

New Model A Engine Builders Guide

1 Feb 2021

Introduction

Congratulations on your purchase of the parts kit (Cylinder Block, Crankshaft, and Connecting Rods) that you can use to build a Model A engine that will replace the frail original parts but looks stock on the exterior.

You will need to supply all other parts to build an engine. The new engine can be built as stock, or it can be built for higher performance.

We ask that you (or your engine builder) consider using our recommendations in this guide to build an engine. If there is a conflict, please use your engine builder or parts supplier recommendations.

Please read this Builders Guide and make a list of parts and supplies needed as you read the guide. Equivalent substitutes of parts, lubricants, and sealants are acceptable.

This guide is a working document that will be updated as needed. The latest update will have a date published under the title, and available at this website (<http://www.modelaengine.com/>).

Please call our attention to errors, omissions, unclear language, and material that should be added so we can make the corrections.

For quality control purposes, every cylinder block has a unique hidden serial number located on the gasket surface behind the timing gear inspection cover.

CA Proposition 65 Warning

Breathing air in the area or contact with solvents, lubricants, sealants, paints, valve grinding compound, and almost every other part mentioned in this builders guide is known by the state of California to cause cancer and birth defects or other reproductive harm. Do not stay in the area of engine assembly longer than necessary.

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1) Inspection and de-burring

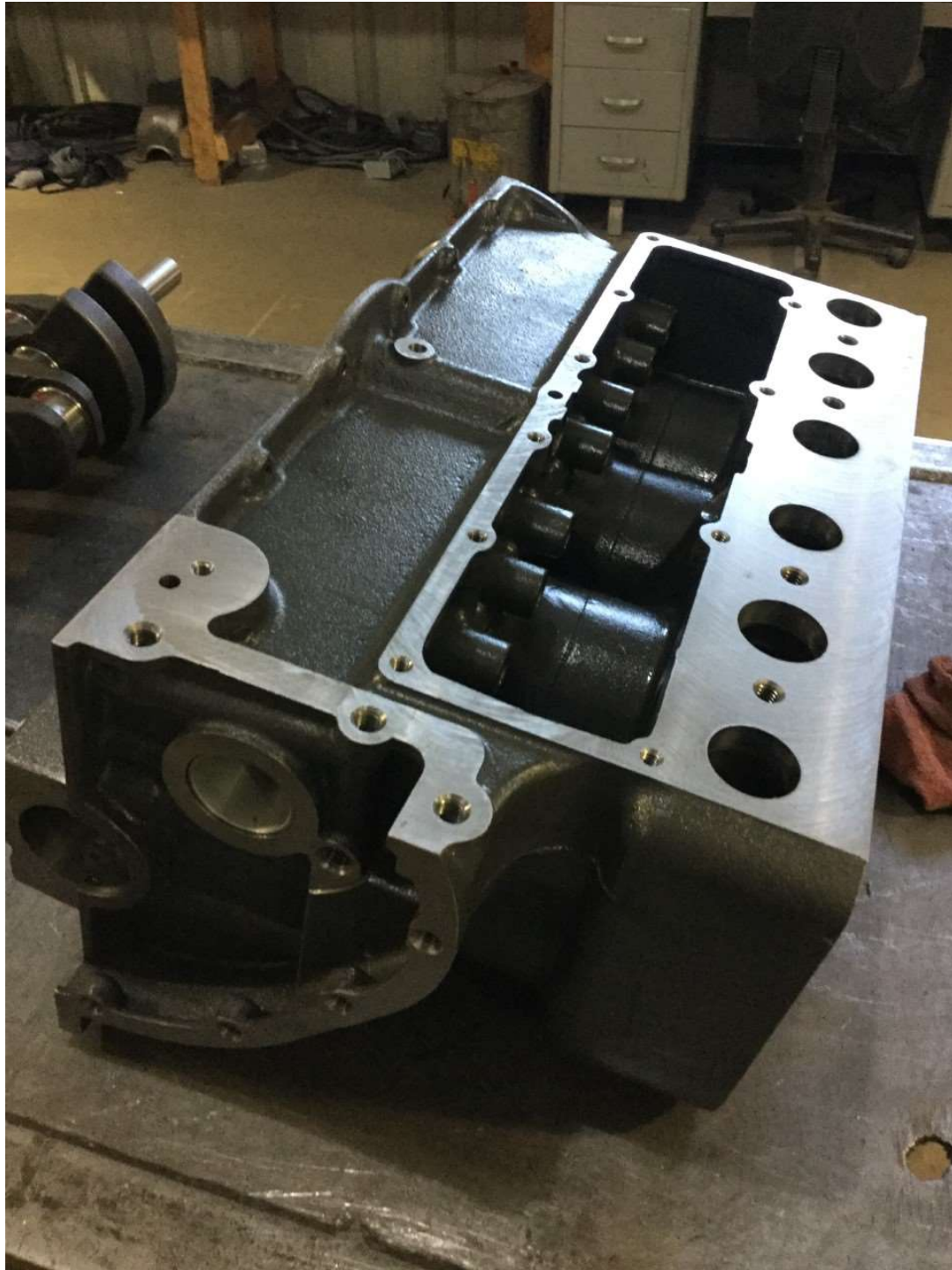
Please inspect your new engine parts kit thoroughly, and look to see that all parts are included. The following is the list of parts that are included.

