McCulloch Mc8 Engine Rebuild

by Scott Kneisel

To vintage karting enthusiasts everywhere

This publication is meant to describe the overall process I use to rebuild a McCulloch racing engine. It is not a fully detailed document but does reference where missing information may be found. I had a lot of fun putting this together with a little help from my friends. Many thanks to Jeff Campbell, Ron, Perry and Chris.

The first step in this process is to totally disassemble the engine, clean and inspect the individual parts and replace anything that is damaged or worn beyond repair. I usually completely strip the paint off all exposed parts as well. This particular engine needed a carburetor, flywheel, crankshaft, piston, rod & wrist pin as well as the usual rebuild parts such as gaskets, ignition parts, rings and bearings, carb kit and hardware.

Preparing the bore

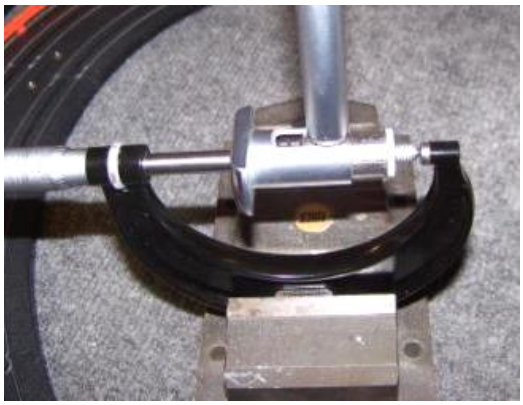
After a thorough cleaning and media blasting of the block the existing bore is measured using an inside micrometer and an appropriate size piston is selected for the rebuild. In this case the bore was only slightly worn and had only minimal taper or out of roundness. This resulted in selection of a standard piston measuring 2.160" and honing to increase the piston – bore clearance to 0.007". McCulloch recommends clearance of 0.0056"– 0.006" but I have found that using 0.006" to 0.0075" lessens the likelihood of engine seizure under racing conditions. Of course this means less time between rebuilds but most of us do not put a large amount of hours on these vintage engines anyway so I don't consider it an issue.
(Note – bore sizing is done using the piston skirt dimension)

Tools needed for measurement

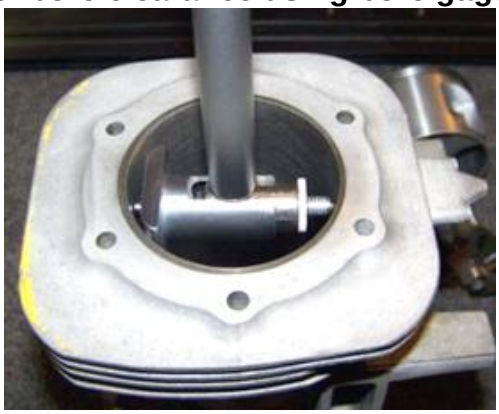
2-3" Outside Micrometer
Inside Micrometer set
Digital Bore Gage
0-1" Micrometer (Not Shown)

Measuring the piston using outside micrometer and existing bore with inside micrometer


Zero the bore gage
Bore gage zero is set using the 2-3” micrometer set to the piston skirt diameter.

