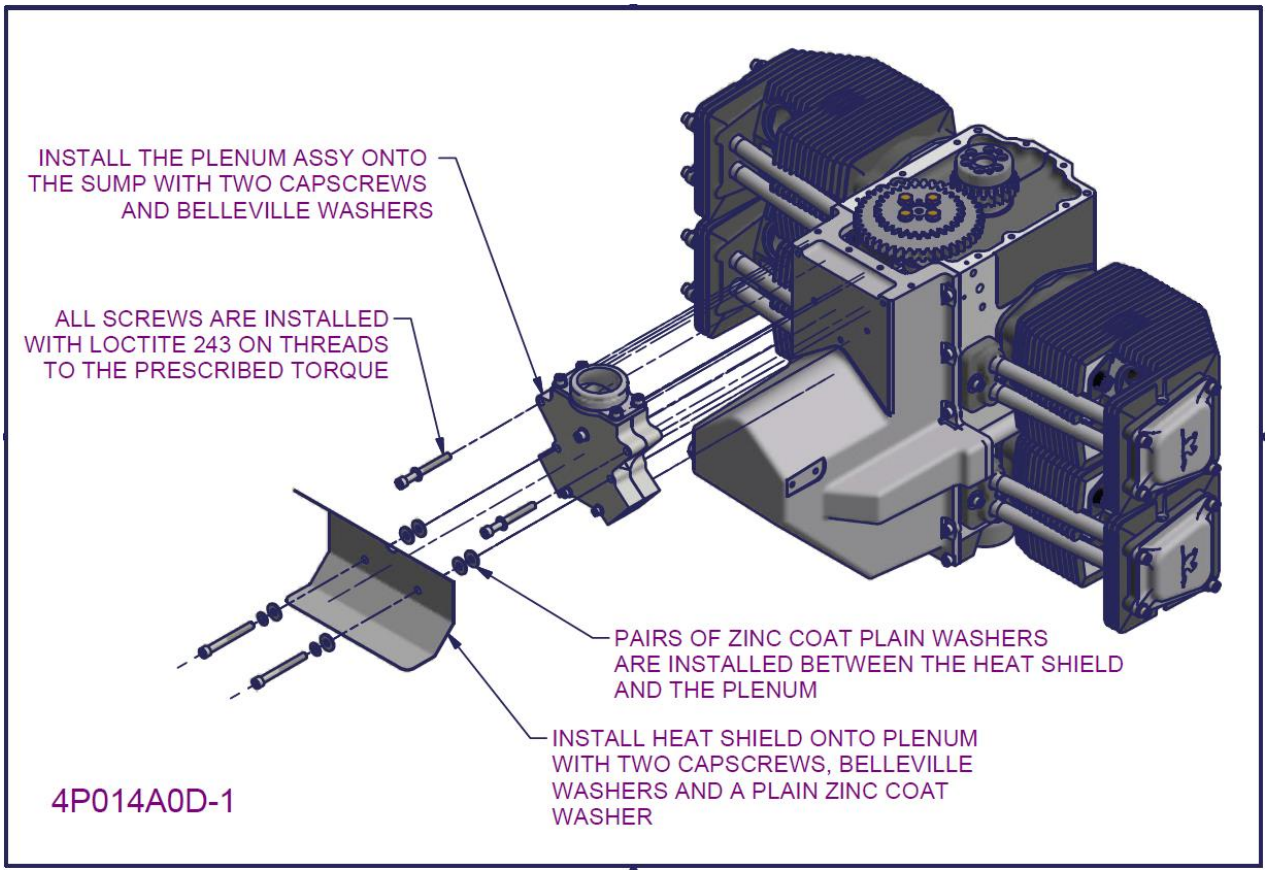


Figure 135- 2200/3300 Plenum and Heat shield installation 1

- Install the plenum chamber onto the sump with two capscrews and Belleville washers
- Install the heat shield onto the plenum chamber with two capscrews
    - Heat shield screws have a Belleville washer and a plain zinc plate washer under the head
    - Between the heat shield and plenum chamber two pairs of plain zinc plate washers are installed
    - All four capscrews installed with Loctite 243 to the torque setting prescribed in section 0 and marked with a paint pen.
- This completes the **Plenum and heat shield installation**

4.11.6 2200/3300 Heat shield installation (integral plenum)

- The assembly instructions for the heat shield installation onto an integral plenum sump are no different to that of a separate machined plenum. Refer to the previous section.

4.12 Back plate and distributor gearbox installation

4.12.1 2200 back plate and distributor gearbox installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P015A0D-1	2210 HEAT SHIELD INSTALLATION (INTERGRAL PLENUM)	1
2	PH9852N-1	PLUG	1
3	4A529A0D-4	2210/3310 REAR PLATE MACHINED	1
4	PH10724-2	1/4" BELLEVILLE WASHER	17
5	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	7
6	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	2
7	4P005A0D-1	2210 DISTRIBUTOR GEARBOX ASSY	1
8	PH15434	SOCKET HD SCREW 1/4 UNC X 1-1/4	6
9	PH4A080N	1/4-18 NPT PRESSURE PLUG	2
10	PH4A000	SOCKET HD SCREW 1/4 UNC X 1-3/4	4
11	AN960-516	WASHER	2
12	PH0625N	5/16" UNC x 1 1/4" CAP SCREW	2

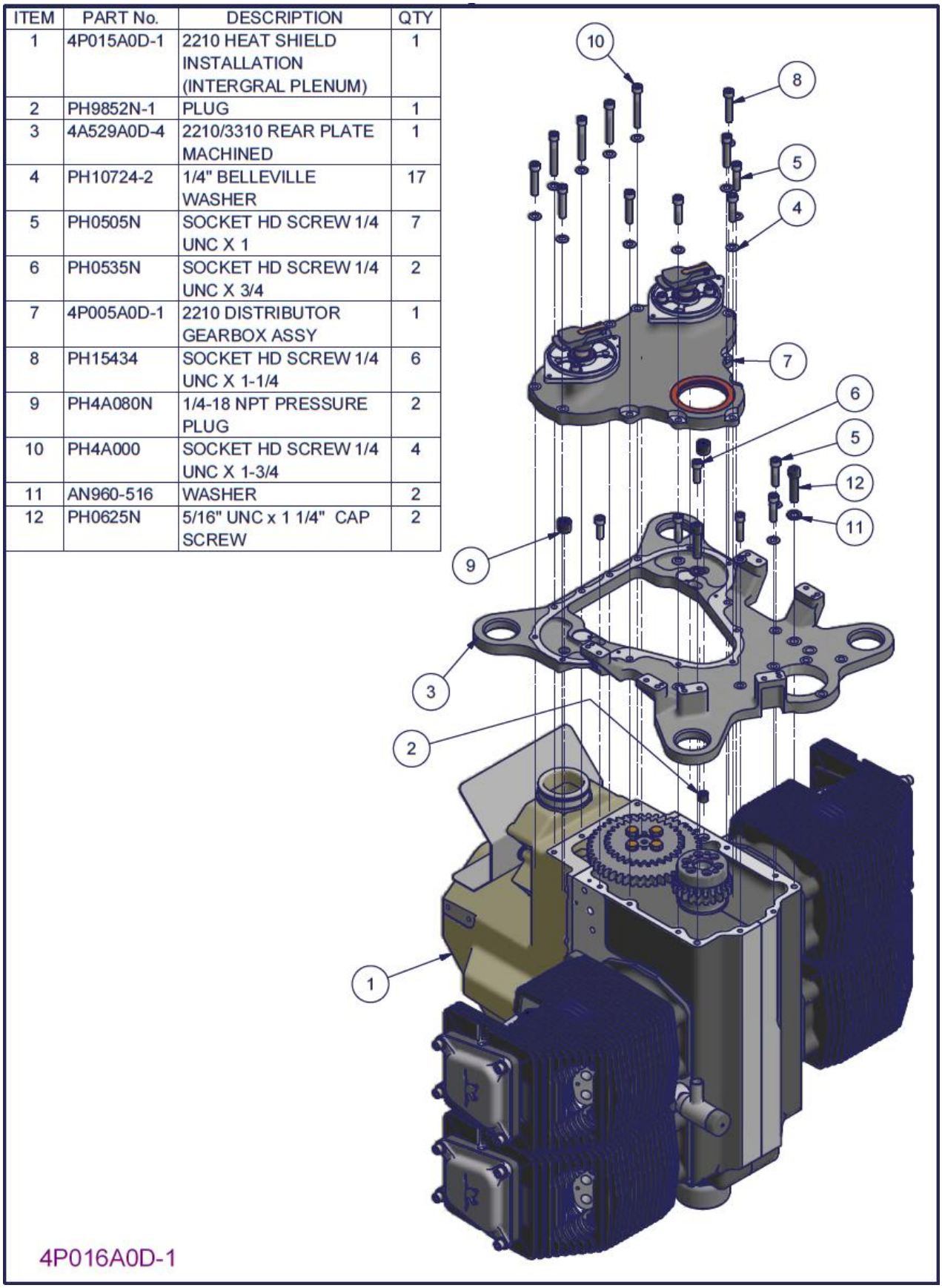


Figure 136 – 2200 back plate and distributor gearbox installation – Parts List

4.12.2 3300 back plate and distributor gearbox installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P014A1D-1	3310 HEAT SHIELD AND PLENUM INSTALLATION	1
2	PH9852N-1	PLUG	1
3	4A529A0D-4	2210/3310 REAR PLATE MACHINED	1
4	PH10724-2	1/4" BELLEVILLE WASHER	17
5	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	7
6	PH0535N	SOCKET HD SCREW 1/4 UNC X 3/4	2
7	PH15434	SOCKET HD SCREW 1/4 UNC X 1-1/4	6
8	PH4A080N	1/4-18 NPT PRESSURE PLUG	2
9	PH4A000	SOCKET HD SCREW 1/4 UNC X 1-3/4	4
10	AN960-516	WASHER	2
11	PH0625N	5/16" UNC x 1 1/4" CAP SCREW	2
12	4P005A1D-1	2210/3310 DISTRIBUTOR GEARBOX ASSY	1

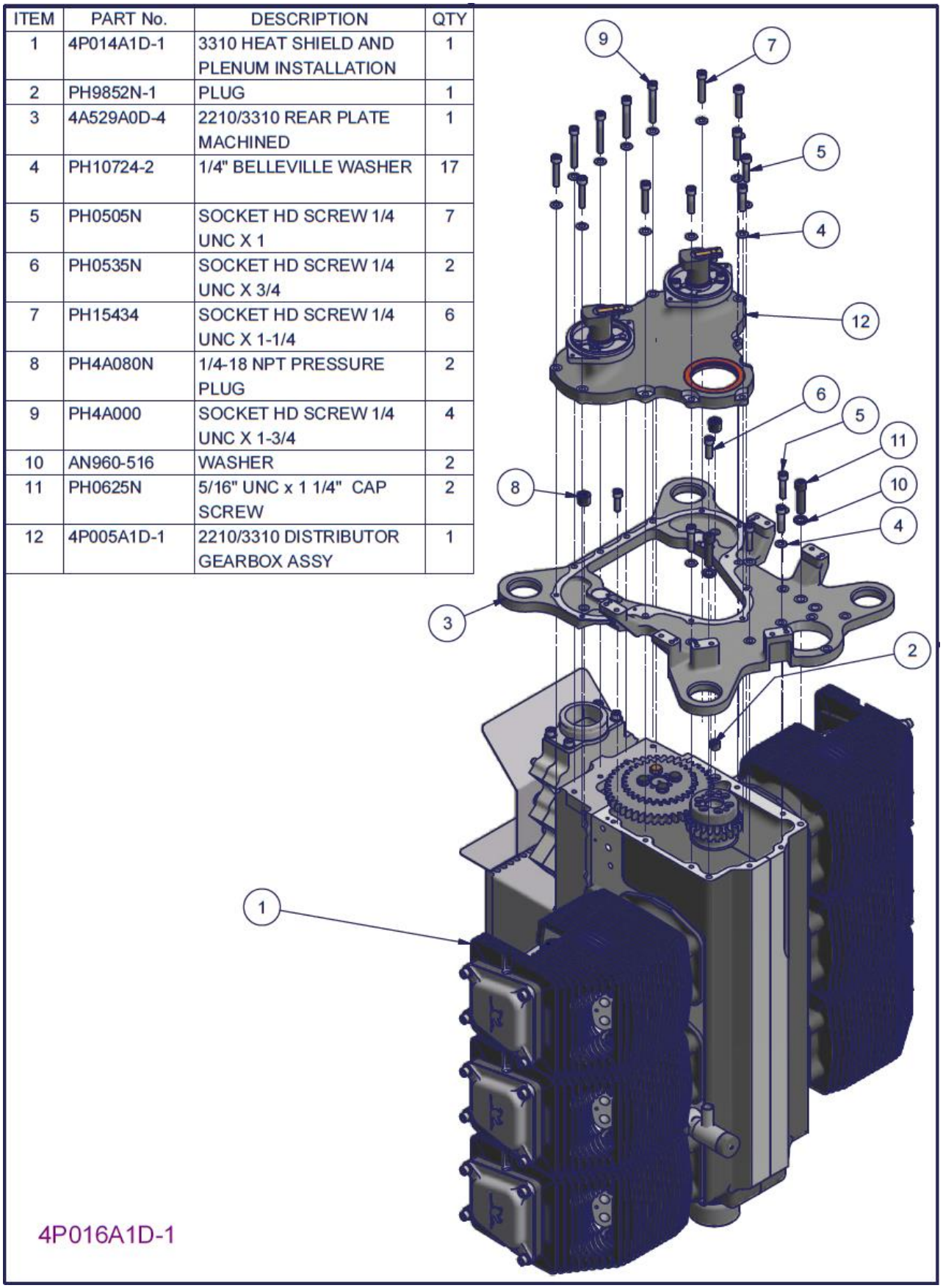


Figure 137 – 3300 back plate and distributor gearbox installation – Parts List

4.12.3 2200/3300 back plate and distributor gearbox installation procedure

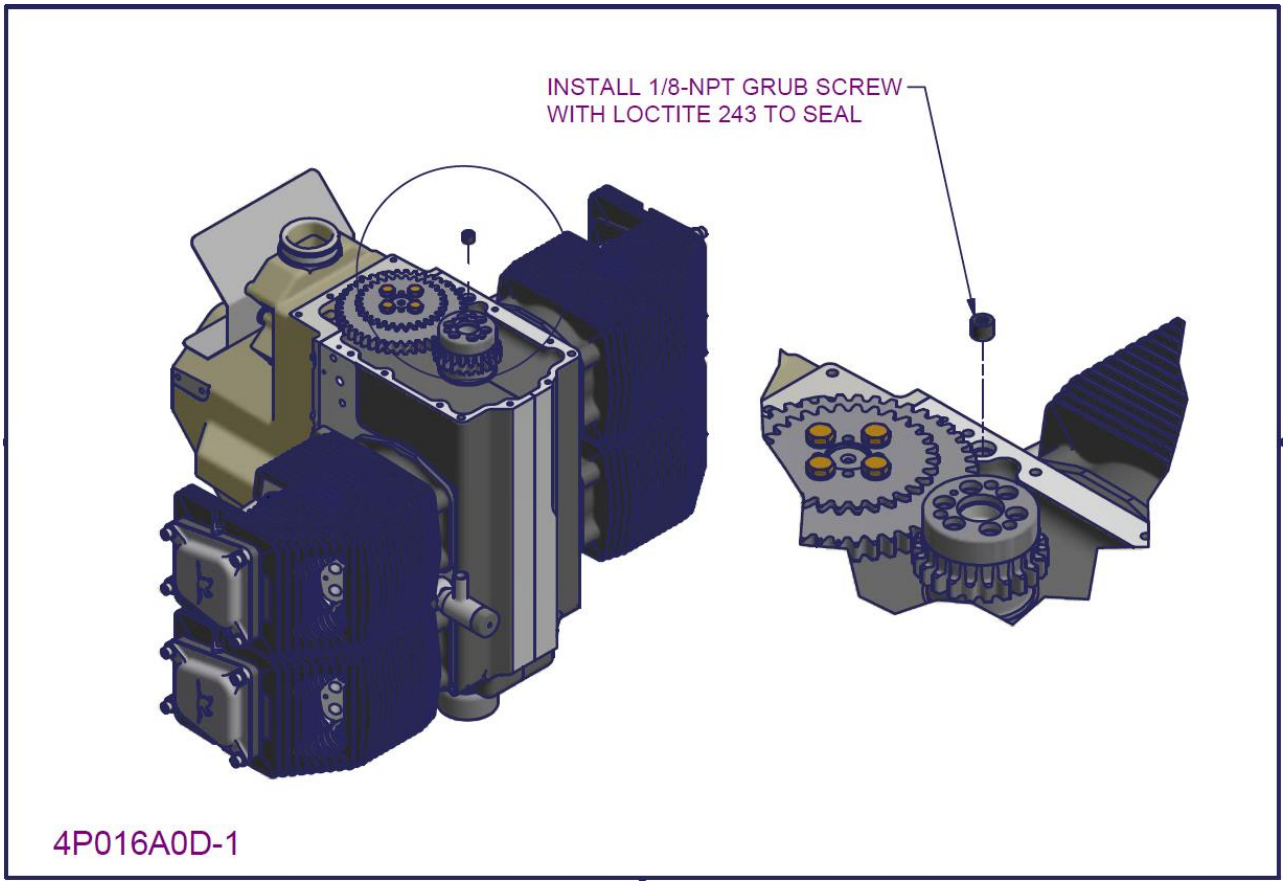


Figure 138 – 2200/3300 back plate and distributor gearbox installation 1

- Prime the oil gallery hole and 1/8-NPT plug with Loctite 747, apply Loctite 243 to the thread and install.
    - There is no specific torque setting for this plug, instead it requires operator experience to determine the degree of tightness required for the screw to adequately tighten the plug to achieve full seal.

DO NOT OVERTIGHTEN. If the thread is damaged during installation the plug will not seal properly and the engine will not develop oil pressure when running.

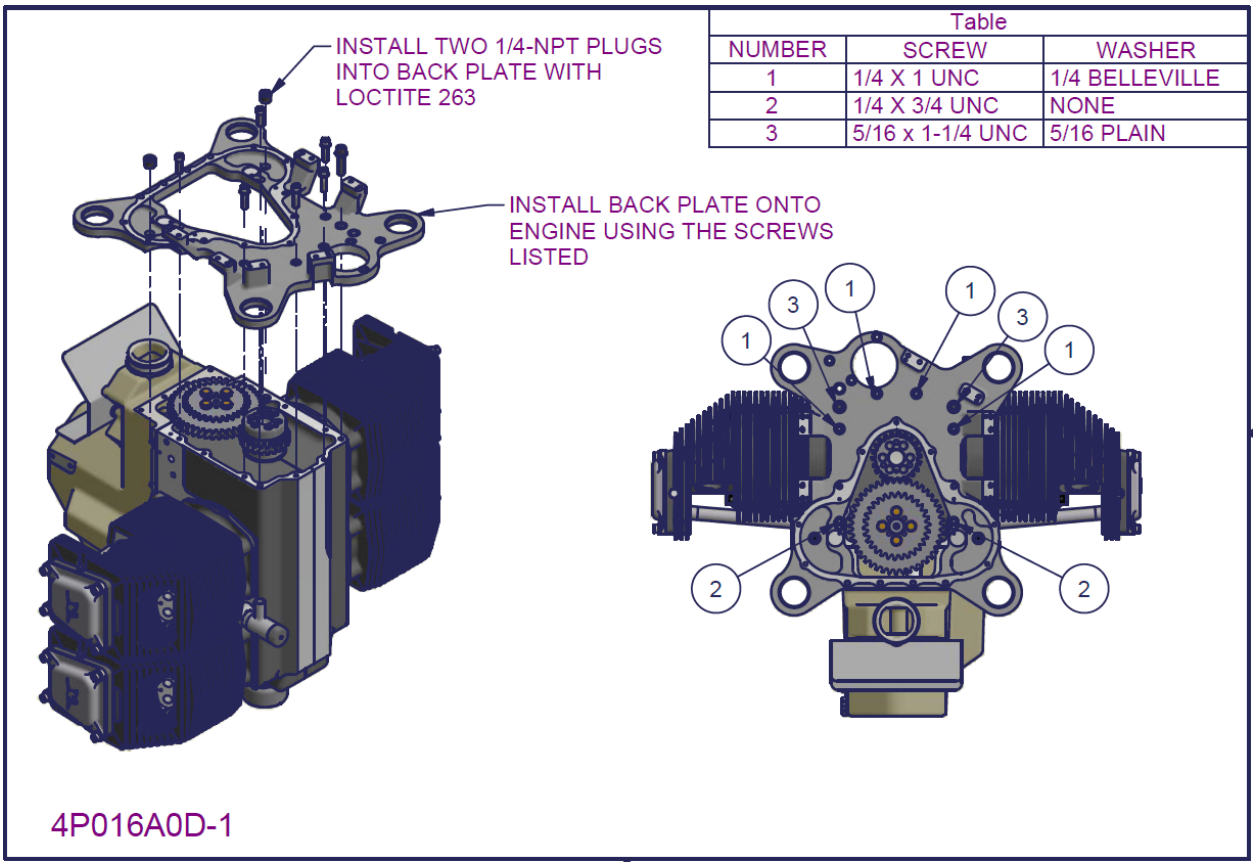


Figure 139 – 2200/3300 back plate and distributor gearbox installation 2

- Install two ¼-NPT plugs into the back plate.
  - Plugs and holes are primed with Loctite 747 and the plug installed with Loctite 263 on the threads.
  - Again no specific torque setting is used the plug must be installed sufficiently deep and tight to ensure a seal without overtightening and damaging the thread.
  - *Record the serial number of the back plate used in the build log (section 6.15)*
- Ensure all mating surfaces on the back plate and crankcase are clean and dry.
- Prime all tapped holes and screws with Loctite 747.
- Apply Loctite 518 sealant to all mating faces on the crankcase using a dabbing action to peak the compound and ensure a complete seal.
- Position back plate on engine. Install capscrews to retain back plate in place.
  - The required screws and washers used are listing in Figure 139.
  - All screws are installed with Loctite 243 on the threads to a torque setting prescribed in section 0 and marked with a paint pen.

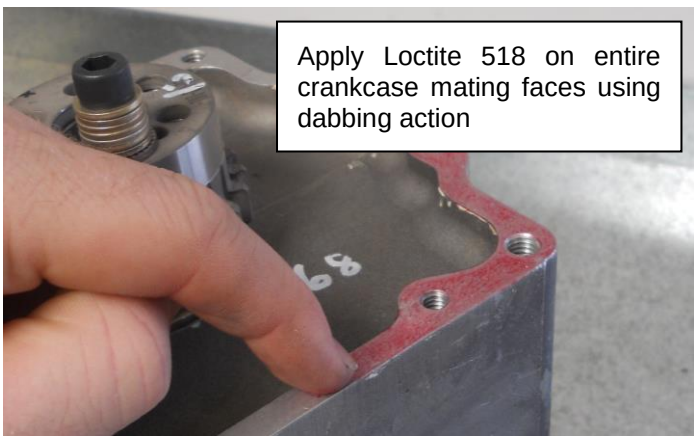


Figure 140 - Applying three-bond to crankcase faces

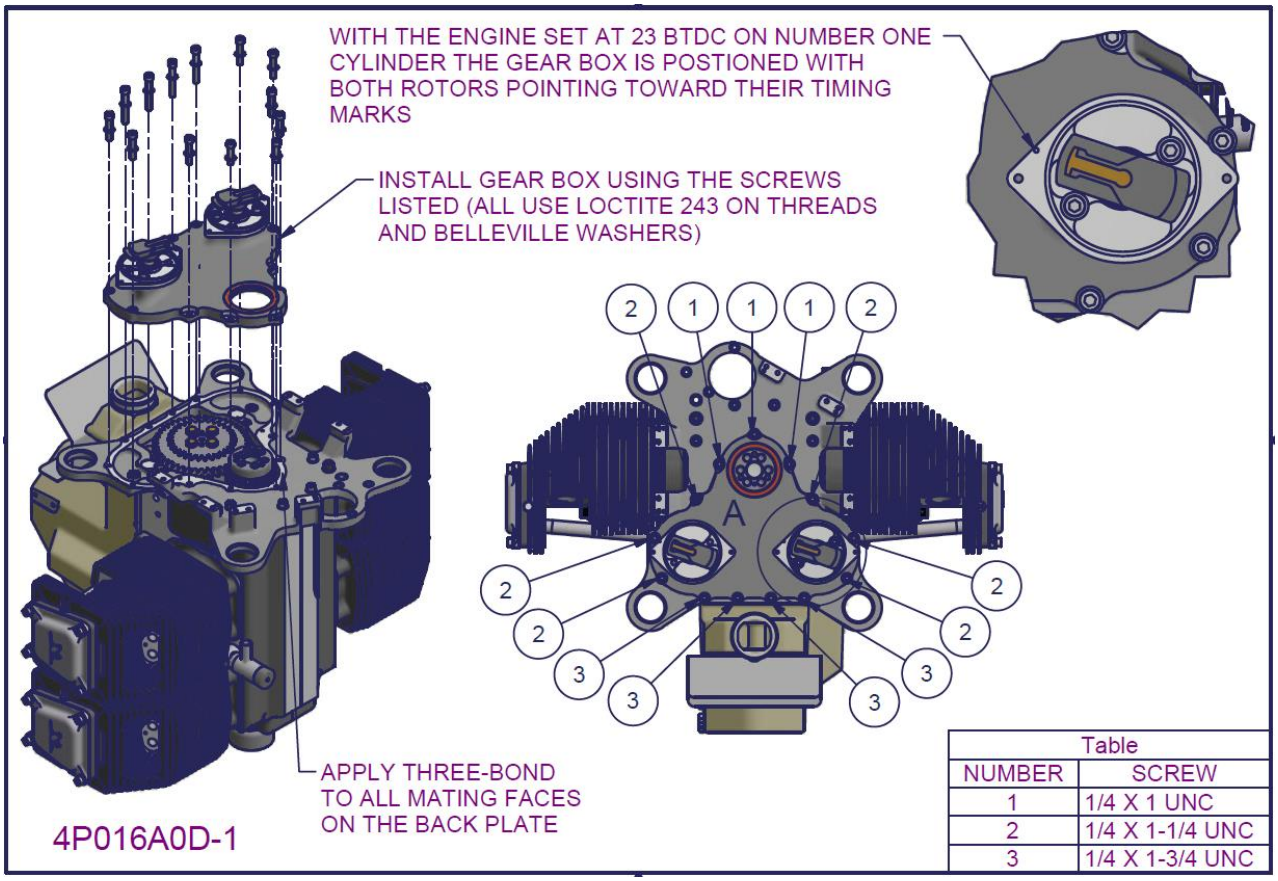


Figure 141 – 2200/3300 back plate and distributor gearbox installation 3

- Ensure all mating faces on the back plate and gearbox are clean and dry.
- Prime all tapped holes and capscrews with Loctite 747.
- Apply Loctite 518 sealant to all mating faces on the back plate using a dabbing action to peak the compound and ensure a complete seal.
- Rotate the engine to 23 degrees before TDC on the timing plate (for both 4 and 6 cylinder engines).
- Apply engine oil to the top of the cam gear
- Position the distributor gearbox assembly in place on the back plate with the two rotors pointing to the timing marks on their respective distributor mount plates. Ensure the gear teeth mesh as the gearbox is positioned.
- Install the retaining screws as listed in Figure 141 with Belleville washers and Loctite 243 on the threads, to the torque setting prescribed in section 0 and mark with a paint pen.
- This completes the **back plate and distributor gear box installation**.