Cylinder Block

Qty 1, cylinder block with 4 hard exhaust seats, 5 cam bearings, and 10 cylinder block/main cap dowel pins installed. The following loose parts are either assembled to the cylinder block or they are packaged separately.

Qty 5, main caps

Qty 4, stepped (7/16 UNF x 1/2 UNF) studs for #1 and #3 main bearings
Qty 4, 1/2-20 UNF tall castle nuts for #1 and #3 main bearing studs
Qty 4, 7/16 UNC x 7/16 UNF studs for #2 and #4 main bearings
Qty 8, 7/16-20 UNF 12-point nuts for main bearing studs #1, #2, #3, and #4
Qty 2, 1/2 UNC x 1/2 UNF studs for #5 main bearing
Qty 2, 1/2-20 UNF 12-point nuts for main bearing #5 studs
Qty 2, 1/2-13 x 3/8 UNC setscrew for main oil galley end plug
Qty 5, 3/8-16 x 1/4 UNC setscrew for oil galley plug
Qty 1, 7/16 x 3/8 UNC setscrew for oil galley plug
Qty 1, 1/8-27 NPT slotted plug
Qty 2, dowel pins for cylinder block/flywheel housing interface
Qty 3, thrust washer half
Qty 6, 8-32 x 3/8 Phillips flat head brass screw for thrust washer halves
Qty 4, special small diameter studs with hardware used for line boring of main bearings 1 and 3 (to be discarded after verification of match marks)



Crankshaft

Qty 1, dynamically balanced crankshaft with 2 rear dowel pins, 4 setscrew oil passage plugs, and 1 Woodruff key installed.



Connecting Rod

Qty 4, balanced connecting rods each with wrist pin bushing, 2 dowel pins at the cap interface installed, and 2, 12-point 3/8-16 x 1 1/4 UNF bolts.



Do not disassemble the main and connecting rod bearing caps until the match marks are verified.

After match mark verification, the main bearing studs and associated hardware for main bearings 1 and 3 need to be discarded. On final assembly, they will be replaced with the special stepped studs (7/16 UNF x 1/2 UNF) and nuts supplied separately.

The cylinder block main bearings and connecting rod bearings were machined to size while assembled. When taken apart, there will be burrs and sharp edges that need to be de-burred. There are also burrs and sharp edges at other locations that need to be removed. De-burring can be done with a Dremel tool, a small mill file, a rotary wire wheel brush, and 320 grit wet-or dry sandpaper. After de-burring, every part needs to be surgically clean for a long engine life.

2) Oil System Options

Building the new engine to appear stock requires no changes to the new cylinder block.

If desired, the new engine can be built to utilize a full flow oil filter as detailed on this website (<http://www.modelaengine.com/>) at "Installing an Oil Filter" and this modification of 2 holes will create chips that need to be cleaned before engine assembly. The modifications required for an oil filter can be reversed in the future and the cylinder block will again look to be original.