Measure piston skirt–to–bore clearance using bore gage

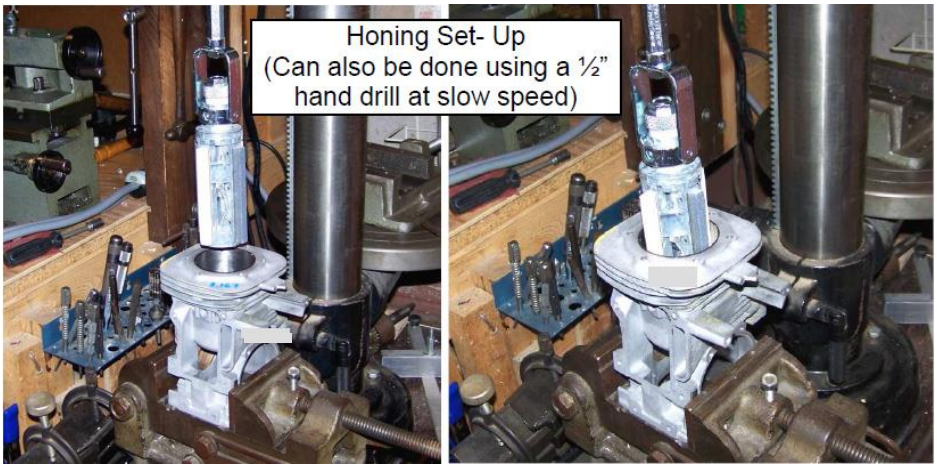



<u>Honing to size:</u> The target size for this bore is 2.167” which leaves 0.007” clearance.

Block is then honed to size using a rigid hone at about 450RPM while moving the hone up and down to achieve about a 30-45degree cross hatch pattern on the surface of the bore. This improves oil retention as well as helps the rings to seat properly. When complete, clean block thoroughly. I use soap & water followed by air blow & coating of WD40.

Things to be aware of during the honing process

1) Be sure to measure often watching for taper and out of round.
2) Out-of-roundness will correct itself as the hone makes the bore true, if a lot of material is going to be removed; however, the bore may start to develop a taper. If this happens it can be corrected by reversing the block and honing from the bottom rather than the top as shown to correct the taper.
3) Honing oil is recommended and lots of it. Professional honing machines use a continuous flow of cooling lubricant while honing. I use WD-40 as a honing fluid. I try to keep the stones wet at all times by flooding the hone and cylinder with fluid, then run the hone for awhile and re-apply the fluid, hone some more, etc. Other honing oils are available but WD40 is plentiful, cheap and relatively non-toxic. A "home brew" honing oil can be made up of 1 part 30W to 8 parts kerosene.



Assembling rod and piston
While heating rod in oven to about 180-200 degrees F, set up piston block in press as shown. When rod is heated, insert into piston and press new wrist pin into place. This needs to be done quickly or pin will become very tight in rod when it begins to heat. Be careful not to bottom wrist pin against closed bearing. If this is the case, the pin it the wrong length. This dimension can be checked before rod is installed. The correct length pin should be flush to 0.010" below flush at the bearing and not quite bottomed on the closed end bearing. There is a service bulletin covering this K-138 and is available on the McCulloch page of the R.E.A.R. website. (see the McCulloch service documents section on that page)

Measuring Crank journals using 0-1" micrometer
Measure at several places around the circumference and compare with McCulloch

Sometimes with these old parts, we need to use parts that are slightly outside specifications just because of parts availability.

McCulloch Specs for Crankshaft
Crankpin – 0.6298” (0.6295” to 0.6300”)
Flywheel end – 0.6696 (mean dimension)
Drive End – 0.7498 (mean dimension)

Installing inboard crankshaft bearing
Heat bearing with heat gun as shown or in oven at 200-300F (Do not overheat). With crank placed on aluminum press plate across vice jaws as shown, drop the hot bearing onto the flywheel end shaft and tap into place until bearing seats against crank shoulder. Use appropriate driver that will press against inner race only. Pressing on the outer race may damage bearing. I protect the rod journal by wrapping a couple layers of painters tape around journal just to be safe.

Prepare crankcase side cover:

Installing a new seal

(I like SKF seals because they have sealing compound applied to the OD. If you use other types, Pliobond or equivalent sealer is recommended by McCulloch)

I utilize a bushing driver set as shown for installation of seals, bearings and bushings but an appropriate sized socket will also suffice.

Install seal with lip facing the inside of the crankcase. Use caution to start seal straight into bore before applying pressure. Also make sure bore is clean of any remaining sealer.
I use the back of a socket at the back side of the bore to act as a stop to press the seal against. (see photo below)

Install Seal (continued)

Install Crankshaft/bearing assembly
Check side cover for bearing press fit. If the bearing slips into the bore with hand pressure only and no heat then it is too loose. Blue Loctite 242 can be used for this and if applied evenly around the outer race will help center the bearing and keep it in place.

