

INSTALLING PISTONS IN AN ARIEL SQUARE 4

I recently received the rebuilt lower end of my 1953 Square 4 Mk II from noted Ariel expert Paul Ackerman.

One of the next tasks for me was to install the cylinder block and finally, the head. I have read the factory workshop manual many times, noting the rather scanty description of each system. The factory suggests installing the crankcase in the frame first (due to weight considerations), installing all 4 pistons on their respective rods, and then, by some miracle, lowering the block down on all 4 pistons, compressing the rings for each until all 4 pistons are in their cylinders.

Although I haven't attempted using this approach, it doesn't take much reflection to envision a nightmare procedure, solvable only with a minimum of 4 patient friends and much cursing.

Paul suggested another method, once which I've seen bandied about on the UK Ariel forum as well, one that seems ultimately more achievable without calling for an act of God. In brief summary, Paul's method consists of installing all 4 rods to the crank, but WITHOUT pistons attached. Instead, all 4 pistons are installed, one at a time, into the cylinder block, with each piston protruding out the bottom just far enough to insert a pin through each rod when installing.

I've seen fit to document the process, primarily for my own future reference, with a special note that the details of virtually every step most certainly is attributed to Paul and his expertise:

- 1) Wash each bore in the cylinder MULTIPLE times with warm soapy water until each is squeaky clean. Then spray the walls with WD-40. Wipe clean.. if any residue shows up on the cloth, repeat the entire process.
- 2) Make sure all the cam followers are seated in their cradles, and the guide retaining plates are properly secured with the lock plates provided. There is a tiny circular circlip that rides in the recessed portion of the follower shaft. The sole purpose of the circlip is to retain the follower during assembly, otherwise it is certain to fall out in the process. If your circlips are missing, it would be wise to order replacements prior to proceeding. Otherwise, it is going to be difficult to prevent one or more follower from falling out during the mating process. Paul suggests, in the absence of the circlips, using some heavy grease to hold them in place, but I am skeptical, and strongly recommend just ordering the inexpensive circlips from Draganfly.

It requires a bit of patience and finesse to get those circlips started down the guide hole.. somewhat like getting a piston ring started in a cylinder. I relied on the aid of my wife, who held the follower shaft partially extended its guide hole, revealing the recessed center groove, and then I used a couple of dental picks to get the circlip started into the groove. Once in place, the follower should then be able to be pushed all the way home. Don't be alarmed if the follower drops down a half inch or so once you invert turn the block upright. The circlip in the center groove will prevent it from dropping further.

- 3) Perform a test fit of the cylinder block to crankcase, making sure the 2 locating dowels have been installed, and that they will mate up properly with the block.
- 4) Remove the two top rings from each piston (Paul recommended an antique KD Tools #875 ring expander.. I found several used ones on Ebay from \$15 - \$50.. using a garden variety Harbor Freight expander would be dicey at best, and likely will result in a couple of broken rings). Then slip each ring into its respective cylinder an inch or so down from the top, and measure the ring gap. There seems to be no definitive ring gap specs for Ariels, but conventional wisdom calls for a minimum of .004 for each 1" of piston diameter. The Square 4 has 2.5" pistons, so you would want to see at least .010 gap. The rings supplied with my IMD brand pistons gapped out between .013 and .014, and I'm happy with that.

- 5) Most of the new pistons being sold have the pin boss slightly asymmetrical, so there is a right and wrong direction to install each piston. There should be an arrow on top of each piston, and every arrow should point to the CENTER or inside of the engine. I used a felt marker to mark the cylinder number both from top and underneath (you'll be installing your pistons from the BOTTOM of the block), following the factory numbering (looking from above) beginning with the front right hand cylinder as #1, then numbering clockwise from there, 2,3,4.

I also duplicated the arrow on top of the piston with a marker INSIDE the piston, so I would have a reference when installing each piston from the bottom of the cylinder block.