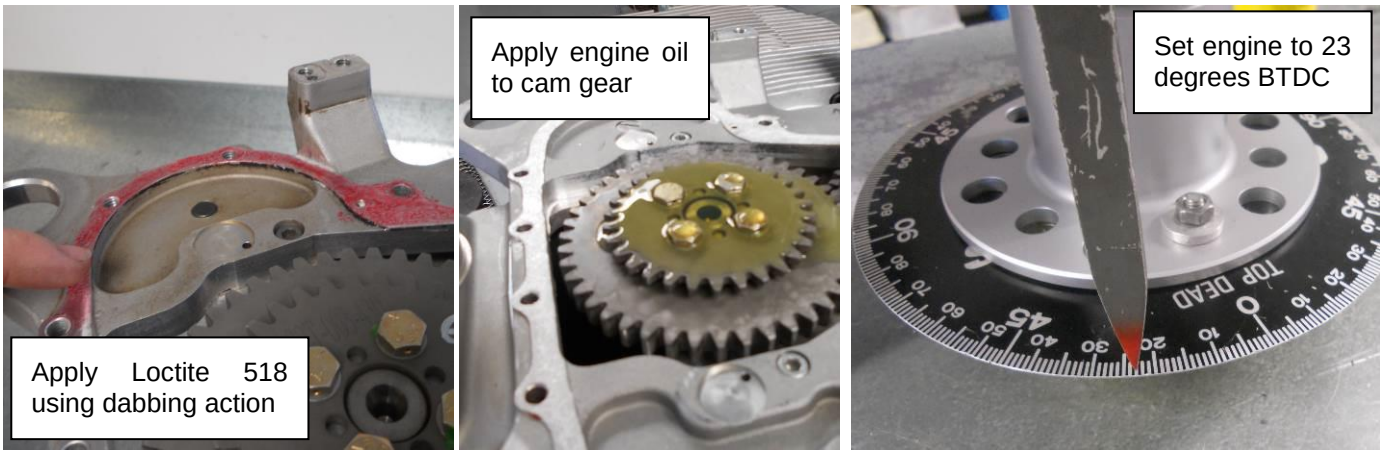


Figure 142 - Distributor gearbox installation

4.13 Flywheel and alternator installation

4.13.1 2200 Flywheel and alternator installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P016A0D-1	2210 BACK PLATE AND DISTRIBUTOR GEARBOX INSTALLATION	1
2	4P008A0D-1	2210/3310 ALTERNATOR ASSY	1
3	4P007A0D-1	4 CYLINDER CAST FLYWHEEL ASSY - ALUM CENTRE SOLID 3/8"	1
4	PH4A076N	3/8 SS NORDLOC WASHER (NL3/8ss)	6
5	PH4A072N	CAP SCREW 3/8 UNF X 1-1/4 CAPSCREW	6
6	PH10724-2	1/4" BELLEVILLE WASHER	4
7	PH4A002	SOCKET HD SCREW 1/4 UNC X 2-1/4	4
8	PE4A007N-1	DOWEL PIN. 6mm OD x 24mm LONG	3
9	4A200A0D-6	POST - TACHO PICKUP - BOLTED THRU REAR PLATE	1
10	PH0555N	SOCKET HD SCREW 5/16 UNC X 3/4	1
11	4A820A0D-1	3/8 FLYWHEEL NORLOC WASHER STEEL WEAR PLATE	1
12	9A026A0N	CLAMP - PIPE / CABLE 6MM (NOT SHOWN)	2

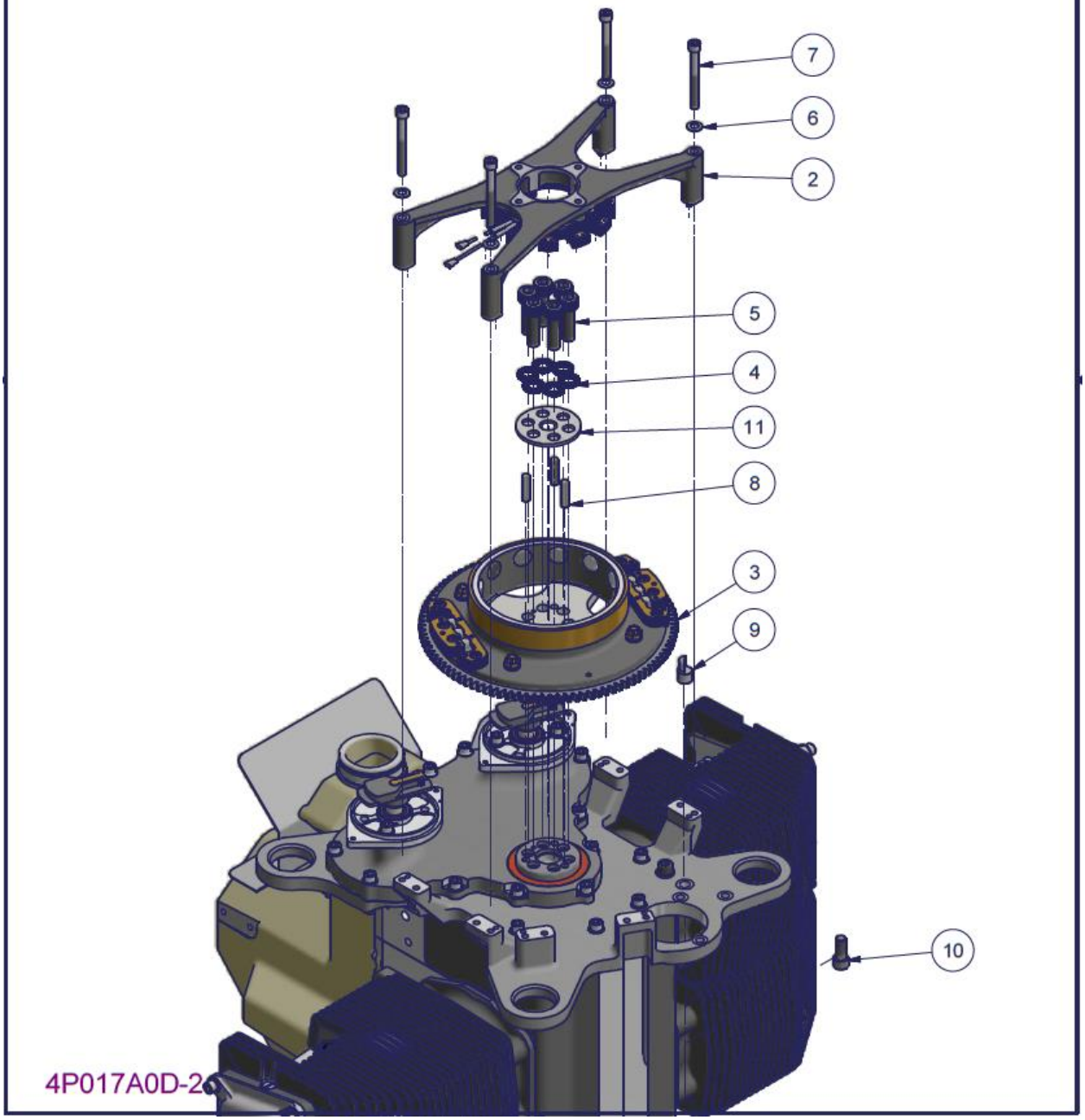


Figure 143 – 2200 flywheel and alternator installation – Parts List

4.13.2 3300 Flywheel and alternator installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P016A1D-1	3310 BACK PLATE AND DISTRIBUTOR GEARBOX INSTALLATION	1
2	4P008A0D-1	2210/3310 ALTERNATOR ASSY	1
3	PH10724-2	1/4" BELLEVILLE WASHER	4
4	PH4A002	SOCKET HD SCREW 1/4 UNC X 2-1/4	4
5	4P007A1D-1	6 CYLINDER CAST FLYWHEEL ASSY - ALUM CENTRE SOLID CONNECTION 3/8"	1
6	PH4A076N	3/8 SS NORDLOC WASHER (NL3/8ss)	6
7	PH4A072N	CAP SCREW 3/8 UNF X 1-1/4 CAPSCREW	6
8	PE4A007N-1	DOWEL PIN. 6mm OD x 24mm LONG	3
9	4A200A0D-6	POST - TACHO PICKUP - BOLTED THRU REAR PLATE	1
10	PH0555N	SOCKET HD SCREW 5/16 UNC X 3/4	1
11	4A820A0D-1	3/8 FLYWHEEL NORLOC WASHER STEEL WEAR PLATE	1
12	9A026A0N	CLAMP - PIPE / CABLE 6MM (NOT SHOWN)	2

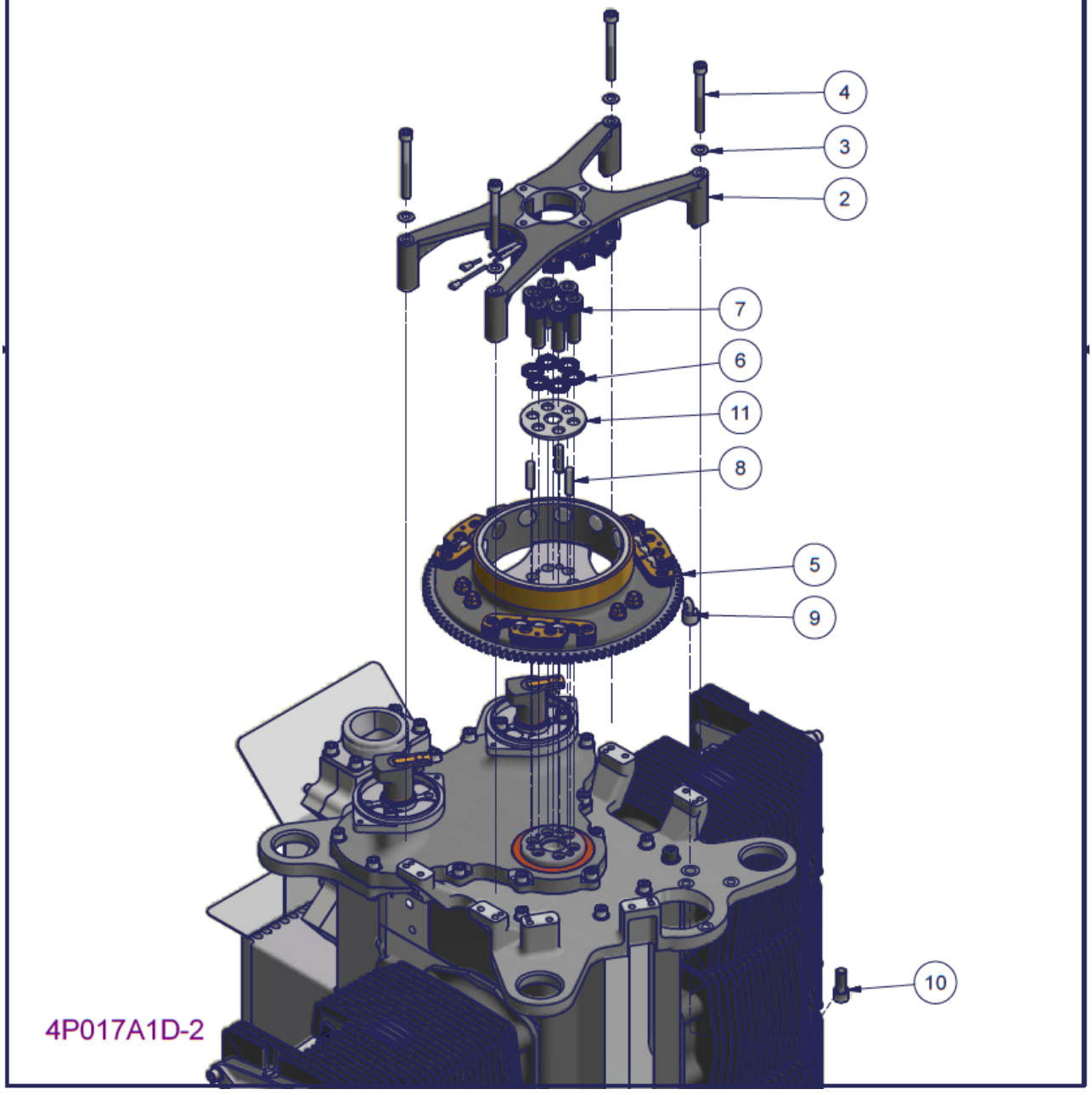


Figure 144 – 3300 flywheel and alternator installation – Parts List

4.13.3 2200/3300 Flywheel and alternator installation procedure

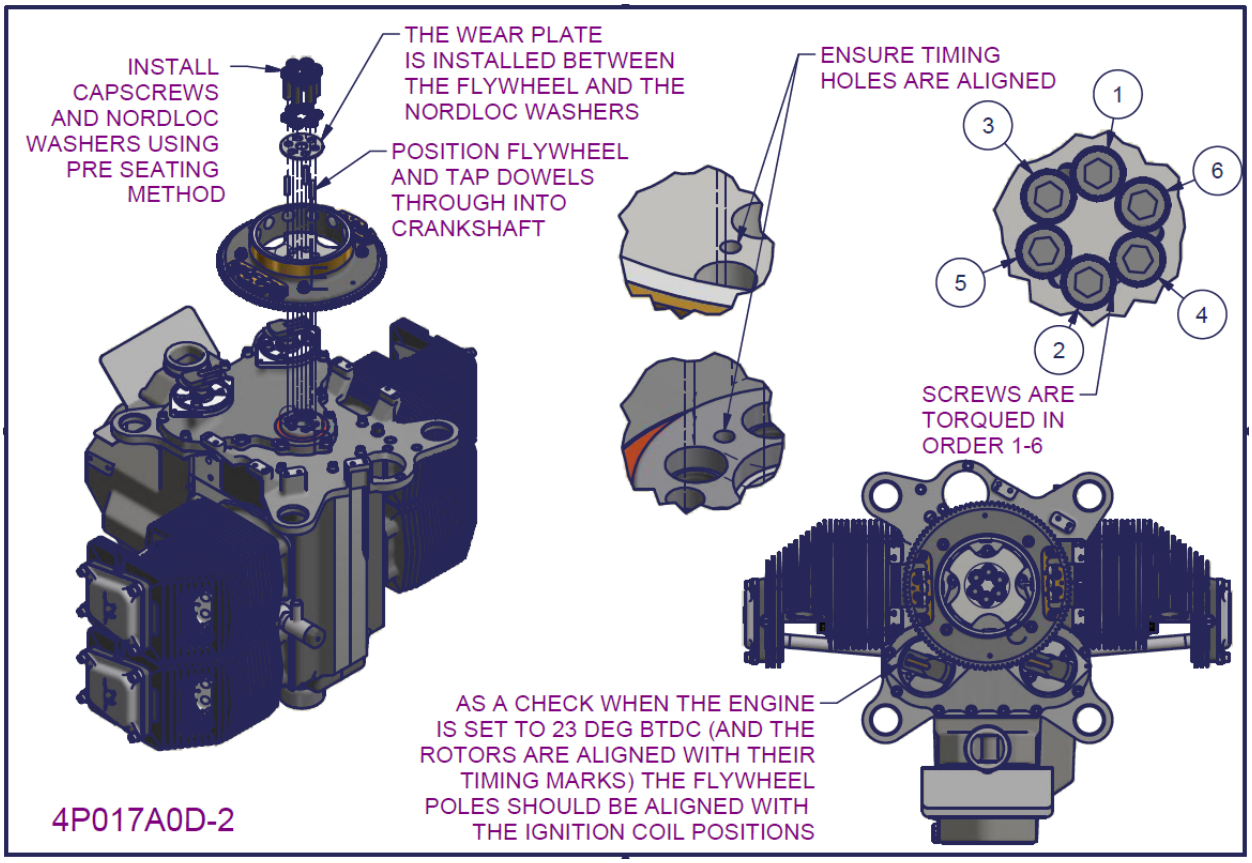


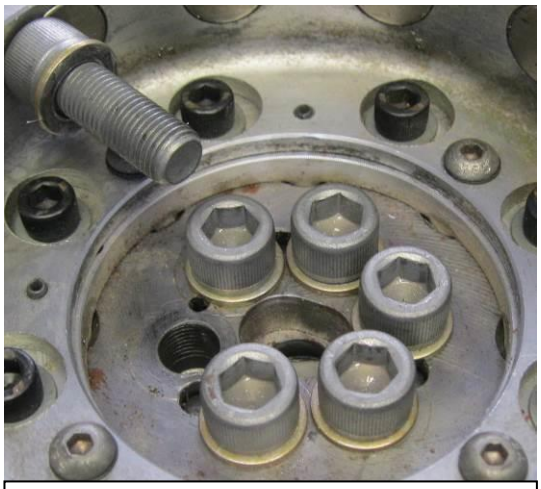
Figure 145 – 2200/3300 flywheel and alternator installation 1

WARNING

The flywheel connection is a critical interface on the engine. Ensure the installation instructions are followed correctly. This task must be attempted by sufficiently trained and experienced persons only

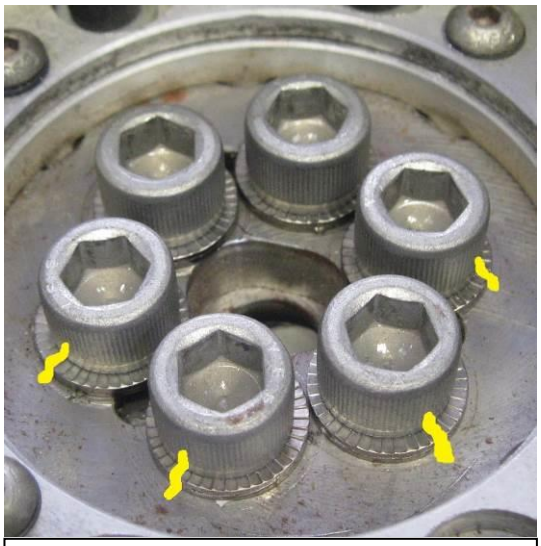
- Ensure the flywheel and crank gear mating surfaces and crankshaft threads are completely dry and clean from all dirt and oils
  - **This is very important since oil in this connection will reduce the strength of the connection potentially leading to flywheel retaining screw failure.**
- Position the flywheel on crank gear and tap the dowel pins through the flywheel into the crankshaft with a small hammer. Use a draft punch to tap the dowels below the surface of the flywheel until they bottom out on the crankshaft (the dowels must be installed with the taper pointing down into the crankshaft).
  - Check the timing holes on the crank gear and flywheel hub are aligned.
  - As another check when the engine is set at 23 degrees before TDC the ignition poles on the flywheel should align with the ignition coil positions (3 o'clock and 9 o'clock positons for 4 cylinder engines and 1 o'clock, 5 o'clock and 9 o'clock for 6 cylinder engines).
- Place the Nordloc Washer wear plate onto the flywheel.
- The flywheel is now retained using the pre-seating method as described:
  - Install the six capscrews dry with plain washers to contact
  - Tighten each screw to 15ft.lb using the diagonal tightening pattern shown in Figure 145.
  - Now tighten each screw to the torque setting prescribed in section 0 using the same diagonal tightening pattern shown in Figure 145.
  - Remove ONE capscrew and plain washer (discard plain washer).
  - Reinstall the previously removed capscrew this time with ONE Nordloc Washer pair. Install directly to the prescribed torque setting in section 0 (**screws must be installed DRY, without Loctite**). Tighten in one smooth motion without pause.
  - Apply torque seal or paint pen from capscrew across washers and onto the flywheel.
  - Repeat the previous three steps installing the other five screws ONE AT A TIME using the diagonal pattern order shown in Figure 145.

Install capscrews with 6 plain washers to **15ft.lb** and then the **Prescribed Torque** (section 0) progressively using diagonal pattern shown in Figure 145



Remove ONE capscrew (discard plain washer).

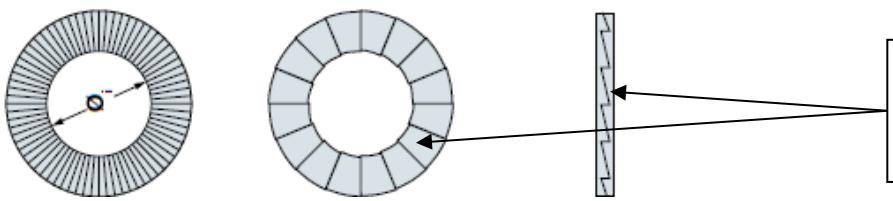
Reinstall capscrew with ONE Nordloc washer pair to **Prescribed Torque** (section 0) directly. Mark with Torque seal, or paint pen.



Repeat for the other five screws ONE AT A TIME using the diagonal pattern shown in section 0)

Figure 146 - Flywheel pre-seating installation method

- A Nordloc washer pair features two separate halves. Ensure the two halves are installed with the broad wedges of each half contacting each other (not the thin wedges) see Figure 147.
- Generally Nordloc washers are supplied preassembled with a small amount of temporary adhesive holding the two halves together.
- If for whatever reason you must disassemble the screws again. You MUST NOT reuse the Nordloc washers or bolts. **Always use new Nordloc washers and bolts for flywheel installations.**



The Nordloc washer halves are assembled together with the broad wedges facing into each other

Figure 147 - Nordloc washer halves assembled

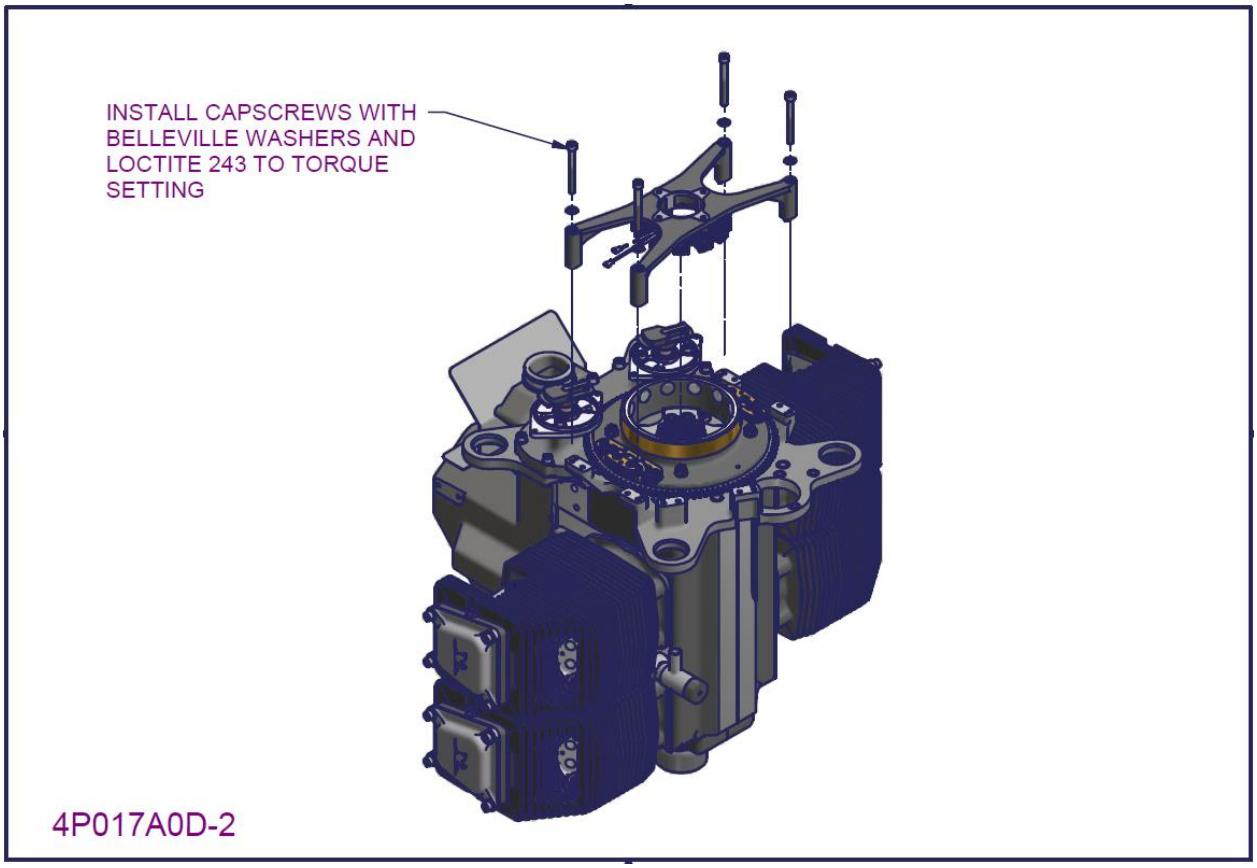


Figure 148 – 2200/3300 flywheel and alternator installation 2

- Prime the tapped holes and screws with Loctite 747.
- Position alternator stator assembly on the back plate mounting points and tap each leg down with a soft mallet to seat the roll pins in the respective holes.
    - Check the alternator stator is oriented so the electrical leads are directed out the right side of the mount and bend up to the top of the engine as shown in Figure 149. Attach clamps to hold cable to alternator mount.
- Install four capscrews with Belleville washers to retain the alternator stator
    - The capscrews are installed with Loctite 243 on the threads and are tightened to the torque setting prescribed in section 0 and mark with a paint pen.

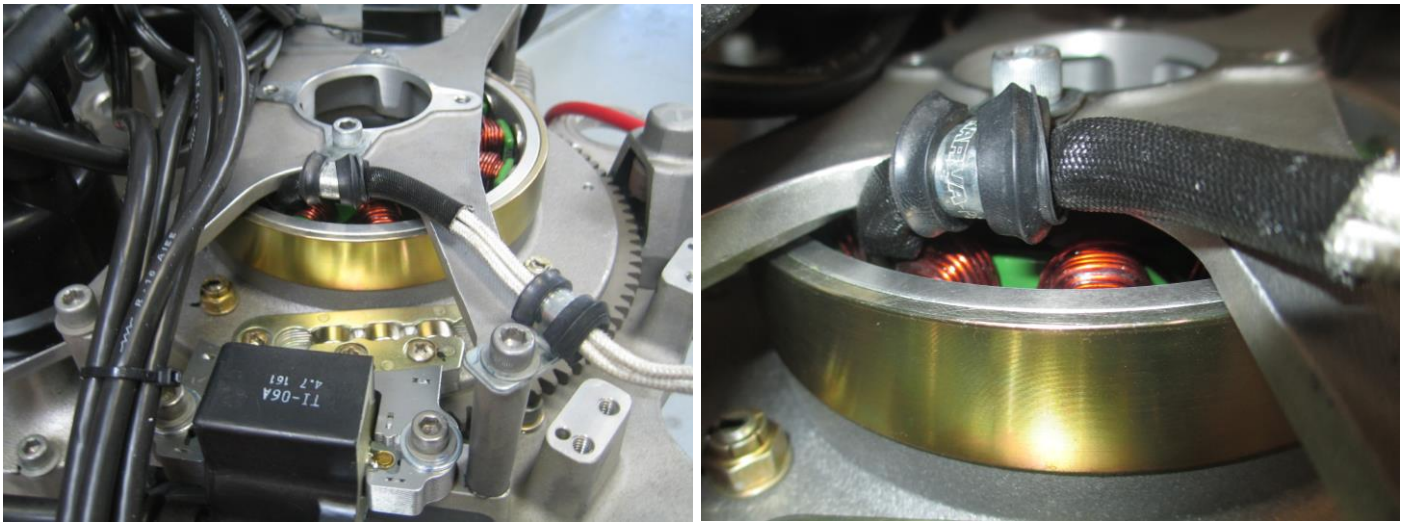


Figure 149 – Stator cable orientation

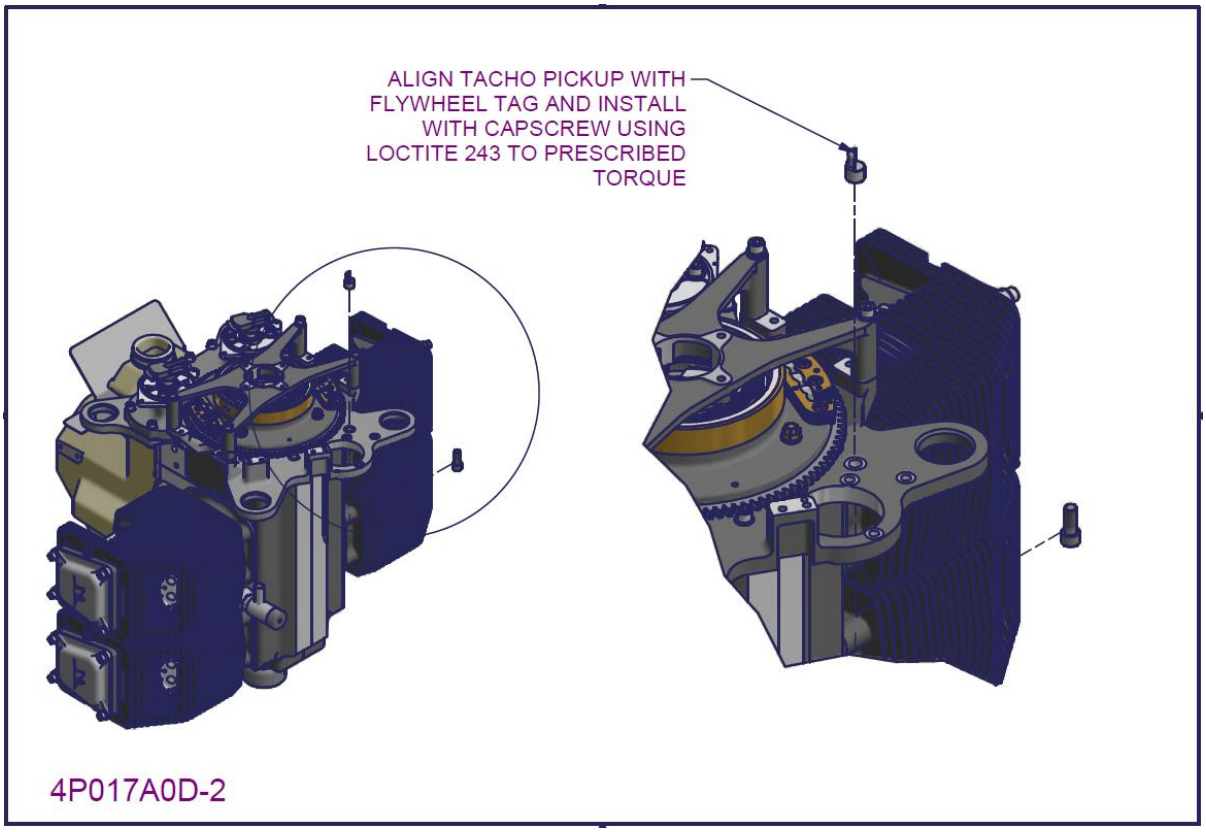


Figure 150 – 2200/3300 flywheel and alternator installation 3

- Install tacho pickup through rear plate as shown in Figure 151. Make sure tacho pick up is aligned with tacho tag. Fit tacho pickup with capscrew, plain washer and Loctite 243 to torque setting.