If the bearing is a press fit, heat side cover in oven to 180-200 degrees F or use heat gun to heat bearing bore area. Use caution if using heat gun not to damage seal. Keep heat flow low on the side of the bore and move heat gun around the OD for even heating. I wet my finger and touch the surface, if it sizzles, it is ready. (low tech approach)

Oil crank IB shaft and seal lip before inserting, Crank and bearing should drop right into bore with minimum force. Be very careful not to dislodge the seal garter spring, this happens often, insert the shaft carefully rotating a bit as it goes thru. Tap the end of the crank with a dead blow hammer to make sure it is seated.


Install PTO Bearing
Use the press and the bushing drivers to install a new PTO bearing. Do not press bearing beyond the inside bronze thrust surface as shown.


Install crankcase side cover
Cover should slip right in, make sure to install the o-ring gasket and fasten with 6ea 10-24x 7/8" grade 5 or better bolts. Torque to 60-65 in-lbs. Coat bolts with sealer to prevent crankcase leaks. I use black high temp silicone gasket sealer but blue Loctite 242 can also be used and will seal the bolts as well as lock them into place. Bolts locked with 242 can usually be removed with regular tools, if not heating will aid in removal.


Install crankcase side cover (continued)


Check & Adjust ring gap

This is an important step. If the ring gap is too tight, rings will butt when hot and damage the cylinder and piston. Ring gap should be 0.004" - 0.050" for pistons without pinned rings and 0.051" – 0.091" for pistons with pinned rings. A gap in the middle to high end of the spec is probably best here and has been proven not to hinder performance.

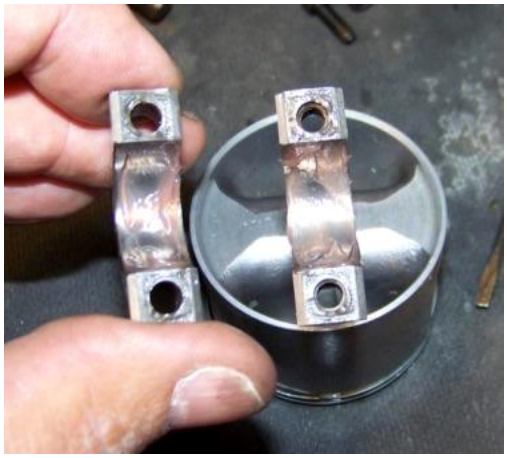
Slip ring into cylinder and use piston to push it down halfway between ports and top of block. If gap is too small, I use a Dremel with carbide cutting disc to remove a small amount of material from the end of the ring and re-check until the desired gap is attained. Dress the ring ends with emery cloth to remove any burrs from the grinding. A file can also be used to remove material if a Dremel is not available. (This step is easier if done before side cover installation.)

Caution: be extremely careful not to nick the sealing surface if using a cutting disk, this will ruin the ring

Installing the Rod and piston assembly
Insert the piston in the bore with the closed wrist pin bearing toward the exhaust port. Push the piston all the way down into the bore until bottomed. Turn assembly upside down and I use a wooden prop to hold piston in the bottomed position. The prop also supports the entire assembly.

Apply light grease or Vaseline to both halves of the connecting rod assembly as shown before inserting the piston.

(Caution….Do not use wheel bearing grease for this step, wheel bearing grease will not wash out and the result will be a burnt rod and crank – speaking from experience)



Place needles onto rod ends
I use a tweezer to do this, 12 needles in each half. I also place the needles in a clean disposable plastic bowl to pick from, this method has worked well.

Placing Needles

After the upper section of the rod is populated with 12 needles, carefully push the piston back down the bore until the crank journal clears the rod. Carefully center the rod and align with journal then push the piston to seat the rod/needles onto the journal. Now carefully place the rod cap/needles in place making sure the alignment nubs on the caps match.

Install 2 new rod bolts and snug them. Rotate the crank several times to make sure the rod halves are seated and torque to appropriate specifications. Refer to appendix 1 (Rod Bolt Torques) at the end of the document.

