HOW TO MODIFY YOUR MERCURY OUTBOARD MOTOR

BY

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HOW TWO

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Manual number 2

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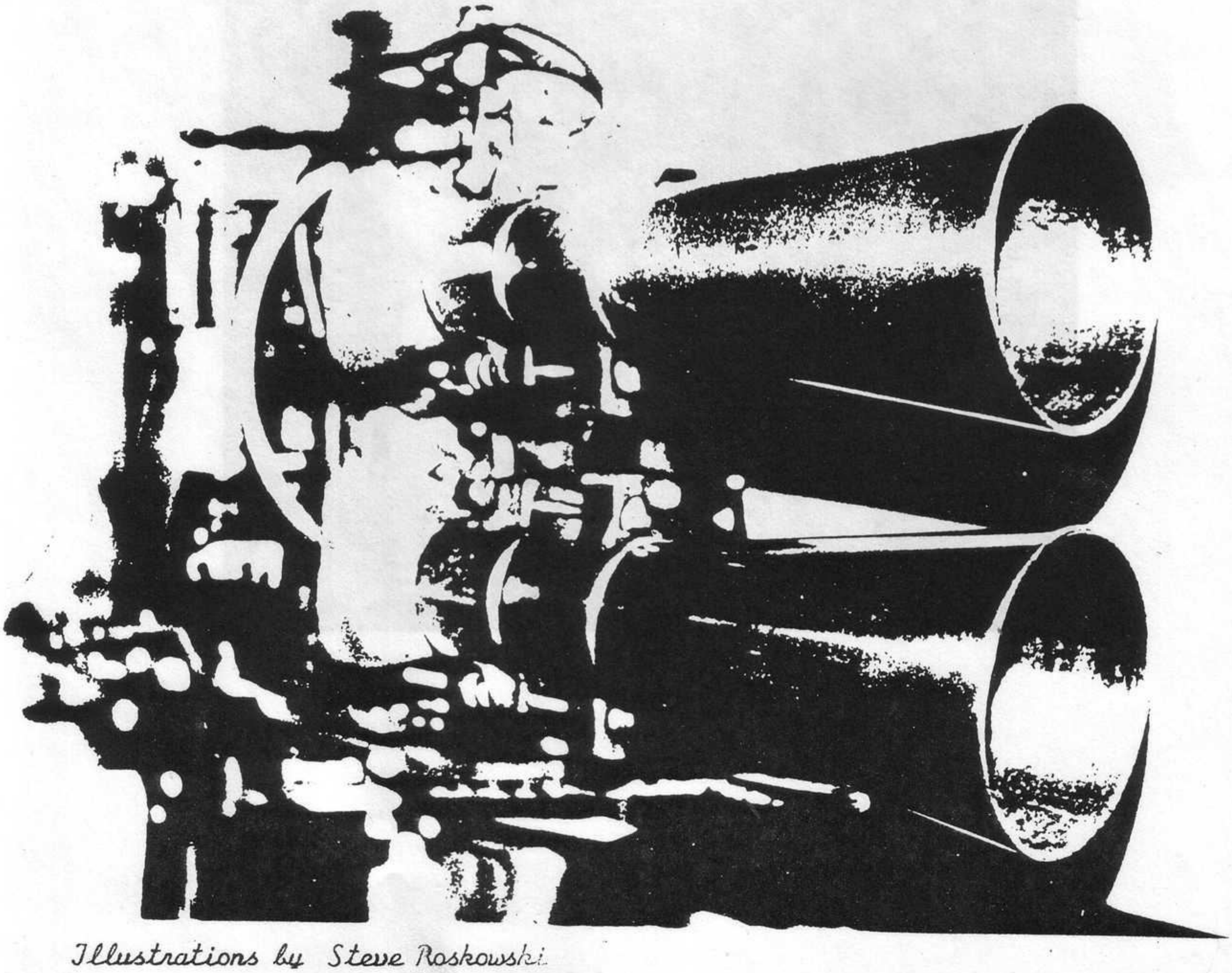

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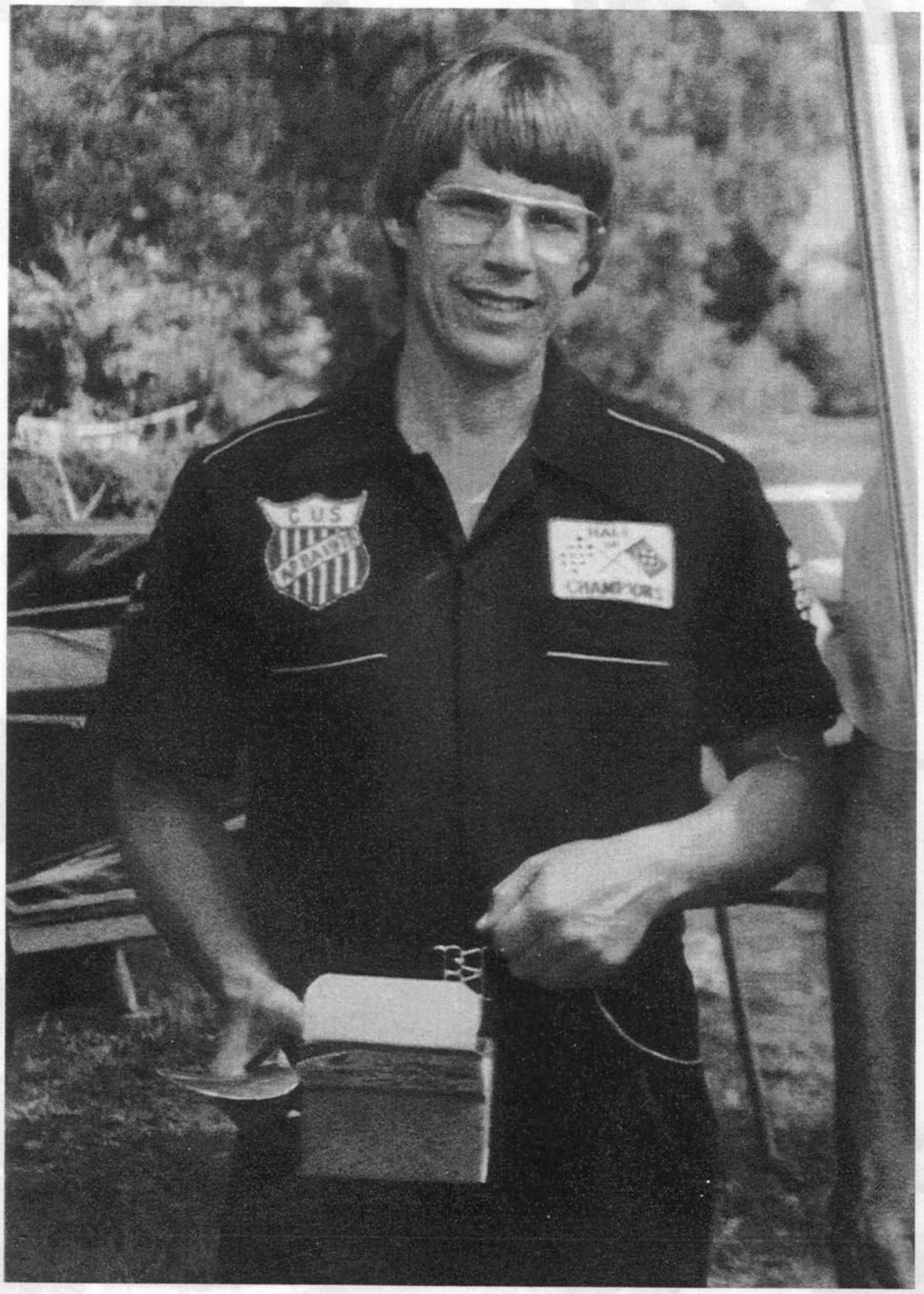

HALL
CHAMPIONS

Contents

Chapter

The focus of this Manual is the Modified Mercury Outboard Racer. Four Cylinder 1950's Mercury motors are still being raced in the U.S.

A lot of this information is helpful to the Stock Mercury Racers running the current 44XS motor.

Antiquers interested in the High Performance aspects of their Merc Outboards will find many items of interest.

Modifications done to Outboard motors need to be done in clusters to have the desired effect. One modification taken by itself may have no effect at all. **Moderation** in all things and don't get greedy. **More** is not always better.

This manual represents good advice, well intended and I build my own engines this way. There are alternative ways to achieve the same results I am sure. Use your head and common sense. Listen to everybody and take the best of the best advice for yourself.

Now start reading and take notes......

BORE GUIDE

What is your cylinder bore condition and diameter? You will need machinist tools and or a dial bore guage to measure a bore properly. If you have any damage or the bore is worn more than .002 inch anywhere, then you have to bore it oversize. My own criteria is .0015 in. egg, taper or oversize and I bore it. **I cannot emphasize it more. A perfect set of cylinders is the heart of any engine, stock or MOD.** You cannot make a great Mod engine with a worn out cylinder bore as your starting point.

Once you have committed to an overbore and found your pistons and rings, then you must think about "piston clearances". This is arrived at by comparing the diameter of your piston to the diameter of the new bore. Pistons diameters are measured ½ inch above the skirt bottom at 90 deg. from wrist pin. You had better measure with the pin also and if the piston is not round, then make adjustments in your calculations. You should have a new cylinder bore that is +-.0003 tolerance. If not then find the **smallest diameter** in each bore and use that for your calculations. The chart below gives factory reccommended diameters for pistons and cylinders for stock **closed up exhaust** motors, along with some Modified clearances that may be used; but **only if** you have used a dial bore guage and know exactly what your cylinder measures along with other criteria.*.

standard bore dia	piston dia. top land	piston dia. near skirt	stock clearance	Mod clearance HOT F.B.	Mod clearance Cold
C 2.112"	2.1007"	2.1067"	.0053"	.005	.0033"
D 2.441"	2.4285"	2.4345"	.0065"	.0065	~~.0045~~" 0055
E 2.565"	2.552"	2.558"	.007"	.0075	~~.0055~~" 007-009" X

tolerance +-.0005 inches   F.B. means Filler Block

Note- Mod clearance HOT is for tuned megaphone exhaust with a hot filler block installation without direct contact water cooling. Mod clearance Cold is for motors with open megaphone exhaust with internal water cooled filler blocks correctly placed.

For Mercury +.015 over and .030 Oversize pistons just add .015 in. or .030 in to the piston measurement shown above for the factory mean dimension, **but measure your pistons and use that exact dimension to calculate the exact bore diameter you want to end up with <u>after your final honing.</u>**

X New Keystone Ring pistons
Evidently Need more CLEARANCE.

There are other factors which will affect your selection of piston clearance to use. If your cyl block is **already** ported and some *beast* has used a file to make square corners then you should add at least .0005 in. to the Mod clearances. If in addition to this they have thinned the webs while squaring corners then add **another** .001 in. to the Mod clearances shown on preceeding page. A very thin web can really expand inward toward the piston. The best thing is to have a proper Mod port job and then you can run tighter clearances. The Merc 30H "C" motor really reacts well to the tight fit *if* the water cooling, tuned exhaust and the porting is right.

You want to have your block bored at least .0002" to .0003 inch **smaller** than the calculated diameter for your piston fit on an ***unported*** block that you intend to Modify. This is so that you can Ball Hone it yourself after the porting and chamfering is done, and then cross hatch it. These last two FlexHoning operations will remove .0002 to .0003 inch.

I use the Flex-Hone and the Flex-Hone honing oil on all my cylinders. You need to use the proper oil to hold the silicone carbide residue in suspension so it can be cleaned out. You **must** clean out your cylinders with Hot soapy water ***only***. **NEVER** use a solvent like Gas, Kerosene or DeGreaser on your cylinders under any condition at any time! The solvents will only carry the carbide particles deeper into the pores of the cast iron and deposit them there before it runs out and evaporates. Then when you assemble and start your engine these particles work their way out and scratch the pistons and rings all up. This is true after any boring and honing no matter what hone is used. The only thing that should ever touch your cast iron cyl walls is Hot soapy water for cleanup, Flex-Hone Oil for honing, and Outboard Motor oil for storage and running. Not WD40, Not 3-in-1 oil, Not Lubriplate/grease and definetely Not Teflon moly products ever.

CMRS Marine has a complete inventory of the Flex-Hones and Honing oil for sale and many Auto parts places have them also.

For an "A" KG4 and "C" M30H you use a 2¼ in. dia Flex-Hone
For a "B" KG7/M20H and "D" 40 c.i. a 2½ in. dia Flex-Hone
For an "E" M58, M500 & 44XS 44 c.i. a 2½ in. dia. Flexhone
on this "E" a fresh new 2½" hone will work OK as the hones are oversized slightly.

Note the Merc 44XS is called a "D" by APBA racers

So here it is - by the numbers:

1. Determine the exact piston clearance desired for final assembly. (to four places if possible - example .0044")

2. Have the cylinders bored to a specific diameter which is .0002" smaller than your intended assembly diameter. The machinist will bore to get close and then finish hone the cyl to your spec.

3. Now I Mod port the block, chamfer the port edges and do all the modifications that are necessary.

4. Now get yourself a variable speed & reversing drill & With a 320 grit Flex-Hone I run counterclockwise in my drill in each cylinder for 15 seconds making sure that plenty of honing oil gets applied to the walls and hone I actuate the hone up and down/in and out very slowly just making sure that all the cyl wall gets honed and special attention to the port areas. Now I run clockwise in each cyl bore for 15 seconds per hole or a bit more. This removes .0001" from walls

5. Now I put a 180 * grit Flex-Hone in my drill and run it clockwise with plenty hone oil all over. This time you are doing a **crosshatch pattern** on the cyl walls with the hone by actuating the hone full in and back out about once per second while spinning the drill at a 400 RPM for 20 sec. per cyl. Look at the pattern and strive for 22 degrees from horizontal with the lines.

6. Now **wash the cyl block in the sink** with hot soapy water and do a hot rinse. Do this **several** times with a clean bath each time and do it till the bath water stays clear. Hot rinse and air blow dry, preferably with compressed air. Immediately lightly oil cylinders to prevent rust. Use Outboard oil.

7. Now I custom fit my rings with tight butt gap by cutting down oversize rings to each bore. When all the rings are cut and tested in each cyl I remove them and inspect the walls for scratches that the ring tips may have left as I put them in and out in the fitting process. *Sometimes* I re-cross hatch the cyl for 5 to 10 seconds each and then re-wash the cylinders over and over and over again to make them scratch free, perfect and *clean*.

THE EFFECT OF THIS BEARING AREA PRESSURE ON LUBRICATING OIL

The secret of course is lubricating oil and a condition that is going to permit a film between the two metals so that there is no metal to metal contact. In theory 1/10 of a micron of oil lubrication or film between two rubbing surfaces will prevent them from touching. One major oil company expert has stated that all you need is oil one molecule thick. Oil on a standard ½″ ball bearing one molecule thick and enlarged to the size of the earth would only mean oil up to the depth of your waist. However, the viscosity of the oil has been found to be very important and we now realize that we have a lot of other factors that have to be considered. Some of these factors are the blow-by that removes the oil from between the top ring and the piston wall, the pressure of the ring against the wall which squeezes the oil from the surface and heat that destroys it. There must be a film of oil between these two rubbing surfaces if we are going to prevent metal to metal contact because the moment we do have this contact then we are going to have a condition which will lead to excessive heat and possible temporary welding of one surface to another.