We recommend that the oil pump chosen will provide a greater volume of oil. A stock pump can be modified as detailed at "Doubling the Flow Area of a Model A Oil Pump" on this website (<http://www.modelaengine.com/>), or a new pump can be purchased from Bill Stipe (<https://www.specialtymotorcams.com/>).

Either of these pumps must be configured to deliver all oil internally (no filter), or deliver all oil externally (filter). The Stipe pump is designed to deliver all oil externally and the instructions provided with it describe the machining needed to deliver all oil internally.

We recommend that an oil pressure relief valve set no higher than 40 PSI be used. Higher pressures will subject the oil pump/distributor drive gear (A-6551) to higher stresses, and disengagement by compressing the retaining spring (A-6570). The installed stock retaining spring exerts a downward force of 32 pounds, and at 40 PSI the upward force from the oil pressure is 27 pounds. For added insurance, a stronger spring (McMaster Carr 9657K522) that will exert 60 pounds of downward force can be used.

We recommend that a clamp be fabricated to hold the oil pump chosen in place. A 5/16 UNC tapped hole is provided in the new cylinder block for the clamp. See the following photo that shows the oil pump clamp with a 5/16-18 x 1 UNC bolt with lock washer.



3) Oil Pressure Monitoring

If you look at the bottom of the valve chamber cavity, there are 2 oil passages from the main oil galley that connect to 2 valve cover bolts. These passages can be used for an oil pressure gauge or to provide oil for an overhead valve conversion. To utilize these oil passages, a special bolt needs to be made from 1/2 inch hexagon stock. One end is threaded 5/16 -18 x 3/4 UNC and the other end is threaded 1/8 UNPF. The special bolt is shown in the following picture.



4) Recommendations Regarding Adhesives and Sealants

The 3 main bearing studs that have nuts on the exterior (2 at main #1 and 1 at main #3) need to be sealed to prevent oil leakage at the tall castle nut. Sealants can be an epoxy (Loctite 1360700), a flexible sealant (Permatex Black Gasket Maker 27037) or a packing (cotton string and Permatex #2, 80011). If the decision to use a packing is made, then the Permatex impregnated string must be wound around the 7/16 inch shank and firmly packed with a curved tool that is .030 inch thick.

We recommend that Permatex #2, 80011 be used to seal the rear main bearing cap/cylinder block interface.

We recommend that Permatex 20539 Indian Head Gasket Shellac be used on the cylinder block side of the flywheel housing, oil pan gaskets, and valve chamber cover.

We recommend Permatex 80045 Pipe Joint Compound be used to seal all NPT and UNC oil passage plugs in the cylinder block and crankshaft.

We recommend a light coat of Permatex 80697 Copper Spray-A-Gasket on both sides of a copper head gasket or Permatex 80064 Sealant for graphite head gaskets just before assembly. Follow the instructions to assemble while the sealant is tacky.

On the engineering evaluation engine, we used Permatex Black Gasket Maker 27037 sealant instead of a gasket at the water outlet to prevent breakage of the outlet when the studs were torqued to 55 lb-ft.

If you have any concern about head gasket sealing or the integrity of your head, we recommend Irontite All Weather Seal because it is compatible with antifreeze.

5) Recommendations Regarding Lubricants

We recommend that Permatex 81950 Ultra Slick assembly lube be used on all parts that are in contact and slide or rotate including seal rubbing surfaces.

We recommend that head and manifold studs threaded into the cylinder block be coated with Permatex 80078 Anti-Seize Lubricant to make future removal easier.

We recommend that 10W-40 or 20w-50 motor oil be used both for break-in and thereafter.

6) Recommendations Regarding Add-on Parts

All interfaces on the new cylinder block, crankshaft, and connecting rods where parts are attached are identical to stock. In other words, if a part fits an original Model A engine, it will fit the new cylinder block, crankshaft, and connecting rods.

All threads in the new engine parts are either UNC, UNF, or NPT. There are no metric threads.