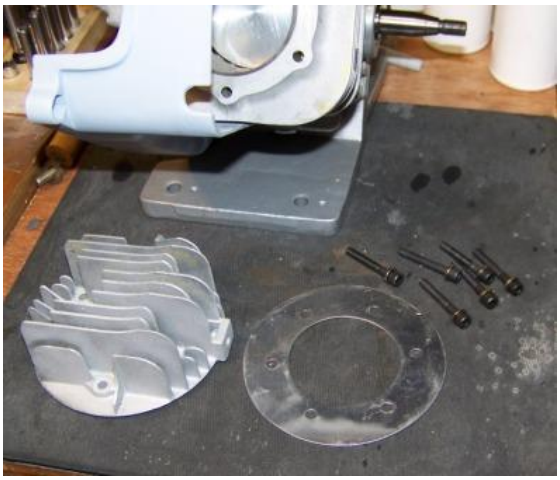
Note: Count and double count the needles before and during installation to make sure one has not fallen into the engine, this could be disastrous if the needle is not retrieved or if one is left out of the rod. McCulloch usually supplies and extra needle with a set so save it for future use.



At this point in the assembly, I wash out the grease used in placing the needles with fuel mix (or WD40) and lube the bearings with light oil. Then I install the stuffer and gasket and bolt the engine to a mount for the rest of the assembly.

Install Head:
I use new head bolts and washers and a new head gasket for this step. Re-using a used head gasket is not recommended. Head bolts for the Mc8 are 10-24 x 1 3/8". A special washer is needed with a smaller than standard OD, I use metric washers for an M5 screw, they work very well. McCulloch recommends oiling the bolt heads with 10W oil before assembly. Refer to service bulletin K153A

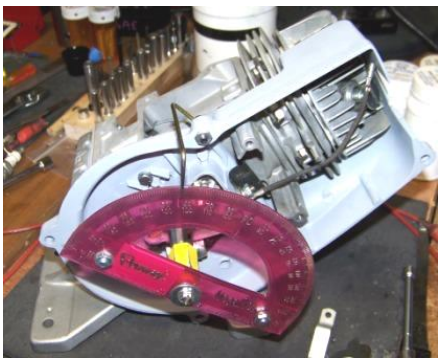
After head is in place and all bolts are snugged, torque bolts evenly in a cross pattern to 50 in-lb and then re-torque to 65-75in-lbs.

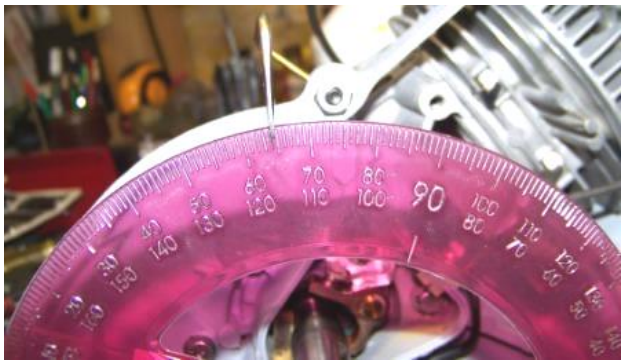


Install Ignition
Remove new points from package and inspect the contacts. The factory applies a coating of wax for protection which can be removed with alcohol but If they look tarnished, there is a simple process explained on the REAR site to remove the tarnish. After thorough cleaning, check the electrical resistance across the point contacts with a multi-meter. The resistance should be below 1 ohm. If higher, re-clean and use crocus cloth to polish the contacts if necessary. Install points, condenser, coil wire, insulator and rubbing felt. Put a little light oil on the felt where it contacts the crankshaft. Set points to 0.018" at the full open point as a starting point for setting the timing in a later step.