There is solid friction and fluid friction and there are three major features to determine the amount of each. Solid friction is the load or the amount of pressure that is placed upon the metal whether it be a ring or a bearing. Three factors in order of importance are first, the contact area which supports the load; second, the speed at which it travels; and third, the viscosity of the oil itself. Contact area, speed and lubrication. Consider the fact that oil is going to be squeezed out either by the pressure of the ring against the cylinder wall or the pressure of the connecting rod against the bearing. In order to have full film lubrication the oil must be replaced faster than what it is squeezed out. If the speed is too great or the area is too small for the load, then solid friction with accelerated wear is going to be the result. When an engine is started up from a standing stop we are going to pass through three phases of lubrication. This period of time is going to last from the time you start the engine until you see the oil pressure gauge reach its proper operating pressure. We will probably start off by having almost metal to metal contact with very little or no lubrication. Then we will have a thin film — a boundary or border-like lubrication. Then a thick film or a full film lubrication. It is very important, therefore, to have a surface that is capable of being wetted out or a surface that is going to maintain and hold a thin film of oil either when the engine is in operation or after it has stopped and is standing still. With a porous surface as you might find in some chrome cylinders or in some chrome rings, the oil will drain from the porosity whereas if you have a proper cross hatch finish with the proper valleys for oil retention the oil may remain wetted out on that surface. Viscosities of oils are an extremely important consideration at this point depending upon compression ratios, clearances, types of rings and cylinder wall surfaces, engine types, lubrications, heat of the engines, etc.

BLOW-BY

A piston on its up-stroke really acts like an air compressor. It takes all of the air that has been sucked into the cylinder on its down-stroke and compresses it to a ratio of either 8 to 1 or 22 to 1 or any range in between. This pressure gradually builds up not only on the top of the piston but also on the top of the piston ring and the pressure gets down in behind the ring and forces it outward to the cylinder. On a diesel the compression of these gases builds up heat until it reaches an ignition point and we have a resulting heat flame that in the combustion area is probably as hot, if not hotter, than an oxyacetylene torch. This instant heat, of course, expands the top of the cylinder head and piston, and the top ring and also the top part of the liner. At this point we have some distortion prior to the downward movement of the piston. If the ring is not mated or seated to the cylinder wall the greatest blow-by is going to be at this initial point of contact or **lack of contact.** Any blow-by is going to escape past the top ring, past the junction of the split in the ring (or at the horns) and the pressure is going to continue down to the second compression ring. The action there is going to be the same as with the first, where the pressure is going to get in behind the ring and force it out to the surface. There is a second danger at this point that we might suffer ring-collapse of the first ring and oil carbonization might build up between the ring and its groove which will prevent its future function and ring breakage will result. Sometimes there is so much blow-by on the first ring, that the major part of the pressure is on the second ring as we quite often see scuffing starting to develop at the second ring before we see scuffing on the first one. If these hot blow-by gases escape between the ring and the cylinder wall, then at this point any oil film that might be there is going to be burned off. When we talk about the use of the Flex-Hone™ we always say to be sure to bring the Flex-Hone™ out of the cylinder while it is still rotating, because we want to produce a uniform cross-hatch finish completely throughout the entire length of the cylinder and particularly at the top of the ring travel. This advice then becomes more apparent to you because of the utmost necessity of trying to have a plateaued finish at the top of the ring travel to eliminate as much as possible the initial blow-by with the destroying of whatever oil film might be there. The pressure of the ring to the cylinder wall is going to have a squeeze-action on whatever lubrication might have been placed there by the upward travel of the piston before its power stroke and by the connecting rod splashing or otherwise depositing oil on the cylinder wall itself. On its downward stroke the oil rings are going to scrape the oil back into the oil reservoir in the pan. The cylinder wall is cooled by the oil as the oil becomes a heat-sink. It is also going to be cooled in a wet sleeve by the water circulating around portions of the liner. The block itself is also going to be cooled by the oil going down through the oil galleries. The piston and the ring which are much hotter than the cylinder wall, are going to be cooled by the cylinder wall itself on its downward stroke and by the taking in of new air. We see that we have rapid expansion and contraction of the piston and the rings and actually the liner itself. One of the major causes of scuffing, particularly in the early running-in stages, is this initial lack of seating on a peaked finish which might be alleviated greatly by having a plateaued finish. All of this is extremely important on a new engine where a plateau might help eliminate or alleviate the start of the troubles. A peaky finish will give us less contact area for the rings themselves, thus greatly increasing the load or the pressure. Because of the lessening of this contact area we have the possibility of greater blowby thus destroying the oil film with greatly increased temperatures. This results in the rings themselves heating to a point whereby they might melt the peaked metal off the cylinder wall and weld it to the ring. **At this point we have scuffing.** Be sure to study the engine tests on the effects of finish.

The rings themselves often have to do the final honing job and remove by abrasion all the peaks from the surface of the cylinder wall. In doing this the metal is worn away, imbedding particles of this metal into the cylinder wall and sometimes into the ring. If you have chrome rings, the chrome laminate is sometimes removed from the ring face itself. The heat reaches such a temperature that instead of the metal being worn down in a normal abraded fashion by the rings, it is smeared in a plastic formation against the cylinder wall. This is evident in some of the cylinder wall surfaces that you see after a failure during a running-in process. This plastic deformation or smearing of the metal down a cylinder wall removes all of the necessary cross hatch that is needed to hold a film of oil. The rigid hone often covers up in its smearing and plowing action the very important graphite particles that are part of the cylinder wall surface. These graphite particles besides being a lubricant themselves will also hold large amounts of lubrication and the Flex-Hone™ will cut the surface finish clean and expose the graphite particles. We used to say during our very early advertising, "will allow the walls to breathe." This breathing or opening up of the surface permits oil retention and lubrication. Otherwise this plastic deformation of the cylinder wall metal and the changing of the micro sub-structure to an inferior status is compounded and additional scuffing is an inevitable result.

OTHER CONTRIBUTING FACTORS TO SCUFFING

In the early days of selling to the small engine rebuilder we used to get the comment that the Flex-Hone was great for the "Hard Spots" or the "Hot Spots". What did they mean? On an originally finished cylinder wall there might be a spot where dirt or imbedded metal (such as the torn and folded metal from heavy rigid honing) which would cause a greater spot resistance to the rings. This area would have greater heat build-up from the increased friction and the metal would expand at this point forming a "bump." Sometimes these bumps got abraded off and sometimes they just continued to get bigger, thus being just another cause of scuffing. Excessive heating caused this Hard Spot which originally was a Hot Spot, which was originally debris imbedded into the wall or a fault in the finish. Some of these spots may be eliminated by proper original honing methods as they are difficult to analyze after they have developed.

When a surface is not too rough and there is a large contact area which will hold the necessary film of oil there is always some wear that takes place between the rings and the cylinder wall. In developing a mating surface, there is a mild abrasion which at some point may cause heat build-up to a point where there may be some initial minor scuffing. If the rings bed down or seat during this initial period, then this initial scuffing may not be too serious, and may completely disappear, and providing no great damage is done, the scuffing may even heal itself.

PISTON RING TYPES

Rings of all types have been experimented with and tested in order to give the optimum contact area to the cylinder wall, to prevent the rings from sticking, and allowing them to operate freely within the ring grooves and to have the proper outward pressure caused by the expanding gasses in the power stroke. Many different shapes and surface finishes and surface treatments have been developed mainly in order to accommodate a particular engine manufacturer to overcome blow-by, excessive heat, elimination of oil film, smearing of the metal and the resulting scuffing. One car manufacturer is now working with a piston ring manufacturer to develop a ring design that would reduce the outward ring pressure to 50% or less in order to reduce the problems that we have been discussing. Along with ring design different component expansions must be taken into consideration. As for an example when using aluminum pistons in a cast iron block, it is important to determine the proper cold clearance between pistons and bore. Perhaps, as an example, the cold clearance should be .005 inches in order to insure a reliable hot clearance of .0007 for minimum blow-by. Rings in their upwards and downwards travel tend to become worn off and have a barrel-shaped surface so a popular ring today is one that is made in that configuration in an attempt to prevent this initial wear on the ring, and its subsequent damage to the cylinder walls. Rings are chromed, they are treated with molybdenum, the cylinder walls themselves are chemically treated by Nitriding and other hardness treatments — and cylinder walls are chromed. So far all of these are still in the great stage of experimentation and development and many new innovations will continue to be introduced as the years go by. In the midst of all this activity and research work that is going on with ring development and cylinder wall preparation, I believe that the Flex-Hone™ has arrived at just the right time. As a plateau developing tool, the Flex-Hone™ is something that there is an immediate great need of.

ADDITIONAL PROBLEMS CAUSED BY SCUFFING

There is general agreement that scuffing is a running-in problem. The damaged surfaces have quite often been associated with the appearance of a white layer. This white layer is noticeable in both steels and cast irons and this white layer usually forms not only during the running-in but generally increases in coverage over the surface prior to the formation of an oxide which seems to take place towards the end of the running-in process. This white layer has been studied and although the researchers do not know exactly how it forms, it seems to be a carbide structure. Almost always this white layer didn't form immediately, but was preceeded by a plastic flow of the surface, which deforms the subsurface structure, and causes hardening and other transformations of the metal structure itself. This hardened surface layer usually oxidizes, and after wear would eventually disappear off the surface. This white layer also appeared on piston rings, and the heat affected microstructure would extend in depth up to about 10 microns with about 10 microns on the cylinder wall. The white layer, as we stated, seemed to be a carbide in a very small crystal size which seemed to be a product of the deformation of the metal together with high friction temperatures. It is usually produced under unlubricated conditions with very high temperatures. It is very hard and brittle and eventually will spall from the surface to form an abrasive-wear debris, and seems to be the result of and not the cause of scuffing. Graphite which is present in cast iron in different forms reduces the coefficiency of friction and actually to quite an extent, resists scuffing, and after the oxide film is formed these graphite particles also form areas which will retain and hold oil.

SOLUTIONS

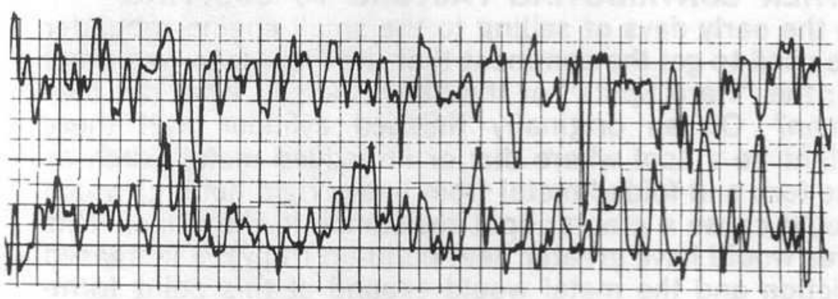
There are many, many reasons for engine failure, breakdown, scuffing, or for the local breakdown of oil film, and almost any engineer can give you up to 50 reasons that may be contributing factors. This is mentioned because we don't want you to get the idea that we feel that everything is going to depend upon cylinder wall finish because it does not. One of the prime causes, of course, is poor surface finish of the bore. Then we have many other causes such as the wrong design of rings, overheating, distortion of the rings, the pistons, the top of the cylinder; incorrect use of oil, or the wrong viscosity of the oil; improper fuel mixtures, carbonizing or sticking of the rings themselves; ring collapse or breakage; improper cooling or water distribution in the cylinder block; incorrect oil galleries which also should aid in the cooling; improper oiling from the connecting rod itself into the cylinder wall: incorrect fuel, valve clearances, fuel mixtures. Any or all of these may be at fault. The one thing that the Flex-Hone can do and that is possibly to assist in one of these areas, which is to improve a poor surface finish that might be the major initial contributing fault.

Let's go back to diamond honing which we agreed is an excellent means of bringing a bore to its proper size, but it is an operation that must be very carefully controlled. It must be a suitable honing procedure, stones must be straight and dressed or it's going to produce totally unsuitable surfaces. Follow this, however, with a secondary honing method that is going to remove the peaks and establish a plateaued finish, the FlexHone may correct a lot of the problems that we have just discussed and which contribute to piston ring scuffing and engine failure. Many piston rings have been made with hardened rough surfaces in order to do the final honing, and perhaps if a plateaued finish were developed these very hard and abrasive surfaces might not be necessary, as they might also contribute to the harm. We will show at the bottom of this paragraph a profile of a molybdenum ring in its new state. We have included in this booklet the Korody-Colyer test report and our own four stage engine test-runs. The profile of the ring that was used after 10 hours of running, (below) shows what happens to a ring when it is subjected to this severe running-in process of bedding down on a peaked surface. So it is altogether possible that a different type of ring may be more suitable on a Flex-Hone plateaued finish than the ring best suited for the "unacceptable finish" which is all too common today. Standard cast iron rings have been found to be excellent with a scuff resistance somewhere between the chromium and the molybdenum and it might be interesting for you to measure the before-and-after ring gap difference between operations over an equivalent number of miles when running on an unacceptable finish versus an acceptable plateaued finish.

THE PLATEAUED FINISH

VARIANCES OF PRESSURE ON A BEARING SURFACE DUE TO FINISH

Whether we are considering surface finish on the piston ring or the cylinder wall or for that matter the main bearings of an engine, we do have two pieces of metal in contact, working under pressure. As neither of these two surfaces is completely smooth we must first realize that we will have a certain amount of interlocking.



We would first like to bring to your attention the differences in the bearing pressure on different percentages of plateau on one square inch or one square centimeter of two contacting surfaces. In the first illustration we do have in theory two completely flat surfaces and on the top of number 1 let us assume that we have 500 pounds of pressure so that we have 500 pounds per square inch pressure on the lower surface.

If we have for example an 80% plateaued area then we will have a surface pressure of 625 pounds per square inch.

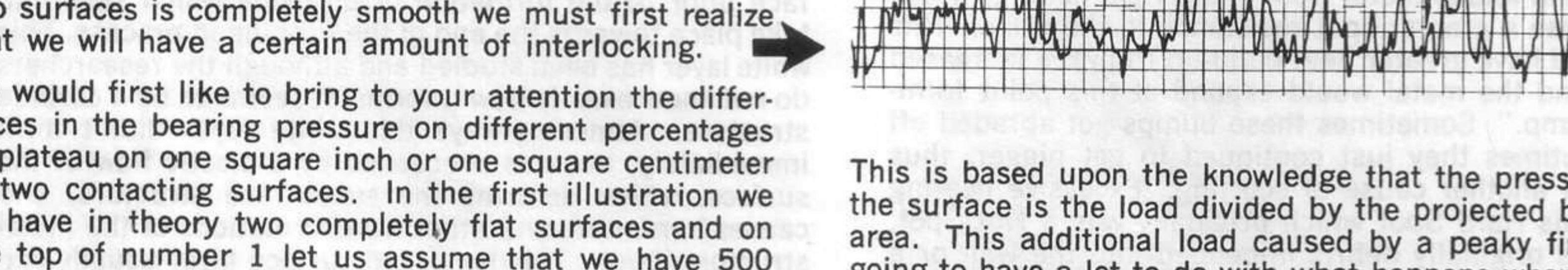
With a 40% plateau the 500 pounds pressure will now increase to 1,250 pounds per square inch.