- 6) Choose a piston, find its respective cylinder and piston pin, check that you will be able to insert the pin both through the piston AND the rod bushing. Then, with the piston's arrow correctly oriented, install the pin retaining circlip only on the side of the piston that will face to the inside of the engine (you would never be able to get that circlip in once all pistons are mated to their rods).
- 7) I used one of those sponge paint brushes to lightly paint motor oil over the entire piston and ring area, and just a bit of oil on the cylinder lip as well. Then use a simple ring compressor to compress the rings on that piston. I found mine on eBay, a 65-70mm size, for a pittance:



- 8) When tightening the ring compressor, leave just about 1/16" of the piston top exposed above the compressor band, so that the piston can help register itself in the cylinder. Then, while pressing down continuously on the compressor band, gently tap the piston down into the cylinder (I used a well-smoothed and cleaned wooden hammer handle for the job). DON'T FORCE IT, and don't get in a hurry. Just use light taps, observing the incremental movement of the piston downward. If by chance, a ring pops free before going into the cylinder?... it ain't gonna go with force. If it

resists and you continue, you will certainly break a ring. If there is any significant resistance, just pull the piston out, double check that all rings are compressed, and try again.

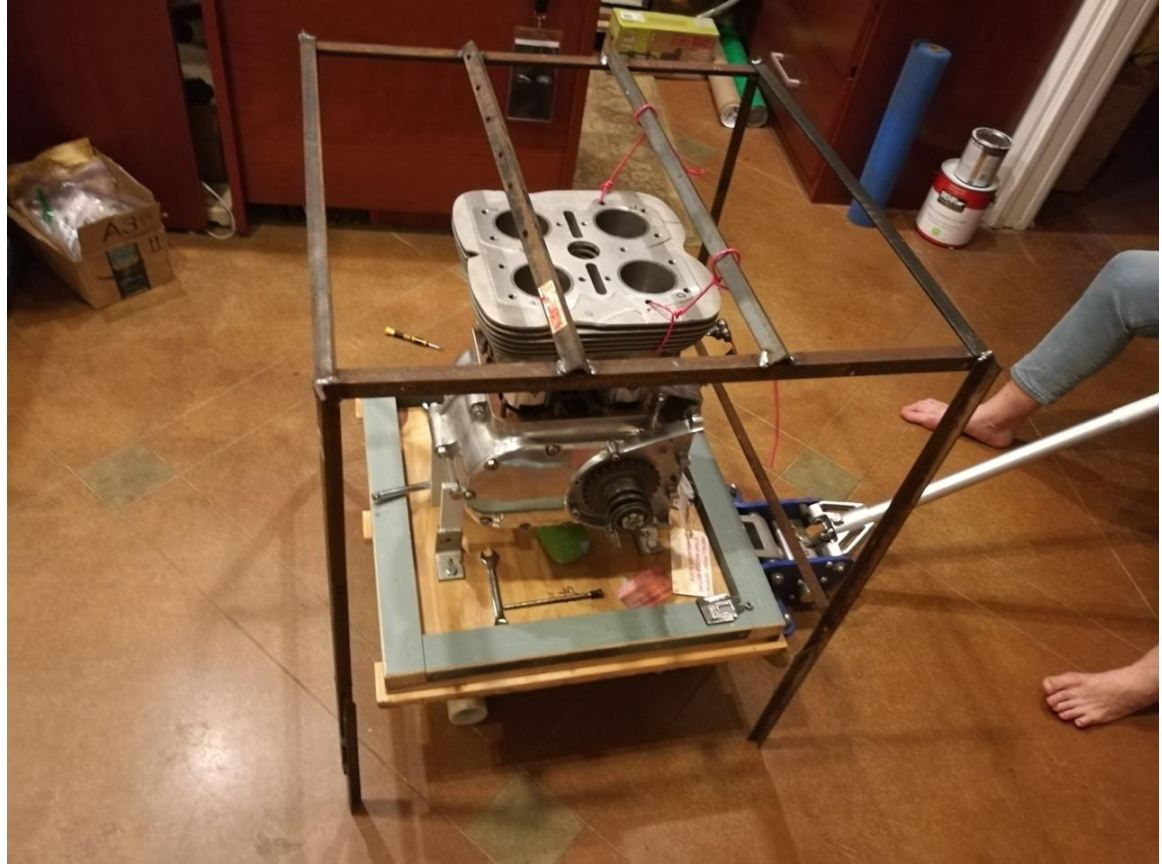
Here's the compressor band on the piston during installation:



- 9) Once the piston has been installed just far enough to seat all the rings in the cylinder, but leaving the pin bosses exposed, it is time to remove the compressor band, then lightly oil the matching piston pin and insert it just through the outer pin boss. Here's what the cylinder block will look like with all 4 pistons partially installed and pins started:



- 10) Now we are ready to mate the cylinder block, with installed pistons, and the crankcase, with installed rods. The block is quite heavy and cumbersome. Trying to hold it over the crankcase by hand is going to be tedious and trying. My solution: the crankcase was still mounted securely to the base of its packing crate. I sat that base on a motorcycle lift to I could control the height of the crankcase. Then, I fabricated a quick frame from scrap metal to suspend the cylinder block from (using 10GA solid wire). The block remains stationary, while I raise the crankcase with the jack as necessary to mate the pistons and rods:



- 11) Spray copper gasket spray on the cylinder base gasket and install, in preparation for the cylinder block installation.
- 12) There needs to be a way to lock the crankshaft to prevent it turning while installing the pistons to each rod. I milled a crude lock for the primary sprocket, anchoring it to the aft case bolt. Note that because that case stud is so short, I had to mill a recess in the area where the nut would be installed:



- 13) Turn the crank until one opposing pair of rods are fully extended (It is almost mandatory that the first pair you install includes the right hand rear rod (nearest the timing chest casting, since the since that extended casting could make it difficult to get that piston pin installed unless it is completed first).
- 14) Have an assistant carefully raise the jack (and corresponding crankcase) as you guide the first 2 rods into their respective pistons. I used a small mirror to confirm that the rod small end was properly engaging the pin bosses on the piston. Once you feel you are close, go ahead and remove the piston pin you had partially installed, so that you can sight through the piston boss and line up the rod. Then insert the piston pin through the outer piston boss, on through the rod bushing, and finally snug against the inner circlip you previously installed. In some cases, it may be necessary to heat the piston slightly to enlarge the boss (with a hair dryer or heat gun) to get the pin to slide in. Fortunately, all 4 of my pistons were sized just right, and allowed installation with just a firm push. It will take some jiggling, but in short order, you should have each of those first two pins mated with their respective pistons and rods.
- 15) Don't forget to now install the outer pin circlips. If you forget this and move on to the next pair of pistons, you'll have difficulty installing the circlips later. Stuff a plastic bag into the openings around the crankcase. You do NOT want to have to go fishing down inside the crankcase for an errant circlip, and those little buggers can be stubborn sometimes.
- 16) Now comes the tricky part. With help from your assistant, you will need to simultaneously raise the engine jack (and the crankcase, of course, effectively lowering the block further down on the crankcase), and as the crankcase comes up, turn the crankshaft (after removing the sprocket lock) to lower the first pair of installed piston assemblies, while raising the two remaining rods. I found that ultimately I had to lower the block almost until the remaining piston skirts reached the

crankcase opening. You won't easily and safely be able to fully extend the two remaining rods and be able to keep the first two pistons safely in their cylinders, but that isn't necessary. As long as the piston's pin boss clears the deck of the crankcase, and you have a small amount of access with a thin tool to position the rod correctly in the piston, it should go easily. In fact, you will likely find that during installation of the final pair of pistons, all 4 will be almost even with each other (refer to the photo accompanying the next paragraph).

- 17) Finally that magic moment arrives when all 4 pistons have been mated to their rods and all 4 of your outer pin retaining circlips have been installed:



- 18) Now it is just a matter of removing the wire supports from the top of the block, and slowly and carefully tap the block down onto the crankcase! Take a break, pour yourself a big glass of beer, and congratulate yourself on a job well done!