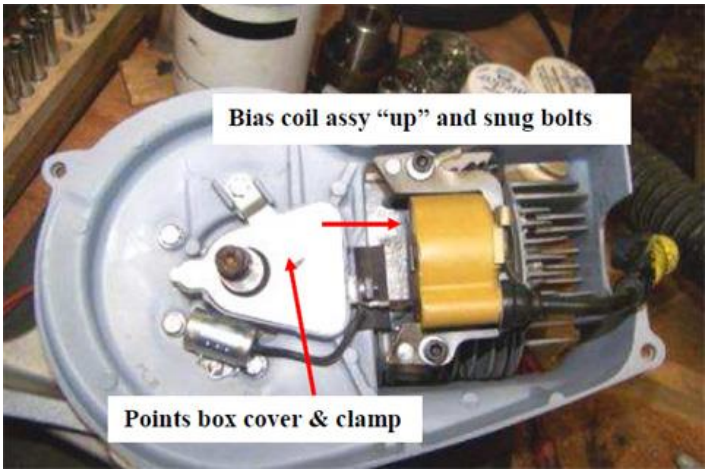
Set Timing
I use a home made timing kit containing a special crankshaft nut to mount degree wheel, degree wheel made from protractor, pointer made from coat hanger wire, a flashlight continuity checker and a TDC finder made from a hollowed out spark plug and a bolt drilled for venting.

I am not going to explain the process here, it is well explained in any of the McCulloch engine manuals, I use the same process to find TDC (top dead center) and set the timing to 25degrees BTDC



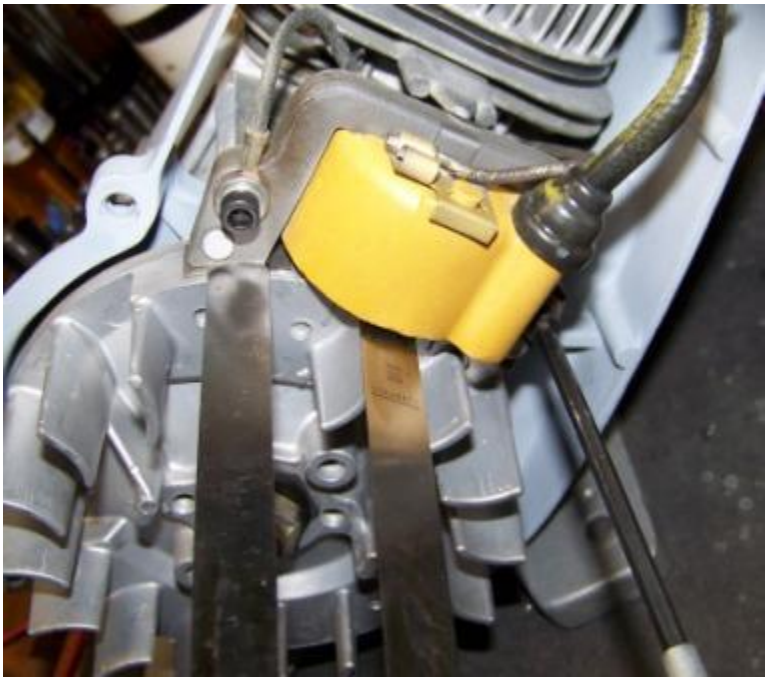


Install Point Box cover and coil assembly:
Move coil fully up in the slots and snug the bolts.



Install flywheel, torque to specifications (see Appendix 2 for torque requirements) and set coil lamination gap to 0.010” – 0.012” as follows.

Align flywheel so magnets are under coil assembly and slip feeler gages under center post and upper post. Loosen coil screws and allow the coil to snap down to the feeler gages. Torque coil bolts to 60-65 in-lbs and remove gages and check the clearance under the lower post and make sure it is at lease 0.010”. Check for spark.



Install Manifold and reed plate:
Disassemble reed plate, remove all gasket remains and clean each part. Inspect the reeds and replace if worn on both sides or frayed or damaged in any way. These reeds were in good shape so I just reversed them for new sealing surfaces.