With a 10% plateaued area, such as we would find in an extremely peaked surface, then the bearing area is 1/10 which increases the pressure of the contacting surfaces up to 5,000 pounds per square inch.

This is based upon the knowledge that the pressure on the surface is the load divided by the projected bearing area. This additional load caused by a peaky finish is going to have a lot to do with what happens when these two metal surfaces start rubbing together.

A diesel engine in a small boat proceeding at 15 knots is going to have piston rings that exceed speeds of 30 miles per hour within their stroke. They are going to stop and start an average of 4,000 times a minute, and during an hour of running time are going to be dragged across the cylinder surface a distance of about 19 miles. A mental realization of this will emphasize the importance of the surface finish that is needed on a cylinder wall when you think of the punishment that the piston ring is going to be subjected to in the first hour of running on a cylinder that may have a peaked finish.

500 lbs. sq. in. | 500 lbs. sq. in. | 500 lbs. sq. in. | 500 lbs. sq. in.

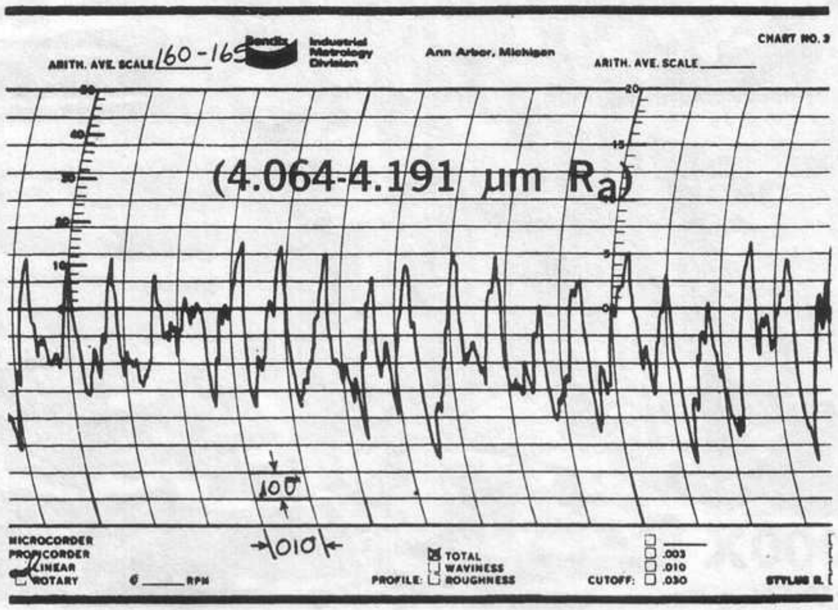


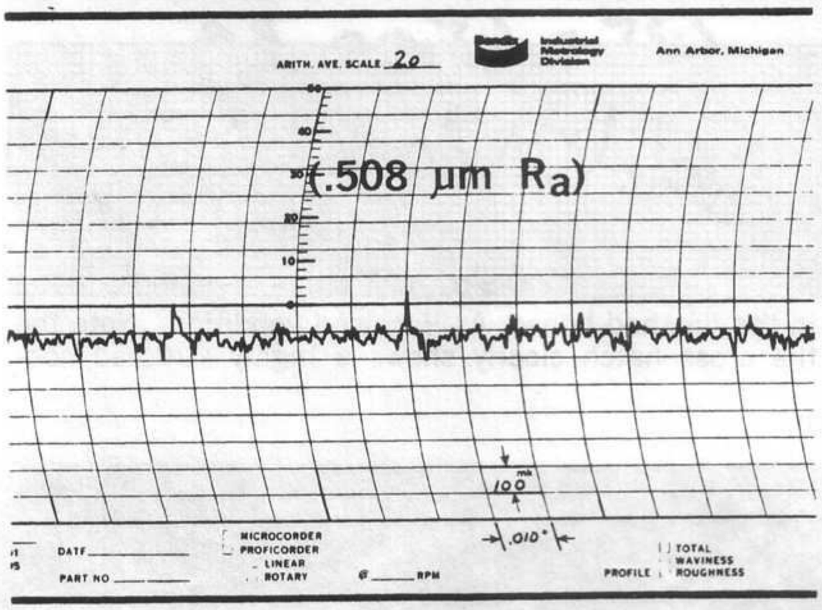
100% CONTACT
500 lbs. sq. in.

80%
Approx. plateau area
625 lbs. sq. in.

40%
Approx. plateau area
1250 lbs. sq. in.

10%
Approx. plateau area
5000 lbs. sq. in. pressure





The cylinder wall profile on the left is a newly bored cylinder wall with a finish of 160-165 Arithmetic Average. (175-180 RMS) Note the fine cutting tool marks with the helical path of the boring bar. — Some boring tools plow a furrow rather than cutting a chip — and we will go into this later in this report.

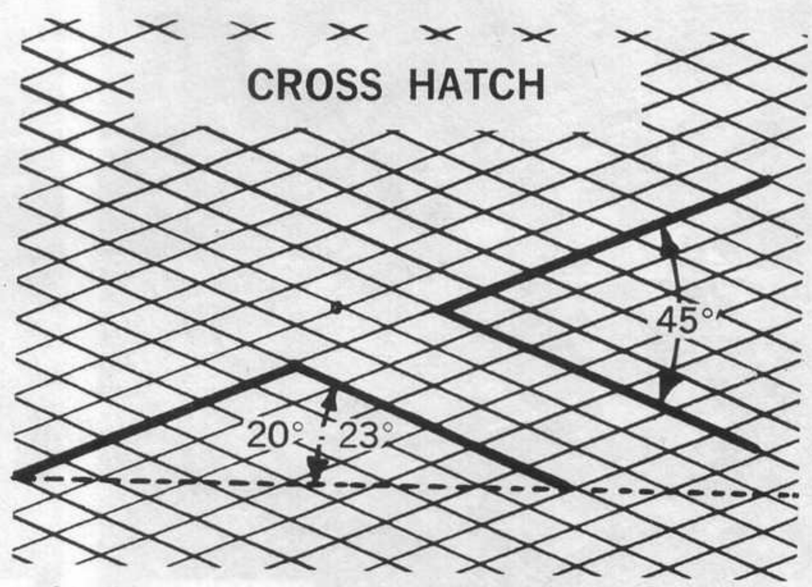
WHERE ARE THE PLATEAUS WE NEED? They are not there. There is a lot of proud metal sticking up — that friable material they used to talk about that was desirable for the piston rings to wear down before the rings would seat. Now

with a 120 grit silicon carbide on a newly bored cylinder that had a finish reading of 160 to 165 AA. It took the Flex-Hone 60 seconds to cut the tops off the metal

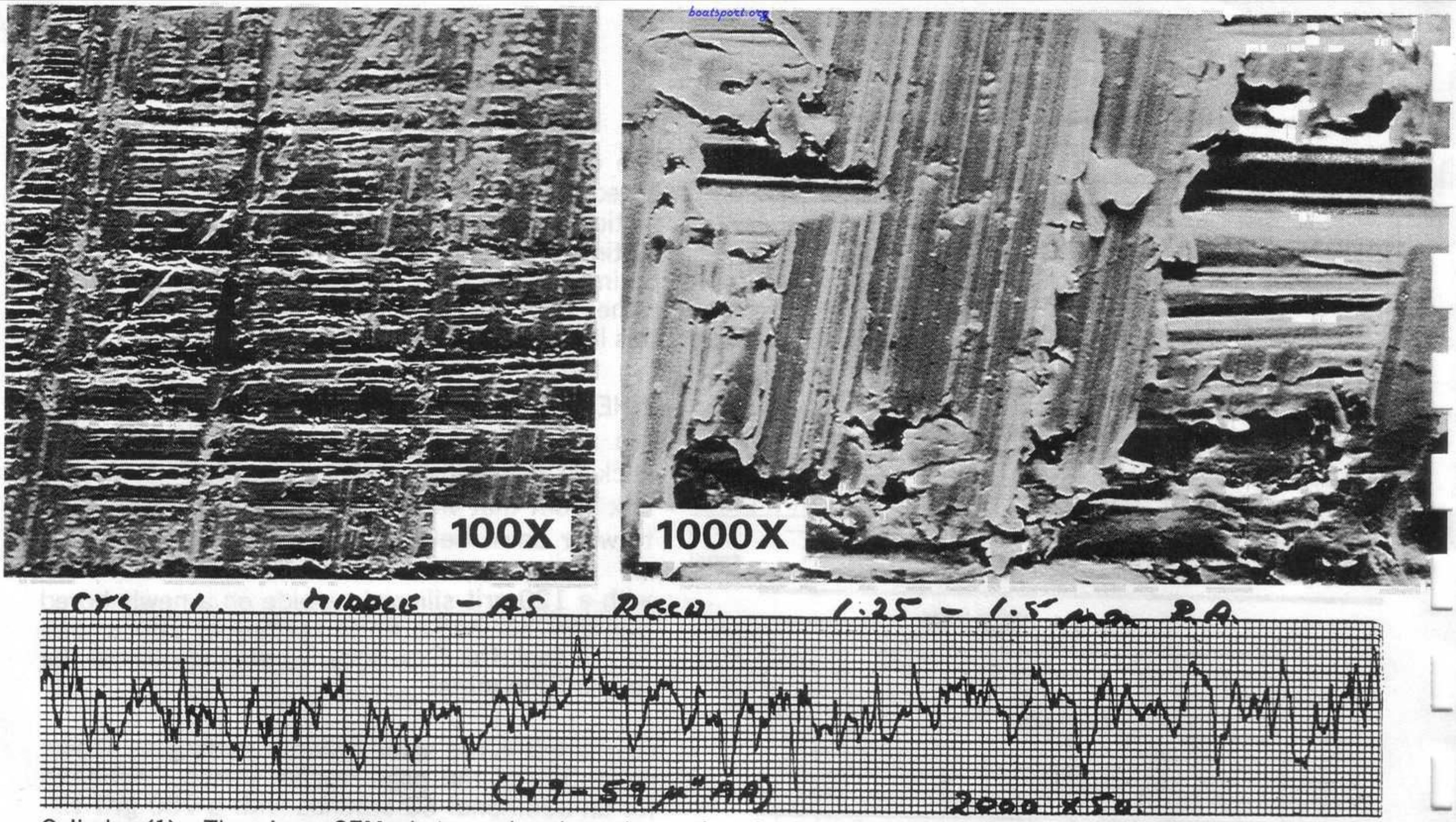
On the left is the same cylinder surface as shown at the top of the page, except it was FlexHoned for an additional 60 seconds with a 180 grit silicon carbide. You can see that the finish was reduced from 22 to 15AA in the 60 seconds. We still have the Plateaus and the Valleys for oil retention. But finer or smaller.

Why have a radius on the ring edges, caused by forcing the rings to do the final honing job? The FlexHone does it better and faster — creates the plateaus which allows the rings to seat. That is why ALL the users of our new hone say, INSTANT RING SEATING. We say, now, "almost

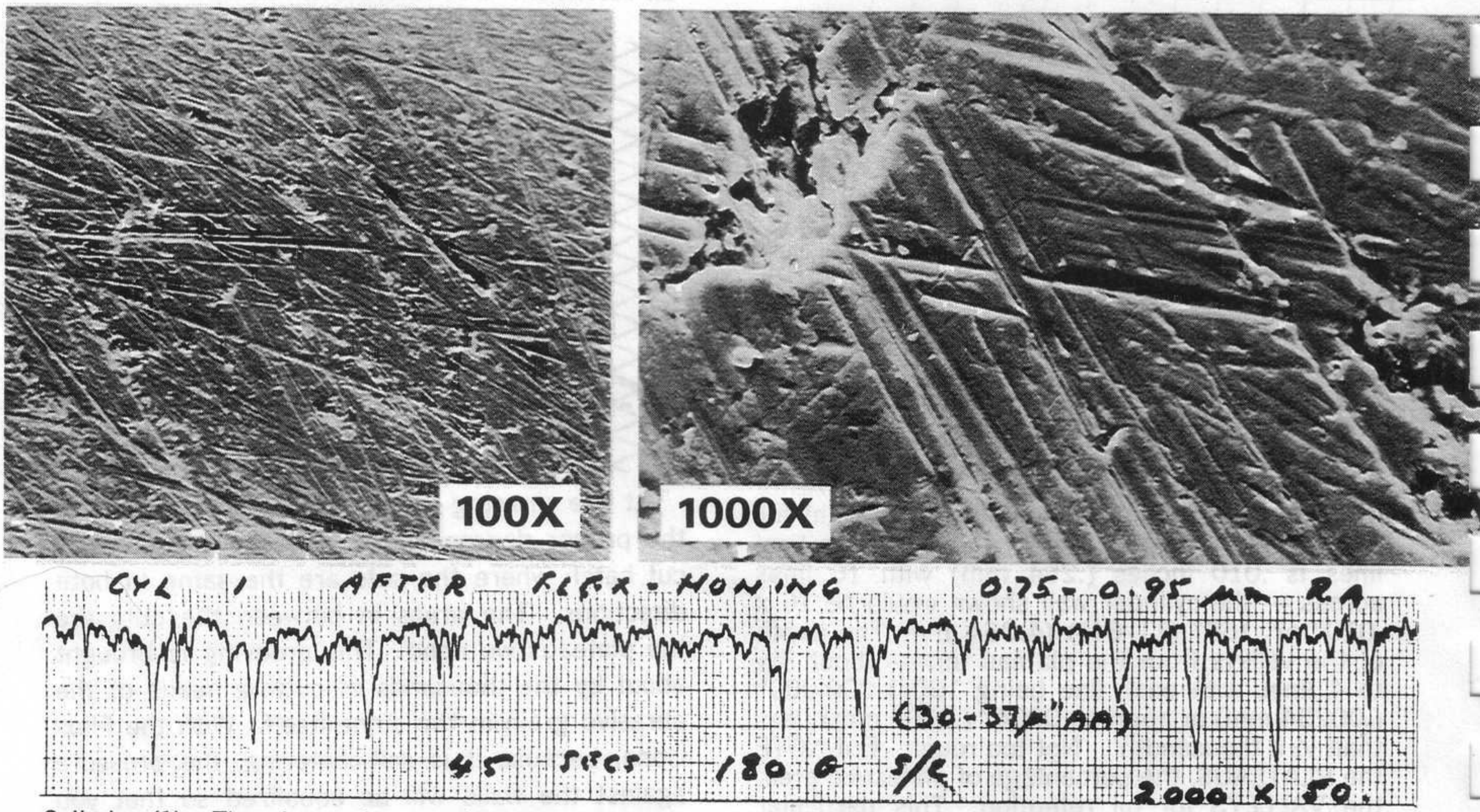
This is a profile of a cast iron cylinder taken on a Bendix Proficorder with a diamond stylus with an accuracy of .0000005" (.0000127 mm) per inch. The roughness reading of 22 is the Arithmetic Average or about 25 RMS. About right for the average engine. Distance between vertical lines is .010 inches (.254 mm) with 16 lines across — the cylinder wall shown would be 16 x .010" or .160" (11/64") (4.064 mm).The depth of the valleys from the plateau top — about 3½ to 4 lines with each line being 100/1,000,000" (.00254 mm) or approx. .0004" (.0102 mm) (less than ½ a thousandth". Not too rough. But NOTE the PLATEAUS, the percentage of plateaued area, the VALLEYS for oil retention. This particular finish was obtained by using the FLEX-HONE™



At the drawing on the above are marked in the proper degree angles and shows an evenly cut hatch where the cuts are the same in both directions. The areas in between the cuts are the plateaus we need. This grooving is brought about by the thousands of cutting heads of the abrasive grain in the stone itself. With the Flex-Hone, because it is self-centering, the pressure against the walls will be equalized so that you have no worry about even cuts in both directions.