Add-on parts, whether new, used, NOS, or aftermarket, need to be clean and inspected for wear and flatness. Flatness is critical at the cylinder block/head interface, cylinder block/manifold interface, and cylinder block/oil pan interface.

Some aftermarket high compression flat heads have a reputation for not being flat. If your head is not within .003 of being flat, it will need to be resurfaced.

The upper surface of an original oil pan is often distorted due to over tightening with the thick cork gasket, and will need to be straightened.

Original Model A pistons are split skirt, have 1/8 inch wide compression rings, 3/32 inch wide oil ring, 1.906 compression height, 0.000 inch wrist pin offset, and use a .9996 inch diameter wrist pin.

Pistons sold by the Model A parts vendors are solid skirt and use original width rings.

We used EGGE (<https://egge.com>) part number E1104-4 pistons in the engineering evaluation engine. They use narrow rings (5/32 inch wide compression, 3/16 inch wide oil) and they fit with .004 inch piston/wall clearance so no honing was needed. The EGGE pistons are solid skirt with an expansion slot that does not extend to the bottom of the piston.

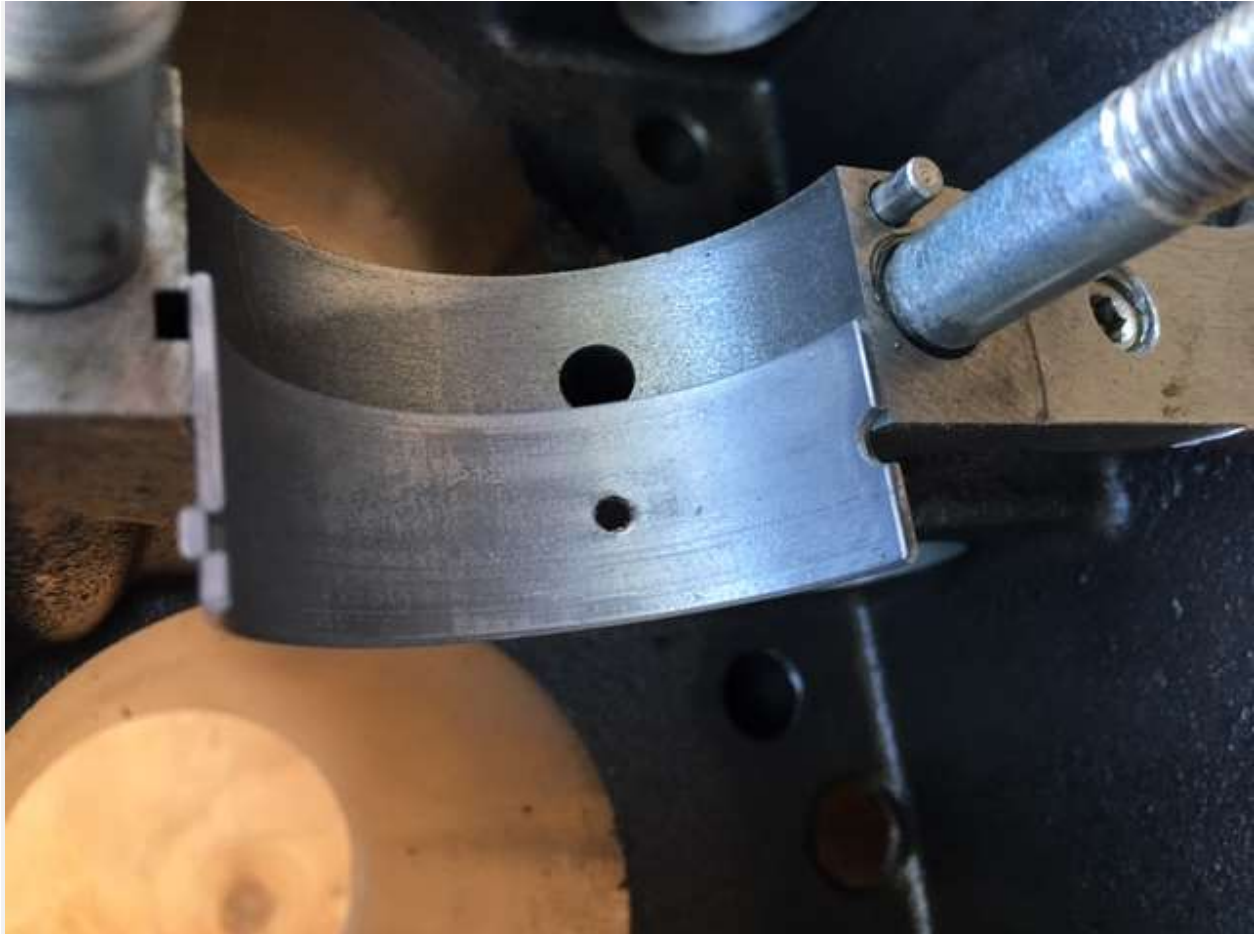
If the pistons chosen have expansion slots, the expansion slots need to be on the non camshaft side of the engine.