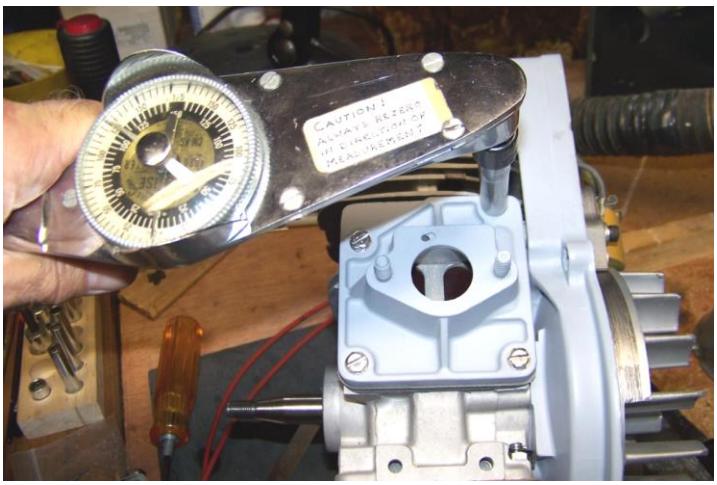
Dress reed plate on a sanding block to make sure it is flat and smooth on the reed side. I use 220Grit, then 400 grit wet or dry paper.

Re-assemble reeds, deflector and lock plate, torque bolts to specification and bend up tabs on lock plate to prevent screws from loosening.



Reed Plate Re-assembled

Install Manifold & Reed Plate:
Using the proper new gaskets (I soak them with WD40 before installation and do not use any kind of sealer), install the manifold and reed plate and torque bolts to the specified values. This is a good time to install the carburetor with a new gasket, nuts and lock washers. Loctite 242 is also a good idea on these bolts to keep them from vibrating loose.

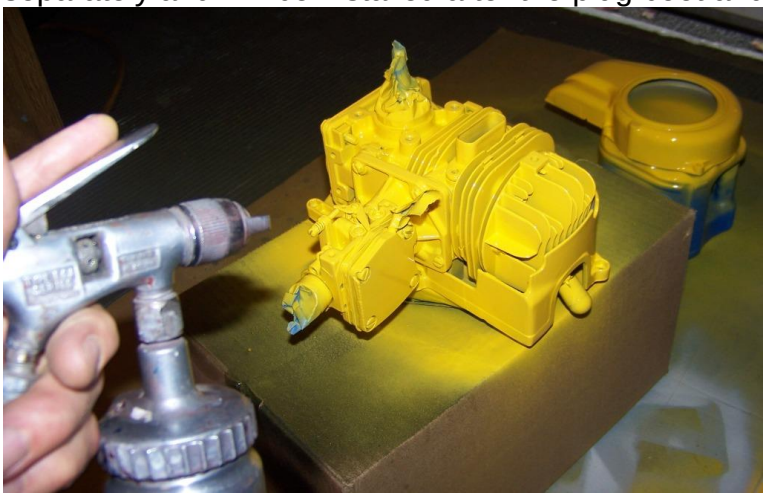


Install PTO Seal

C. Scott Kneisel

Place seal over PTO shaft with the lip facing in toward the bearing. Use a seal protector if you have one or using a small plastic probe, carefully slip the seal lip over the sealing shaft portion. Using a seal installer, press the seal home until it is