Cylinder (1). The above SEM photographs show the surface in the finished honed, As Received condition. Note the degree of smeared, torn and folded metal. The intersection of the cross hatch clearly shows a highly stressed condition.
The profile of this cylinder shows a "peaky saw tooth" finish.



Cylinder (1). The above photographs show the surface of this cylinder after FLEX-HONING. Note that the surface is now largely free of smeared, torn and folded metal. Especially note that the intersections of the cross hatching have been stress relieved. The surface has also been "opened up" in that the graphite grains on or close to the surface have been revealed rather than smeared over.
The profile of the surface shows quite clearly that FLEX-HONING has provided an excellent "plateau".

Piston ring fitting

After putting a number of hours on a new ring job it gets *tired* and compression is down. Part of the reason for this is that the ring butt gap has opened up. You need to custom fit rings for maximum compression and longevity.
This means that you should get the next size **oversize** rings and custom cut them down to fit. You can take up to +.015 in. oversize rings and cut them down and they will still be round and fit a standard bore very well. Larger than .015" oversize rings start to go away fast and will not be round in the smaller diameter bore. This is true for bore diameters up to 2½ inches more or less.
Merc standard bore rings in standard bore cylinders will have a butt gap of .012" to .014 in. when **new**. This is **not** satisfactory for racing.
There are a lot of factors which influence minimum butt clearance. Compression ratio in the Mercs is a factor only if you have welded in cyl head padding. Whether or not you are running factory closed exhaust and how good the cooling system design is on that particular block. Whether you are using tuned exhaust, megaphones or expansion chamber? Have you water cooled the exhaust filler block on your tuned system? All these will determine your minimum butt gap to a very wide degree. There are other variations brought about by things like is your water jacket all full of crap that is plastered on the aluminum cylinders or your water pump half shot? If you fit rings tight then **everything** has to be perfect! Especially the cyl bore has to be perfectly straight. If not you will be forced to fit the minimum clearance at the point where the bore is smallest. A tapered or egged bore causes the rings to dance in the grooves, the tips opening and closing .006 in or more. NOT good.
You cannot fit as tight with engines running factory closed up exhaust, especially where you have engine exhaust running over/against areas on the crankcase/block that are not protected by a water jacket. Everything gets HOT and rings can't dump off heat and they expand more. Case in point the old Mark 40H "D" Merc four cylinder motor. The bottom two cylinders should have several thousands **more** butt gap than the top two cyls due to the setup on the exhaust. The **Hurricane** Mark 20H cylinder on a closed up exhaust setup will go with a tighter butt gap than earlier 20H blocks due to the extra water jacket under the bottom cylinder. The older the KG7 block is, the less water jacket it has under

the bottom cylinder and the hotter that bottom cylinder will get. It needs more butt gap than the top if you decide to fit them tighter than the factory does. That's why Merc has .012 gap on stock rings, to cover worst case situations. On Mod engines the exhaust heat is a factor in the (tuned exhaust) filler block. Is it water cooled or not? The CMRS built Mod "C" Mark 30H with a water cooled filler block will easily accept a .003" piston clearance and a .003 in. butt gap on the bottom and second ring. I go for .0035" on the top ring butt gap. I add .001 inch to those numbers for a CMRS "D" engine. Everything has to be perfect to get down that close and not have trouble. It is possible to fit tighter than this but the break in gets really difficult.

To cut down an oversize ring you need some special files:
A small flat file #2 or #4 cut with a nice little handle.
A pillar or equalling file with no cut sides, # 2 cut.
A .093 inch round file which has a fine cut.
A round needle file about .113" Dia. and tapering to a point, with a #2 cut.
A small set of hone stones both round and flat.
The butts must meet squarely and touch with no daylite showing. This takes practice, so use some old worn out rings at first. Check the ring in the bore to see how much too big it really is. Set up a small vice with wood or copper jaw protectors. Set the ring in the vice as in fig. 1. You must file the ring so that the ends will meet when the ring is compressed. This is a line perpendicular to the chord of the ring (when compressed). Take only a few strokes at a time and check the progress, both in the bore and butt alignment. I alternate between ring tips taking them down evenly as I go, not worrying about the pin cut at this point. Before you insert the ring into the bore each time after you make a cut you should take the hone stone and knock off the burr. See fig. 2. If you don't you will scratch the bore every time you insert the ring. Just one lite stroke will do the job. As you get closer you are shooting for zero butt clearance with the butt ends perfectly aligned. Once you have all the rings cut to zero you can go back and do the proper pin cut. Lastly you can finish the job by cutting the rings to the exact clearance desired. This is a one stroke at a time process at the end. I use paper envelopes and mark them for cyl # 1, top ring groove, etc. Each ring gets an envelope to keep track. You really need a fine cut file to do this last touch. I set the ring into the bore and square it up. It is

hard to get the shim guage into the crack of the butts, so I usually push the ring downward in the cyl on the opposite side from the butts. This opens up the butts a little and you can get the shim in there. Then bring the ring back up horizontal and test whether the shim blade gets stuck in the crack, whether it is just snug, or whether it falls out loose. In this last case try a thicker shim. This will tell you within half a thousands what the butt gap really is. When you are finished put the ring back in its envelope so that you know where it will go later on.
We'll go back a little and discuss the pin cuts. The Mercs all have an "internal pin". The APBA stockers are "stuck" with having to use only Merc rings but the Mods can use any brand. The Hastings and other rings are sometimes available in oversizes with No pin cuts. To start a pin cut on a fresh ring you can use a small flat file or even better a pillar file. See fig.3. A pillar or equalling file will start a square cut and the dead no-cut side will keep it from cutting in two directions at once. As soon as you have a small notch started you can switch to a small round file to finish the pin cut (quarter circle). You **want** a radius in the pin cut for strength. When the pin cut is the correct size to give you full clearance all aound the ring pin then stone all the burrs off with a tiny round pointy stone. Hastings rings and the last few years of Merc 44 c.i. rings all have a small radius in the pin cuts. The good old Merc rings of the 50's, 60's and early 70's all had a larger radius in the pin cut. These also had distinct "break-in grooves" in the ring face and these "white tin coated" babies were the best rings ever made.
There are almost no rings available for the A-B-C-D Mercs at this point. See CMRS Ad for availability. If anyone has a large number for sale call me!

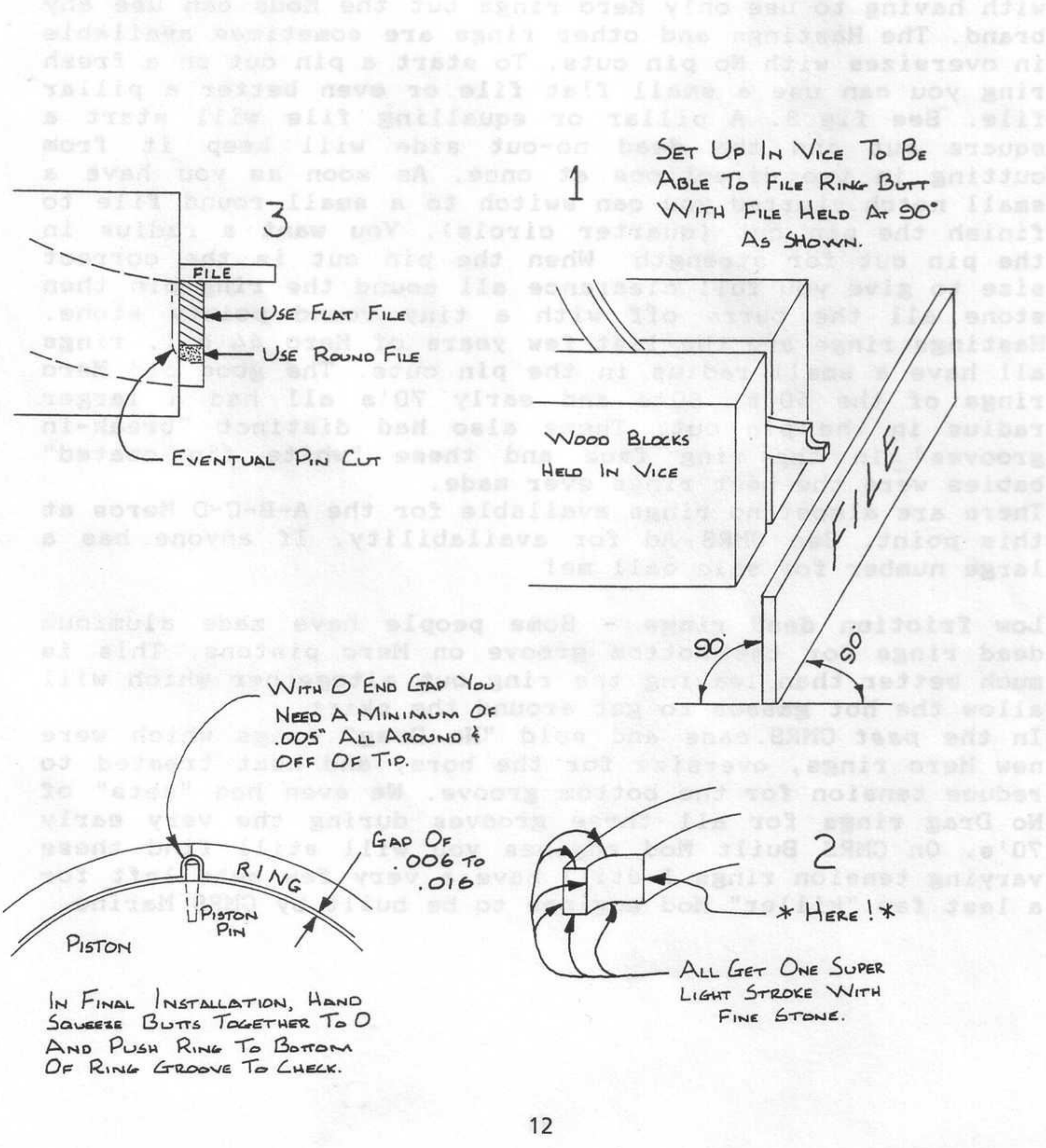
Low friction dead rings - Some people have made aluminum dead rings for the bottom groove on Merc pistons. This is much better than leaving the ring out altogether which will allow the hot gasses to get around the skirt.
In the *past* CMRS made and sold "No Drag" rings which were new Merc rings, oversize for the bore, and heat treated to reduce tension for the bottom groove. We even had "sets" of No Drag rings for all three grooves during the very early 70's. On CMRS Built Mod engines you will still find these varying tension rings I still have a very few sets left for a last few "killer" Mod engines to be built by CMRS Marine.

Ring Butt gap chart

Piston Ring Groove	Stock Merc closed up A/C	B/D	44	Mod with stacks hot Filler Block A/C	B/D	44c.i.	Mod with water cooled F.B. A/C	B/D	44ci
TOP	.005	.006	.007	.004	.005	.006 in.	.003½	.004	.005
2nd	.004	.005	.006	.003½	.004	.005 in.	.003	.003	.004
BOT	.004	.005	.006	.003	.003	.004 in.	.003	.003	.003

This is just a general info chart. If you are not sure what you're doing, add a couple thousands to each number. If you are positive that you know what you are doing, try less. It can be done if you and everything are perfect.

Piston Ring Filing And Fitting



ROD HONING CLEARANCES

Here is a very basic way to make sure you get the performance you want from your Mercury Outboard motor. This applies to 4 cylinder Merc Mark 30,55 & 58's, C & D Mods as well as the stock Merc D 44XS & Merc 500 motors. In the 1950's the Merc crankshaft Rod journal diameters were at least .001 to .002 in. dia. smaller than most of the crank diameters of the 70's and 80's. ***IF*** you have a powerhead made after 1958 or someone has installed a later style crankshaft in your old powerhead, you might have a problem, because the bearings and rod i.d.'s have remained **the same**. This results in a pretty tight fit. Your Merc **will not** easily attain the high RPM needed for racing. This tight fit will give you the following results: Blue heat marking the journals and the rod overheating, a big loss of **RPM** in the racing ranges, and a quieter running motor.....

There are several ways to measure the rod/crank fit. Here is mine. Refer to the drawing.
With the bearings in place and the rod on the journal tighten and torque the rod nuts to 180 in. lbs. Put the crank on a flat surface lying horrizontal with the rod/journal -to be measured- up a bit and free of the table surface.Place the rod horizontally in the center of the journal so it doesn't touch either side and rides free of everything. The small end of the rod now can be moved in a left/right direction just a bit. Measure the full left to full right position movement (wobble). at the very top edge of the rods machined surface.The big end of the rod needs to remain centered on the journal while you wobble the small end. Don't allow the big end to slide or shift left right when you move the small end and measure the travel. You can use a dial indicator or even a machinist rule. Your observation will be from .040 in.total movement on a tight setup, up to more than .125 in. for a slightly worn 1950's setup. The bulk of the **stock outboard** new 44XS motors will be on the tight end unless worked over by an expert.
The best measurement I can suggest is .095 in. total wobble or 3/32 as measured on a rule. Anything much tighter will hurt your racing RPM and anything larger will start hurting performance also, but to a lesser degree.
Keep in mind your rod journal end i.d. also has to be **round**,

not egg shaped. I start out by measuring all my old rods, grouping them into batches with approximately the same diameters and amount of surface wear. They will need about the same amount of honing to correct egging and get back to a smooth finish. On egged rods use the ***Max*** O.D. for your grouping measurement. Every rod in each set should be honed to the same diameter,that diameter being the one that will **just** clean up the **worst** rod in the set. From this point you select the rod **set** that is closest to the proper fit for your particular crankshaft. A final honing might be in order to bring a set into proper tolerance. A machine shop sunnen hone setup is the proper place to do your honing for you. I **don't reccommend** any home brewed methods.

To give you a starting point for rod I.D. and crank journal O.D. relationship the following:

Shoot for about .2556 in. difference to get you into the ballpark for a .095 in. wobble. It doesn't **always** come out right but it is very close most of the time. Come at it slowly so as not to make the rod I.D. too large. Even .0001 in. difference can change the wobble quite a bit so ***be careful!***

Ballpark Examples:

ROD I.D.	JOURNAL O.D.	WOBBLE
1.1378 in.	.8821 in.	.095 in.
1.1379 in.	.8824 in.	.090 in.
1.1369 in.	.880 in.	.120 in.