We used Hastings ring set 665. They fit with proper ring gaps, and no filing was needed.

See section 8) Recommendations Regarding Tolerances for piston/cylinder wall clearance and ring gaps.

We recommend that all 12 pairs of bearing inserts be Clevite CB-745P or Federal Mogul 2020cp, both of which are tri-metal. Buy standard size bearing inserts.

The upper bearing inserts for main bearings 2 and 4 need an 1/8 inch diameter hole to open the oil supply passage in the cylinder block. See the following photo that shows a bearing insert with the added feed hole.



We recommend that main and connecting rod bearing clearances be verified to be .002 inch with oiled Plastigage (SPG-1, range .001 to .003 inch). Oil prevents the deformed Plastigage from sticking to the journal or bearing shell.

We recommend that an aluminum camshaft gear with a deepened dimple be used for ease of ignition timing.

We recommend that a National 415035 (4.000 inch ID, 4.999 inch OD, x .468 inch wide) or equivalent rear main seal be used with the

garter spring removed. See the following photo that shows the garter spring partially removed.



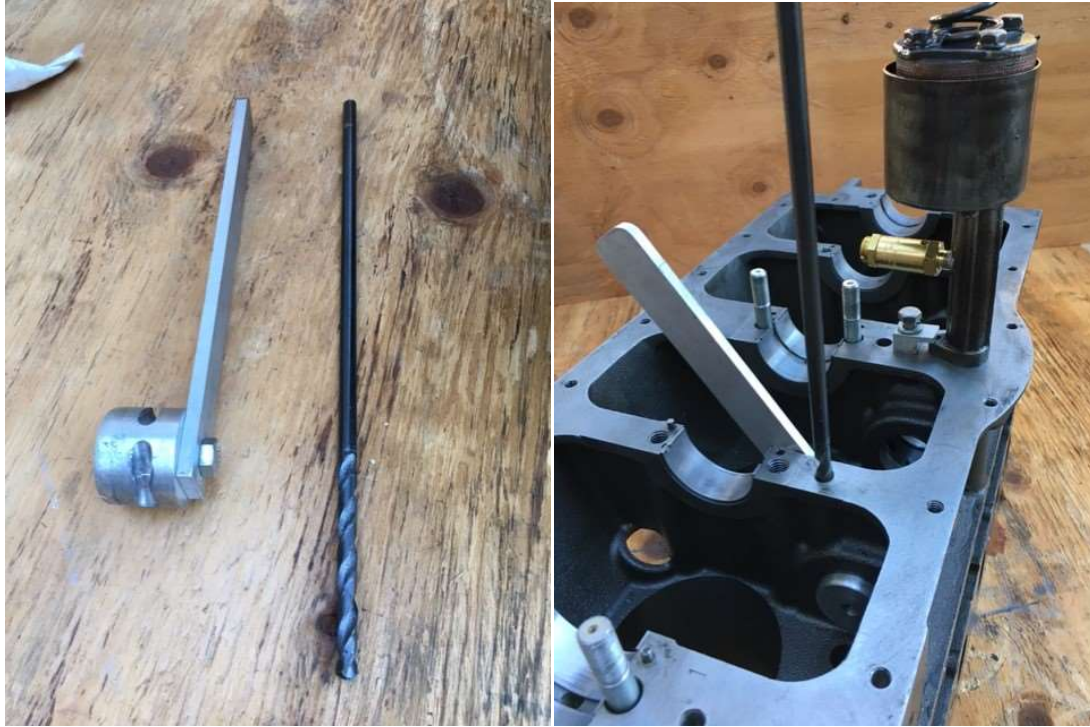
The garter spring side of the seal needs to be installed towards the interior of the engine. The seal must be driven evenly until it bottoms out. The seal cavity is deep enough for 2 seals. If 2 seals are used, leave a cavity between seals and fill the cavity with a high quality oil.