Figure 151 – Tacho pickup installation

- This completes the **Flywheel and Alternator installation.**

4.14 Fuel pump installation

4.14.1 2200 Fuel pump installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P017A0D-2	2210 FLYWHEEL AND ALTERNATOR INSTALLATION	1
2	4510054-9	FUEL PUMP PUSHROD 73.8MM	1
3	PG10342N	GASKET FUEL PUMP	2
4	PG118634	FUEL PUMP INSULATOR	1
5	PH0666N	5/16" BELLEVILLE WASHER	2
6	AN960-516	WASHER	2
7	PH4A001	5/16" UNC x 1 1/2" CAP SCREW	2
8	PG10332N-1	GOSS MECHANICAL FUEL PUMP ASSY	1

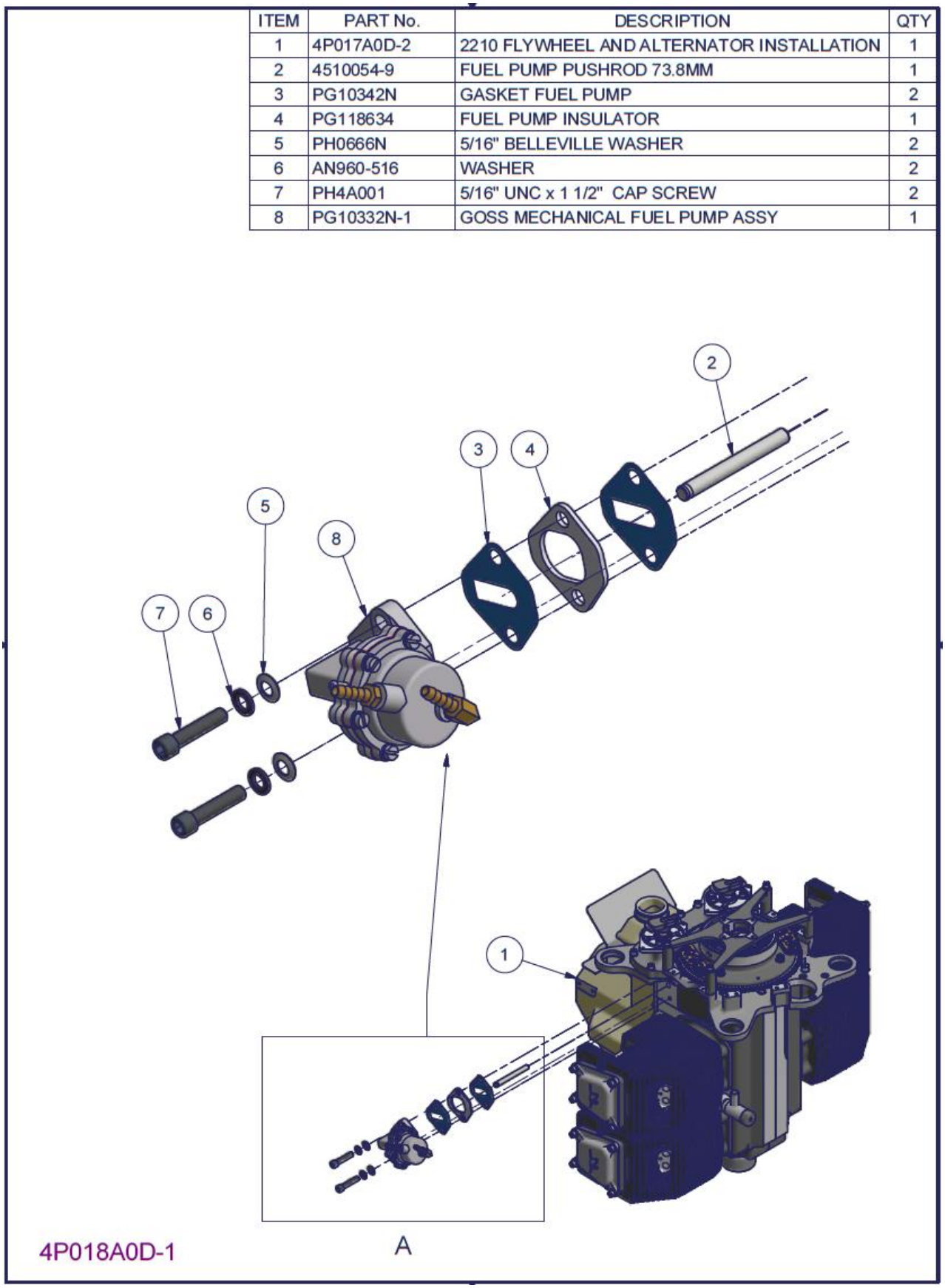


Figure 152 – 2200 Fuel pump installation – Parts List

4.14.2 3300 Fuel pump installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P017A1D-2	3310 FLYWHEEL AND ALTERNATOR INSTALLATION	1
2	4510054-9	FUEL PUMP PUSHROD 73.8MM	1
3	PG10342N	GASKET FUEL PUMP	2
4	PG118634	FUEL PUMP INSULATOR	1
5	PH0666N	5/16" BELLEVILLE WASHER	2
6	AN960-516	WASHER	2
7	PG10332N-1	GOSS MECHANICAL FUEL PUMP ASSY	1
8	PH4A001	5/16" UNC x 1 1/2" CAP SCREW	2

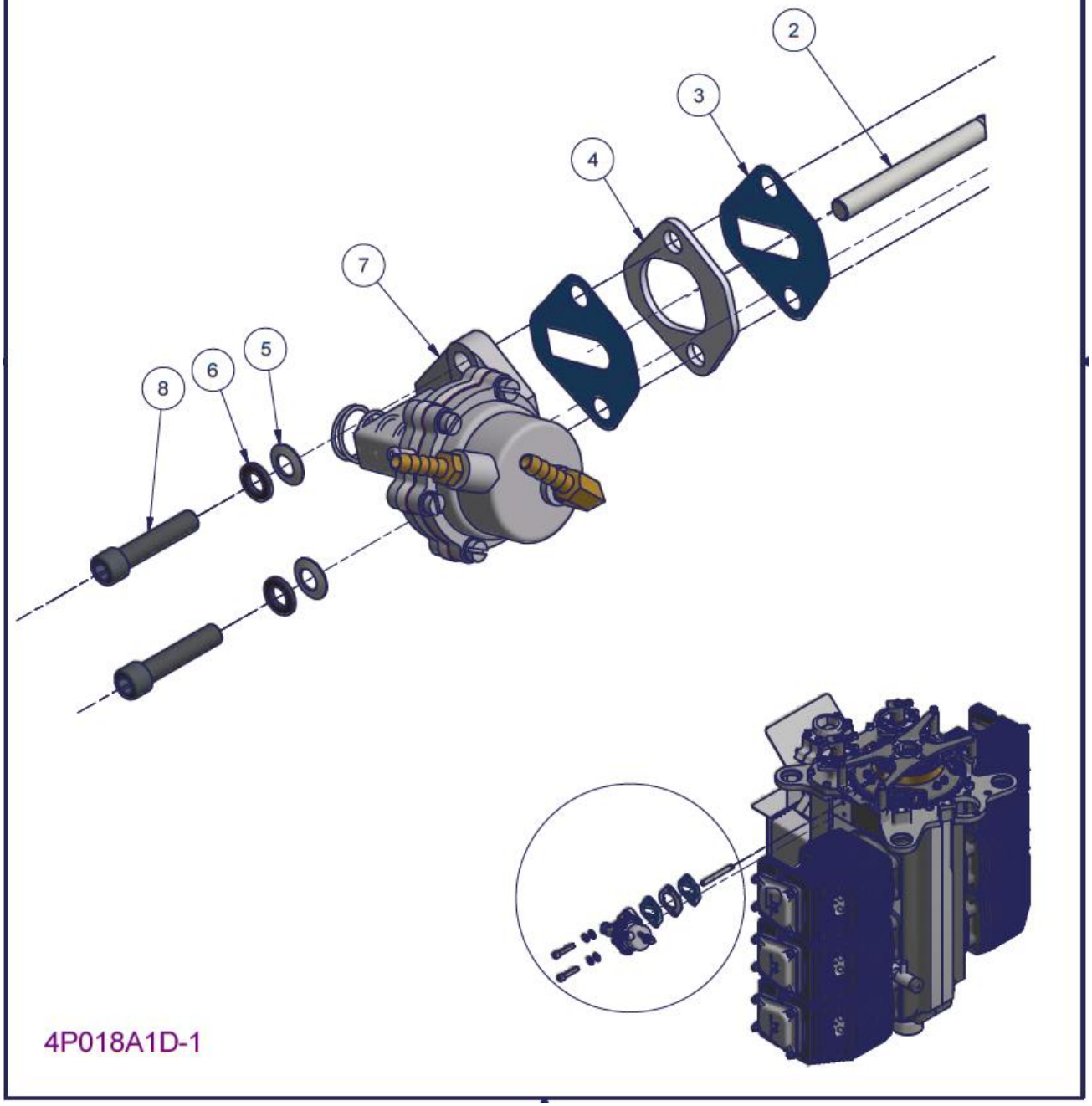


Figure 153 – 3300 Fuel pump installation – Parts List

4.14.3 2200/3300 Fuel pump installation procedure

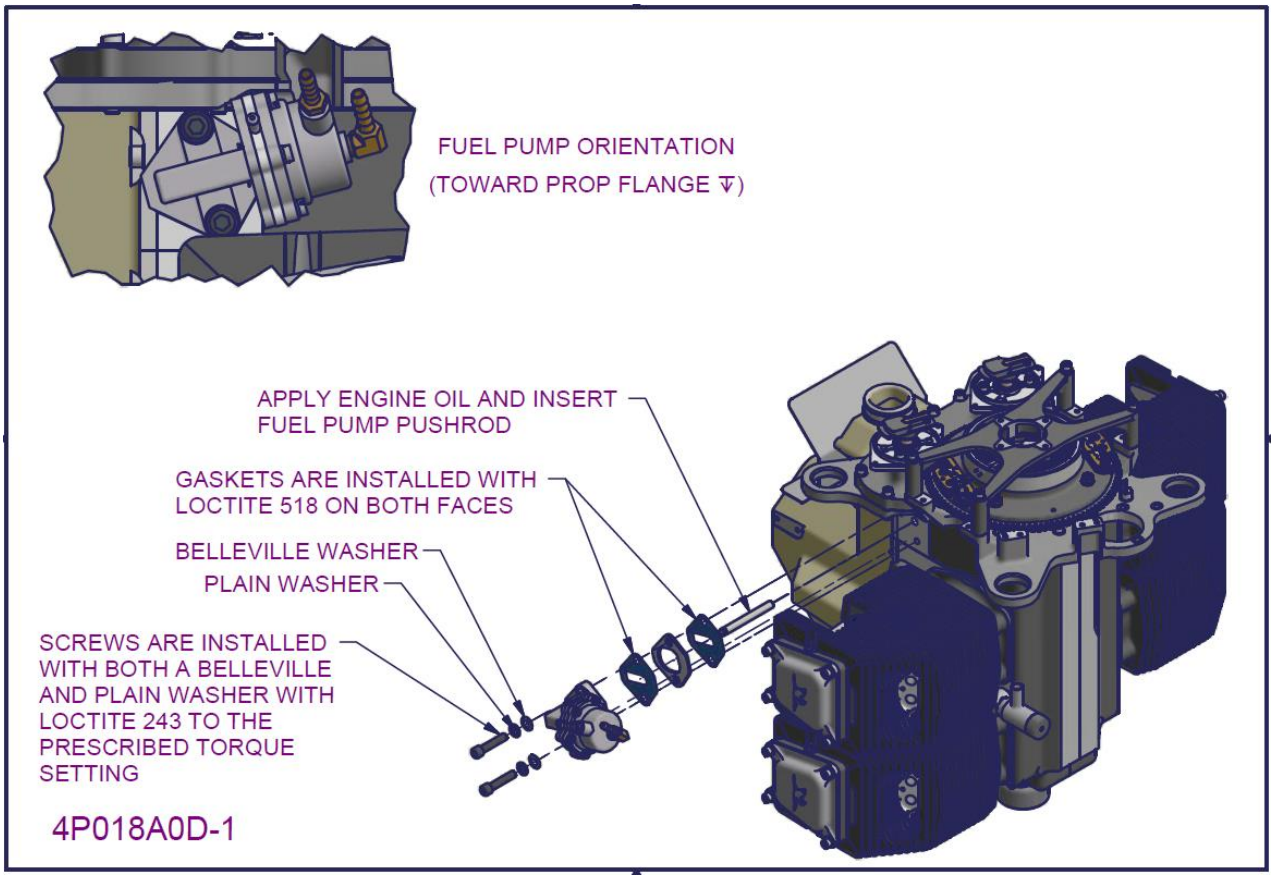


Figure 154 – 2200/330 Fuel pump installation 1

- *Record the serial number and type of the fuel pump used in the build log (section 6.17)*

- Ensure all mating faces on the crankcase and fuel pump are clean and dry.
- Apply engine oil to the fuel pump pushrod and insert into the crankcase.
- Apply Loctite 518 sealant to both faces of the two gaskets using a dabbing action.
- Install the fuel pump with the two gaskets and white spacer in the order shown in Figure 154.
  - The two retaining capscrews are installed with both a Belleville and plain washer (in that order) and Loctite 243 on the threads. Tighten these screws to the torque setting prescribed in section 0 and mark with a paint pen.
- This completes the **fuel pump installation**.

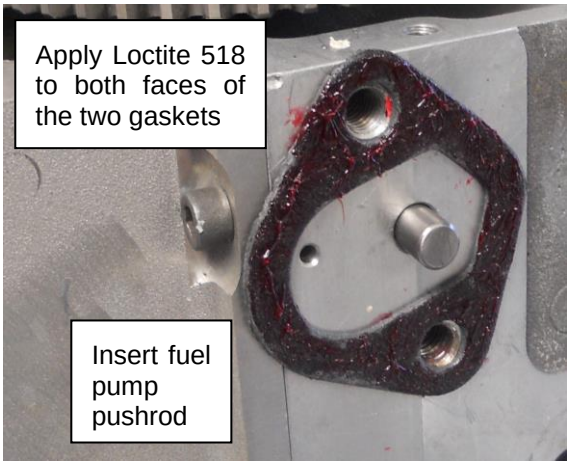


Figure 155 - Fuel pump installation

4.15 Oil pump and filter installation

4.15.1 2200/3300 Oil pump and filter installation (Cast Crankcase) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	PX4A002D-3	SPRING OIL PRESSURE RELIEF 3.5 BAR	1
2	AN960-416	1/4" FLAT WASHER	1
3	4536064-7	PLUNGER OIL PUMP RELIEF VALVE (2.2L)	1
4	PH10142N	CIRCLIP 16MM INT	1
5	4A490A0D-1	THREADED ADAPTOR M/M OIL FILTER-OIL COOLER	1
6	4581064-14	OIL COOLER ADAPTOR	1
7	PG4A043N-1	OIL COOLER ADAPTOR HOSETAIL - 1/4" THRU	2
8	PG4A038N-1_BS228	ORING BS229 (NOTE: NOT VITON)	1
9	PG10162N	FILTER	1
10	4280044-13	BACK PLATE OIL PUMP	1
11	4652084-8	HOUSING OIL PUMP (3.3L) 20mm GEAR	1
12	PH115334-1	DRIVE - OIL PUMP 1/8" X 1/2"DIA WOODRUF	1
13	PG10122N	O-RING BS143V	1
14	PG0035N	O-RING BS112V	1
15	PH0625N	5/16" UNC x 1 1/4" CAP SCREW	4
16	PI10182N-1	OIL PRESSURE SENDER	1
17	PH06864	WASHER, OIL PRESSURE RELIEF VALVE SEAT	1
18	472609D-13	OIL PUMP OUTER GEAR	1
19	466108D-14	OIL PUMP INNER GEAR	1
23	AN960-516	WASHER	4

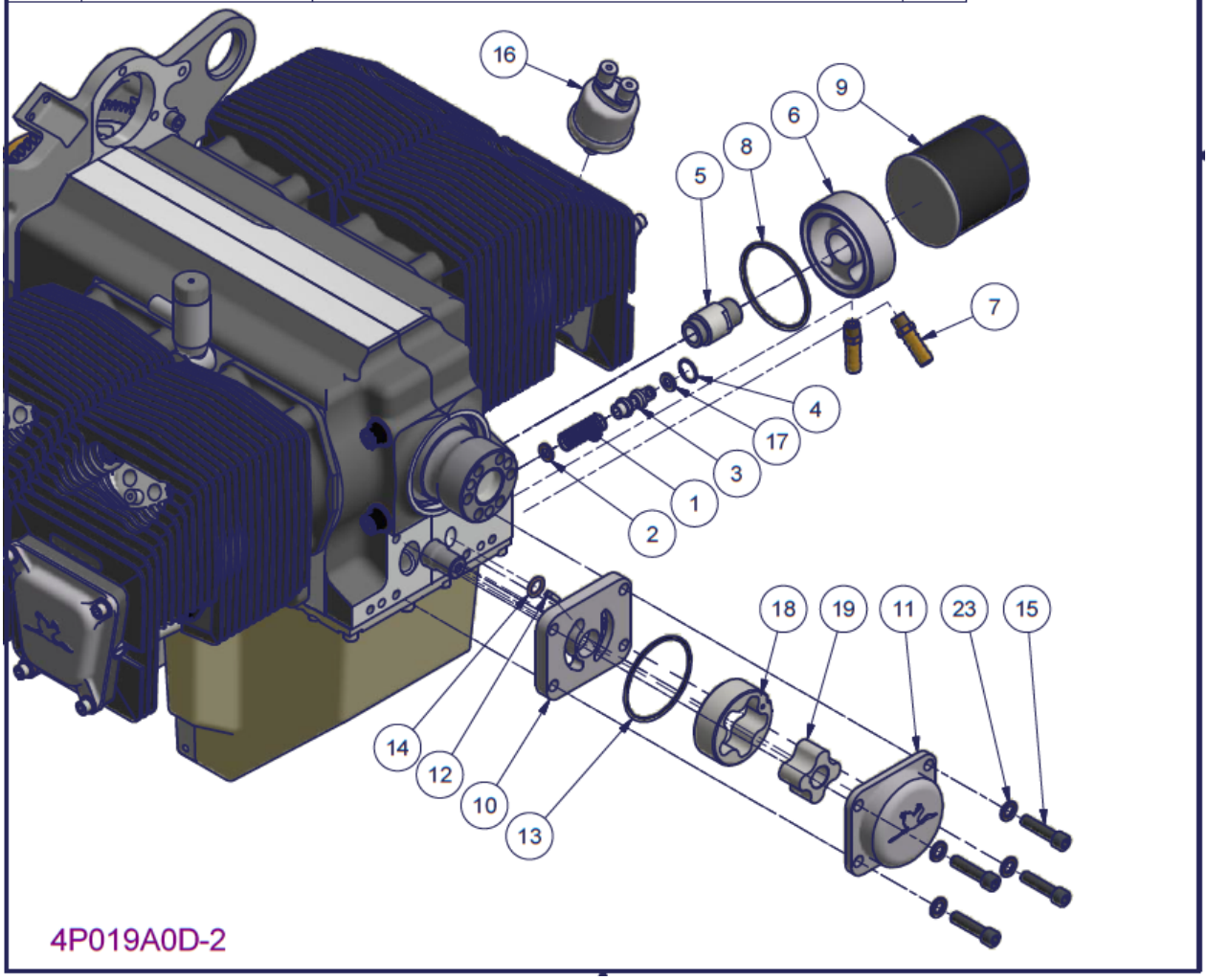


Figure 156 – 2200/3300 Oil pump and filter installation – Parts List

4.15.2 3300 Oil pump and filter installation (billet crankcase) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P018A1D-1	3310 FUEL PUMP INSTALLATION	1
2	PX4A002D-3	SPRING OIL PRESSURE RELIEF 3.5 BAR	1
3	AN960-416	1/4" FLAT WASHER	1
4	4536064-7	PLUNGER OIL PUMP RELIEF VALVE (2.2L)	1
5	PH10142N	CIRCLIP 16MM INT	1
6	PG4A043N-1	OIL COOLER ADAPTOR HOSETAIL - 1/4" THRU	2
7	PG4A038N-1_BS228	ORING BS229 (NOTE: NOT VITON)	1
8	PG10162N	FILTER	1
9	4280044-13	BACK PLATE OIL PUMP	1
10	PH115334-1	DRIVE - OIL PUMP 1/8" X 1/2"DIA WOODRUF	1
11	PG10122N	O-RING BS143V	1
12	PG0035N	O-RING BS112V	1
13	PH0625N	5/16" UNC x 1 1/4" CAP SCREW	4
14	PI10182N-1	OIL PRESSURE SENDER	1
15	PH06864	WASHER, OIL PRESSURE RELIEF VALVE SEAT	1
16	4652084-8	HOUSING OIL PUMP (3.3L) 20mm GEAR	1
19	4A751A0D-1	OFFSET OIL FILTER ADAPTOR	1
20	4A752A0D-1	SCALLOPED OIL FILTER ATTACHMENT STUB	1
21	4120534-5	FITTING OIL FILTER	1
22	PH1011N	5/16" UNC x 1" CAP SCREW	1
23	AN960-516L	HALF WASHER	1
24	466108D-14	OIL PUMP INNER GEAR	1
25	472609D-13	OIL PUMP OUTER GEAR	1
26	AN960-516	WASHER	4

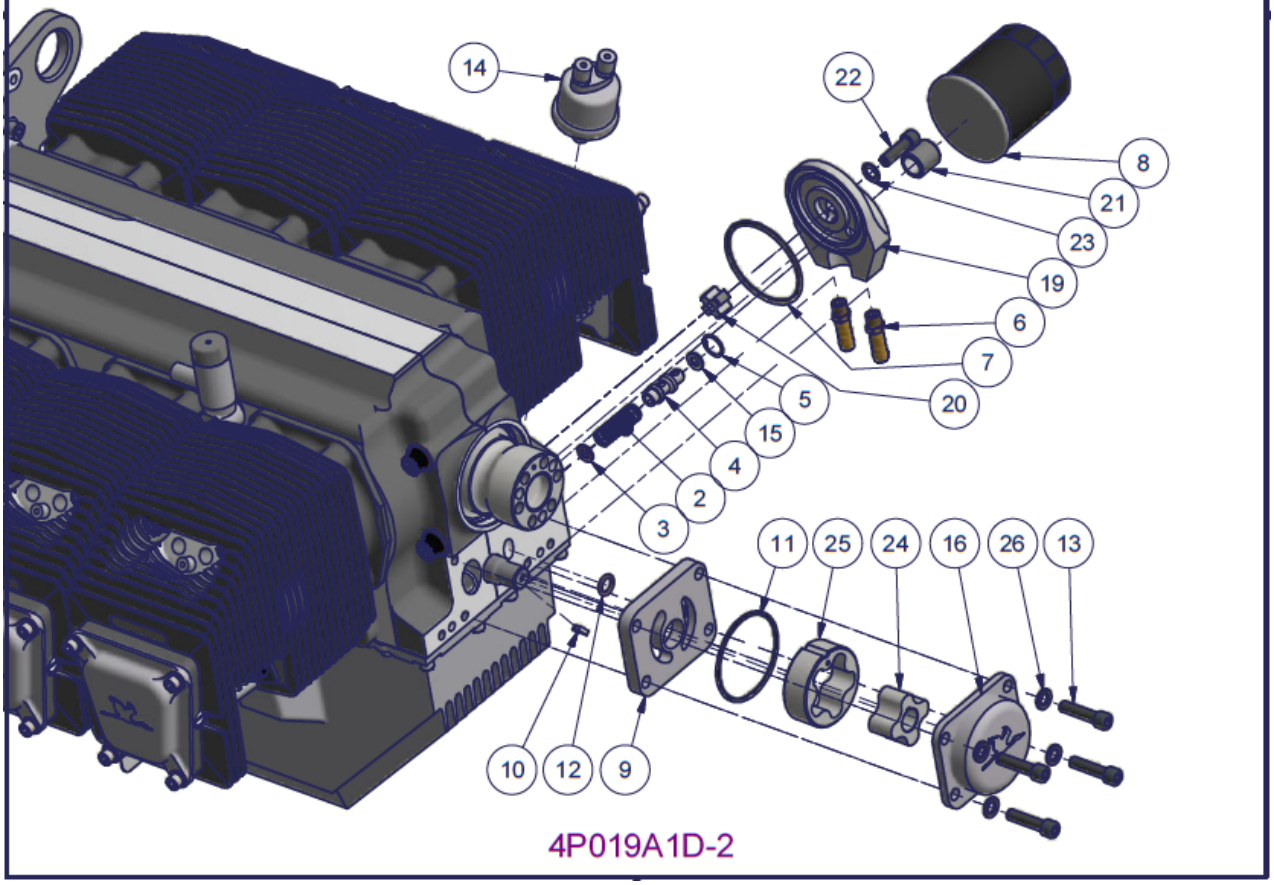


Figure 157 – 3300 Oil pump and filter installation (billet crankcase) – Parts List

4.15.3 2200/3300 Oil pump and filter installation procedure

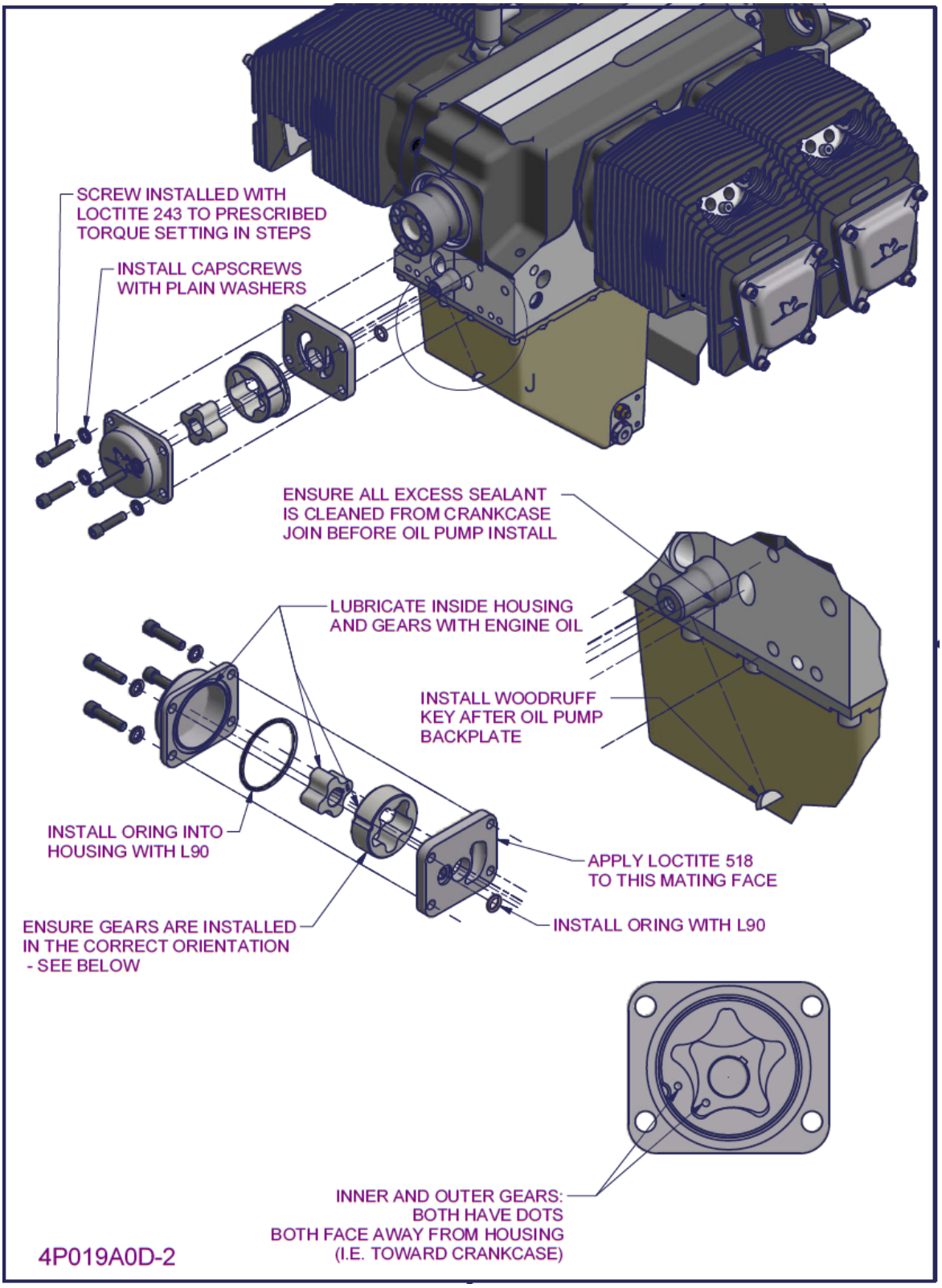


Figure 158 –2200/3300 Oil pump and filter installation 1

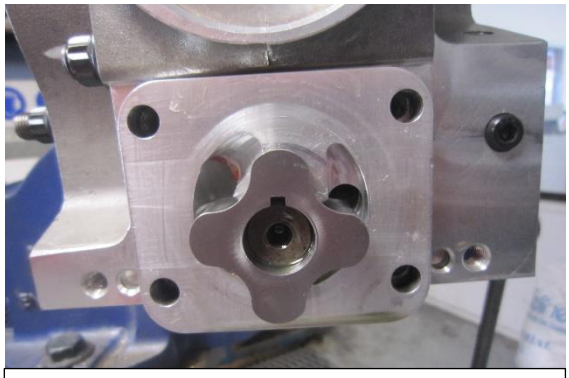
NOTE

Figure 158 shows the oil pump installation with the engine positioned horizontally FOR CLARITY ONLY. The oil pump installation MUST be conducted with the engine mounted vertically on the prop flange to prevent lubricating oil from seeping between the back plate and crankcase during installation.

Oil Pump Assembly

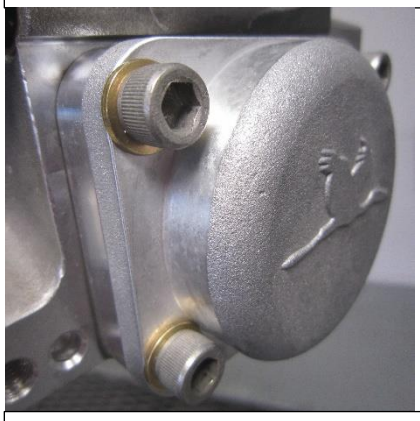
- Ensure all oil pump components are clean. Prime the capscrews and tapped holes with Loctite 747.
- Clean the excess dried sealant from the crankcase halves mating where the oil pump attaches onto the crankcase.
- Apply engine oil inside the housing and to both inner and outer gears.
- Install the small O-ring into the back plate with Loctite 518
- Install the large O-ring into the housing with Loctite 518
- Apply Loctite 518 to the back plate on the face which contacts the crankcase (i.e. the same face into which the small O-ring was installed) using a dabbing action.
- Position the back plate on the engine and install the woodruff key into the camshaft. Then align the inner gear keyway with the woodruff key, then the outer gear and the housing.
    - Screw in the four capscrews with washers, with 243 Loctite to hold the oil pump in place. **DO NOT TIGHTEN!** Assemble until the O ring in the housing touches the back plate. The oil pump must remain loose at this point.
    - Carefully rotate the engine by hand feeling for resistance in the oil pump. If there is too much resistance then **STOP TURNING**! Excessive resistance indicates the oil pump is not positioned correctly, in this case loosen the screws slightly and try again.
    - Once the engine can be turned without excessive resistance the four cap screws can be tightened to take up free play in the oil pump (i.e. tighten until the oil pump is no longer loose).
    - Again carefully rotate the engine feeling for excessive resistance.
    - If the engine can be rotated without excessive resistance all capscrews should now tightened to the torque setting prescribed in Section 3.10.3. JEM0004.
      Mark with a paint pen.
    - Finally rotate the engine a few times to verify that the oil pump turns smoothly without excessive resistance.

Lubricate housing and gears with engine oil



Align inner oil pump inner gear with woodruff key

Apply Loctite 518 to the back plate (**on the crankcase mating face only**)



Installed oil pump assembly with washers under the cap screws.