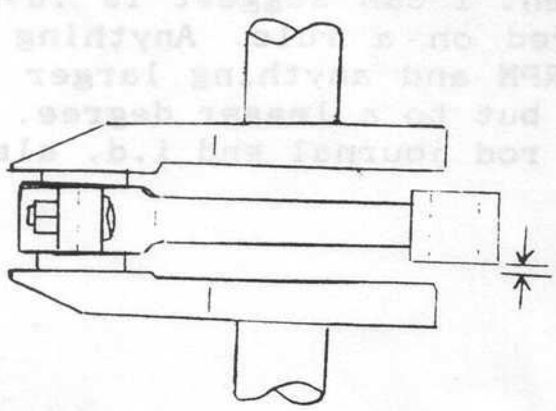
4 CYL Merc Crankshaft journal diameters

Late style, big taper + thicker top cheek	.8821 to .8827
Mid years big taper 4 cylinder crankshafts	.8814 to .8818
Old original small taper 4 cyl crankshafts	.8794 to .8795

Connecting Rods big end inner diameters

Most all rods when new start at 1.1364 inch +-.0002

Use diameters to get you close and then go to wobble for exact clearancing. This is just **one** of the many small but important engine building tricks that apply to stock & Mod.



For the older 1950's Mercs

When you have an old crankshaft and an egged/worn rod combination, the side wobble will be considerably more than the original .125 inch plus that it had when new. Much more than .125 in. is not great for Modified **racing** but will probably run just fine at regular RPMs.
You might try to replace your worn out rods with some old style rods that are in better shape. Racers like myself usually have some of the old hole end rods lying around.

The ideal .095 side wobble can only be achieved by using a later model crank with larger journals; and .125 in. wobble is still within racing parameters.
The larger wobbles will not hurt you near as bad as the too small wobble.

Keep in mind that the hole-end rods are lighter, older and weaker than the newer style 1960's and 70's rods. They might break/destruct in a Mod motor and so I don't use them there. I wouldn't worry about them in a regular light load lower RPM application.

If I were to use a set of the hole-end rods, I would want to bevel/chamfer and radius the inside edges of the oil holes in the big end of each rod. If you will notice the rollers on some of these setups, they are scored up pretty badly. The sharp edges of those oil holes ***eat up*** bearings. If you should have a set of these rods honed then you ***MUST*** take the sharp edges off those oil holes inside the rod.

I have never done the measurements and wobble on the KG motors with the old rods. They all seem to be really loose and there were no new cranks to worry about for the KG-4, KG-7 & KG-9 anyway. With a slight bit of work you could probably use a new 1950's or early 60's crank in a Mark 40; although I haven't tried it myself.

I always like to use new rod nuts each time I assemble a motor and always follow the torque readings in the Merc manual.

Mercury Motor blocks

4 Cyl Block 40 c.i.	**Model Number**	**Serial # info** *begins with*
Mark 50	800-8 A2	
Mark 55H Old original	808-325 1955-#8__ 1956-#9__ 1957-#10__	
Mark 55 E&L	808-325 A3, 808-1321 A2, 808-1321 A3	
Mark 35A, Merc 300, & Merc 350	808-1321 A4	small carbs
Mark 55H later style	808-1320, 808-1137	

4 Cyl Block 30 c.i.	
Mark 30, Mark 30H	821-1315 (2 port), 821-1012 (4 port)

4 Cyl Block 44 c.i.		
Mark 55 A , Mark 58	831-1410 A5 (both), 831-1866 (Mk58)	
Merc 500, Merc 44XS	863-8981 A6	lost-foam cast block
	other numbers	*for Merc 500 N/A*

Class C 30H - The main factor in whether a particular model new motor block was faster than another model was, how many C.C.s does it measure at TDC in the combustion chamber? Both the 1012 and the 1315 blocks had **some** factory casting runs that had much lower C.C.s than same model blocks run at different periods. The machining and bore quality on all these die cast blocks was very good. The tiny differences in port timing wouldn't account for much. There were other differences in the casting shape around the intake and exhaust ports, but the lower C.C.s (cubic centimeters volume of the combustion chamber at top dead center) had to be the difference for stock racers and this was **absolutely** true for Modified motors. The 4 intake port cover style block has much less "meat" in the aluminum casting around the ports and you can not modify them as much as the two port blocks.

Class D 55H - Stock racers found that the old Mark 55 pleasure block with the lower port timing was just as good or better than the 55H that has .060 in. higher ports. Some of the reasons were probably hand picked low C.C. blocks and heavy runabouts responded to the lower RPM powerband of the lower ports. This is also true in Modified engines. Again the older 4 port blocks had less material surrounding the ports and you cannot remove as much aluminum as you can on later style 2 port blocks. In Mod I would choose the round port (.625 in.) model pleasure block with low ports. Of course you have to enlarge/widen the (smaller carb) intake manifold, remove the small carb studs and fill the holes with aluminum studs and then re-locate larger 5/16 in. studs to match the larger KA Tillotson carbs.

44 Cubic inch - The Mark 58 blocks responded well to Modifications and I can't tell you if or how much better the Merc 500 style block is. The Merc 44XS stock racer block has about 4 cu. in. extra cooling water capacity than all of the older styles and some of the extra room is right down around the ports and nearby cylinder walls where it belongs. It has to make a bit more H.P. than a comparable setup on a Mark 58 block. All models of the 500 style blocks have a bit better water cooling system setup than the Mark 58. The updated exhaust splitter plate and inner tuned exhaust tube on late model Merc 500's was an improvement for sure on the closed up exhaust motors, including the 44XS race motor. Just how good is the Merc stock 44XS with this partially tuned exhaust? A good CMRS MOD 44 hydro has about 4 MPH top end over the best 44XS Stock hydroplane and half way thru the turn the MOD will blow it away.

Two Cylinder Mercs

I don't have the kind of info for a chart like four cylinder motors above.
Generally the older the 20 c.i. (KE,KF,KG,20H) cylinders, the more primitive the block and motor. Tiny exhaust ports and two reeds per cylinder on the KE7; and the block had little water jacket cooling under the bottom cylinder to protect it from the exhaust gasses in the exhaust downhousing. The later the block, the better the water jacket covered on the bottom cylinder underneath. The late model replacement **Mark 20H "Hurricane" blocks** had the most extensive water jacket of all, but since the blocks went onto Conversion 20H's with seperate tuned exhausts, the benefit was not as great as it would be on a closed up downhousing setup.

Water outlets
I recommend that you install two outlet fittings on the top of any hi performance motor block (water jacket) for extra cooling. **DO NOT** vent any extra water out below this point.

Porting for performance

There are two major factors involved in porting Mercury Outboard motor blocks. Port width and port shape. The shape of the top of the port has to do with the duration of the sound wave generated by escaping gasses as the port is just being barely uncovered by the top edge of the piston on its way down. If the port is round, the duration of the sound being made is extended. If the top is square then the duration is shorter because the gasses get out quicker, The longer the duration of the wave the wider is the powerband where you make power with the pipe. The trade off here is that the longer the duration, the weaker the wave that works the pipe. The gasses have "X" amount of energy to work with which is related to their heat content. If you "pop" them out with a wide square port, all that energy is concentrated and the wave generated is strong. If you "squish" them out with a round narrow port, you will have a wider powerband - weaker wave in the pipe.
The cross flow, deflector Mercs seem to need the **strong** wave that generates the low pressure (negative) that pulls the air thru the engine; and, since the pressure period (positive) is a **secondary** wave, initial strength is necessary to have *anything* left in this *secondary* function.
For a good fast powerful Modified engine you **do not** have to raise the port timing. You just make the exhaust ports wider without thinning the webs. You **do not** have to modify the intake ports. When porting C&D exhaust ports I find the widest point near center on each side of each web (fig. 1) and then **back off** .005" to .010" from those points when squaring up the port, making the web very healthy. On the 44 c.i. and other 5/8" round port blocks I find the narrowest point on the web, back off .012" to .020" and square up on that line. If you clean up the web on both sides at its narrowest points then the web is **too thin**. It will cause you trouble because it cannot dump off heat fast enough.

CMRS uses a ¼ in. dia. milling cutter in the vertical mill to do most of the port work. It leaves a 1/8th in. radius in all corners which is minimum acceptable. You **do not** want a true square corner port as made with a square file *like we all did in 1965*. The heat buildup is bad news, the cylinder won't stay as round and a square hole doesn't flow well.
Bottoms of exhaust ports are important also. When the piston is at top dead center of its stroke the bottom exhaust side

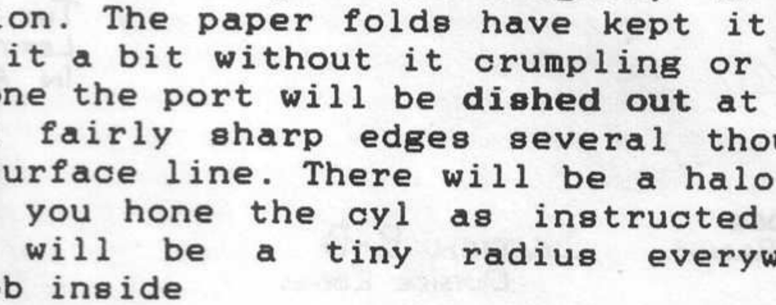
of the piston skirt can **UN cover** the port and open up the crankcase via the bottom outside edges of the two outside exhaust ports. This is why the 30H Mercury has the two shortened up exhaust ports. When you square out the bottoms of the exhaust ports you can uncover the crankcase at TDC, especially if you widen these ports and especially on the 44 c.i. and 25 Mod Mercs. **For this reason** CMRS Marine port Jobs employ an angle cut on the bottoms so that this does not occur. I **have** built good fast C engines with square bottom exhaust ports that uncovered the crankcase, so this is one of those areas where you can make your own choice and it may not be important, at least not on 30H's with Quincy pipes. Porting for engines with tuned exhaust pipes is different than porting improvements to engines that will be running closed up. Additionally some of the "closed up" engines like the Merc500 employ **a splitter plate** sandwiched between the outer exhaust cover plate and the motor block **and** even a tuned tube that runs down into the motor leg. Each situation takes a different treatment on the porting to take maximum advantage of the situation without introducing negative factors. The porting illustrations to follow are of a basic nature but they contain most of the things to give you performance and still keep you out of trouble.

Port jobs done by CMRS **will** have slight differences and *nuances* of angles and additional flowing and radiusing from the drawings. This is leading edge technology which will probably be in the **next** manual.
When widening ports you have the danger of busting thru the block wall into the water jacket, so don't go any further than measurements given. There always **is** the possibility of going thru anyway in a slightly defective casting. I **always** bead blast out the water jackets on blocks and measure with a special tool down inside the jacket, across the port area. The overall width across the port area casting down inside will give you a good idea of how thick the outside walls are, and how much you can widen them. On the 4 cylinder motors, the later model two *intake* port covers style blocks on the C & D motors have thicker walls to work with. The older style four port covers blocks have barely enough wall thickness to do a **full** Mod port job as depicted. The two cylinder blocks seem to be even thinner in spots and **you must measure** down in the water jacket O.D. to see how much you can remove. On some 2 and 4 cyl blocks you **won't** be able to go all the way, especially on the top most Exhaust port

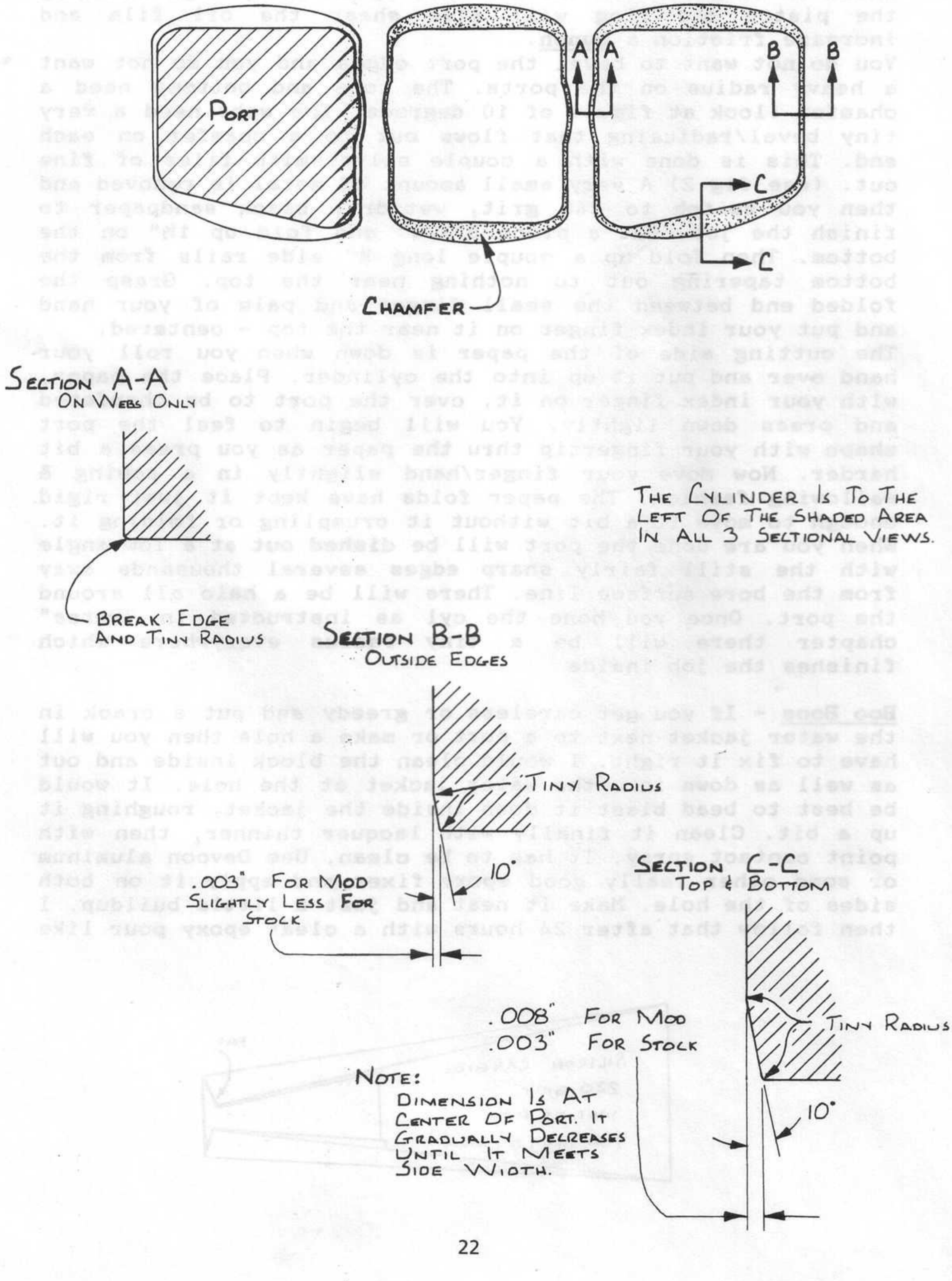
Port Chamfering

All ports in the cyl walls need chamfering, especially after a Bore job or a Mod port job. The edges are like a serrated knife. They will scratch up your rings and piston skirts which in turn scratch the new bore up. A sharp edge touching the piston and ring will also shear the oil film and increase friction a **bunch**.
You **do not** want to bevel the port edges and you do not want a heavy radius on the ports. The tops and bottoms need a chamfer (look at fig.1) of 10 degrees. The webs need a very tiny bevel/radiusing that flows out to a chamfer on each end. This is done with a couple silversmith files of fine cut. (see fig.2) A very small amount of metal is removed and then you switch to 240 grit, wet/dry, black sandpaper to finish the job. Cut a piece 8"X2¼" and fold up 1½" on the bottom. Then fold up a couple long ¼" side rails from the bottom tapering out to nothing near the top. Grasp the folded end between the small finger and palm of your hand and put your index finger on it near the top - centered.
The cutting side of the paper is down when you roll your hand over and put it up into the cylinder. Place the paper, with your index finger on it, over the port to be chamfered and press down lightly. You will begin to feel the port **shape** with your fingertip thru the paper as you press a bit harder. Now move your finger/hand slightly in a sawing & wallowing fashion. The paper folds have kept it just rigid enough to move it a bit without it crumpling or folding it. When you are done the port will be **dished out** at a low angle with the still fairly sharp edges several thousands away from the bore surface line. There will be a halo all around the port. Once you hone the cyl as instructed in "Bores" chapter there will be a tiny radius everywhere which finishes the job inside