We recommend leaving the dipper tray in place because the baffles on the bottom help to mitigate oil sloshing and starving the oil pump. The new connecting rods have reinforcing ridges that dip into the troughs on the upper side of the tray and this creates an oil mist to lubricate the wrist pins, valve guides, tappets, and timing gears.

Two-piece original, one-piece with shoulder, or press-in valve guides with appropriate valves can be used. We recommend that the valves be lapped using Permatex 80036 Valve Grinding Compound. Oversize intake valves can be used. The thickness of the upper surface of the new cylinder block and an original cylinder block are identical at .375 inch.

We recommend that "single lock" Colony CM1008 tappets be used.

We recommend that a new 5 bearing or reground stock 3 bearing camshaft be used. To prevent the build-up of oil pressure behind camshaft bearing #5 which may force the camshaft forward, we recommend that it be vented to the crankcase. Model A camshafts have full length oil distribution grooves that provide a sufficient vent. Model B camshafts have short grooves that need to be lengthened or a vent hole needs to be added. If using a 5 bearing camshaft, the oil supply passages in camshaft bushings 2 and 4 in the cylinder block are blocked by cam bushings and need to be opened. This can be done by using an aircraft extension drill and drilling from the bottom upwards. To prevent drill breakage, an aluminum plug should fill the camshaft bearing hole (1.563 inch dia.) and support the drill when drilling the second hole. See photos of the tools and tools in use.



We recommend that grade 8 head studs be used and installed using Permatex 80078 anti seize compound. They are much stronger and less likely to twist off during removal in a future rebuild.

The studs for main bearings 1 and 3 are very close to the backside of the bearing inserts. See the photo and verify that there is clearance. If there is no clearance, file the backside of the insert corner slightly to provide clearance.



The connecting rod big end comes very close to the cylinder block walls, oil pan walls, and the camshaft. Verify that there is clearance by rotating the crankshaft after assembly of each connecting rod/piston assembly.

7) Cleanliness

Light oil was applied to the new engine kit parts to prevent corrosion, and it has likely collected a lot of dust particles during transportation. In addition, every oil passage and threaded hole may have machining chips and grit that needs to be removed.

Remove the 4 setscrew plugs in the crankshaft to open all passages for cleaning.

For a long engine life, every part (new or old) needs to be surgically clean.

If you are building the new engine in a home shop without a solvent wash tank or air compressor, we recommend that you take all of your parts to a shop for cleaning that has these tools.

8) Recommendations Regarding Tolerances

We recommend that you follow the dimensional specifications from your parts suppliers. If specifications are not available, then use these recommendations.

Upper ring gap .012 to .015 inch

Middle ring gap .010 - .012 inch

Lower ring gap .008 - .010 inch

Piston to cylinder wall clearance measured at the bottom of the piston and at 90 degrees to the wristpin. .0035-.004 inch if using solid skirt pistons, .002-.003 inch if using split skirt pistons, .007-.008 inch if using forged pistons.

Intake valve/Tappet clearance .011-.012 inch

Exhaust valve/Tappet clearance .012-.013 inch

Main and Connecting Rod bearing clearance .0015 - .0020 inch

Crankshaft end play .002 - .007 inch

9) Recommendations Regarding Fastener Torque

The following torque values assume that the threads are clean and not lubricated with wax or something else that will reduce friction.