Figure 159 - Installing the oil pump

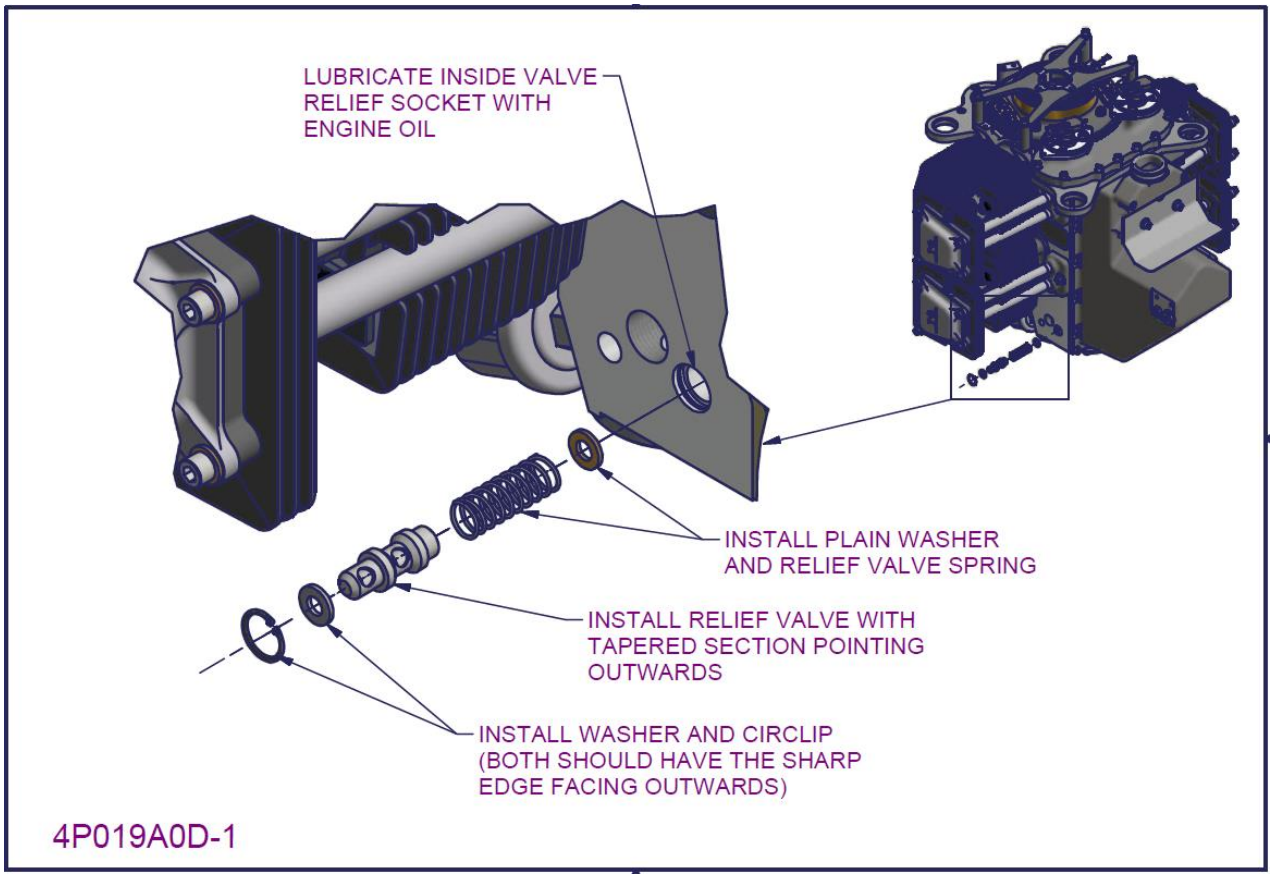


Figure 160 – 2200/3300 Oil pump and filter installation 2

- Apply engine oil inside the oil pressure relief valve socket to lubricate
- Install a plain washer, the relief valve spring and the relief valve into the socket
  - Ensure the relief valve has the tapered section facing outward
- Retain the valve in place by installing the relief valve washer and a circlip
  - Ensure that both the retaining washer and circlip is installed correctly with the sharp edge facing outwards and the circlip fully seated in the circlip groove.

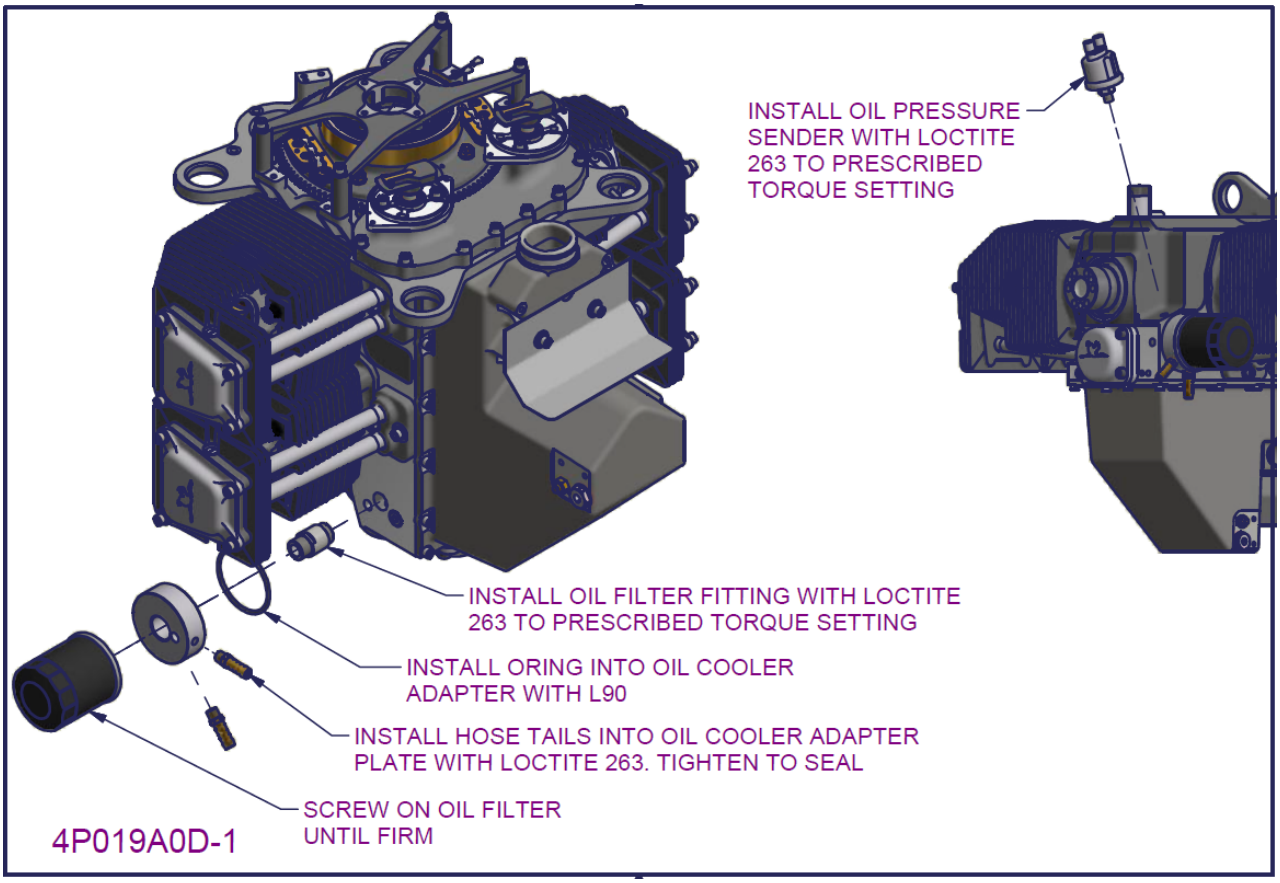


Figure 161 – 2200/3300 Oil pump and filter installation 3

- Ensure all components and the crankcase mating face is clean.
- Prime the oil filter fitting, hose tails and taped holes with Loctite 747.
- Install the oil filter fitting into the crankcase (the short threaded end goes into the crankcase) with Loctite 263 on the threads. Tighten to the torque setting prescribed in section 0 and mark with a paint pen.
- Install the hose tail fitting into the oil cooler adaptor plate with Loctite 263 on the threads. Tighten sufficiently to seal.
- Install the O-ring into the oil cooler adaptor plate with L90 lubricant.
- Apply engine oil to the top of the installed O-ring and fit the oil cooler adaptor plate over the oil filter fitting with the hose tails pointing toward the sump.
- Fill the oil filter with engine oil and apply oil to the sealing surface of the filter. Screw the filter onto oil filter fitting and tighten until firm on the oil cooler adaptor plate. Clean away excess oil.
- Install the oil pressure sender with Loctite 263 on the thread. Tighten to the torque setting prescribed in section 0 and mark with a paint pen.
- This completes the **oil pump and filter installation.**
- For engines built with a reworked billet crankcase see the following section for additional notes.

4.15.4 Oil filter installation (Reworked Billet crankcase) – additional notes

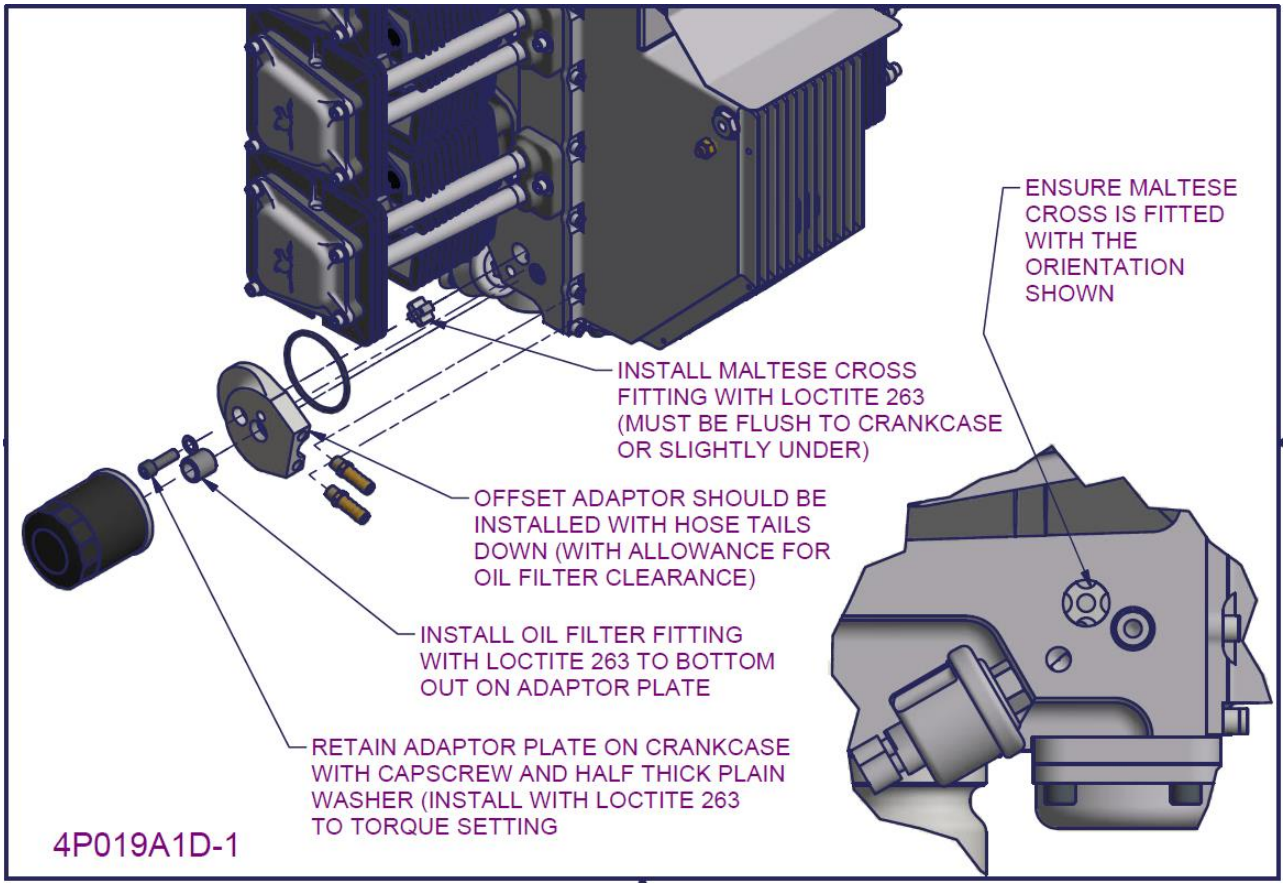


Figure 162 – Reworked Billet crankcase oil filter adaptor installation

- The oil filter adaptor installation for a reworked billet crankcase differs to that of the cast crankcase since it uses an offset adaptor plate to provide clearance between the oil filter and cylinder barrel.
- Install the Maltese fitting into the crankcase with Loctite 263
  - Note that it is very important that this fitting **is NOT installed to bottom out** on the crankcase, it should be installed flush, or slightly below the surface of the crankcase.
  - The fitting must also be installed with the orientation shown in Figure 162.
  - These requirements exist to ensure the fitting does not partially block the oil gallery which would restrict oil flow through the engine.
- The offset oil filter adaptor plate should be orientated with the hose tails pointed down (towards the sump) and slightly forward (towards to prop flange).
- The adaptor plate is retained on the engine with a capscrew and half thickness plain washer. Install the capscrew with Loctite 263 to the torque setting prescribed in section 0 and mark with a paint pen.
- Install the oil filter fitting into the oil filter adaptor plate with Loctite 263 until it bottoms out.

4.16 Exhaust and induction pipe installation

4.16.1 2200 Exhaust and induction pipe installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P019A0D-1	2210 OIL PUMP AND FILTER INSTALLATION	1
2	PE4A030N	EXHAUST GASKET COPPER - 32ID 4CS	4
3	PG4A048N	ORING NBR 32X4MM	4
4	4A721A0D-3	2210 INDUCTION EXHAUST CLAMP TURTLE	4
5	PH4A082N	5/16" UNC x 1-3/4" CAP SCREW	4
6	PV102924	HOSE INDUCTION 32 ID	4
7	PG102924	CLAMP	8
8	PG10212N	O-RING	4
9	4A636A0D-2	2210 EXHAUST PIPE W/ASSY SET	1
10	4A641A0D-3	2210 INDUCTION PIPE W/ASSY SET	1
11	PH4A077N	5/16" SS NORDLOC WASHER (NL8spss)	4

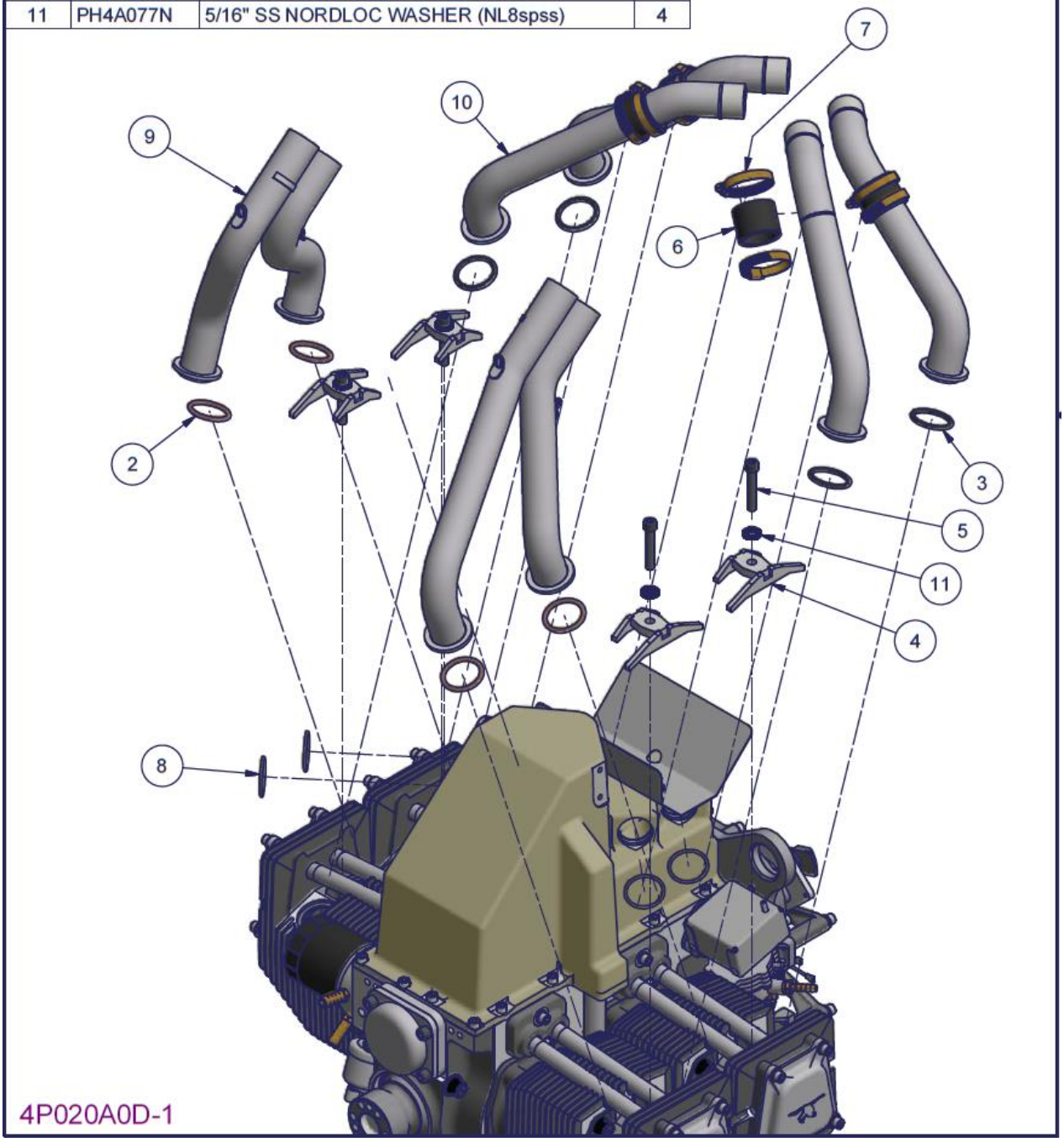


Figure 163 – 2200 Exhaust and induction pipe installation

4.16.2 3300 Exhaust and induction pipe installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P019A1D-1	3310 OIL PUMP AND FILTER INSTALLATION	1
2	PE4A030N	EXHAUST GASKET COPPER - 32ID 4CS	6
3	PH4A082N	5/16" UNC x 1-3/4" CAP SCREW	6
4	PV102924	HOSE INDUCTION 32 ID	6
5	PG102924	CLAMP	12
6	PG10212N	O-RING	6
7	PG4A048N	ORING NBR 32X4MM	6
8	4A721A0D-3	2210 INDUCTION EXHAUST CLAMP TURTLE	6
9	4A782A0D-2	3310 INDUCTION PIPE W/ASSY SET	1
10	4A769A0D-2	3310 EXHAUST PIPE W/ASSY SET	1
11	PH4A077N	5/16" SS NORDLOC WASHER (NL8spss)	6

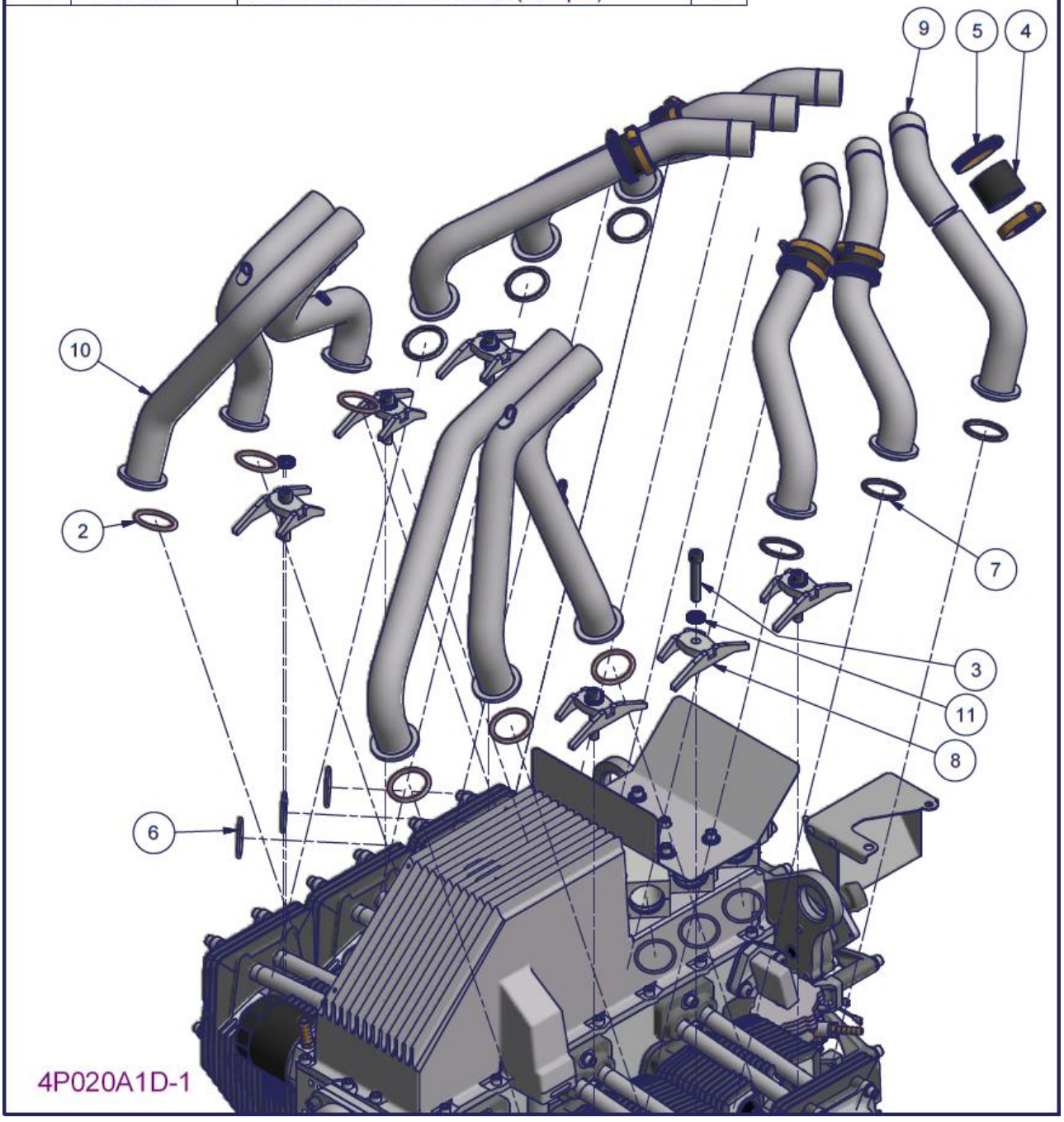


Figure 164 – 3300 Exhaust and induction pipe installation

4.16.3 2200/3300 Exhaust and induction pipe installation procedure

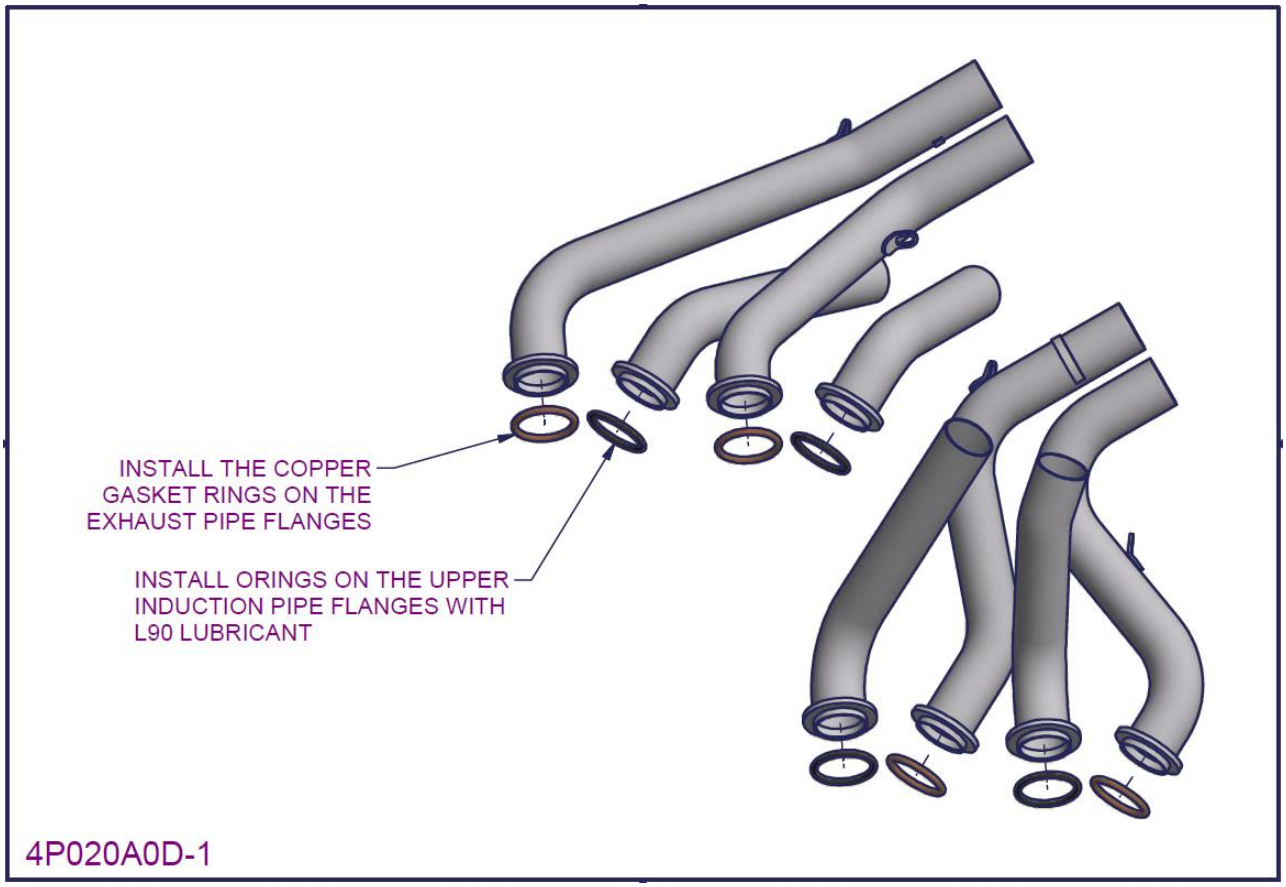


Figure 165 – 2200/3300 Exhaust and induction pipe installation 1

- Ensure that all induction and exhaust pipes are completely clean of any dirt or oil.
- Install the copper gasket rings on the exhaust pipes.
  - The seam of the gasket ring should be facing outwards.
- Apply L90 lubricant to the flanges of the upper induction pipes and install the O-rings onto the flanges (the L90 helps the O-rings adhere in place during pipe installation).

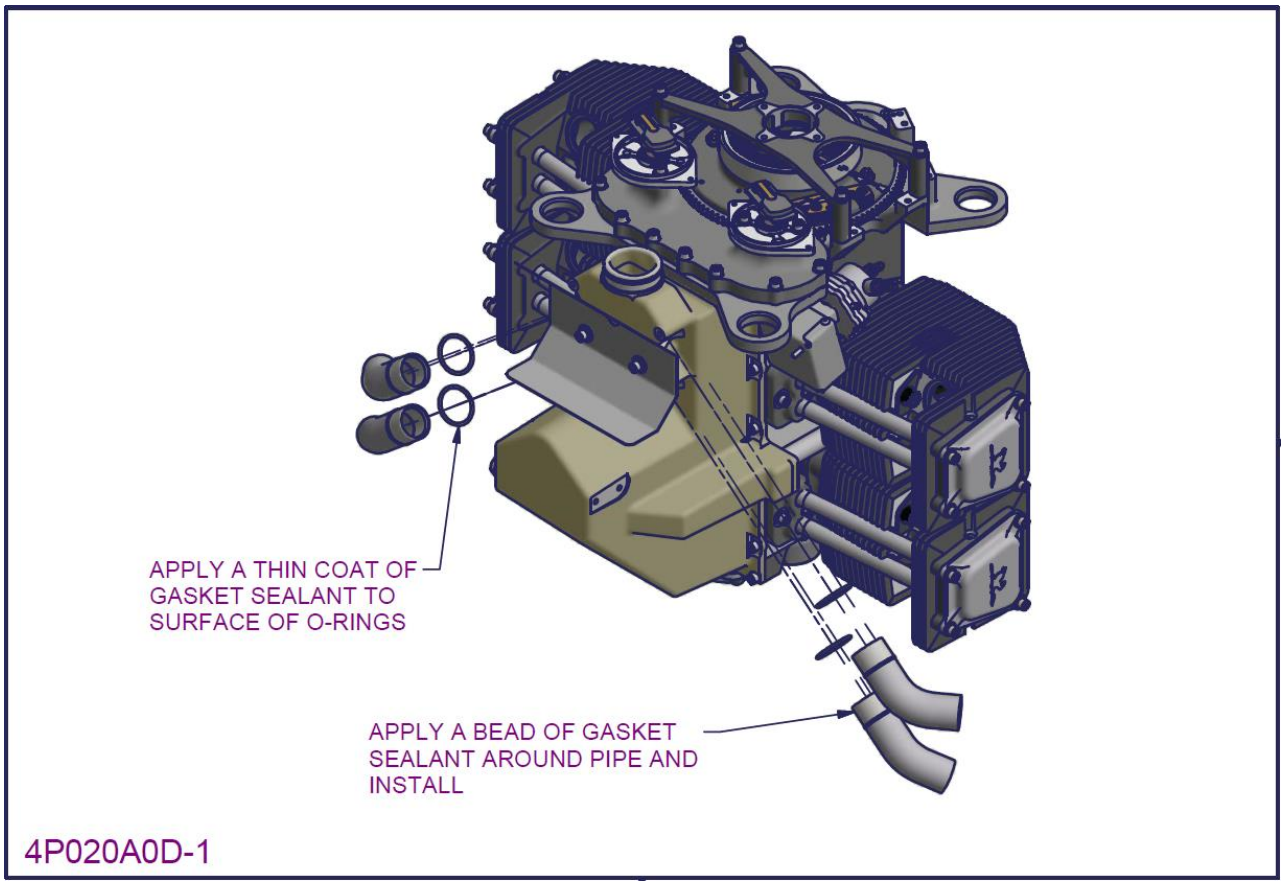


Figure 166 – 2200/3300 Exhaust and induction pipe installation 2

- Apply a thin coating of Gasket sealant to O-rings and install in the plenum chamber
- Apply a bead of Gasket sealant around the perimeter of each lower induction pipe and install into the plenum chamber
    - Make sure the correct end is installed into the plenum (i.e. the end with the machined spigot welded onto it, not the bare pipe end)
    - The bead should be applied approximately 5mm from the end of the pipe spigot
    - When installing the pipes into the plenum give each a slight twisting movement. This helps to ensure the gasket sealant contacts the entire perimeter of the plenum bore inlet.