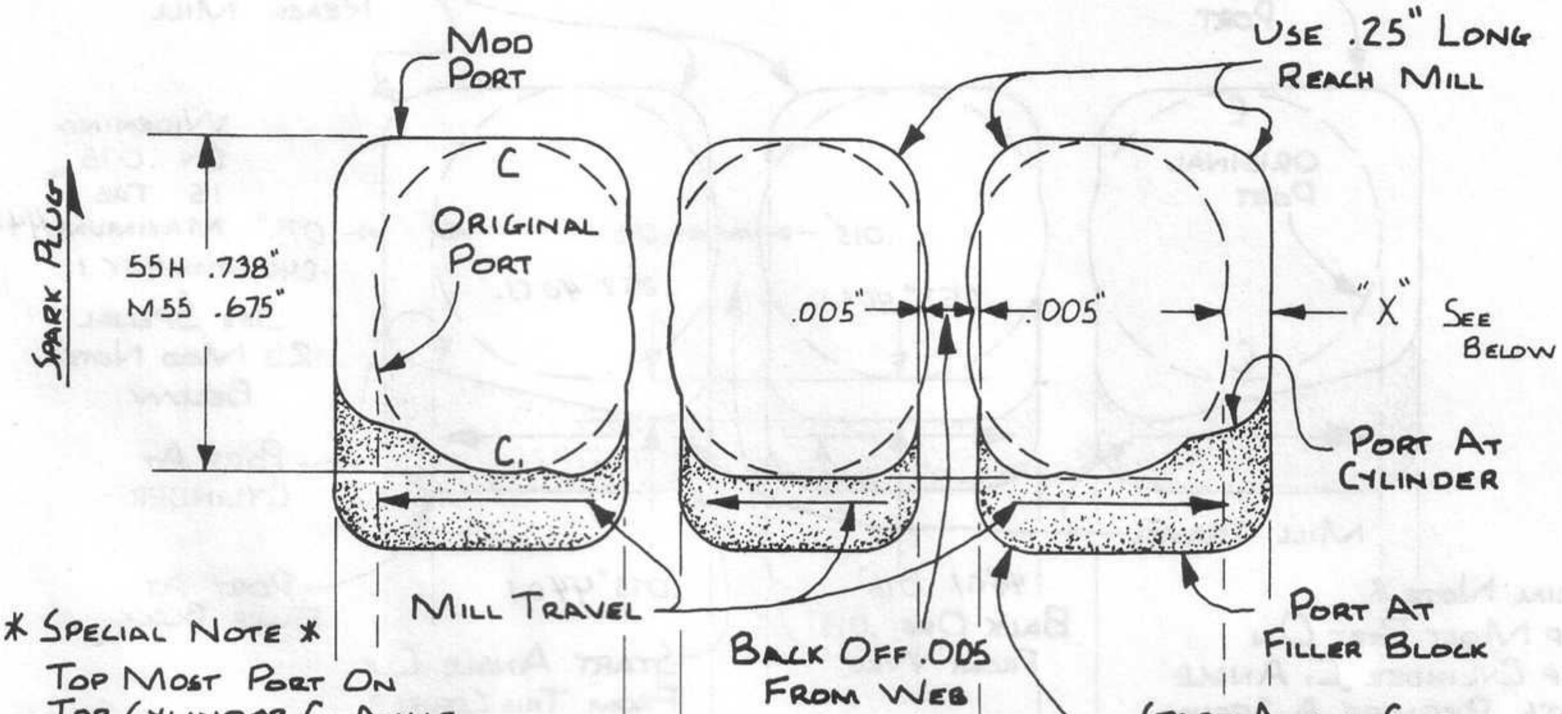
Boo Boos - If you get careless or greedy and put a crack in the water jacket next to a port or make a hole then you will have to fix it right. I would clean the block inside and out as well as down into the water jacket at the hole. It would be best to bead blast it down inside the jacket, roughing it up a bit. Clean it finally with lacquer thinner, then with point contact spray. It **has to be clean**. Use Devcon aluminum or some other really good **epoxy** fixer and apply it on both sides of the hole. Make it neat and just a little buildup. I then follow that after 24 hours with a clear epoxy pour like



PORT CHAMFERING FIG 1



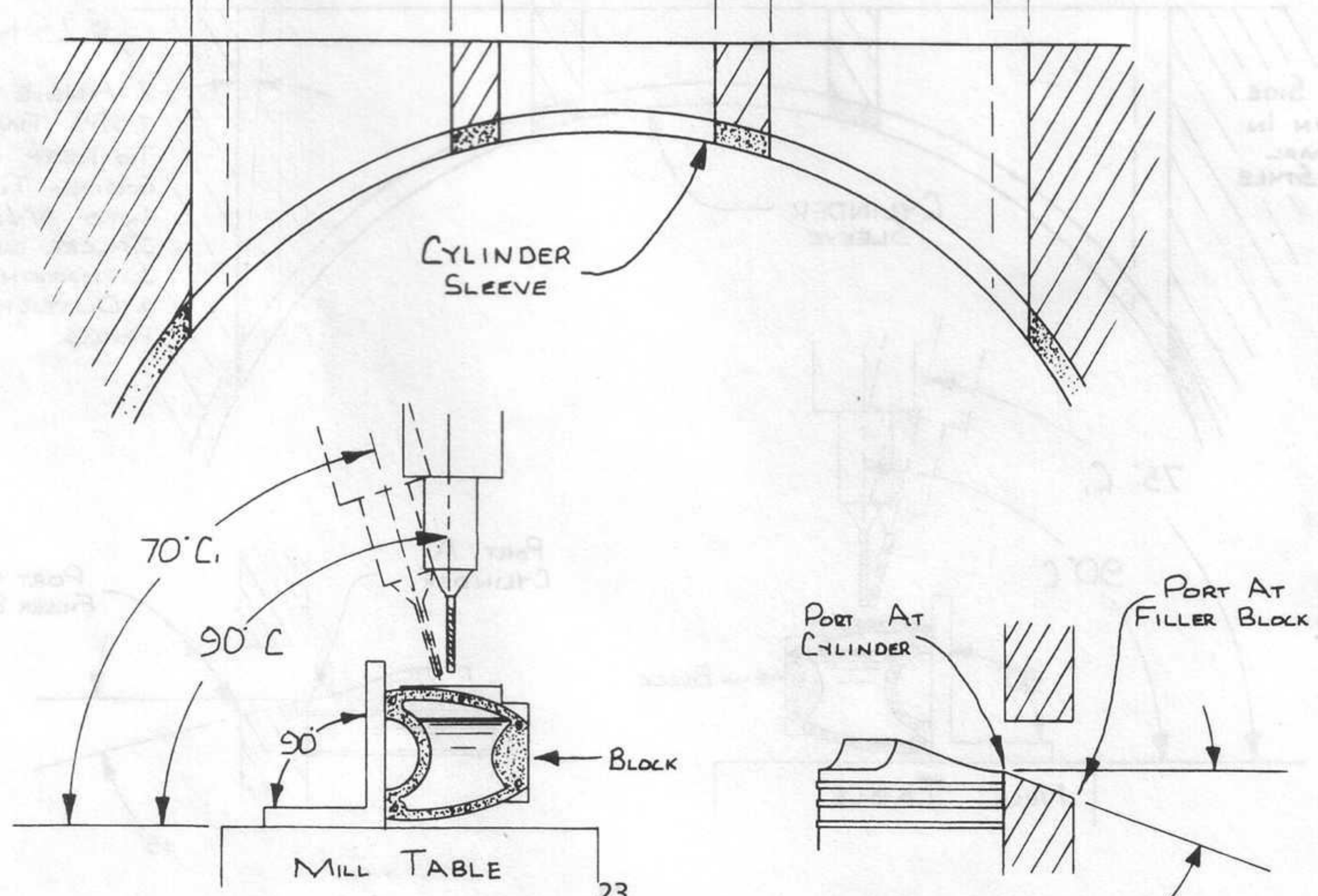
Mark 55 & 55H Mod Exhaust Ports



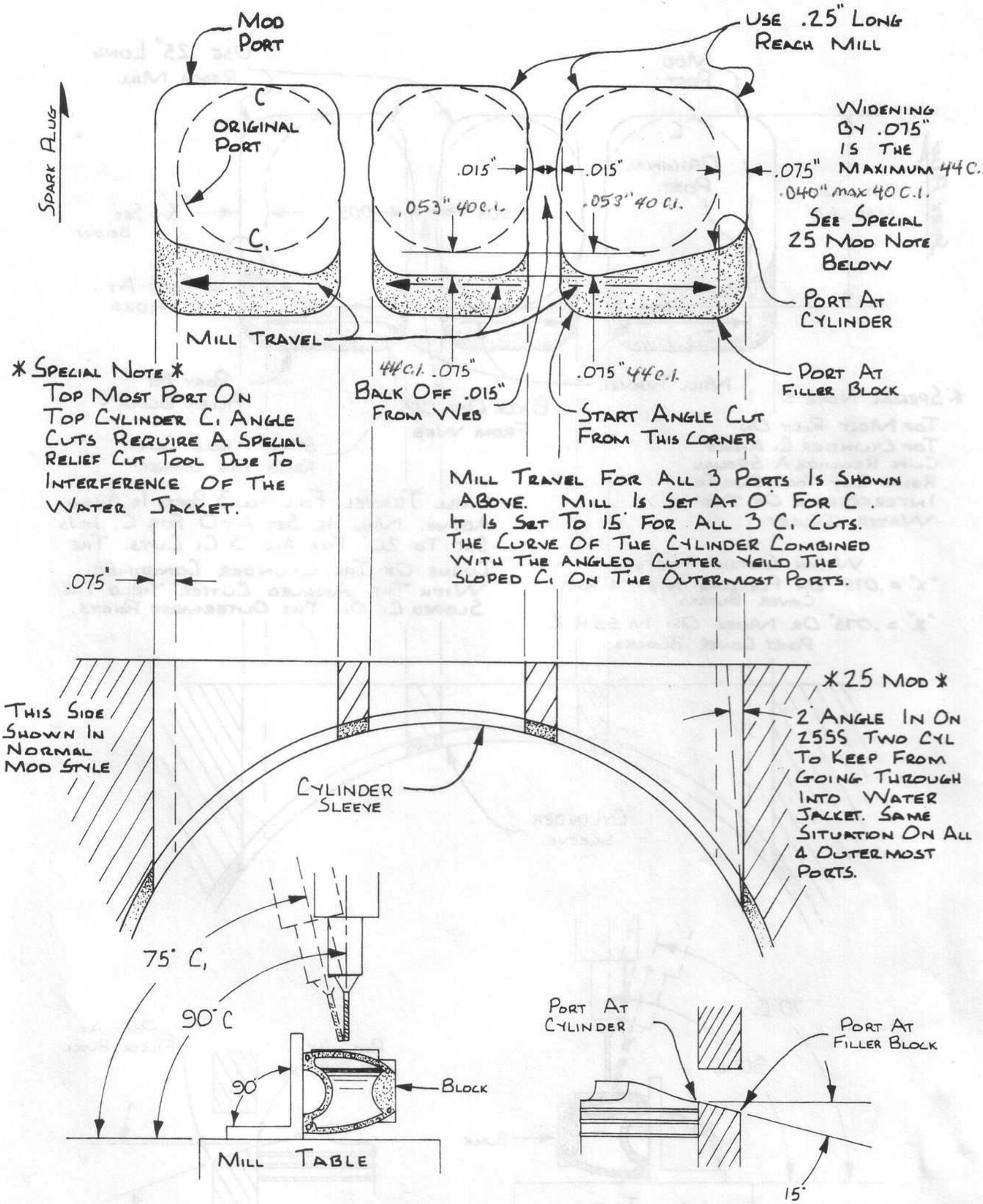
* Special Note *
Top Most Port On Top Cylinder C_1 Angle Cuts Require A Special Relief Cut Tool Due To Interference Of The Water Jacket.

Mill Travel For All 3 Ports Is Shown Above. Mill Is Set At 0° For C. It Is Set To 20° For All 3 C_1 Cuts. The Curve Of The Cylinder Combined With The Angled Cutter Yield The Sloped C_1 On The Outermost Ports.

Widen Outside Ports:
"X" = .075" On Pleasure M55 4 Port Cover Blocks
"X" = .075" Or More On M55H 2 Port Cover Blocks

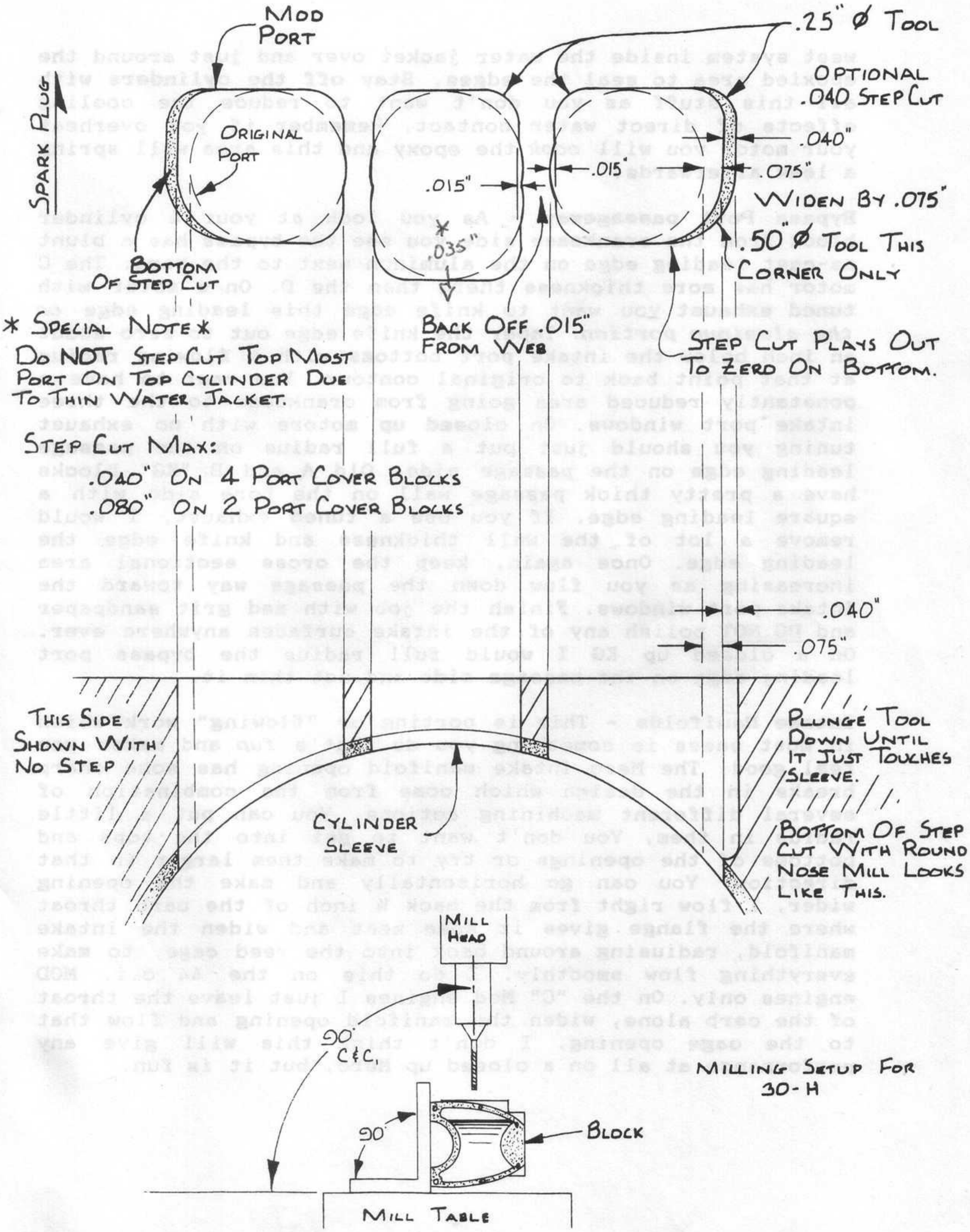


Mark 58 Merc 500 & 40ci Round Port Blocks
Mod Exhaust Ports



* CALL FOR "NEW" C PORTING

MARK 30-H MOD EXHAUST PORTS



west system inside the water jacket over and just around the epoxied area to seal the edges. **Stay off the cylinders** with all this stuff as you don't want to reduce the cooling effects of direct water contact. Remember if you overheat your motor you will *cook* the epoxy and this area will spring a leak afterwards.