We recommend a head stud torque of 55 lb-ft applied in increments of 10 lb-ft. Start with the stud closest to the center of the block and work outwards in a spiral. If greater torque is desired, consider inserting stainless steel Heli-Coils into the cylinder block which will provide additional shear area.

We recommend main bearing torque to be 55 lb-ft.

We recommend a connecting rod torque of 40 lb-ft. A thin-wall 12-point deep socket is needed (Craftsman 43301 or equivalent).

We recommend a manifold stud torque of 30 lb-ft, again starting at the center and spiraling out in 5 lb-ft increments.

Instead of using the original 7/16 UNF x 13/16 inch long flywheel attachment bolts, we recommend 7/16 UNF x 1.5 inch long Grade 8 bolts with a torque of 60 lb-ft.

10) Recommendations Before Starting Engine

We recommend that the spark plugs be removed, and the newly assembled engine be cranked by the starter to confirm oil pressure.

If the choice is made to use an oil filter, we recommend that the filter be filled before assembly.

11) Common Sense

Please don't plan on building an engine that can continuously keep up with modern traffic. Short bursts of speed are fine like passing slower traffic or entering a freeway on ramp, but attempting to continuously keep pace with modern traffic may result in other problems and is not recommended.

We are confident that the new engine will survive short bursts of speed because we assembled the "Engineering Evaluation Engine" and then broke it in by intentionally abusing it to see if anything would break by running it continuously at 3100 RPM (75 MPH) for 6 hours, and nothing broke.

We recommend that you break your new engine in at varying speeds, but not over 2400 RPM (58 MPH) for the first 1000 miles.

12) Flywheel

The optional 30 pound flywheel is machined to use the Ford V-8 9 inch Long design pressure plate (48-7563 or 09A-7563). We do not recommend the use of the 8N-7563 tractor pressure plate. The new flywheel is machined to accept the original Ford shoulder bolts (350433-S) that attach the pressure plate to the flywheel. Other 5/16-18 shoulder bolts can be used. Shoulder bolts are much stronger in shear than fully threaded bolts. These bolts should use lock washers and we recommend a torque of 18 lb-ft.

The new flywheel does not come with a ring gear installed because the beveled teeth on the ring gear need to be at the rear if using a Model A starter, and at the front if using a gear reduction starter.

We do not recommend the use of a "barrel" tractor starter drive instead of an original Bendix because the "barrel" drive has a shorter throw (distance that the pinion gear moves between rest and extension), and it will not engage the ring gear completely.

The new flywheel does not come with a pilot bearing because some people prefer the porous bronze oil impregnated bushing while others prefer a ball bearing.

13) Detailing the New Engine for Judging

Steve Plucker has documented the evolution of the Model A cylinder block. Steve's extensive documentation can be found here:

http://www.plucks329s.org/pdf/engineblock/cylinder%20block%20guide_1.pdf

The main oil galley in the new cylinder block is very long and had to be drilled from both the front and rear of the cylinder block. The front drilling and plugging is internal and hidden. The rear drilling and plugging is between the cylinder block and flywheel housing and is very hard to see, but if the cylinder block is to be used in judging, the depression should be filled and textured.

The serial number pad may need shortening. (Engines before Feb 1929) The serial number is hand stamped (Numbers are slightly crooked and spacing is uneven) at the top of the pad. Stamps with the correct font are available at <https://restostamps.com/collections>. Note the serial number location and crookedness in the following picture.

The small external bump near camshaft bearing number 5 may need to be removed. (Engines before April 22, 1929)

Grind marks on the water jacket need to be made. These marks are between cylinders 1 and 2, and 3 and 4 where water jacket core support wires exited the cylinder block. Look at an original cylinder block for the locations. The next photo shows one that was ground very poorly or was possibly plugged, but provides location.



14) Project History, Design Details, Pictures, and Videos

This project started in 2007, stalled in May 2015, and was resurrected in July 2019.