Figure 167 - Lower induction pipe installation

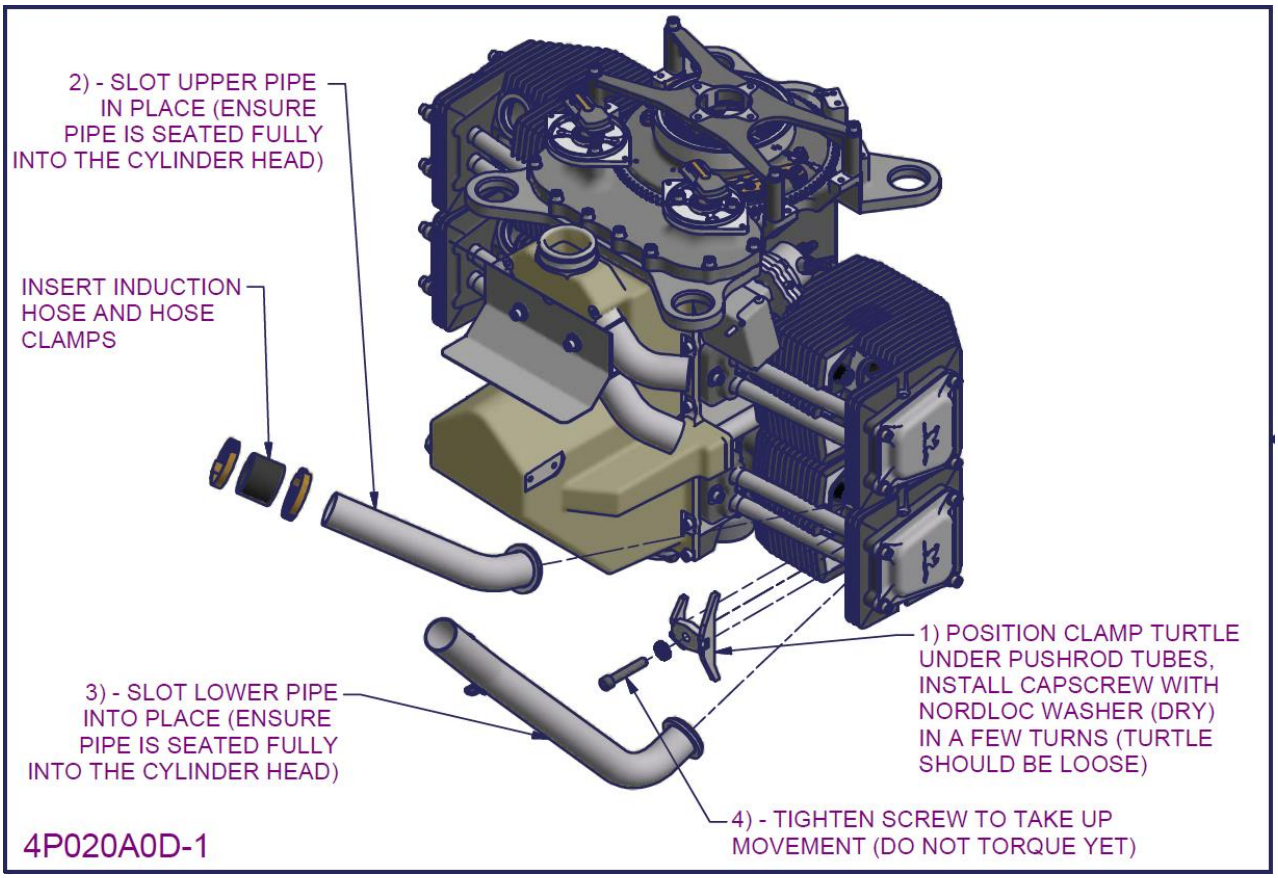


Figure 168 – 2200/3300 Exhaust and induction pipe installation 3

- The upper induction and exhaust pipes are now installed. Due to the design of the clamping device each cylinder head must have both the upper induction and exhaust pipe positioned and installed simultaneously.
- With the engine mounted vertically on the propeller flange begin with the lowest cylinders (#1 and #2) and install each pair of pipes, the following method has been found convenient:
    - Install the induction rubber hose and two hose clamps on the upper induction pipe.
    - Position the clamp turtle under the pushrod tubes and install the retaining capscrew (**dry**) with a Nordloc washer, only install the screw a few turns to stop the turtle falling out, it should be loose.
    - Slot the top pipe in first (independent of weather it is an exhaust or induction pipe) ensuring the gaskets ring or O-ring remains in place on the pipe flange and the pipe flange seat fully into the cylinder head.
    - Now bring the bottom pipe up and slot into place (again ensure the pipe seats fully).
    - Bring the upper and lower induction pipes to meet and slide the rubber hose over the join.
    - Tighten the retaining capscrew some more to stop the pipes falling out (**do not torque screws yet**).
- Repeat these steps for the other pipe pairs until all cylinders are done.

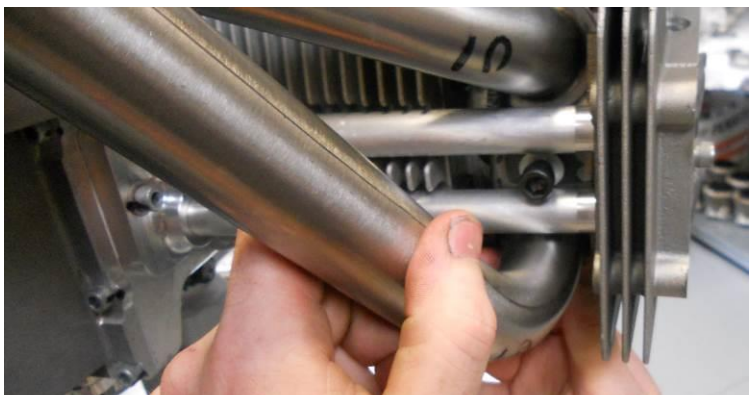


Figure 169 - position exhaust and upper induction pipes with clamp turtles

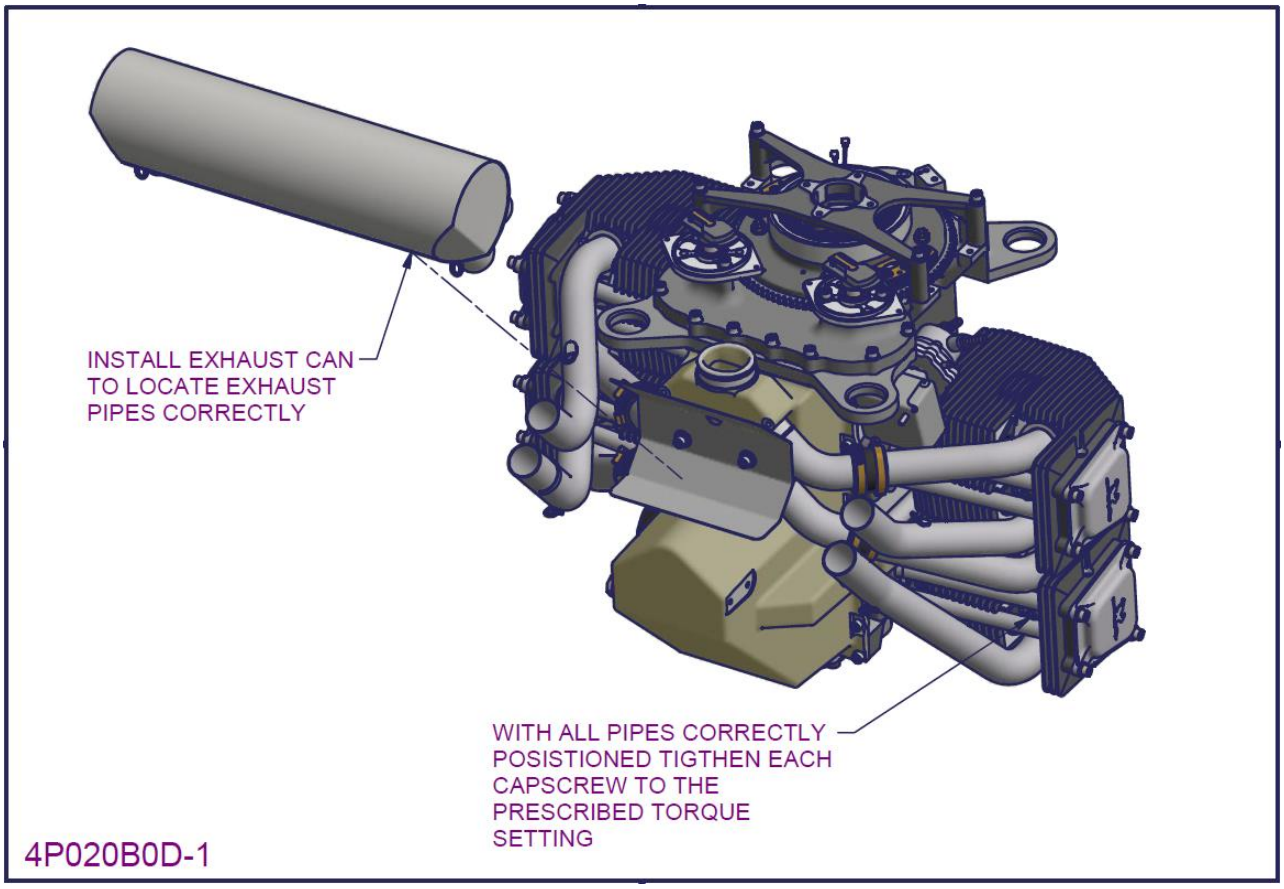


Figure 170 – 2200/3300 Exhaust and induction pipe installation 4

- With all pipes loosely installed, the positioning of the exhaust pipes is checked.
- Take and exhaust muffler can or complete exhaust muffler assembly and place on the exhaust pipes.
    - Loosen the clamp turtle screws and reposition the exhaust pipes as needed until the exhaust muffler can slides onto all exhaust pipes.
- As a final check verify that all pipes are sitting correctly in the respective cylinder heads, that all induction pipes meet and have the rubber hoses in place and check the exhaust muffler sits correctly on exhaust pipes.
- Now tighten all induction hose clamps until firm (there is no specific torque setting). **Do not over tighten**, they must be tight enough to prevent hose movement but not as tight as to cause the hose clamps to bite into the induction hose.
- Tighten each retaining cap screw to the torque setting prescribed in section 0 and mark with a paint pen.
- Remove the exhaust muffle can from the engine once all screws have been tightened.
- This completes the **Exhaust and Induction pipe installation.**

NOTE – Exhaust gasket rings and induction O-rings are ONE USE ONLY if the pipes have to be removed for any reason NEW hardware must be used upon reinstallation.

Figure 171 - Pipe positioning and torqueing

4.17 Ignition system installation

4.17.1 2200 Ignition system installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P020A0D-1	2210 PIPES INSTALLATION	1
2	PH4A004-1	FIBRE WASHER - IGNITION COIL INSULATING	4
3	PI0525N	IGNITION COIL (HONDA 30500ZE2007)	2
4	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	4
5	PH10724-2	1/4" BELLEVILLE WASHER	4
6	PH0219N	WASHER 1/4 X 5/8 FLAT Z/P	4
7	PI10642N	DISTRIBUTOR CAP	2
8	4096124-5	CLAMP DISTRIBUTOR CAP	4
9	PH72B24	SOCKET HD SCREW 10-32 X 1 1/4	4
10	PH4A003N	3/16" BELLEVILLE WASHER	4
11	PI10582N	SPARK PLUG	8
12	PI4A000N-1	SPARK PLUG TERMINAL NUT	8
13	PI119034	4 CYLINDER IGNITION LEAD SET (NOT SHOWN)	1

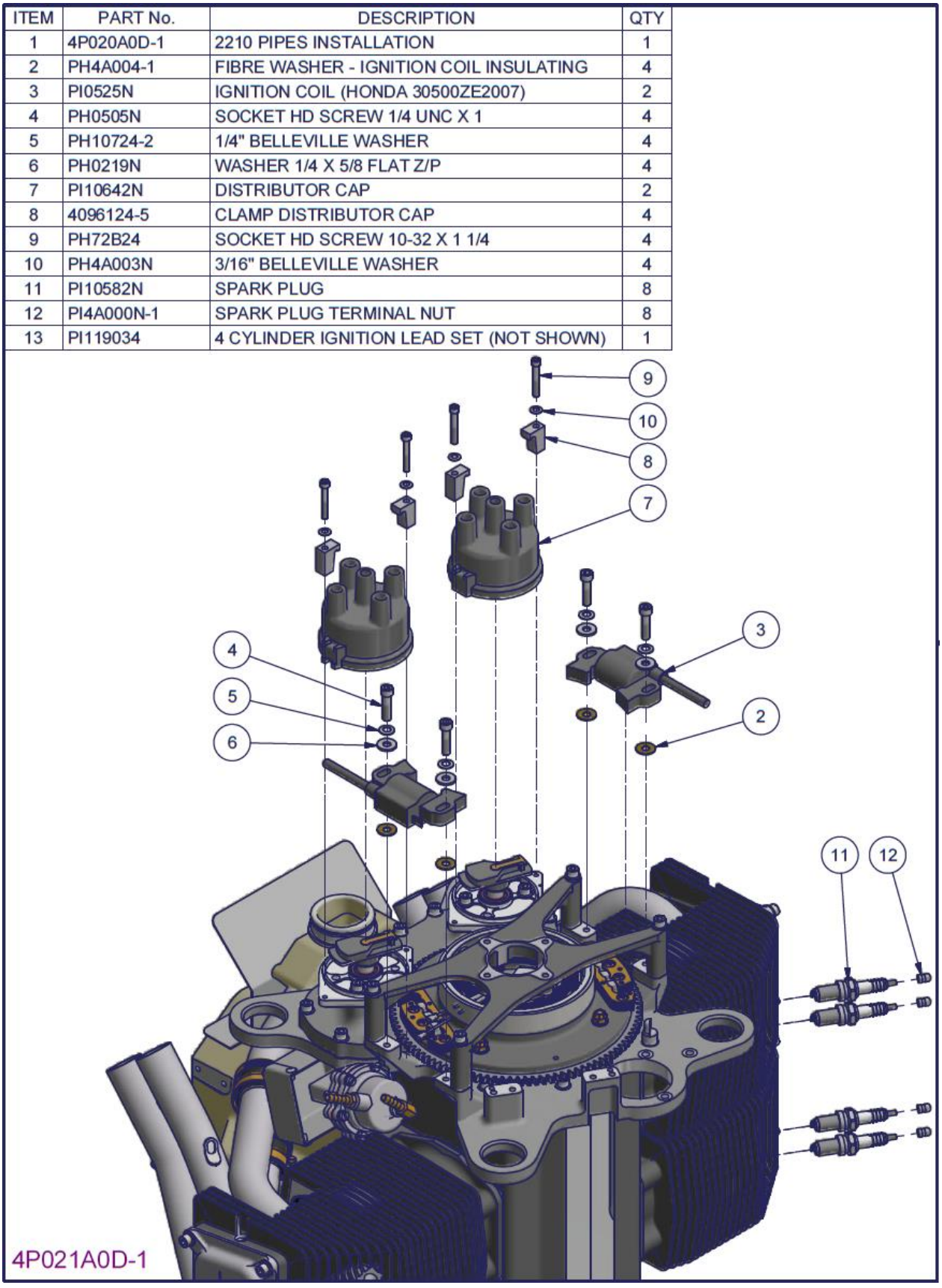


Figure 172 – 2200 Ignition system installation – Parts List

4.17.2 3300 Ignition system installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P020A1D-1	3310 PIPES INSTALLATION (SINGLE CARBY)	1
2	PI10582N	SPARK PLUG	12
3	PI4A000N-1	SPARK PLUG TERMINAL NUT	12
4	PH4A004-1	FIBRE WASHER - IGNITION COIL INSULATING	4
5	PI0525N	IGNITION COIL (HONDA 30500ZE2007)	2
6	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	4
7	PH10724-2	1/4" BELLEVILLE WASHER	4
8	PH0219N	WASHER 1/4 X 5/8 FLAT Z/P	4
9	PI10643N-1	CAP DISTRIBUTOR (3300)	2
10	PH72B24	SOCKET HD SCREW 10-32 X 1 1/4	4
11	PH4A003N	3/16" BELLEVILLE WASHER	4
12	4881014-2	CLAMP DISTRIBUTOR CAP (3.3L)	4
13	PI4A013N	6 CYLINDER LEAD KIT (NOT SHOWN)	1

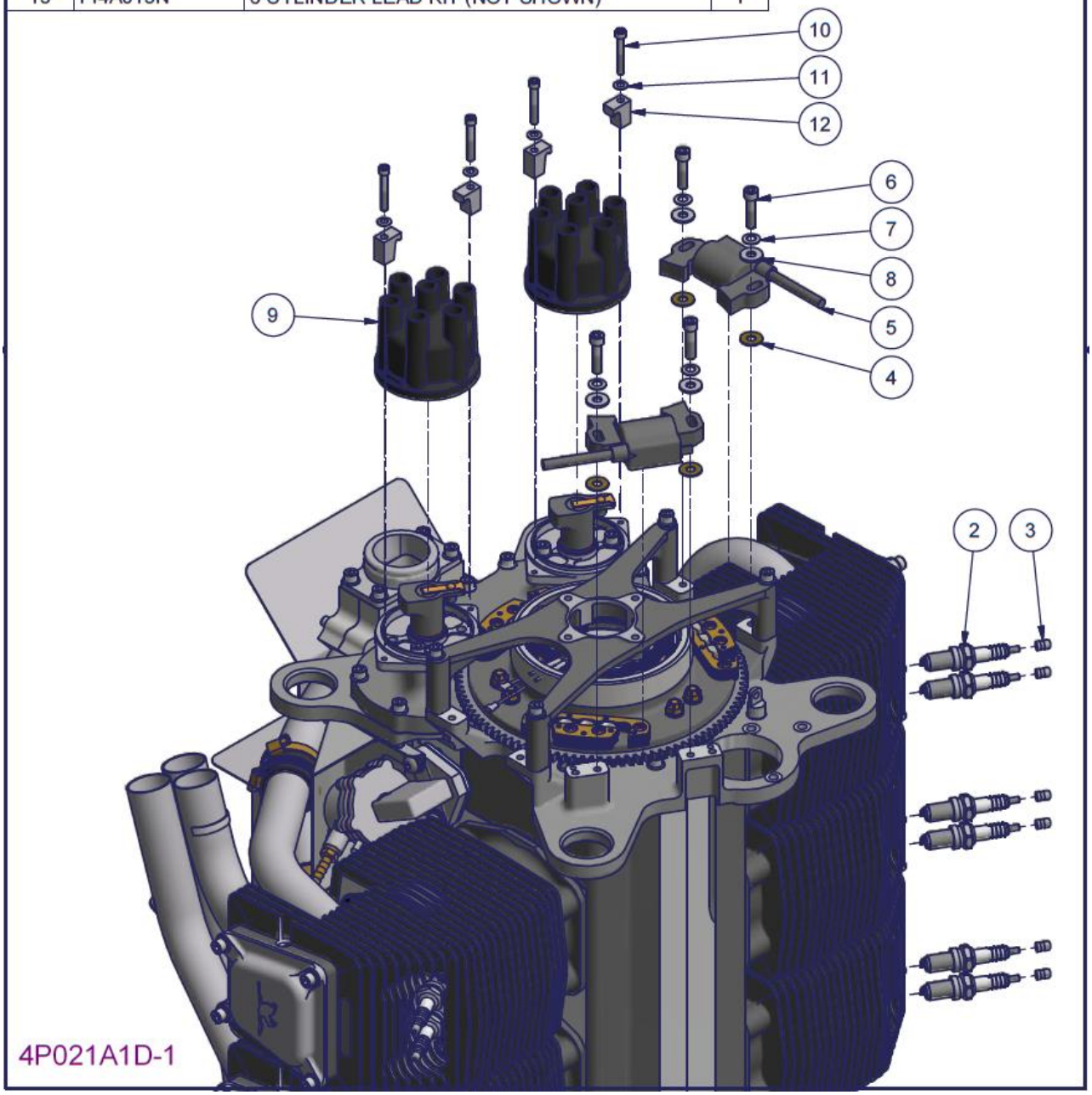


Figure 173 – 3300 Ignition system installation – Parts List

4.17.3 2200/3300 Ignition system installation procedure

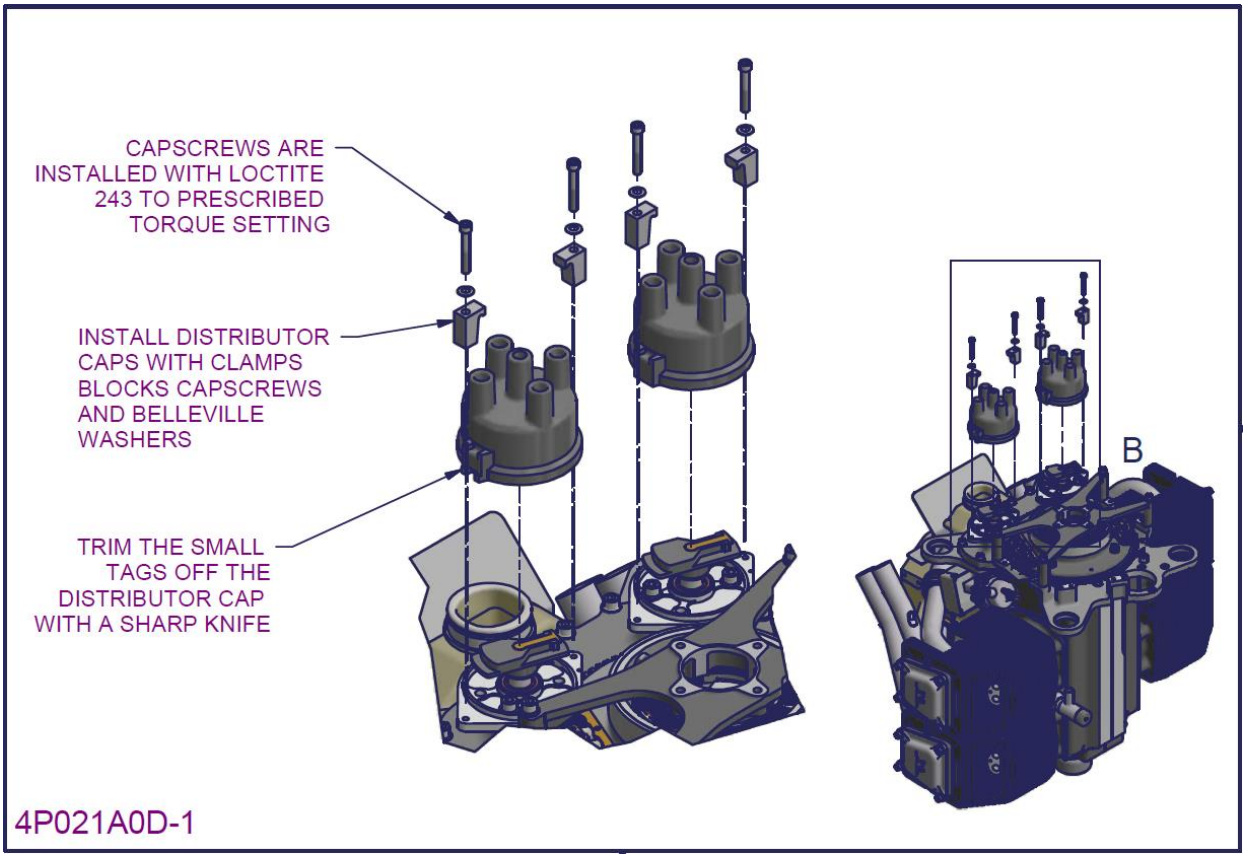


Figure 174 – 2200/3300 Ignition system installation 1

- Trim the small tags on the base of the distributor cap off using a sharp knife.
  - This step need only be done for the 4 cylinder engine. The 6 cylinder does not have these tags.
- Prime all tapped holes and screws with Loctite 747.
- Position the distributor caps on the mount plate and retain in place with the retaining clamps
  - The retaining clamps are fixed in place with capscrews and Belleville washers.
  - Install the capscrews with Loctite 243 to the torque setting prescribed in section 0 and mark with a paint pen.

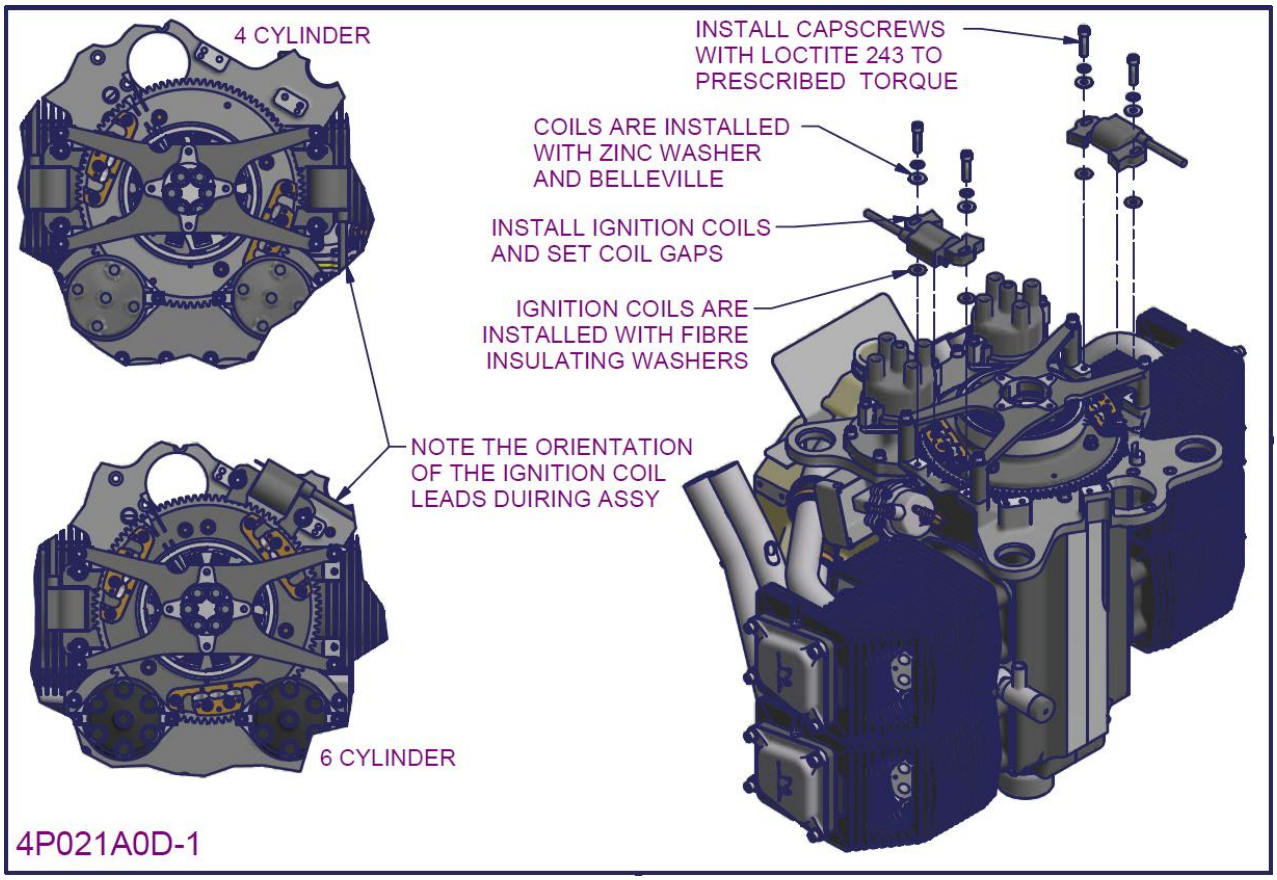
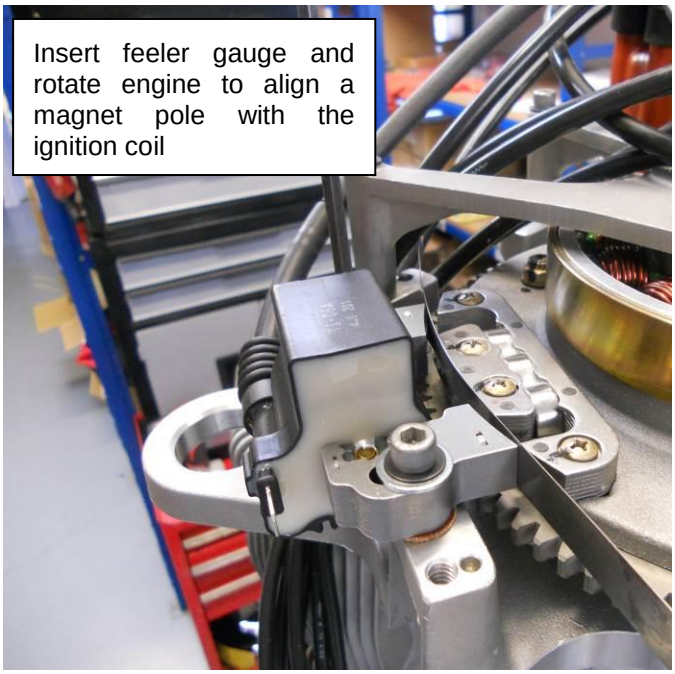
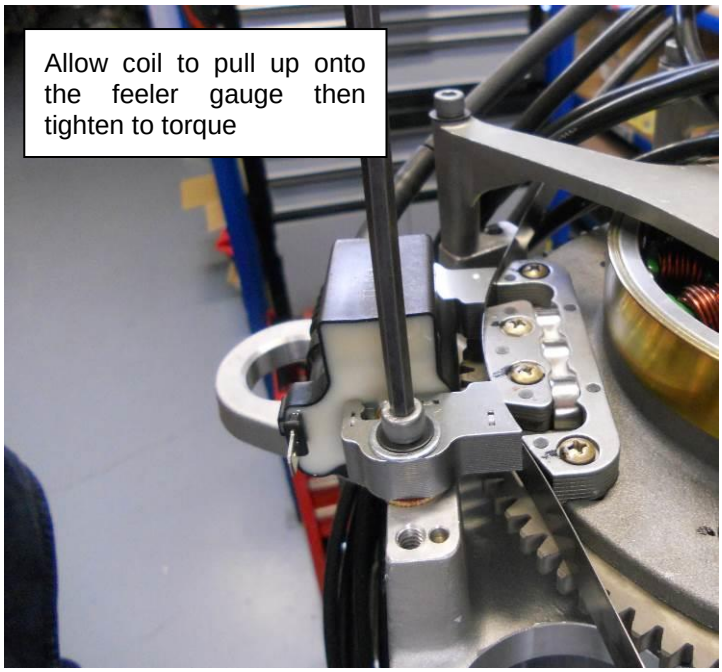


Figure 175 – 2200/3300 Ignition system installation 2

- *Record the ignition coil types installed on the left and right of the engine in the build log (section 6.20)*

- Rotate the engine so the flywheel ignition magnets are NOT aligned with the ignition coil positions.
- Prime the tapped holes and capscrews with Loctite 747.
- Apply Loctite 243 to the threads of the capscrews.
- Install the ignition coils with Belleville washers, wide zinc washers and backed by fibre insulating washers.
  - Ensure the ignition coils are installed with the correct orientation as shown in Figure 175 (i.e. the coil leads are pointing in the clockwise direction when view from the flywheel).
- Now the ignition coil gaps are set using feeler gauges, this must be done quickly both the Loctite on the capscrew sets. The coil gaps are set to the value prescribed in section 3.11.4.
  - Secure one coil out of the way of the flywheel magnet pole by pulling it radially outward to the far extreme and tightening the capscrew sufficiently to hold it.
  - Leave the other coil loose and insert a long series 0.012” (0.30mm) thick feeler gauge.
  - Rotate the engine (in the same direction as the feeler gauge was inserted from) until one of the flywheel magnet pole aligns with the ignition coil. The flywheel magnets will pull the ignition coil inwards onto the feeler gauge.
  - Tighten the ignition coil retaining screw to the torque setting prescribed in section 0.
- Flywheel assemblies will inevitably have one pole slightly higher than the others. The coil gap clearance for the ignition coil must be checked against the other magnet pole (or poles in the case of a 6 cylinder)
  - Using a long series 0.010” (0.25mm) thick feeler gauge check for coil gap clearance by inserting the feeler gauge beside the ignition coil and rotating the engine to align each flywheel pole with the ignition coil.
  - If clearance is not observed (i.e. the engine will not rotate without interference on one of the poles) then that pole must be the highest, it should be marked clearly with the letter ‘H’ or an ‘X’ using a paint pen for future coil gap clearance checks. Loosen the coil retaining screws and reset the coil gap clearance as previously described, using the highest flywheel pole.
- Repeat installation and coil gap setting procedures for the second ignition coil using the highest pole.
- Once both ignition coils have been set and the retaining capscrews torqued, mark each capscrew with a paint pen.
- Rotate the engine several times around as a final verification that the coils have been set sith sufficient clearance.