Bypass Port passageway - As you look at your 4 cylinder block from the crankcase side you see the bypass has a blunt as-cast leading edge on the aluminum next to the bore. The C motor has more thickness there than the D. On a motor **with tuned exhaust** you want to knife edge this leading edge ***on the aluminum portion***. Taper the knife edge out to zero about an inch below the intake port bottoms with a flowing radius at that point back to original contour. You want to have a constantly reduced area going from crankcase to the three intake port windows. On **closed up** motors with no exhaust tuning you should just put a full radius on the passage leading edge on the passage side. Old A and B "KG" blocks have a pretty thick passage wall on the bore side with a square leading edge. If you use a tuned exhaust, I would remove a lot of the wall thickness and knife edge the leading edge. Once again, keep the cross sectional area increasing as you flow down the passage way toward the intake port windows. Finish the job with med grit sandpaper and **DO NOT** polish any of the intake surfaces anywhere **ever**. On a closed up KG I would full radius the bypass port leading edge on the passage side and not thin it.

Intake Manifolds - This is porting or "flowing" work which in most cases is something you do that's *fun* and makes you feel good. The Merc intake manifold opening has some sharp breaks in the design which come from the combination of several different machining actions. You can put a little radius in them. You don't want to get into the tops and bottoms of the openings or try to make them larger in that direction. You can go horizontally and make the opening wider. I flow right from the back ¼ inch of the carb throat where the flange gives it some meat and widen the intake manifold, radiusing around back into the reed cage, to make everything flow smoothly. I do this on the 44 c.i. MOD engines only. On the "C" Mod engines I just leave the throat of the carb alone, widen the manifold opening and flow that to the cage opening. I don't think this will give any performance at all on a closed up Merc, but it is fun.

Pistons

Pistons manufactured by Mercury thru the 1960's and 1970's were **really good** die cast pistons. They were strong **and light weight** and held to tight tolerances. The Merc pistons for the A/C and B/D engines were sold in a "last batch sale" in the early 80's. They usually had blue paint marks inside and were good, **but** not as **round** as usual. They were sold at a bargain price and a number of people are hoarding them. The Aftermarket pistons of the 50's and 60's are still around today. Turner, Quincy and Wiseco all made pistons in many configurations for Mod and Alky Mercs. On gasoline and with normal high timing these sand cast pistons **did** burn more easily than the Merc pistons and they were heavier.

Pistons made for the four cyl 44c.i. Mark 58 and Merc500's, six cyl Mark78's and two cyl Merc 25's are a different story. *Some* early Mark 58's and the Mark 78's had **centered up wrist pin pistons**. Later Mark 58's and all the Merc500's had **offset** wrist pin locations. They are offset to the intake side .062 in. and these pistons all had a heavier square design wrist pin boss cast inside. I like the old centered up wrist pin piston **best**. There are engines out there with offset pistons that run well also; so the difference is not great.
Sometime in the 80's Mercury went to "lost foam casting" on the new "**big**" wrist pin pistons for the 44. (or something that *looks* like it). These pistons are thicker and heavier than the old pistons. They also have the ring pins relocated. Two ring pins are offset to the intake side where they don't hurt anything, but one ring pin is offset to the **exhaust** side where it causes trouble. If you do a decent MOD port job you will put that exhaust port into the ring butt gap area. You will probably break that ring when you fire the engine up. This **BIG** wrist pin in the Merc500 piston required a different rod with a bigger hole in the small end. The large journal end was the same. **I like these rods if** you are going to use the newer pistons in MOD. Later in the Mid 80's Mercury went to an all new rod for the big wrist pin that had a re-designed journal end.
For 1994 Mercury has a **new** piston for the 44 with a new ring design. The rings are a "keystone" design that have a slight angle on top. The ring pin appears to be a dowel pin **location** but it is set down inside to function like an

internal pin. This leaves a half-round hole in the piston above the ring that goes down to the ring pin. This does not seem best for hi performance, but maybe the "advanced" ring design will help overcome this for a gain. It shouldn't detract performance too badly **if** you fit tight butt gaps.

Piston taper - Refer to the piston chart page 1. on "Bore Guide" Chapter. See the amount of taper from the skirt to the top of the piston. The taper of .006 inches (which would break down to .003" per side) is common for all pistons in the group. Some pretty respectable people believe that you need **more** taper than this for a racing setup. On my CMRS Marine "C" motors I normally run stock Merc pistons. At piston clearances of around .003" the top lands of my pistons have port web *impressions* that are a tenth or two deep. (1/10,000"). That is pretty tight! On standard bore 44 c.i. Merc500's with standard bore size pistons, the .006 in. piston taper is just fine.
For Mercury die cast pistons the main point of heat induced expansion is all around the top of the piston above the top ring. The secondary area seems to be just below the bottom ring all the way around. A third area would be the two in-between ring lands, but milder in here. The entire skirt from 1/8th in. below the bottom ring does not seem to be any problem at all. If you are going to fit a piston **very** tight then these would be the areas to reduce diameter in order of importance. You would need a fixture to hold your piston to turn the material off. CMRS **has** fixtures for the different size pistons, but I don't have enough experience to come up with a chart for recomended tapers. I am not sure that increased taper is needed on the good old pistons.
You **do not** want to bead blast your pistons. Not on top to clean them up and not inside either, nor anywhere. It is ok to polish the tops of your piston but don't remove material and **stay away** from the intake lip on the top dome of the deflector. This has to be sharp edged with no radius.
The following paragraph is **my** opinion for argumentation.

<u>Absolutely DO NOT</u> moly coat your piston skirts with teflon type products. The reduction in friction at 9500 RPM and below is going to help a tiny bit **but** the reduced crankcase pumping, combined with **piston rings** <u>that never break in right,</u> offsets any gains you might get. Once your bores are contaminated with moly even another set of new uncoated pistons with new rings may not break in correctly.

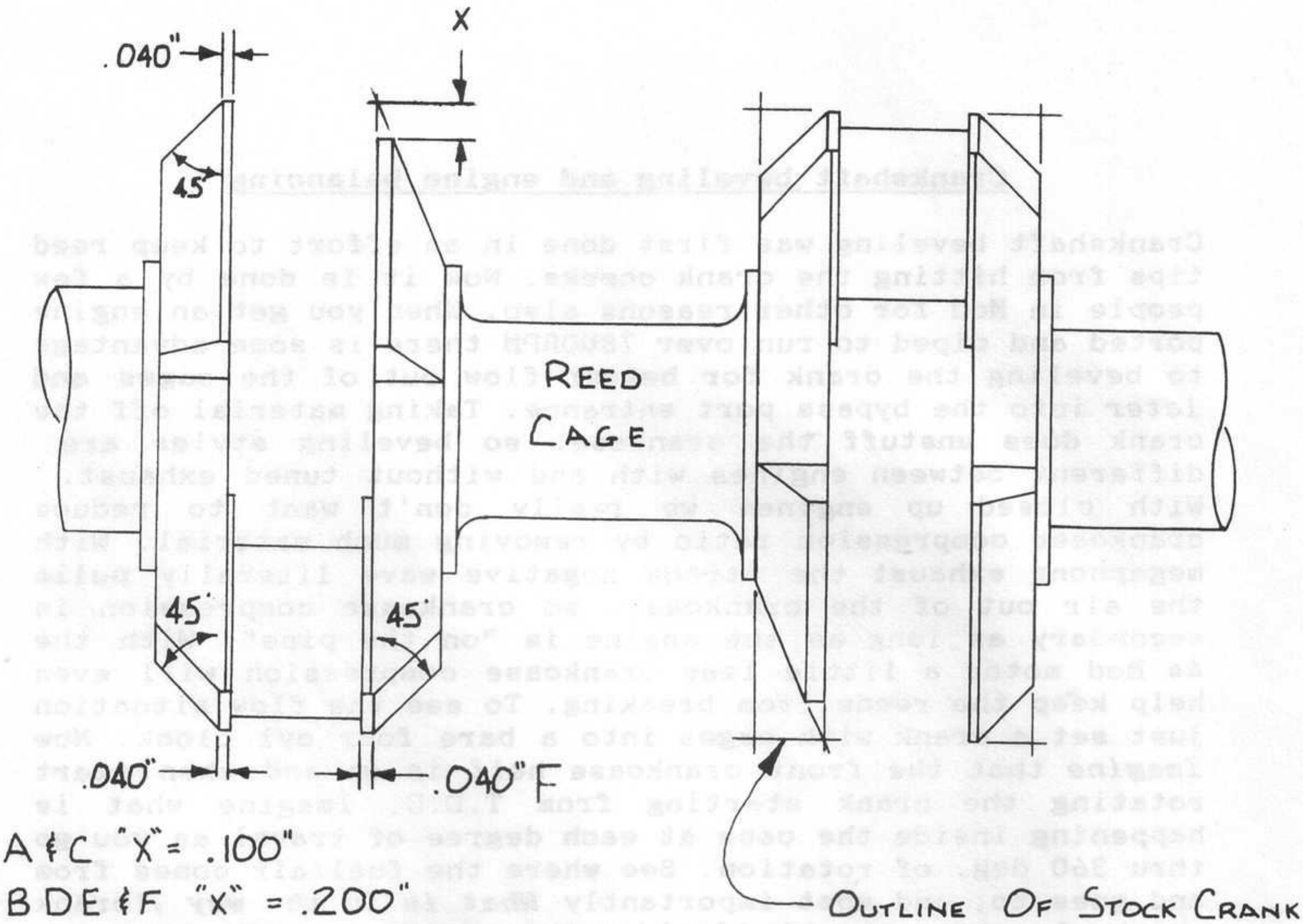
Crankshaft beveling and engine balancing

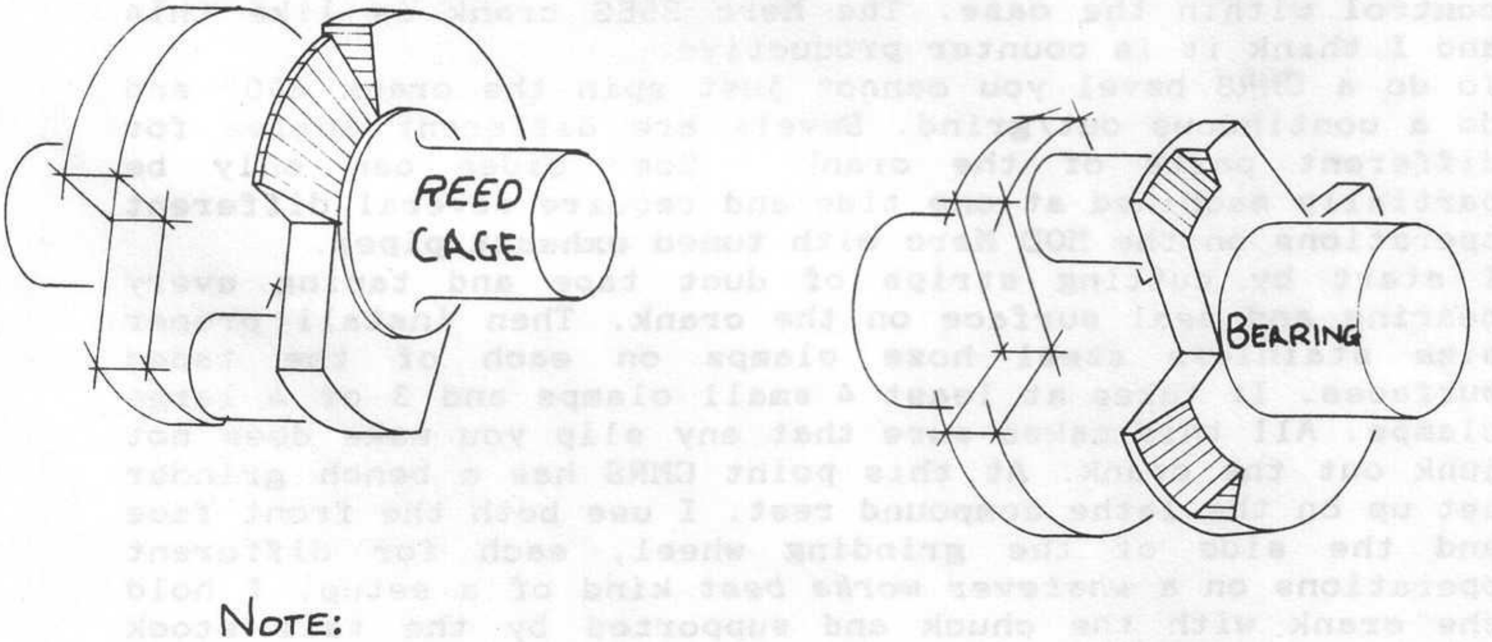
Crankshaft beveling was first done in an effort to keep reed tips from hitting the crank cheeks. Now it is done by a few people in Mod for **other** reasons also. When you get an engine ported and piped to run **over** 7800RPM there is some advantage to beveling the crank for better flow out of the cages **and** *later* into the bypass port entrance. Taking material off the crank **does un**stuff the crankase, so beveling styles **are** different between engines with and without tuned exhaust. With closed up engines we really don't want to reduce crankcase compression ratio by removing much material. With megaphone exhaust the strong negative wave literally **pulls** the air out of the crankcase, so crankcase compression is secondary as long as the engine is "on the pipe". With the 44 Mod motor a little less crankcase compression will even help keep the reeds from breaking. To see the flow situation just set a crank with cages into a bare four cyl block. Now *Imagine* that the front crankcase half is on and then start rotating the crank starting from T.D.C. Imagine what is happening inside the case at **each** degree of travel as you go thru 360 deg. of rotation. See where the fuel/air comes from and goes to; and most importantly ***What is in the way*** ,(crank cheeks & piston skirt),***blocking*** the air from getting to the intake bypass tunnel. I did find that complete removal of the cheek counterweight next to the reed cage was **too much** of a good thing; so there is a need for some **directional control** within the case. The Merc 25SS crank is like this and I think it is counter productive.