Design details, updates (progress reports), pictures, and videos can be found here: <http://www.modelaengine.com>

15) Web Resources

There have been a lot of questions asked and answered along with comments and opinions on social media.

FordBarn:

<https://www.fordbarn.com/forum/showthread.php?t=265782>

VintageFordForum: <https://www.vintagefordforum.com/forum/model-a/188084-new-model-a-engine>

Google

Google search is a wealth of knowledge. Ask it questions like: "What piston is best for my engine?", "Are thin piston rings better than thick?", "What is a tri-metal bearing?", "What motor oil should I use?", etc.

16) Education, Resources, and Making a Decision

Please take the time necessary to educate yourself so you can make a decision regarding what you want your new engine to look like and how you want it to perform.

The following is a list of literature that you may want to read.

Restoration Guidelines and Judging Standards

https://mafca.com/pub_standards.html

Model A Ford Mechanics Handbook Vol. 1, Les Andrews

<https://www.amazon.com/Model-Ford-mechanics-handbook-Andrews/dp/0965824004>

4-bangers And me, Jim Brierley (Self published book, do a Google search), jimb4e4@gmail.com

Secrets of Speed Society <http://www.secretsofspeed.com/>

The following is a partial list of suppliers that provide both stock and performance parts.

Snyder's (<https://www.snydersantiqueauto.com/>)

Bratton's (<https://www.brattons.com/>)

Bert's (<https://modelastore.com/>)

Eckler's (https://www.ecklers.com/ford_model_a)

Gaslight Auto Parts (<http://www.gaslightauto.com/>)

Mike's A Fordable (<https://www.mikes-afordable.com/>)

The Model A Medic (<https://modelamedic.com/>)

Arizona Model A LLC (<http://arizonamodela.com/>)

C W Moss (<https://cwmoss.com/>)

A.E.R. (<https://www.antiqueenginerebuilding.com/>)

The following is a partial list of manufacturers that specialize in performance parts.

Dan Price (<https://www.dan4banger.com/>)

Charlie Yapp (<https://www.secretsofspeed.com/speed-parts>)

Steve Serr (<https://www.millerhi-speedheads.com/>)

Bill Stipe (<https://www.specialtymotorcams.com/>)

H & H Antique (<http://www.handhantique.com/>)

Joe Silvis, Turlock Machine, (209 495-1689)

FSI Ignitions (<http://www.fsignitions.com/>)

Petronix Ignition (<https://pertronix.com/>)

Red's Headers (<http://www.reds-headers.com/>)

Nu-Rex (<https://www.nurex.com/>)

Jim Brierly (jimb4e4@gmail.com)

Piranios (<http://www.modelaparts.net/>)

17) Replacement Parts

The design of the new engine Cylinder Block, Crankshaft, and Connecting Rods has incorporated parts that are readily available from several sources.

If one of your new engine parts gets lost or damaged, replacement parts are available.

With the exception of studs, all fasteners are available from McMaster Carr. Please contact us if you need the McMaster Carr part numbers.

Bearing inserts and seals are available from Jegs, Speedway Motors, O'Reillys, NAPA, Ebay, Amazon, and others.

If you need a cylinder block assembly, crankshaft, or a set of connecting rods, please contact us.

For rebuilds in the future, the Clevite CB-745P bearings are available .001, .002, .010, .020, .030, and .040 inch undersize, and if the housing bore gets damaged, they are available with a housing bore larger by .002 inch as basic bearing number CB-1853.

The exhaust valve seat is dimensionally identical to MAHLE 218-7535, and over sizes are available if needed in a future rebuild.

18) Contact Information

Terry Burtz, (model.a.engine@hotmail.com) Engineering and anything technical including revisions to the "Builders Guide", "Oil Pump Modification", and "Installing an Oil Filter".

John Lampl, (jrlampl@jrlasia.com) Manufacturing, Quality Assurance, Scheduling, and USA Shipping.

Leornard Nettles, (ln.lja@sbcglobal.net) Orders and Disbursements

William Percival, (wrpercival@gmail.com) Business Management, Bookkeeping, and Tax Calculator

If you don't know who to contact, contact any of us and we will figure it out.