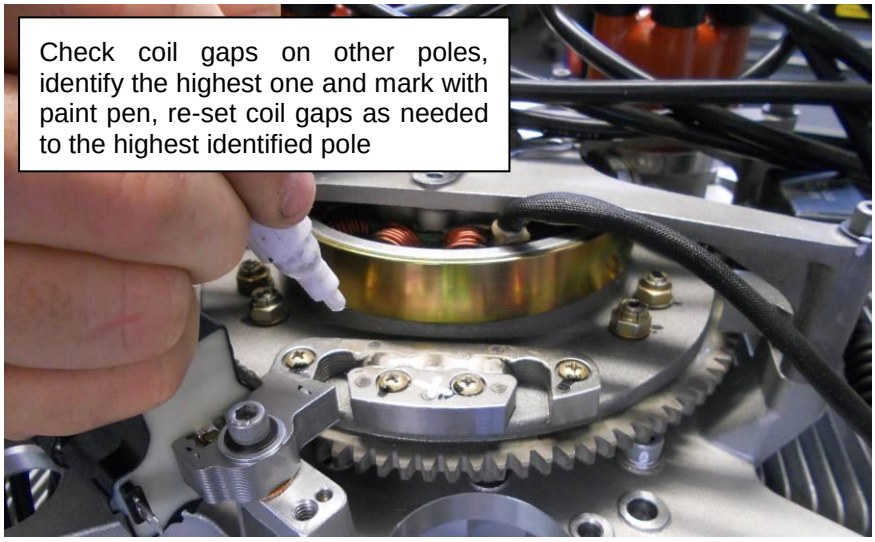


Figure 176 - Setting ignition coil gaps

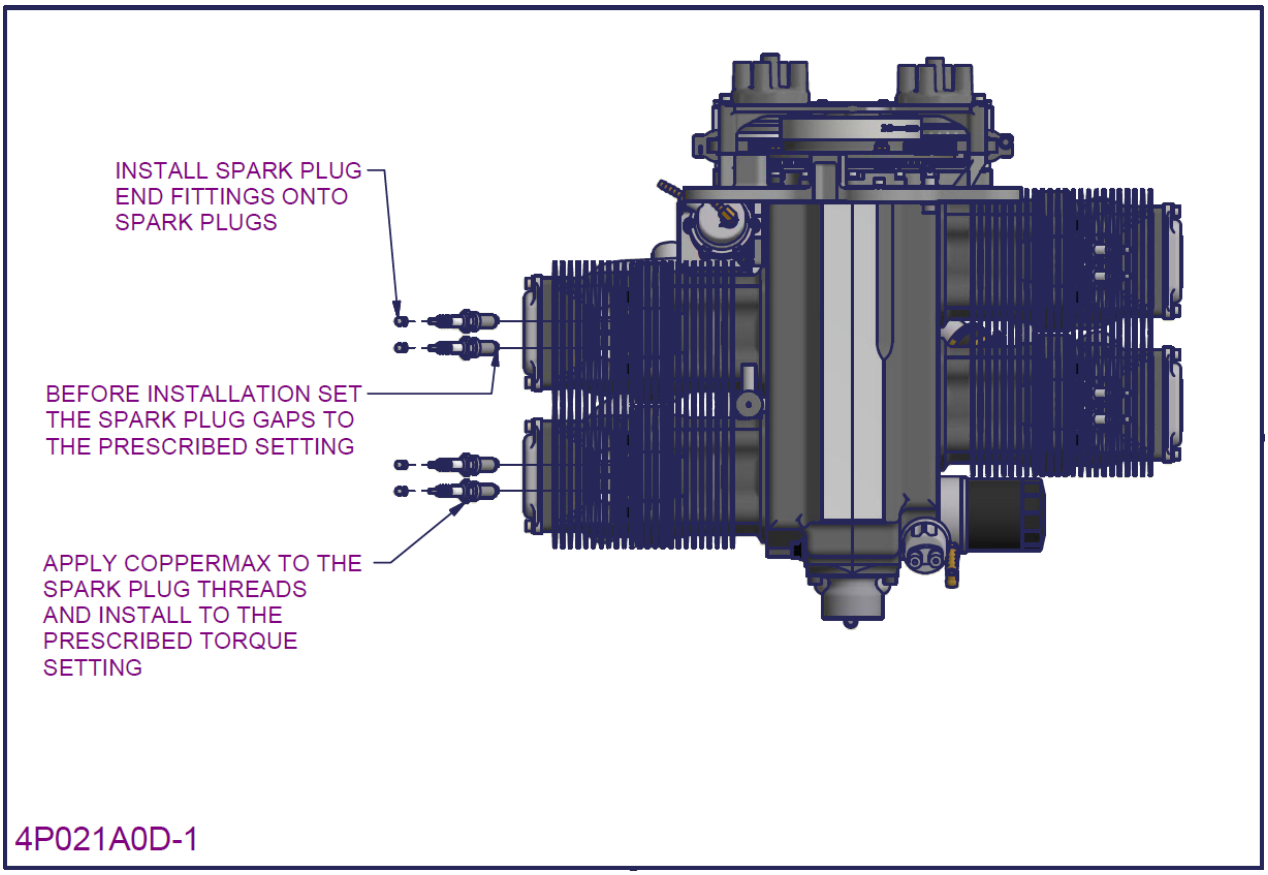


Figure 177 – 2200/3300 Ignition system installation 3

- Before installing spark plugs check the spark plug gap using a feeler gauge. The plug gap must be within the tolerance prescribed in in section 3.11.4.
    - If the spark plug gap is too large the spark plug can be tapped lightly on a hard surface to bend the electrode hook in slightly, recheck the gap and repeat as necessary until the correct gap is achieved.
- Apply Copper-max anti-seize compound to the threads of the spark plugs.
- Install the spark plugs into the cylinder head. Tighten to the torque setting prescribed in section 0.
    - Note that there are two torque settings for spark plugs. The first is for new spark plugs, the second is used any time a spark plug is removed and reinstalled.
- Install spark plug end fittings onto the spark plugs.
    - Use a pair of pliers to tighten the end fittings onto the spark plugs. There is no specific torque setting, they need only be secure.

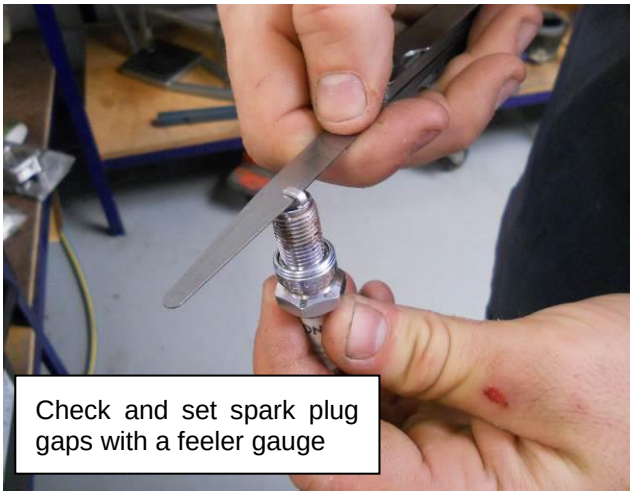


Figure 178 - Checking and setting spark plug gaps

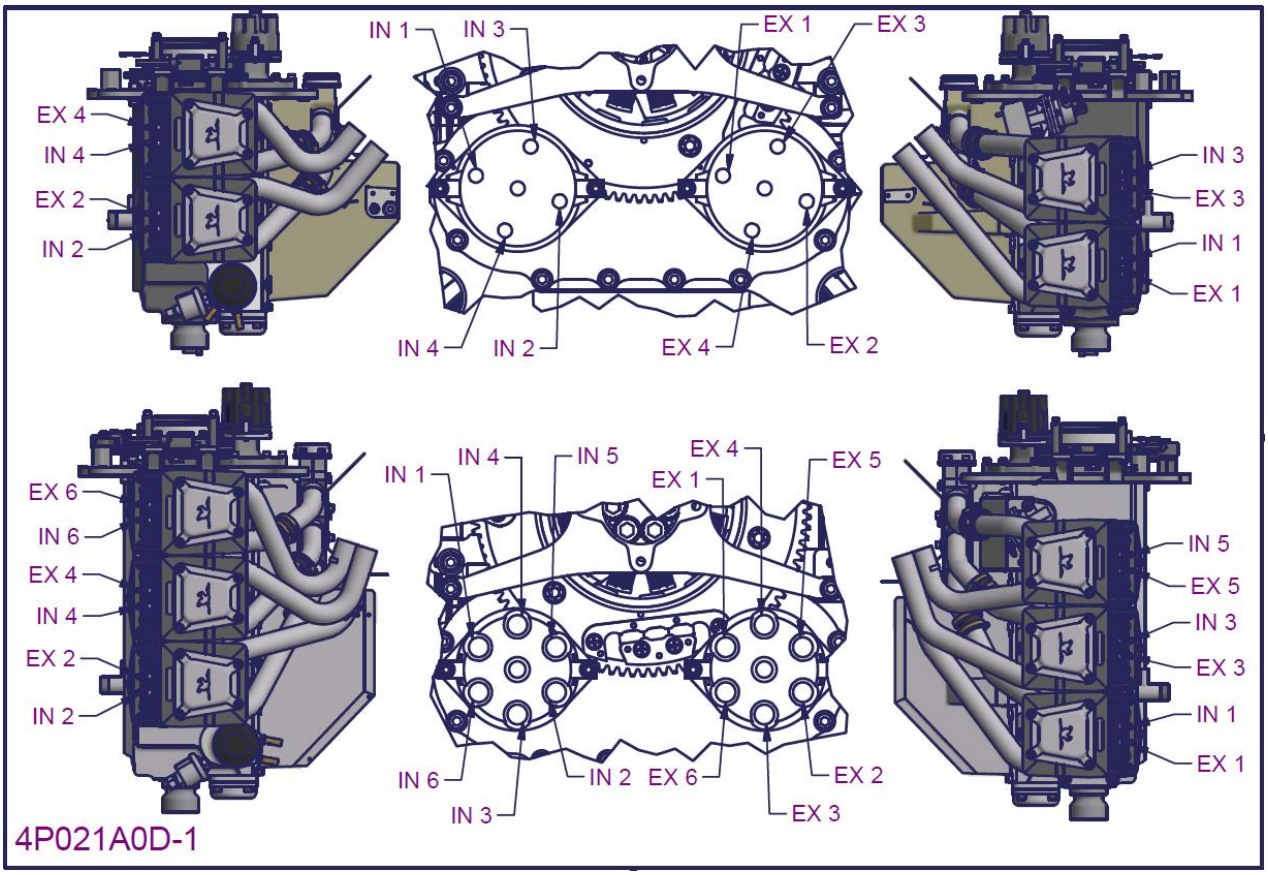


Figure 179 – 2200/3300 Ignition system installation 4

- The ignition lead set is now setup and installed on the engine
- Figure 179 provides a map of the ignition system with each distributor outlet labelled with the corresponding spark plug position. Each ignition lead must be connected between the correct distributor outlet and spark plug. ('IN' refer to the spark plug on the inlet side of the cylinder 'EX' is on the exhaust side of the cylinder).
- The lead sets provided have leads of varying lengths. It is convenient to begin with the longest lead for linking the furthest two points (for example linking the Inlet 1 and exhaust 2 positions) and work in until the shortest leads are installed. Install the adjacent ignition coil lead onto the centre distributor port.
    - Ensure the leads attach firmly and securely to the spark plug and distributor, the conductive caps can be expanded (for the distributor cap end) or contracted (for the spark plug end) as needed (using a screw driver or pliers respectively) until the desired fit is achieved.
    - Noting the position number on each lead using a paint pen also helps quickly identify leads.
- Once all leads are installed, neatly bundle adjacent cables and retain together with zip ties, cut off zip tie tails and trim sharp edges away.
- This completes the **Ignition system installation.**

Figure 180 – Ignition lead installation

4.18 Carburettor and starter installation

4.18.1 2200 Carburettor and starter installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P021A0D-1	2210 IGNITION SYSTEM INSTALLATION	1
2	4886014-9	CARBY ASSY	1
3	4691084-2	CARBY COUPLING (3.3L)	1
4	PH4A053N	HOSE CLAMP 52-70mm	2
5	4A661A0D-4	STARTER MOTOR ASSY	1
6	PH10724-2	1/4" BELLEVILLE WASHER	3
7	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	3
8	PT0019N	FUEL HOSE (NOT SHOWN)	1
9	PH4A013N	FIRESLEEVE (NOT SHOWN)	1
10	4880014	CARBY EARTH STRAP (NOT SHOWN)	1
11	PV4A001N	HOSE CLAMP 11-13 BOLT & NUT TYPE (NOT SHOWN)	1

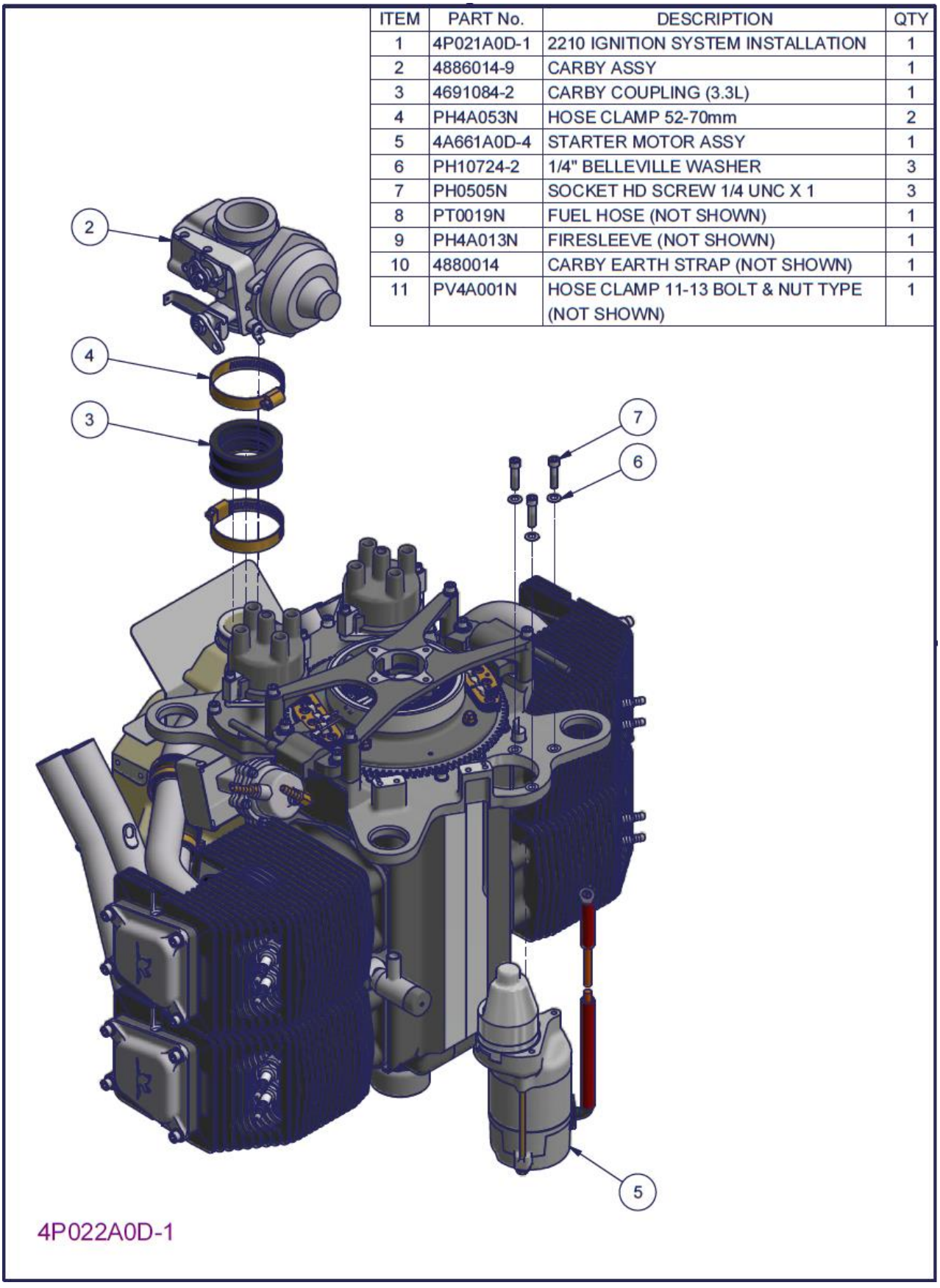


Figure 181 – 2200 Carburettor and Starter installation – Parts List

4.18.2 3300 Carburettor and starter installation – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P021A1D-1	3310 IGNITION SYSTEM INSTALLATION	1
2	4886014-9	CARBY ASSY	1
3	4691084-2	CARBY COUPLING (3.3L)	1
4	PH4A053N	HOSE CLAMP 52-70mm	2
5	4A661A0D-4	STARTER MOTOR ASSY	1
6	PH10724-2	1/4" BELLEVILLE WASHER	3
7	PH0505N	SOCKET HD SCREW 1/4 UNC X 1	3
8	PT0019N	FUEL HOSE (NOT SHOWN)	1
9	PH4A013N	FIRESLEEVE (NOT SHOWN)	1
10	4880014	CARBY EARTH STRAP (NOT SHOWN)	1
11	PV4A001N	HOSE CLAMP 11-13 NUT & BOLT TYPE (NOT SHOWN)	2

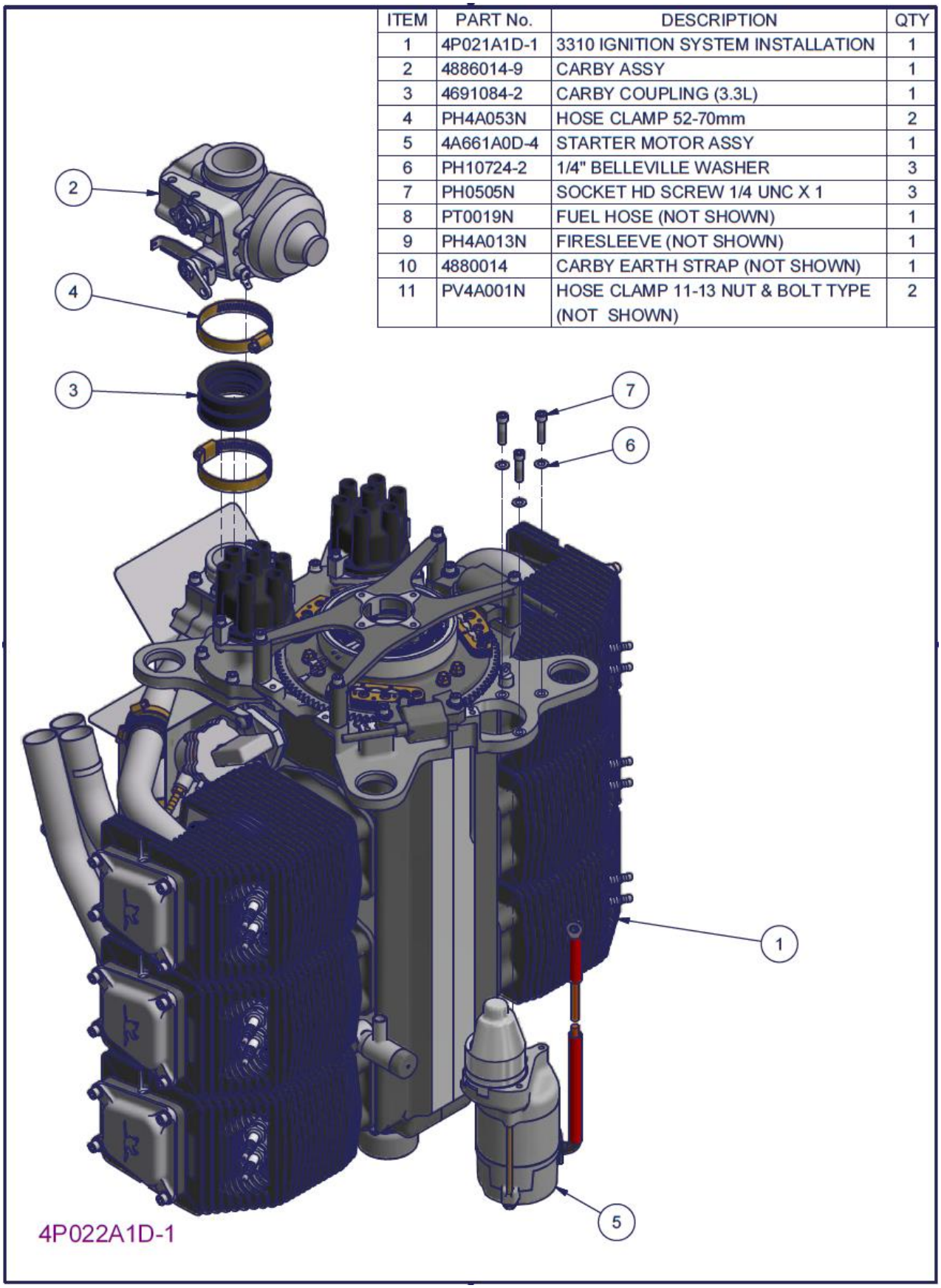


Figure 182 – 3300 Carburettor and Starter installation – Parts List

4.18.3 2200/3300 Carburettor and starter installation procedure

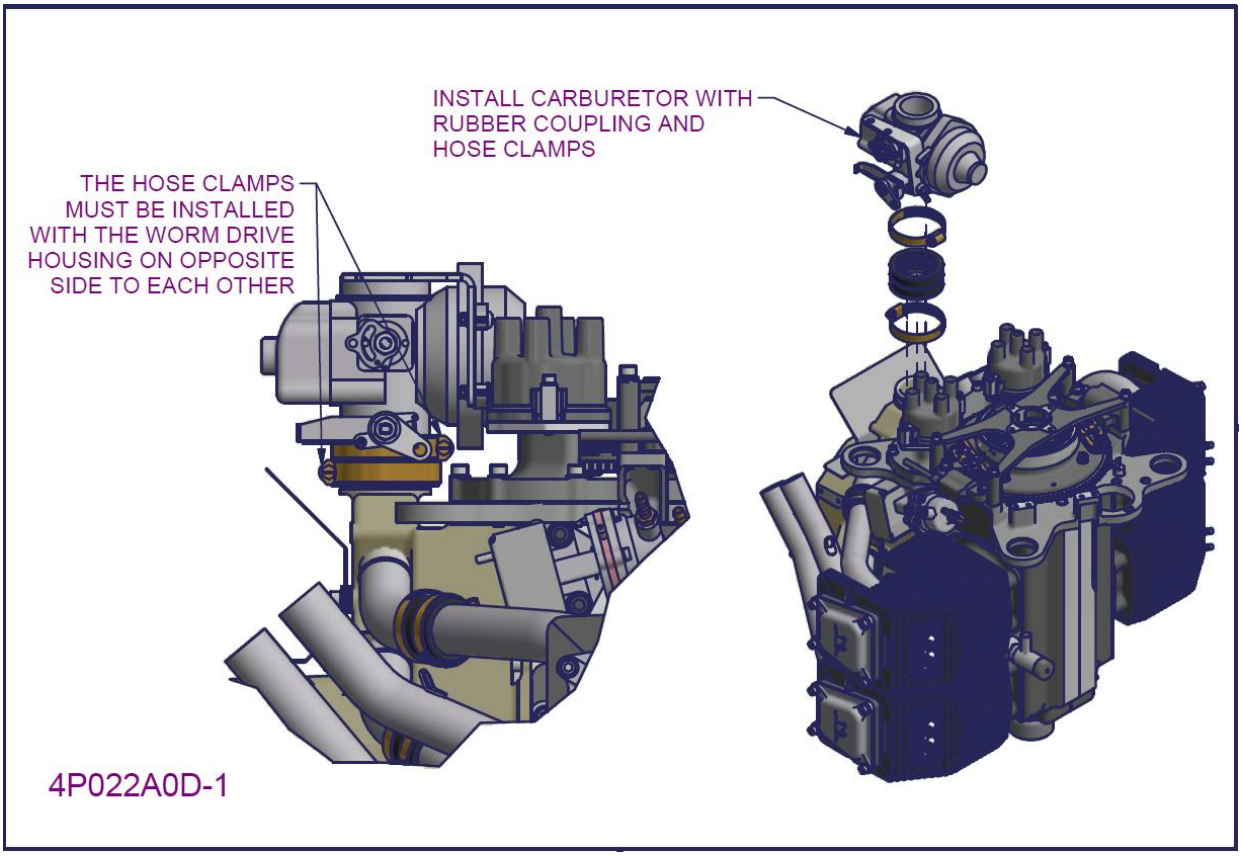


Figure 183 – 2200/3300 Carburettor and starter installation 1

- The carburettor is supplied ready to install with all jets and linkage arms.
- Fit the length of fire sleeve over the fuel hose (using a compressed air gun to blow the sleeve out aids in this process).
- Fit the fuel hose to the carburettor fuel inlet. Install an 11-13mm hose clamp. Tighten to ensure security without overtightening to cause the hose clamp to cut into the hose.
- Push fit the carburettor rubber coupling onto the plenum chamber, place two 52-70mm hose clamps over the coupling and push fit the carburettor onto the rubber coupling. Tighten the two hose clamps.
    - The hose clamps must be orientated so the worm drive housings are on opposite sides of the carburettor as shown in Figure 183.
    - The hose clamps must be tightened sufficiently to secure the carburettor without damaging the rubber coupling.
- Connect the fuel hose to the fuel pump outlet and install a 11-13mm hose clamp to secure
- Secure the fire sleeve with lock wire ties at each end of the sleeve.

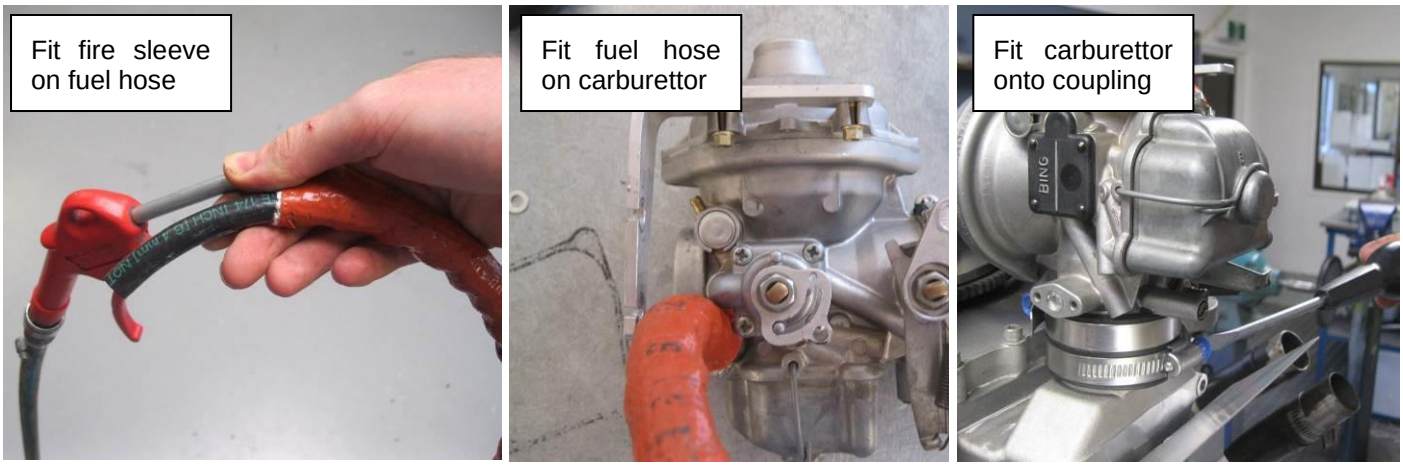


Figure 184 – Carburettor installation

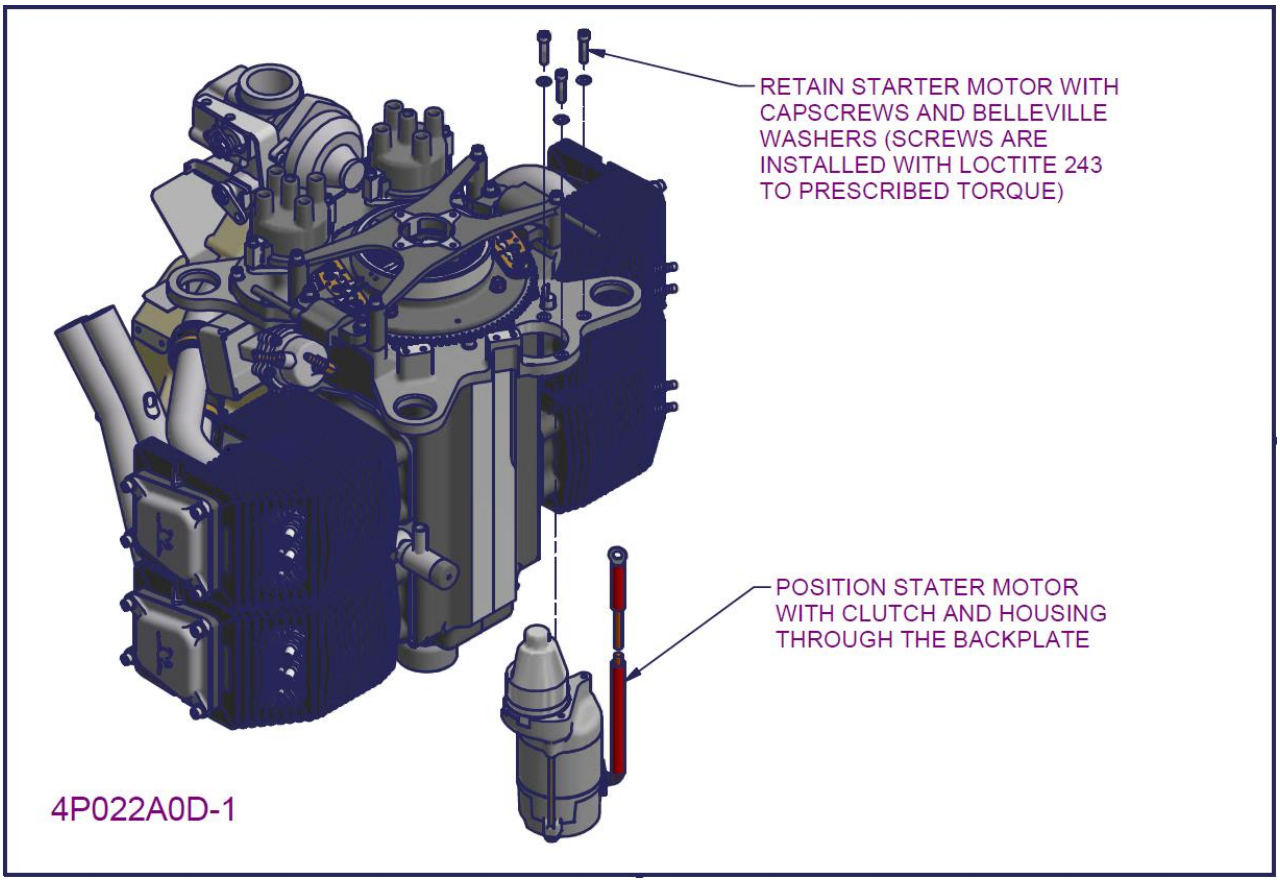


Figure 185 – 2200/3300 Carburettor and starter installation 2

- Prime all tapped holes and screws with Loctite 747.
- Position starter motor with clutch and housing through the front of the back plate
- Retain the starter motor in place with capscrews and Belleville washers.
    - The capscrews are installed with Loctite 243.
    - Tighten to the torque setting prescribed in section 0 and mark with a paint pen.
- This completes the **Carburettor and starter installation**.