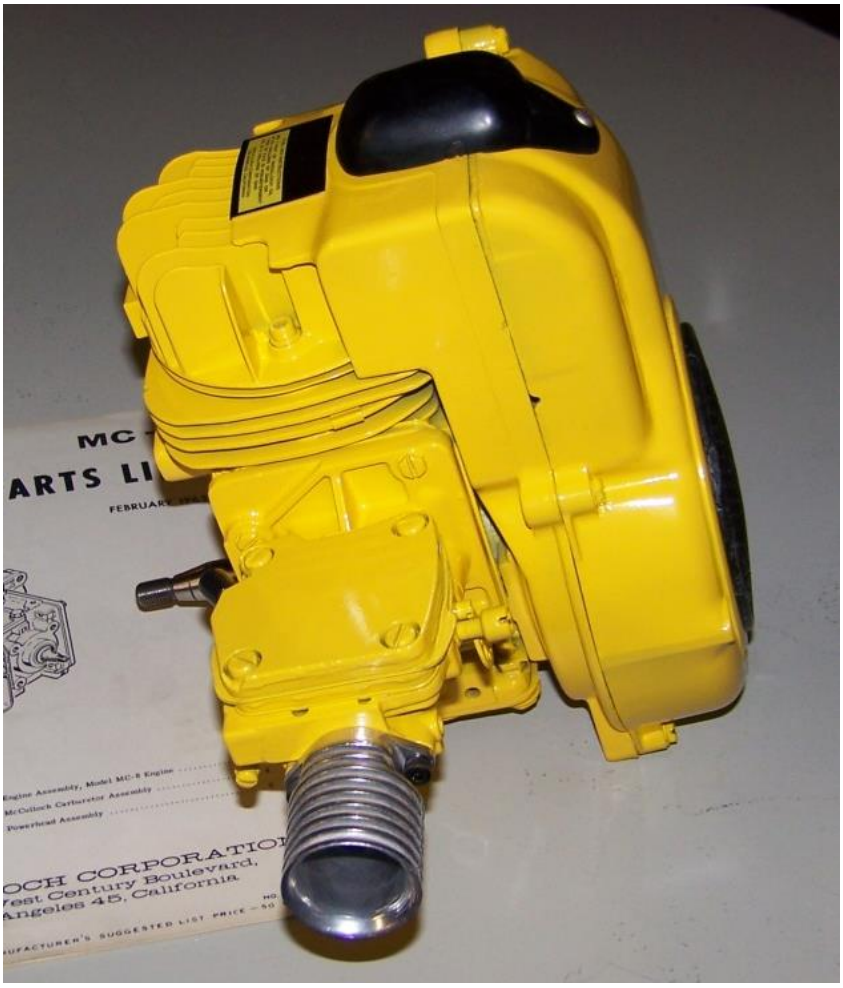
Ready for paint:
The PTO and boss, carb intake and exhaust ports were masked, the fan cover was painted separately and will be installed after the plug boot and sawdust guard are installed.



Remaining steps
Install spark plug boot
Install sawdust guard
Install metal label

Finished Product


MC-8
ILLUSTRATED PARTS LIST
FEBRUARY 1963



Appendix 1

Rod Bolt Torques
This information comes partly from McCulloch Service bulletins K151A and K161 which supersede some torque information in the later kart manuals. A copy of this is located at the McCulloch page of the R.E.A.R. website. (see the McCulloch service documents section on that page)

For all the kart engines from Mc5 up to and including Mc8, alloy socket head cap bolts were used. Torque value recommended for these bolts is 65 – 70 in-lb
Part numbers for the alloy screws are 101356 and 104589.

For engines starting with Mc9 up to and including the 101 series, recommended torque values are 105 – 110 in-lbs.

Part numbers for these bolts are 60210A, 60211A, 47819A and splined head #110720.

These bolts have rolled threads and are stronger than the alloy bolts. The new bolts can be substituted on the older rods but should only be torqued to the value recommend for the alloy bolts. Rods pre-dating the Mc8 are not as robust as the newer rods an could be deformed if torqued over the rated value.

Bolt Identification

Appendix 2 (Table of torque values)

Parts	Torque (in-lbs)	Torque (ft-lbs)
Breaker Point Screw	30 – 35	2.5 – 3
Carburetor Nuts	90 – 100	7.5 – 8.33
Manifold to Block	60 – 65	5 – 5.5
Coil Lamination Screws	55 – 60	4.5 – 5
Condenser Screw	30 – 35	2.5 – 3
Connecting Rod Bolts	(See appendix 1)	
Crankcase End cover Screws	60 – 65	5 – 5.5
Crankcase Bottom Bolts	95 – 100	8 – 8.5
Cylinder Head Bolts	65 – 75	5.5 – 6
Exhaust Stack Screws	55 – 60	4.5 – 5
Fan Housing Screws	55 – 60	4.5 – 5
Flywheel Nut	300 – 360	25 – 30
Reed Valve Clamp Screws	30 – 35	2.5 – 3
Spark Plug	216 – 264	18 – 22
Clutch / Sprocket Nut	260 – 300	22 - 25