4.19 Front seal and propeller flange installation

4.19.1 2200/3300 Front seal and propeller flange installation (integral seal) – Parts list

ITEM	PART No.	DESCRIPTION	QTY
1	4P022A0D-1	2210 CARBURETOR AND STARTER INSTALLATION	1
2	PH4A048N	5/16 X 5/16 UNC GRUB SCREW	2
3	PH9852N-1	PLUG	1
4	466218N-12	FLANGE PROP MOUNT (3.3L) EXT 2" $4662084	1
5	PG9872N	OIL SEAL 55 X 72 X 8 TCV1 VITON	1
6	PH4A058N-1	DOWEL PIN 8mm x 24 LONG (BLACKWOODS P/No. 00939607)	3
7	PH10224-2	3/8" BELLEVILLE WASHER	6
8	PH0676N-1	CAP SCREW 3/8 UNF X 3/4 - UNBRAKO OR BRIGHTON BEST 1960	6

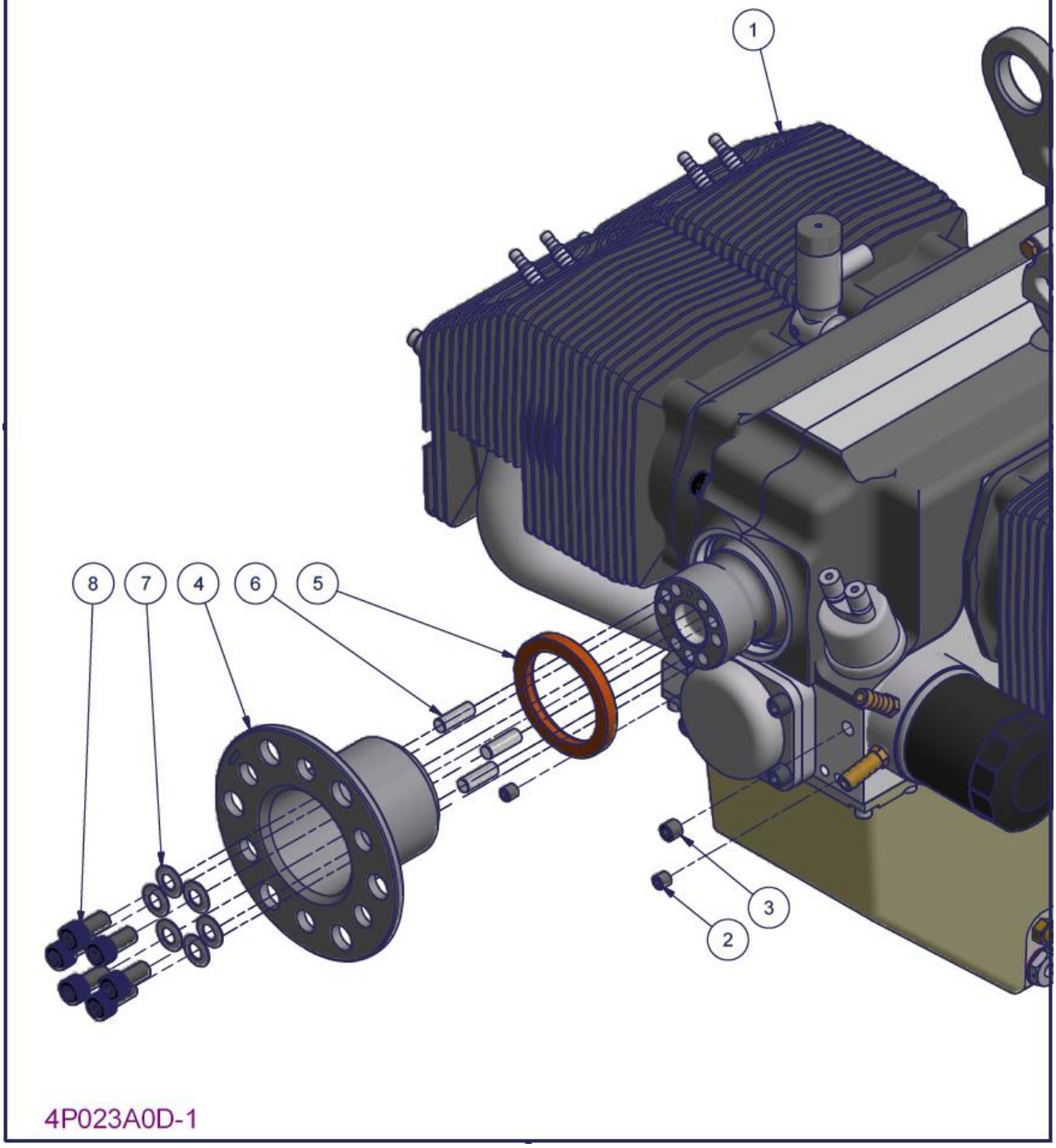


Figure 186 – 2200/3300 Front seal and propeller flange (integral seal) – Parts List

4.19.2 2200/3300 Front seal and propeller flange (separate seal housing) – Parts List

ITEM	PART No.	DESCRIPTION	QTY
1	4P022A1D-1	3310 CARBURETOR AND STARTER INSTALLATION	1
2	PH4A048N	5/16 X 5/16 UNC GRUB SCREW	2
3	PH9852N-1	PLUG	1
4	466218N-12	FLANGE PROP MOUNT (3.3L) EXT 2" $4662084	1
5	PG9872N	OIL SEAL 55 X 72 X 8 TCV1 VITON	1
6	PH4A058N-1	DOWEL PIN 8mm x 24 LONG (BLACKWOODS P/No. 00939607)	3
7	PH10224-2	3/8" BELLEVILLE WASHER	6
8	PH0676N-1	CAP SCREW 3/8 UNF X 3/4 - UNBRAKO OR BRIGHTON BEST 1960	6
9	4956024-3	SEAL HOUSING FRONT 5/16 MOUNTING	1
10	PH0555N	SOCKET HD SCREW 5/16 UNC X 3/4	4

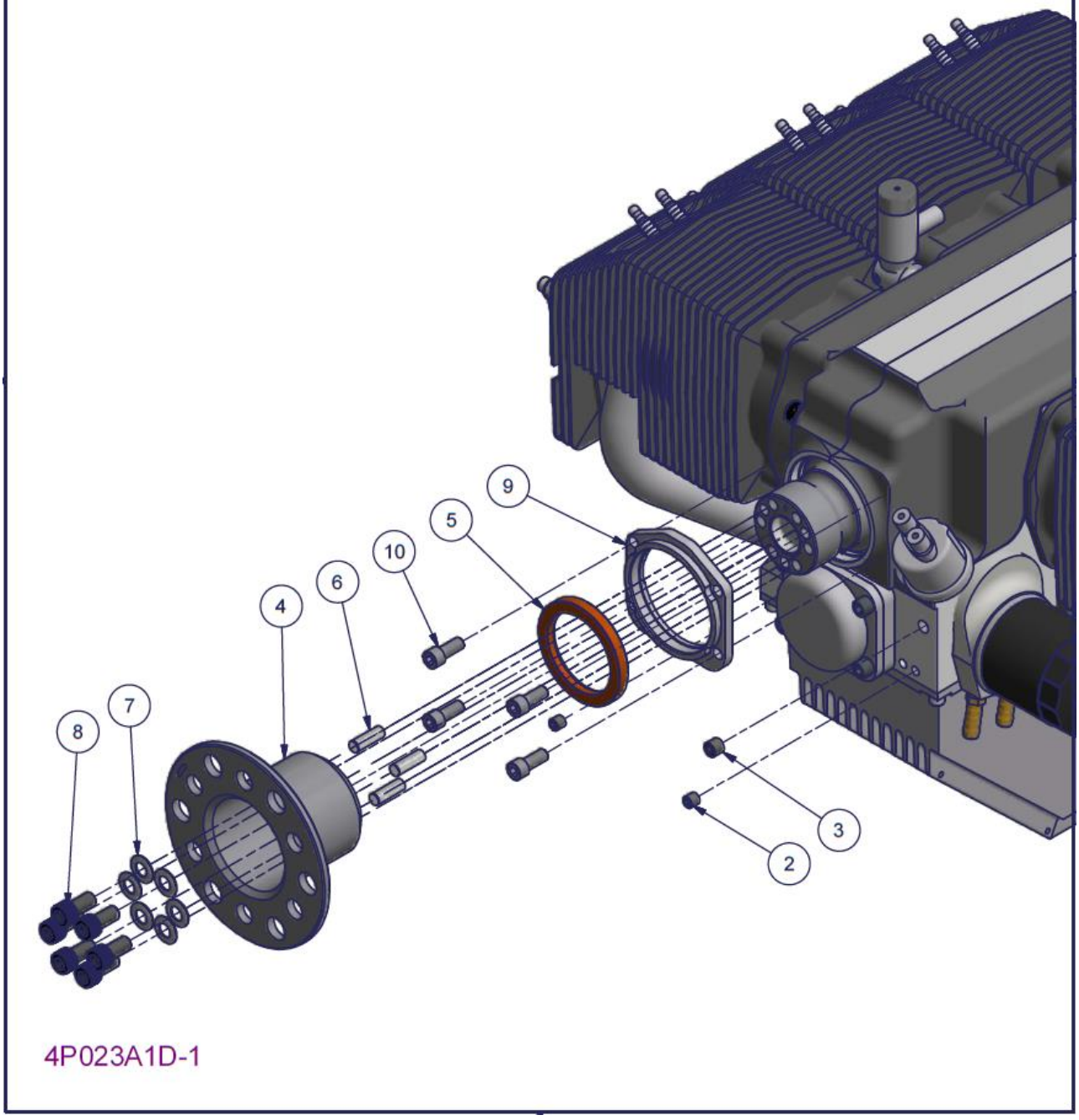


Figure 187 – 2200/3300 Front seal and propeller flange (separate seal housing) – Parts List

4.19.3 2200/3300 Front seal and propeller flange installation procedure

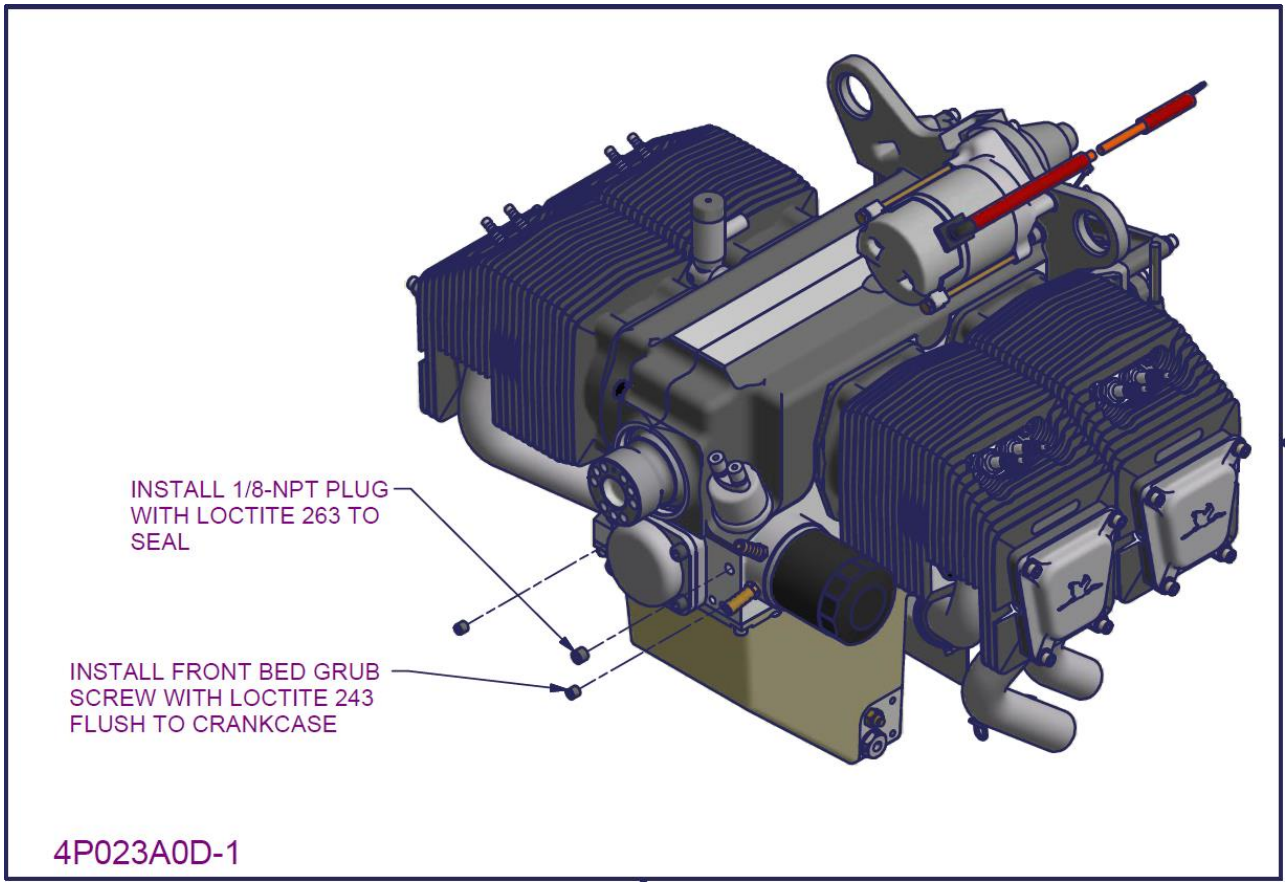


Figure 188 – 2200/3300 Front seal and propeller flange installation 1

- Before any further action **REMOVE ENGINE FROM BUILD STAND** and place supported by the sump on the work bench.
    - Remove the propeller flange which was temporarily fitted during the build (the capscrew screws used to temporarily fit the propeller flange MUST NOT be used in the final propeller flange installation.
- Prime all tapped holes in the crankcase and the grub screws and sealing plug with Loctite 747.
- Install the 1/8-NPT plug with Loctite 263 to seal.
- Install the two grub screws with Loctite 243 to be flush with the crankcase.

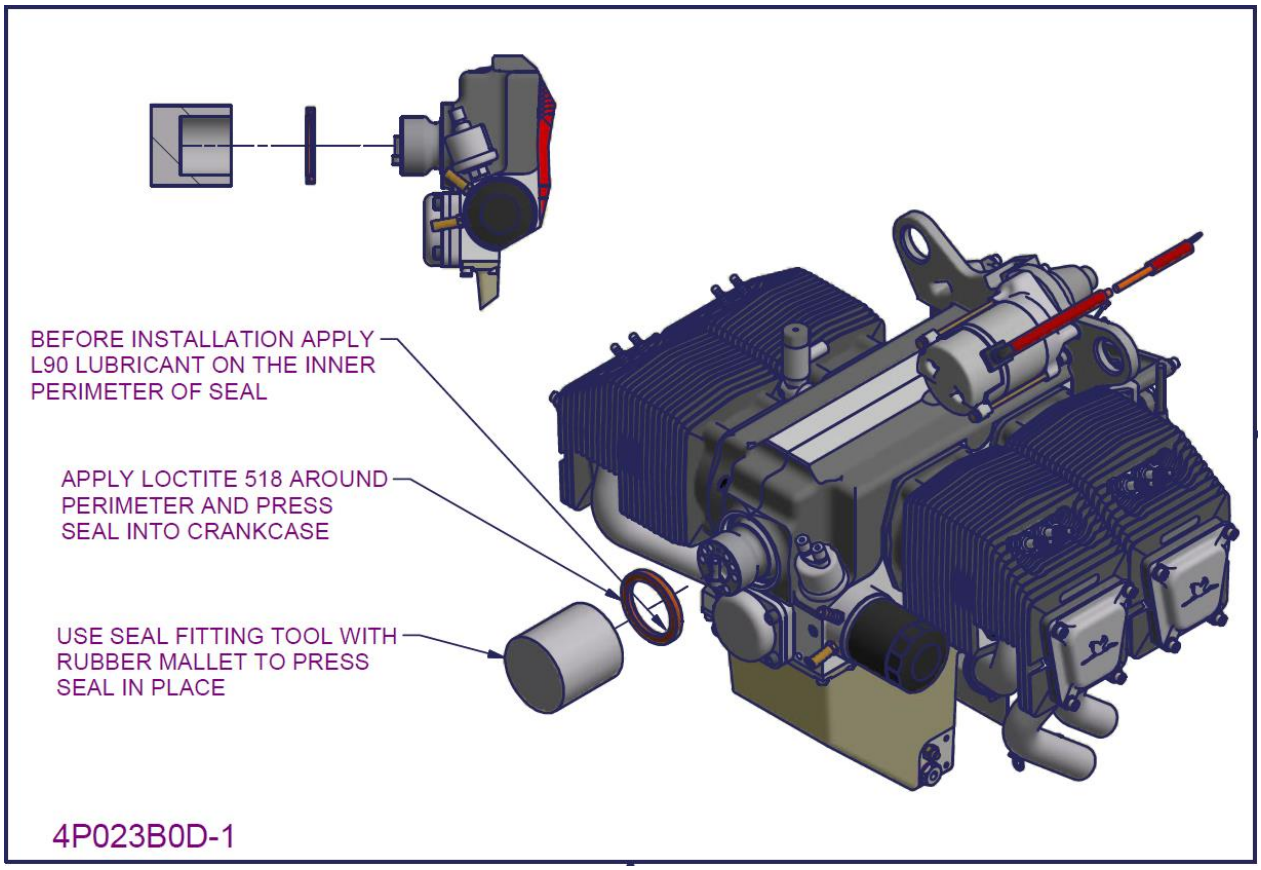


Figure 189 – 2200/3300 Front seal and propeller flange installation 2

- Ensure the seal housing within the crankcase is complete clean. Use Loctite 747 on a clean rag to wipe away dirt and oils inside the seal housing. Also prime the outside perimeter of the seal with Loctite 747.
    - **DO NOT** spray Loctite 747 directly onto the seal housing since overspray will likely destroy the paint on the front of the crankshaft.
- Apply L90 lubricant to the inner perimeter of the seal.
- Apply Loctite 518 sealant around the outer perimeter of the front seal.
- Press the front seal into the crankcase seal housing until it is fully seated.
    - The seal is pressed into place using a special front seal fitting tool (as shown in Figure 189). By striking the tool with a rubber mallet the seal is pressed into the crankcase housing
- Clean away excess sealant.
- For engines built with an external seal housing refer to section 4.19.4 for the installation procedure.

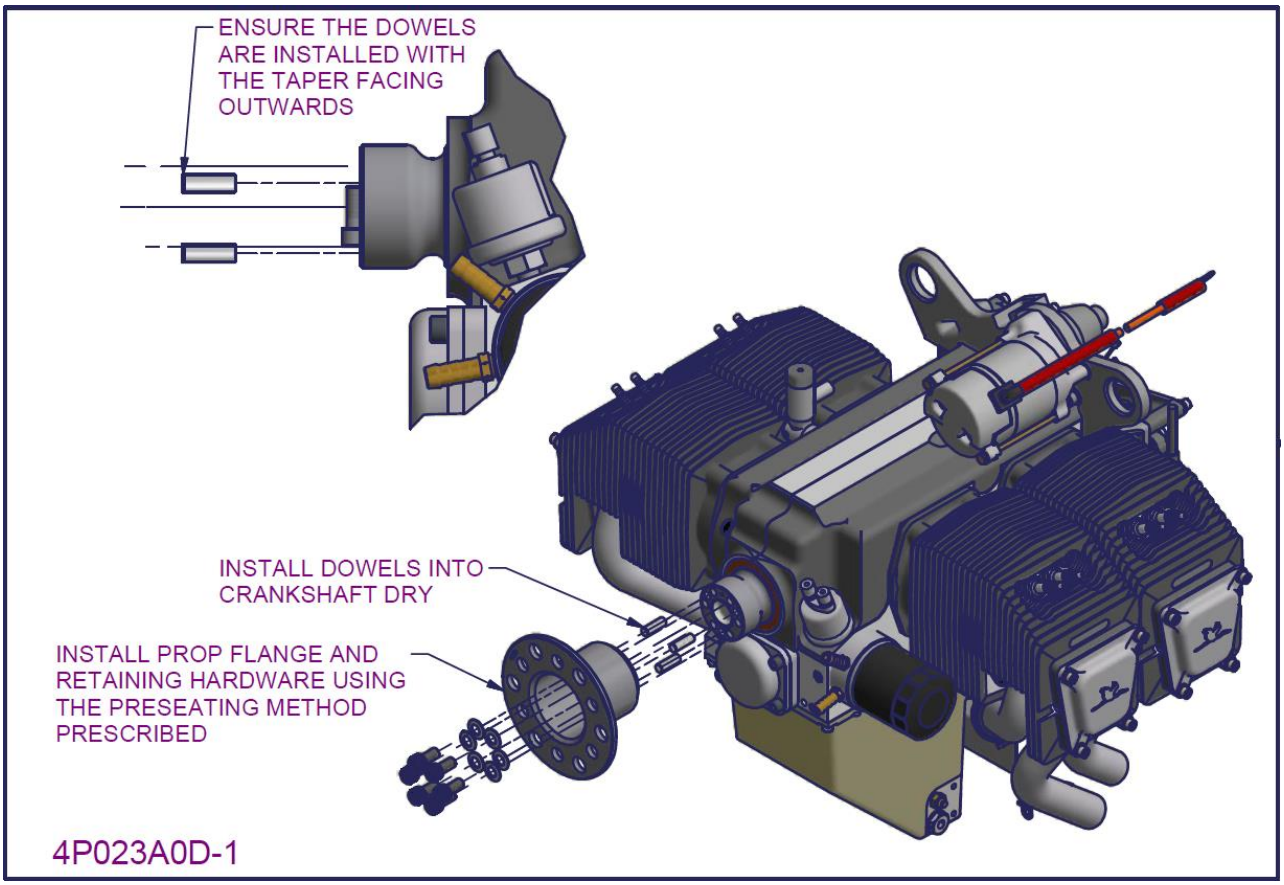


Figure 190 – 2200/3300 Front seal and propeller flange installation 3

WARNING

The propeller flange to crankshaft attachment is of critical importance. Ensure the installation instructions are followed carefully. DO NOT attempt this task unless sufficiently trained and experienced.

- Ensure the mating surfaces on the propeller flange and crankcase are completely dry and clean. Ensure the threads in the crankcase and dowel holes are completely dry and clean
  - **There must be ABSOLUTELY NO OIL between the propeller flange and crankshaft. Oil between these faces will reduce the connection strength and potentially lead to propeller flange connection failure.**
- Install the three dowels into the crankshaft dry, using a small hammer to tap them in. They should be tapped in until they bottom out.
  - Check using a Vernier calliper depth gauge that the height of the dowels protruding above the surface of the crankshaft DOES NOT exceed 7mm (it should be 5.5mm to 6.5mm ideally).
  - The dowels must be installed with the taper pointing outwards.
- Prime all capscrews with Loctite 747.
- Refer to Figure 191 along with the following instructions for the propeller flange installation
  - Position the propeller flange over the dowels. Install three capscrews with Belleville washers dry (i.e. without Loctite) and progressively wind each screw in, in order to pull the propeller flange over the dowels and seat onto the crankshaft.
  - Have a second person hold the crankshaft using a finger tie bar mounted through two propeller bush holes.
  - Install the other three capscrews (dry) with Belleville washers to contact. Tighten all screws to 15ft.lb using the diagonal tightening pattern shown.
  - Tighten all screws to the torque setting prescribed in section 0.
  - Remove ONE screw. Apply Loctite 620 to the first 4-6 threads of the screw. Apply a matchstick head sized dollop of Loctite 620 at the beginning of the crankshaft thread.
  - Reinstall the screw directly to the torque setting prescribed in section 0 and mark with torque seal or a paint pen.
  - Remove, apply Loctite 620 and reinstall the other five screws ONE AT A TIME using the same technique in the order shown in Figure 191.
- This completes the **Front seal and propeller flange installation**.

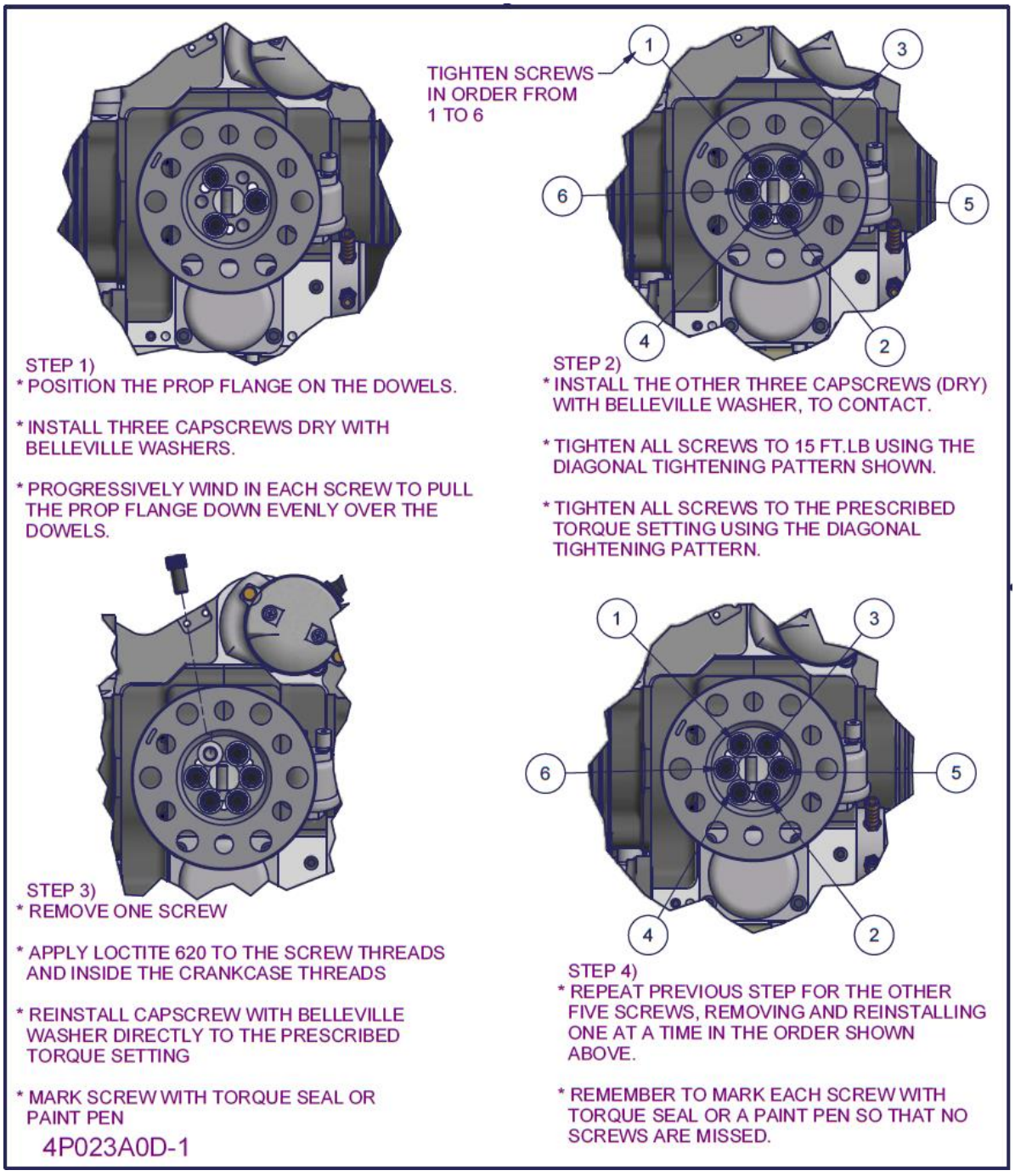


Figure 191 – Propeller flange installation method

4.19.4 Separate front seal housing installation

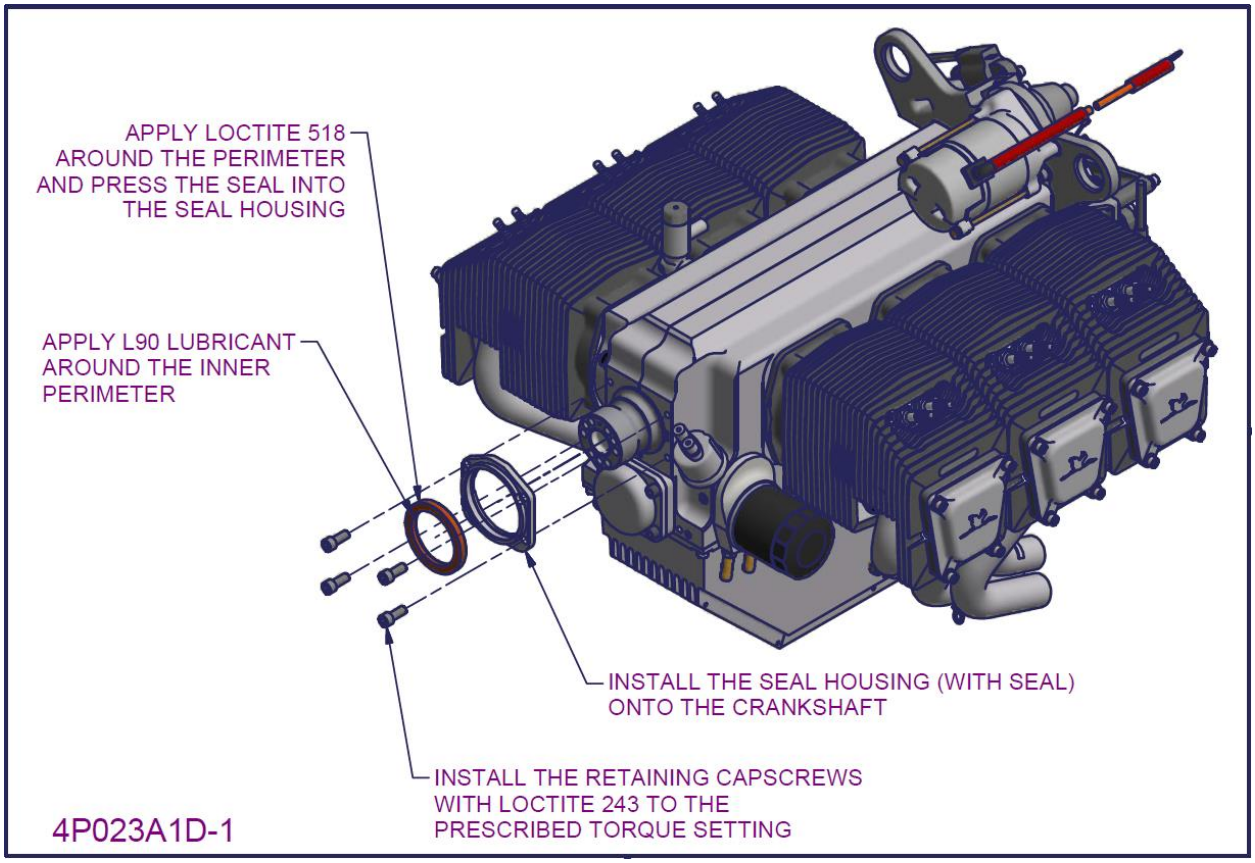


Figure 192 – Front seal installation for engines with a separate housing

- Engines built using a reworked billet crankcase (as opposed to the cast crankcase) use an external housing for the front seal. The procedure for this installation is provided here.
- Prime the seal, housing, tapped threads and cap screws with Loctite 747.
- Apply Loctite 518 around the perimeter of the seal housing
- Press the front seal into the seal housing using a shop press, ensuring it seat fully in the housing.
- Apply Three-bond sealant to the mating face of the seal housing using a dabbing action
- Apply L90 lubricant to the inner perimeter of the front seal
- Push the seal with housing over the crankshaft and up against the crankcase
- Install retaining capscrew with Loctite 263 to the torque setting prescribed in section 0 and mark with a paint pen.

Figure 193 - External housing front seal installation

5 Post-Assembly

5.1 Oils

- During initial running a non-detergent oil must be used to encourage proper bedding-in of components. Oils must meet the following standards:
  - Aero Oil W Multigrade 15W-50, or equivalent Lubricant complying with SAE J-1899, or
  - Lycoming Spec. 301F, or
  - Teledyne–Continental Spec MHF-24B
- Table 3 shows oil recommendations for initial running. We recommend Aero Shell 100, Exxon Aviation Oil 100 or BP Aviation Oil 100.
- This oil must be used for the first 25 hours of operation after a top end inspection or overhaul or whenever new or honed cylinders are fitted.
- For further information on oils to use refer to the Jabiru Instruction & Maintenance Manual appropriate to the engine.

Table 3 – Oil Recommendations for Run-In.

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)

WARNING

Automotive oils MUST NOT be used. Automotive oils are not designed for the unique environment of an air-cooled aero engine and have proven to give disastrous wear rates.

WARNING

Jabiru has not verified the attributes claimed by oil additive manufacturers and warn against using them as they may have detrimental effects.

5.2 Before First Start

- **Check oil pressure.** The simplest way to do this test is to remove a spark plug from each cylinder, then use the starter motor to spin the engine until the oil pressure reading comes up. Alternatively an external oil pressure source can be plumbed into the engine. This test ensures that the oil circuit of the engine is working properly before starting – if a fault in the oil circuit was found with the engine running damage to the main bearings etc is very likely.
- **Install to a suitable running rig.** Engines can be run-in on the ground on a test rig – however it is essential that this rig have oversize cooling ducts for the cylinder heads and for the oil cooler. Normal aircraft ducts are not enough – running an engine on the ground using aircraft cooling ducts can quickly overheat and ruin an engine.

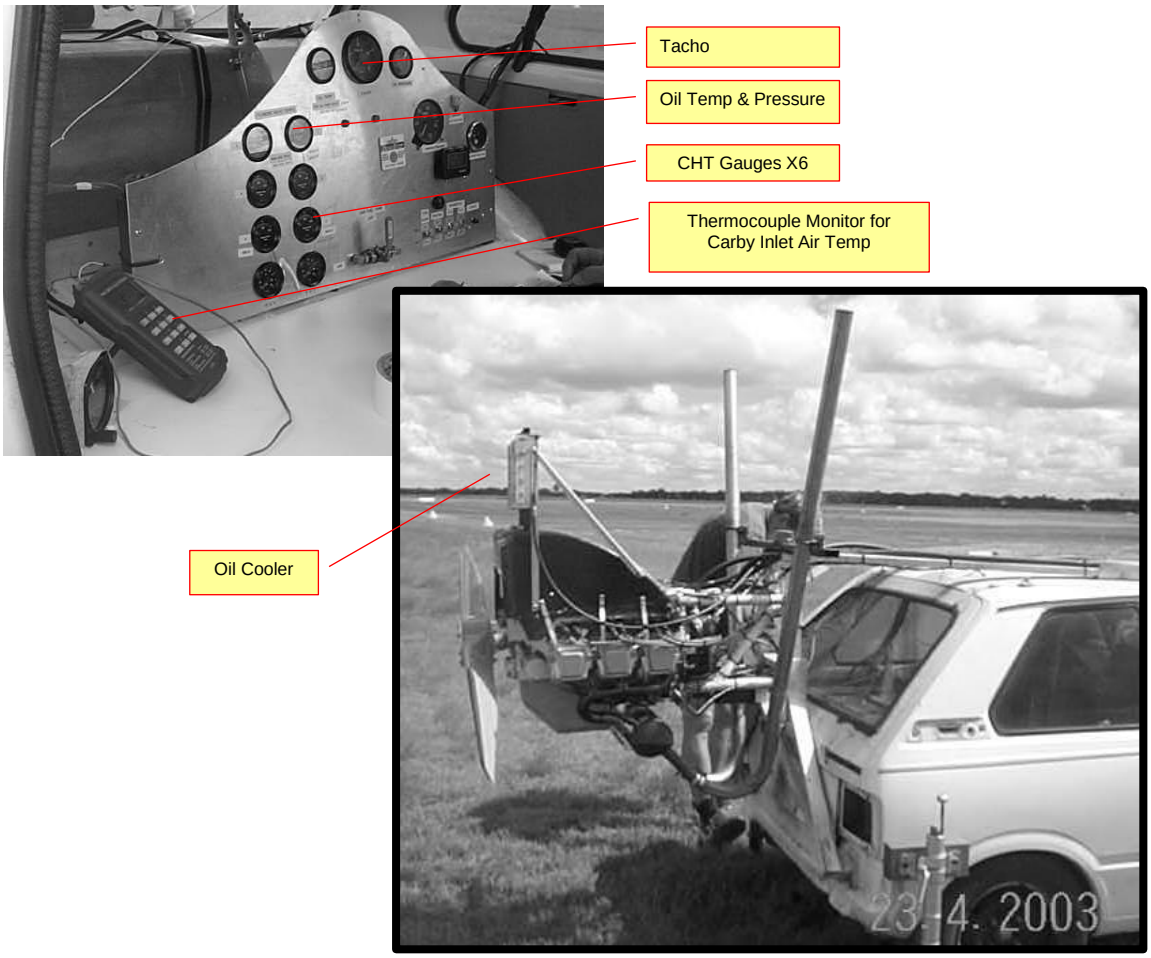


Figure 194 – Engine Ground Running Rig

- **Fit a suitable propeller.** Carrying on from the last point, if the engine is being run on the ground then a suitable "club" prop must be fitted. A club prop must allow the engine to reach a minimum of 3250 RPM and a maximum of 3400 RPM. A prop which does not meet either of these limits will not load the engine correctly and can initiate long-term operating issues.

5.3 Ground Run-In & Test Procedures

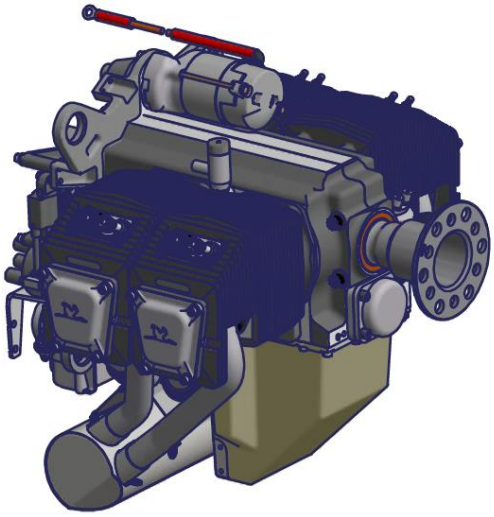
- Test running is an essential part of the full overhaul or top end overhaul process. It is worth spending extra effort during this testing to catch any small issues which may grow more serious in operation.
- At the completion of assembly of the engine after overhaul, it is recommended that the engine be mounted upon a suitable test stand for its initial or run-in operation.
- Alternately the engine may be re-fitted to the aircraft and run. While the very first runs may take place on the ground in an airframe, any further testing must be carried out in the air to ensure sufficient airflow for engine cooling.
- The run-in serves a two-fold purpose; first, to seat piston rings and burnish any new parts that have been installed and second, to give the operator control over the first critical hours of operation, during which time he can observe the functioning of the engine by means of the test cell instruments or, if the engine is re-fitted to the aircraft, the aircraft instrumentation.
- Also at this time any malfunctions can be corrected and oil leaks repaired.
- The first few hours after an overhaul are critical for the rest of the life of the engine and no effort should be spared to conduct engine running according to the following criteria. What follows is a very specific set of power settings, typically periods of full power operation followed by reduced power periods to ensure correct cooling. If these instructions are followed to the letter the rings will bed into the cylinders correctly and this will result in a much more pleasant engine with a decent life expectancy provided that our daily inspection and maintenance procedures are followed. A sample ground run-in procedure is included in the engine overhaul booklets in Section 6.23 below.
- On completion of the run post-run-checks must be carried out – refer to section 6.23 for details.

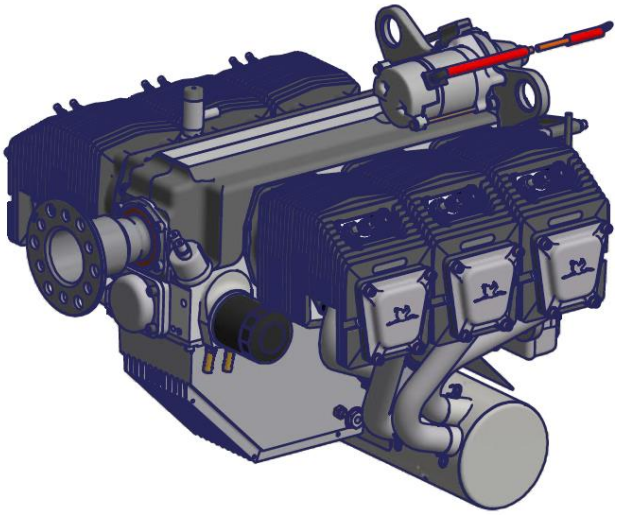
5.4 Final Tasks

- Unless the engine is to be fitted to an aircraft and used immediately it must be inhibited to prevent corrosion. Engines which have recently been run-in are very susceptible to corrosion and must be inhibited immediately once post-run checks have been completed.
- Thoroughly clean engine
- Apply caps to all engine openings: carburettor air intake, fuel pump and carburettor fuel fittings, engine crankcase breather, exhaust tubes, oil cooler adaptor fittings.
- Apply a warning tag to the engine. The tag should state, at a minimum:
  - ENGINE RUN-IN COMPLETED.
  - ENGINE OIL DRAINED
  - CORROSION INHIBITOR APPLIED
  - DO NOT RUN ENGINE UNTIL ALL CAPS HAVE BEEN REMOVED AND OIL HAS BEEN ADDED TO THE SUMP.

- Finally, the documentation must be completed. Build sheets and test cards must be filled out. Normally the statement or report given to the customer will include lists of the new parts fitted. The build sheets used by Jabiru Aircraft are all included in Section 6 and it is strongly recommended that these are used.

6 Jabiru Aircraft engine build log summary





6.1 Engine details

Engine Model	(i.e. 2200 or 3300)
Engine Serial Number	
Build completion date	

6.2 Engine installation details

Aircraft type	Aircraft S/No	Aircraft registration	Installation date	Removal date

6.3 Maintenance / Overhaul details

Date	Details	Signature

6.4 Crankcase subassembly (refer to section 4)

Stage	Description	Initial	Date
CASE 1	• Install bearings with bearing blue • Apply bearing blue to one crankcase half		
CASE 2	• Temporary fit dowels and stud bolts (dry)		
CASE 3	• Join crankcase halves with cylinder barrel flanges and 2200/3300 type through bolts. Torque in stages to prescribed setting		
CASE 4	• Measure and record main bearing bores and cam tunnel bores • Disassemble, check bearing blue coverage, clean all parts		
CASE 5	• Fit dowel O-rings and crankcase dowels		
CASE 6	• In left crankcase half temporarily fit thrust bearings • Fit camshaft and crankshaft, measure and record end float • Remove camshaft, crankshaft and thrust bearings		
CASE 7	• Fit short and long stud bolts into case halves		
CASE 8	• Lubricate and install lifters into lifter sockets • Fit lifter retainers, pushrod tube manifolds and O-rings		
CASE 9	• Fit oil pickup tube, O-ring, Oil strainer and dipstick tube mount		
CASE 10	• Fit thrust bearings		
CASE 11	• **CRANKCASE stage inspection (assembler)**		
	• **CRANCASE checked by (different person to assembler)**		

Crankcase type	(i.e. cast case, reworked billet case)							
LS Crankcase S/No.								
RS Crankcase S/No.								
Crankshaft end float								
Camshaft end float								
Crankcase Bore dia (with bearings)	1	2	3	4	5	6	7	8
Camshaft tunnel diameters	1	2	3	4	5	6	7	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.5 Camshaft subassembly (refer to section 4.2)

Stage	Description	Initial	Date
CAM 1	• Measure and record camshaft journal diameters • Calculate and record camshaft journal clearances		
CAM 2	• Install gears, spacer and retaining bolts		
CAM 3	• **CAMSHAFT stage inspection (assembler)**		
	• **CAMSHAFT checked by (different person to assembler)**		

Camshaft S/No.							
Camshaft Journal diameters (mm)	1	2	3	4	5	6	7
Calculate Camshaft to Tunnel clearance	1	2	3	4	5	6	7
Large Cam-gear S/No.							
Small Cam gear S/No.							

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.6 Crankshaft subassembly (refer to section 4.3)

Stage	Description	Initial	Date
CRANK 1	• Measure and record main journal and conrod journal diameters • Calculate and record main journal clearance		
CRANK 2	• Inspect oil galleries • Install welsh plugs		
CRANK 3	• Temporarily fit propeller flange • Measure and record crankshaft and propeller flange runout		
CRANK 4	• Install conrod bearing into conrod with bearing blue • Assemble conrods and torque to prescribed setting		
CRANK 5	• Measure and record conrod bores • Calculate and record conrod journal clearances		
CRANK 6	• Remove one screw, measure and record bearing crush • Check bearing blue coverage, clean parts		
CRANK 7	• Mount crankshaft vertically on timing plate • Lubricate and install conrods with bearings		
CRANK 8	• **CRANKSHAFT stage inspection (assembler)**		
	• **CRANKSHAFT checked by (different person to assembler)**		

Crankshaft S/No.								
Crankshaft main journal diameters (mm)	1	2	3	4	5	6	7	8
Calculate crankshaft main journal clearance	1	2	3	4	5	6	7	8
Crankshaft conrod journal diameters (mm)	1	2	3	4	5	6		
Propeller Flange runout								
Crankshaft runout								
Conrod Big end diameter (mm)	1	2	3	4	5	6		
Conrod Big end clearance (mm)	1	2	3	4	5	6		
Conrod bearing crush (mm)	1	2	3	4	5	6		
Conrod S/No's.	1	2	3	4	5	6		
Prop Flange S/No								

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Crankshaft MPI Release Note No. (N/A for new engine builds) _____

6.7 Cylinder assemblies (refer to section 4.4)

Stage	Description	Initial	Date
CYL 1	• Check valve seal ring with bearing blue • Measure and record vacuum on valves		
CYL 2	• Measure and record cylinder bores and max out or round • Measure an record valve guide bore, valve stem diameters and valve stem clearance		
CYL 3	• Lubricate and install valves into cylinder head • Install valve springs, collets, top and bottom spring washers		
CYL 4	• Install pushrod tube retaining washer and capscrew **OR** • Install pushrod tube O-rings and circlips (internal O-ring Cyl)		
CYL 5	• Lubricate and install rockers, O-rings, and rocker shafts		
CYL 6	• Install measure and record piston ring gaps • Record the weight of each piston • Measure piston skirt diameter • Calculate and record piston skirt clearance with cylinder bore		
CYL 7	• Install circlip into the flywheel end of the piston only • Install piston rings into each piston • Check fit of gudgeon pin with piston		
CYL 8	• Lubricate piston rings and install pistons into cylinder		
CYL 9	• Install pushrod tubes and O-rings (tubes only for int O-ring cyl) • Place pushrods in oil to prime them prior to joining the engine		
CYL 10	• **CYLINDERS stage inspection (assembler)**		
	• **CYLINDERS checked by (different person to assembler)**		

Max device vacuum (inHg)						
Inlet valve vacuum (inHg)	1.	2.	3.	4.	5.	6.
Exhaust valve vacuum (inHg)	1.	2.	3.	4.	5.	6.
Cylinder S/No	1.	2.	3.	4.	5.	6.
Inlet Valve stem diameter	1.	2.	3.	4.	5.	6.
Inlet Valve guide diameter	1.	2.	3.	4.	5.	6.
Inlet valve clearance = guide – stem dia	1.	2.	3.	4.	5.	6.
Exhaust Valve stem diameter	1.	2.	3.	4.	5.	6.
Exhaust Valve guide diameter	1.	2.	3.	4.	5.	6.
Exhaust Valve clearance = guide – stem	1.	2.	3.	4.	5.	6.

6.7.1 Cylinder bore measurements

Cylinder number	1.	2.	3.	4.	5.	6.
Bores: Top (Up-Down)						
Mid (Up-Down)						
Bottom (Up-down)						
Top (Side-Side)						
Mid (Side-Side)						
Bottom (Side-Side)						
Minimum Bore measured						
Maximum Bore measured						
Max out-of-round						

6.7.2 Pistons

Top piston ring gap	1.	2.	3.	4.	5.	6.
Second piston ring gap	1.	2.	3.	4.	5.	6.
Piston weight (grams)	1.	2.	3.	4.	5.	6.
Piston skirt diameter	1.	2.	3.	4.	5.	6.
Piston skirt clearance	1.	2.	3.	4.	5.	6.

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.8 Distributor gearbox assembly (refer to section 4.4)

Stage	Description	Initial	Date
GEAR 1	• Press bushes into distributor shaft towers		
GEAR 2	• Press seals into gear box and distributor mount plates		
GEAR 3	• Install distributor mounts plates onto gear box		
GEAR 4	• Install gears onto distributor shafts with monel rivets		
GEAR 5	• Lubricate and install distributor shafts into gearbox • Install rotor buttons onto distributor shafts		
GEAR 6	• **DISTRIBUTOR GEARBOX stage inspection (assembler)**		
	• **DISTRIBUTOR GEARBOX checked (different to assembler)**		

Gear case S/No		
Gear S/No	Left:	Right:

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.9 Flywheel assembly (refer to section 4.6)

Stage	Description	Initial	Date
FLY 1	• Assembly poles plates with magnets • Lay silicon beds, install pole plate assemblies into flywheel		
FLY 2	• Install alternator magnet retaining ring		
FLY 3	• Heat ring gear in oven, install ring gear onto flywheel		
FLY 4	• Install alternator magnet rings		
FLY 5	• Install flywheel cross piece hub into flywheel		
FLY 6	• Skim machine pole plates using lathe		
FLY 7	• Install hall effect tacho tags to flywheel		
FLY 8	• **FLYWHEEL stage inspection (assembler)**		
	• **FLYWHEEL checked (different to assembler)**		

Flywheel S/No	
Ring gear S/No	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____ Date:_____ for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____ Date:_____ for Jabiru Aircraft Pty Ltd

6.10 Alternator stator assembly (refer to section 4.7)

Stage	Description	Initial	Date
ALT 1	• Install roll pins into stator mount		
ALT 2	• Install alternator onto mount with screws		
ALT 3	• **ALTERNATOR stage inspection (assembler)**		
	• **ALTERNATOR checked by (different person to assembler)**		

Alternator mount S/No	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____ Date:_____ for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____ Date:_____ for Jabiru Aircraft Pty Ltd

6.11 Joint engine assembly (refer to section 4.8)

Stage	Description	Initial	Date
JOINT 1	• Apply three bond sealant to one crankcase halve • Bring crankcase halves together around crankshaft and camshaft • Install through bolts with vibration damping O-rings		
JOINT 2	• Install primed pushrods into cylinder pushrod tubes • Apply three bond to cylinder base flange		
JOINT 3	• Bring cylinder onto crankcase • Install gudgeon pin through conrod, install retaining circlip • Install washers and nuts to pull cylinder onto case • Repeat for other cylinders		
JOINT 4	• Torque all nuts in stages to the torque setting prescribed		
JOINT 5	• Install rocker covers with O-rings		
JOINT 6	• Apply bead of Loctite 518 around perimeter of crankshaft at the flywheel end		
JOINT 7	• Align cam and crank timing marks, install crank gear • Temporarily fit a capscrew		
JOINT 8	• **JOINT ENGINE stage inspection (assembler)**		
	• **JOINT ENGINE checked by (different person to assembler)**		

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.12 Camshaft timing subassembly

Stage	Description	Initial	Date
TIME 1	• Check and record camshaft timing		
	• Install dowels, remove capscrew		
TIME 2	• **CAMSHAFT TIMING stage inspection (assembler)**		
	• **CAMSHAFT TIMING checked (different person to assembler)**		

Crank gear S/No	
Cam timing	(degrees before BDC exhaust lobe #1 cylinder)

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.13 Sump installation (refer to section 4.10)

Stage	Description	Initial	Date
SUMP 1	• Temporarily fit the back plate		
SUMP 2	• Apply Loctite 518 to crankcase mating face • Install sump onto crankcase (use back plate to pull sump up) • Install oil filler tube O-ring		
SUMP 3	• Install oil temperature probe • Install sump plug and lock wire to oil temperature sender		
SUMP 4	• Assembly dipstick with cap and O-ring • Install dipstick tube, housing and dipstick		
SUMP 5	• **SUMP stage inspection (assembler)**		
	• **SUMP checked by (different person to assembler)**		

Sump type (tick)	No plenum chamber	Integral cast plenum chamber
Sump S/No:		

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.14 Heat shield and Plenum chamber installation (refer to section 4.11)

Stage	Description	Initial	Date
HEAT 1	• Assemble machined plenum chamber (Not applicable for integral plenum sump)		
HEAT 2	• Install plenum assemble (if applicable) and heat shield onto sump		
HEAT 3	• **SHIELD / PLENUM stage inspection (assembler)**		
	• **SHIELD / PLENUM checked (different person to assembler)**		

Plenum chamber S/No	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.15 Back plate and distributor gear box installation (refer to section 4.12)

Stage	Description	Initial	Date
BACK 1	• Install 1/8” NPT plug into crankcase		
BACK 2	• Apply Loctite 518 to crankcase and install back plate		
BACK 3	• Apply Loctite 518 to back plate and install gearbox		
BACK 4	• Check distributor rotor timing		
BACK 5	• **BACK END stage inspection (assembler)**		
	• **BACK END checked (different person to assembler)**		

Back plate S/No	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.16 Flywheel and alternator installation (refer to section 4.13)

Stage	Description	Initial	Date
F/A 1	• Ensure rear crankshaft is completely dry of oils		
F/A 2	• Install flywheel assembly onto back of crankshaft using pre-seating installation method with Nordloc washers		
F/A 3	• Install alternator stator assembly		
F/A 4	• **FLYWHEEL / ALT stage inspection (assembler)**		
	• **FLYWHEEL / ALT checked (different person to assembler)**		

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.17 Fuel pump installation (refer to section 4.14)

Stage	Description	Initial	Date
FUEL 1	• Lubricate and install fuel pump pushrod		
FUEL 2	• Apply Loctite 518 to both faces of the gaskets • Install fuel pump with gaskets, spacer and drip tray		
FUEL 3	• **FUEL PUMP stage inspection (assembler)**		
	• **FUEL PUMP checked (different person to assembler)**		

Fuel pump model:	(e.g. Goss G877)
Fuel pump S/No:	
Pump pushrod length	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.18 Oil pump and filter installation (refer to section 4.15)

Stage	Description	Initial	Date
OIL 1	• Lubricate and assemble oil pump gear into housing • Measure and record oil pump gear clearance		
OIL 2	• Install O-rings • Apply Loctite 518 to back of oil pump back plate • Install oil pump onto camshaft with woodruff key		
OIL 3	• Install Oil pump relief valve with spring, washers and circlip		
OIL 4	• Install O-ring and hose tails into oil cooler adapter • Install Oil filter with fitting and adaptor into crankcase		
OIL 5	• **OIL PUMP / FILTER stage inspection (assembler)**		
	• **OIL PUMP / FILTER checked (different person to assembler)**		

Oil pump gear clearance	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.19 Exhaust and Induction pipes (refer to section 4.16)

Stage	Description	Initial	Date
PIPES 1	• Install gaskets and O-rings onto exhaust and induction pipes		
PIPES 2	• Install O-rings into plenum chamber • Install lower induction pipes into plenum with gasket sealant		
PIPES 3	• Position induction and exhaust pipes on ports with clamping turtles and induction hoses and hose clamps		
PIPES 4	• Use exhaust muffler can to align exhaust pipes • Install retaining screws to prescribed torque with Nordloc washers • Tighten induction rubber hose clamps		
PIPES 5	• **EXH & IND PIPES stage inspection (assembler)**		
	• **EXH & IND PIPES checked (different person to assembler)**		

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.20 Ignition system installation (refer to section 4.17)

Stage	Description	Initial	Date
IGN 1	• Install distributor caps with retaining clamps		
IGN 2	• Install ignition coils and set coil gaps off highest flywheel pole		
IGN 3	• Gap spark plugs and install with end fittings		
IGN 4	• Install lead set and bundle leads with zip-ties		
IGN 5	• **IGNITION SYS stage inspection (assembler)**		
	• **IGNITION SYS checked (different person to assembler)**		

Ignition coil type left	(e.g. Honda, Type 7, Type 8 etc)
Ignition coil type right	(e.g. Honda, Type 7, Type 8 etc)

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.21 Carburettor and starter installation (refer to section 4.18)

Stage	Description	Initial	Date
CARBY 1	• Fit fire proof sleeve over fuel hose • Fit fuel hose to carburettor fuel inlet		
CARBY 2	• Install carburettor with rubber mount and hose clamps		
CARBY 3	• Install earth strap to Carburettor and under a gearbox screw		
CARBY 4	• Install starter motor / Clutch assembly onto back plate		
CARBY 5	• **CARBY / STARTER stage inspection (assembler)**		
	• **CARBY / STARTER checked (different person to assembler)**		

Carburettor S/No	
Main jet size	
Needle jet size	
Idle jet size	
Needle type / position	

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.22 Front seal and propeller flange installation

Stage	Description	Initial	Date
PROP 1	• **REMOVE ENGINE FROM BUILD STAND**		
PROP 2	• Install grub screws and 1/8-NPT plug at front		
PROP 3	• Press front seal into housing (N/A for integral crankcase housing) • Lubricate seal and install over crankshaft onto crankcase		
PROP 4	• Ensure propeller flange and crankshaft mating faces are completely dry and clean		
PROP 5	• Install propeller flange dowels		
PROP 6	• Install propeller flange using pre-seating method		
PROP 7	• **SEAL / PROP stage inspection (assembler)**		
	• **SEAL / PROP checked (different person to assembler)**		

Prop flange S/No	
Prop flange type	(e.g. STD, 2” EXT, 3” EXT etc)

I hereby certify that the above subassembly has been assembled in accordance with the current revision of the Gen 4 2200/ 3300 assembly instructions provided in JEM0004

Assembler:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

Checked by:_____ Signed:_____Date:_____for Jabiru Aircraft Pty Ltd

6.23 Engine ground run-in sheet

Pre Run-In Checks: ☐ Correct Oil Type & Quantity ☐ All connections secure
☐ Idle Set ☐ Propeller Secure

Time	Dur (mins)	Condition	RPM	CHT 4/6 (100 – 180°C)	Oil Temp (50– 118°C)	Oil Pressure, Idle Min 80 kPa (220 – 525 kPa, solid lifter) (350kPa optimal, hydraulic lifter)		Volts AC	Fuel pres	EGT
						Mech gauge	Sender			
	2	Start and Idle	1000 - 1200							
	4	Hot Idle Check 1	1400							
	2	Very High Idle	1800							
	2	High Idle	1400							
	3	Mid Power	2000							
	2	High Idle	1600							
	2	60% Power	2400							
	2	High Idle	1800							
	2	70% Power	2600							
	2	Mid Power	2000							
	2	75% Power	2800							
	2	Mid Power	2200							
	2	85% Power	3000							
	2	Cooling Run	2000							
	4	75% Power	2800							
	2	Mid Power	2000							
	2	85% Power	3000							
	3	60% Power	2400							
	4	85% Power	3000							
	3	50% Power	2400							
	3	Takeoff Power	Full:							
	2	60% Power	2600							
	2	Mid Power	2000							
	2	Cooling Run	1600							
	2	Hot Idle Check 2	Idle (800-1100):							

O.A.T._____ °C	Alternator:_____V (AC), _____V (DC) at 2800 RPM
Magneto RPM Drop Left: _____ Magneto RPM Drop Right: _____ Limits: 0 – 100 RPM Test at 2000 RPM	Use: Aero Shell 100/Exxon 100/BP Aviation Oil 100 2200 2.2 Litres or 2 Litres + Fill Oil Filter 3300 3.4 Litres or 3.2 Litres + Fill Oil Filter
Idle Comments:	Top End (RPM) Comments:
Overall Comments:	Any Changes / Adjustments Made During Run:
Post Run-In Checks: ☐ Check for Oil Leaks ☐ Check Induction / Exhaust	

Leak-down test results	#1	#2	#3	#4	#5	#6
	/80	/80	/80	/80	/80	/80

I hereby certify that the above engine has been run-in in accordance with the current revision of the 2200 / 3300 assembly instructions provided in JEM0004

Signed:_____Date:_____for Jabiru Aircraft Pty Ltd