To do a CMRS bevel you cannot just spin the crank 360° and do a continuous cut/grind. Bevels are different angles for different parts of the crank. Some sides can only be partially machined at one time and require several different operations on the MOD Merc **with tuned exhaust pipes**.

I start by cutting strips of duct tape and taping every bearing and seal surface on the crank. Then install proper size stainless steel hoze clamps on each of the taped surfaces. It takes at least 4 small clamps and 3 or 4 large clamps. All this makes sure that any slip you make does not junk out the crank. At this point CMRS has a bench grinder set up on the lathe compound rest. I use both the front face **and** the side of the grinding wheel, each for different operations on a *whatever works best* kind of a setup. I hold the crank with the chuck and supported by the tail stock center. With the lathe motor ***un***plugged and off, I engage the

Crank Grind For Merc Mod Tuned Exhaust





Note:

Grind Goes All The Way Around. Shown As Partial For Clarity.

Reed Cage Side Counterthrow And Crankpin Throw Get 2 Different Grinds.

belt drive to provide a little drag control and hand rotate the crank slowly against the rotating grinder wheel. I slowly move the grinder wheel with the lathe cross slide and carriage wheels and continue to slowly hand rotate the crank in the short arc for that operation. I have done a crank bevel with a bench grinder by hand with no machinery. You still have to use the protective clamps and wear gloves. I finished that job with a file and then 3-M 100 grit wood plastic metal sandpaper for a smooth finish. You have to go slowly using either method and don't force anything. You don't want to heat up the crank much. You can burn the metal at the "f" spot if you force it. Refer to the drawings for the type bevel for you.

Balancing act

They tell me that two cyl cranks cannot be balanced so we will discuss 4 cylinder Merc cranks.

I have found on a few of the highly beveled cranks that it was not possible to balance them afterward. I had removed too much metal in the wrong spots. I had to have metal spraywelded back onto a beveled area in order to get it balanced. The main aggravater here is beveling the counterweight that is **not** next to the reed cage. I solve this problem by beveling only the reed cage side counterweight and journal side and then hot footing it to the balancer for a **check**. He will mark the spots where metal needs to come off (how many grams etc.) to balance this particular crank and then I take that into consideration when I continue to do the rest of the bevel job. Maybe I will not do a complete bevel on a on a **NON**-reed cage counterweight in an area where some weight is needed - you see. This is only necessary when you intend to do a radical bevel. When the crank is beveled I take it to the balancer and have him balance it by removal of material. I tell him do not touch the reed cage side counterweight at all. Once the crank is balanced then I have him mount the flywheel /crankplate on the balanced crankshaft and balance the assembly by removal of material from the flywheel only. I don't worry about "bob weights" and do not use them in balancing. They will not do anything for **us**.

Doing a CMRS MOD bevel without doing a good mod port job will not buy you anything. You have to do groups of well advised modifications that complement each other along with near perfect parts to get significant gains in performance.

Reed cages in the Mercs

Big Brass 55H -	With 1 7/32"X 5/8" reed ports and big front intake opening. **No** oil slots on them.
Big Brass 30H -	With 1 7/32"X 5/8" reed ports and small front opening for AJ carbs. **No** oil slots.
Brass Quincy -	With reed ports from 1 1/8" long (for alky Loopers) to 1 7/32" long X 5/8" wide. They have big front openings and No oil slots. They are .046 in. thicker, top to bottom, than Merc Brass cages for strength. N.L.A.
Brass pleasure	These cages have 1" X 5/8" reed ports and may have either the large or small front intake openings. These also have oil slots
Aluminum cages	All aluminum cages have either steel pins or plastic pins for reeds. Some have 1 7/32" long and others have 1 5/16" long X 5/8" reed port holes.
Brass 20H	Two styles, both with 1" X 5/8" port holes and oil slots. One has drilled inner passages and the other cage has sand cast inner passages that are larger. These cages have a steel centermain roller race.
Brass KG cage	A smaller diameter cage with 1"X5/8" holes and oil slots. Inner passages on most are drilled and a few are sand cast.

Quincy cages are a couple thousands bigger in dia. and .046" thicker and were very strong. Due to being thicker the reed were .023" closer to the crankshaft cheeks. Quincy used to take about .030" off the steel reed tips, blunting them, and put a **bevel** on that side of the crank cheek & side of journals. This is ***why*** crankshaft beveling in Alky and Mod got started. You also should bevel off the top edge of your reed stops for crank clearance with these cages.
The Big Brass cages are next best, as they are stronger than the aluminum which can break under Modified stresses.
Mercury stainless steel reeds are not a problem with stock/closed up engines; also not a problem with "A" and "C" Mod Mercs with pipes. "D" and 44c.i. Mod Mercs with pipes have a tendency to break reeds which then go thru the motor like shrapnel. We tried to "eyebrow" a little arc slot in the surface of the cages under each reed tip which supposedly filled with oil and would cushion the reed. This doesn't help enough.

I use ***Plastic*** reeds (Available from Central Marine Co.)
The plastic/phenolic reeds will not last more than a season and need to be checked often; but will not hurt the engine when they break up. They might even offer a little performance gain.
Try not to run higher reed stop settings than 5/32" and keep the original factory curve/shape in the reed stops. **The stock big Merc cage will flow <u>all the air/fuel that your motor needs</u>**. Maybe the full Mod 44 c.i. with stacks might approach using 100% of the potential flow. Some of the aluminum cages have a reed port hole of 1 5/16" X 5/8" but I don't think that helps. You really **<u>dont</u>** want to elongate the reed port holes in the cage toward the tip end of the reed, **<u>nor</u>** do you want to radius or flow the reed port holes right under the reeds. You **may** radius and flow the inside of the cage to help get the air from the front parts of the cage into the back two port areas, especially on drilled passage cages. The sand cast cages don't even need **this**. For Mod you may mill out part of the sides of the brass cages in a pattern like on the aluminum cages. This makes for more internal volume and helps the flow from the front into the back side of the cage. It is not necessary on a sand cast cage with the bigger internal volume and better flow front to back.
With steel reeds *some people* bend .007" or more pre load into them so their tips lie off the cage. I don't......
To recondition a brass cage I disassemble the cage and drive out the reed pins. Some pins don't drive so I grab them in the big vice jaws and hand rotate the cage a bit while pulling it out. You might tape the cage reed surface to keep it from being hurt. I have the cage **surface ground** at a machine shop to remove all the reed marks. This will create a sharp edge on the inside of the reed port holes. Leave it as it is. Four Cyl Merc rod Journal roller bearings are .001 in. larger dia. than the original reed pins and I install them into the cage in place of the ruined original pins. The first side will go in ok with the cage on a protected flat surface as you drive in the pins. I have made a flat topped anvil with four pin holes so I can lay the just pinned side down flat and drive the pins in the other side. Otherwise you will mark up your pretty new cage.
I center the reeds over the holes and use a **<u>tiny</u>** drop of loctite on the stop screw thread as it goes in. When you tighten it and put the *bite* on it, make sure the reed **and** stop don't rotate clockwise off of center.

Carburetors on 1950's Mercury outboards

The Merc factory repair manual tells you **almost** everything you need to know. All the original float settings and nozzle diameters etc are good for racing with gasoline Mod.
I recommend using a **full** butterfly in all hi performance situations for safety. Bud Parker makes them up for about $5. to $7. apiece.
The older tillotsons had narrow brass float levers in them. The spring on top of the float can hook over the lever accidently in rough water, or by laying the motor in a horrizontal position, or if you install the carb top with the float bowl full of gas and the float in high position. Newer KA and KC Till carbs had wider stainless steel float levers which help solve this problem. Use **those** if you can..
High speed adjustable needles:
AJ carbs will run with needles about 1 1/8 turns out on unmodified engines. For properly ported Mods with tuned exhaust about 1 3/4 turns out.
On the KA Till carbs, hi speed needles ran about 1¼ turn out on the stock engines and slightly richer on Mods with pipes
On KC Till carbs on the MOD 44 Mercs they will run about 2¼ to 2 3/4 turns out. **Always start rich** on the setting on any engine and come down slowly. **Your max power will come at a slightly rich setting on the high speed.** Max RPM will be achieved at a leaner hi speed needle setting but **don't** do it! I always ran my C Mercs as rich as I could run them without 4 stroking. Max power will give you better times around the race course and the engine will last longer. Instructions in the Merc bulletin are to turn the low speed needles out 2½ turns for best acceleration.

To check your **High** speed needles you need to turn them in till they bottom out. **DO NOT** turn the needle in hard and force it into the seat! You will mark the needle with a permanent (ring) damage and it won't flow right. Hold the gland with a 7/16 wrench and turn back the packing nut with a 3/8 wrench until the needle turns as free as possible, then turn the needle in to bottom gently while continuing to hold the packing nut with the 3/8" wrench. Now turn the hi speed needle back out the required number of turns and hold it firm while tightening up the packing nut to the fairly tight range. Put a permanent mark on the carb body to locate this point (set screw at 5 o'clock etc.) for future use.
If you have a hi speed needle with grooves around the tip

because some *clown* ground it hard onto the seat then you must redo it. Take the packing nut and knob off the needle and check it overall for straight & true. Put the bare needle into a electric hand drill and set some 500 grit wet and dry paper onto a very flat, hard surface. Check the angle of the point to be ground and hold drill accordingly. Spin the needle and hold the point against the paper while adjusting the angle. Draw the point across the paper slowly and look at the *gold* trail you are leaving. This shows you the correct angle as well as when the whole point is cleaned up. You want the original angle and a single flat angle, not an arced surface; so don't vary the angle once you get a good flat run going with a wide gold trail.

In the early 60's Mercury had a replacement performance kit for the KA7A carb (20H & 55H), #1399-1620. This kit had a full butterfly and a **longer** hi speed nozzle which was longer on the **bottom** end only. This enabled it to reach down further into the carb body and pick up the last bit of fuel during peak acceleration etc. and solved any lean out problems. If your motor does not have this problem then you will not need the long nozzle. If you rebuild and modify your engine **then** you may need the nozzle.

You can check to see if your KA Tillotson has this 1399-1620 kit by removing the brass plug screw beneath the nozzle area. (this sometimes takes an impact driver and a perfect fitting blade to remove). Look down inside and measure how far down to the nozzle. The good **long** nozzle will be 20/32" below the outside edge whereas the original *fishing* nozzles will be 27/32" below, as measured with the carb up side down. Don't measure off the slender tube that lies inside the nozzle as this is just the idle bypass tube.

CMRS Marine has for sale longer nozzles and high speed adjustable needles & seats for tillotson **KA** and **KC** carbs which reflect update technology. You have to furnish the gland and packing nuts (*from old AJ tillotsons*) to use my needles.

Some of the racers have used the smaller diameter AJ Till. adjustable needles and drilled and chamfered stock **jets** to simulate the adjustable seat. **If** they work, then fine.

In 1994 the APBA Modified people have allowed the use of most any AJ carbs and the KB2A carbs on the class C Mark 30H motors. My choice will be the KB2A carb and I will install a full butterfly and KA7A type adjustable hi speed needle and seat. If the 30H is correctly ported and stacked it should run about 300 RPM better with this carb.

The Tillotson AJ49,51 and 47A are all legal with the AJ47A being 1/32" larger venturi of the three, hence **better** on most hi performance situations. These AJ carbs get the MOD treatment in APBA racing as follows:

If you take the choke assembly off permanently, be sure to put a screw into the threaded hole in front to block it off. If you look into the venturi you will see a bulge running from 3 o'clock to 6 o'clock blocking air flow. This is the slow speed transfer tube boss. I take a small thin oval needle file and remove about 70% of this material. Stay away from the 3 and 6 o'clock spots as you work or you will enlarge the 13/16 inch dimension which is legal maximum i.d. for this carb venturi. The carb venturi is **already** at its maximum except for the boss itself. Touch it once elsewhere and you are screwed. Don't get greedy and remove too much. You could be illegal or go thru the boss wall into the slow speed system. This modification along with radiusing of the intake leading edge of the carb will give you about 300 RPM on a good Mod with pipes. It may not be much gain on a stock old powerhead. Keep off the throat of the carb which is the rear portion next to the engine because it is also at maximum legal i.d. already. If you are not racing then you don't have to comply with the Specifications. **Don't polish** anything in the carb air passages. polishing is ***counter productive*** here as well as in any intake manifold or passageway. Finish up your filing and radiusing with some 240 grit wet and dry black sand paper in **dry** mode.
A nice radius on the intake of your carb is very productive and this is about the only other modification to make on the Tillotson carbs.
The Till KC carbs are being used on the MOD 44 c.i. Merc 500's with success. The KC16A has a 1 1/16" venturi which is best. Some of the slightly larger venturi KC's are more difficult to tune. I take the KC6A which has a small venturi and open it to 1 1/32" or 1 1/16" i.d. for the 44 c.i. Merc. CMRS has a 1 1/16 in. boring jig made up to do the job. The special Nozzle and adjustable hi speed needles from CMRS are made just for the KC carbs.
I have also done some special throat work on CMRS Mod 44 carb throats and intake manifolds (bigger plus matchup). This is only productive on a good Mod engine with tuned exhaust megaphones. The KA carb is really big enough for a stock closed up 44 cu. in. Mercury. A big KC carb might have a big B O G during acceleration or just not run.

Ignition systems in Mercs

Four cyl Mercs - My experience is mainly with the Kiekhaefer Merc mags as seen on the Mark 55H and Mark 58 motors.
Again the Merc Service manual has lots of good information. Follow those instructions **to the letter**. When it says to **align the point contact surfaces** by bending the solid contact arm, Do it! Set your point dwell at 48° or .0065 in. gap. For your contact point **spring tension** there **is** a Modification for racing. You need to read a tension of 45 on the Merc point tension guage rather than the 37 recommended for fishing Mercs. Of course the electrical quality of contact needs to be very good also. You also need a high reading condenser. (.32)
The Merc 4D-1 mags used the two screw points sets and you need to use the Merc special tool to align the distributor cap on this mag, same situation as with the Fairbanks FM mags. They have NO alignment lips on the mag body to align the middle plastic cap perfectly; therefore the end cap/middle cap assby has to be aligned with a dummy rotor insert so that the real rotor will be centered inside it. The Merc 4D-3, 4D-5, 4D-7, etc. mags **Have** this alignment lip and don't need the alignment tool/proceedure. They also use the more modern one screw contact points sets.
The new style Merc contact points being sold by Mercury and some aftermarket suppliers seem to have **black plastic** in the body of the swinging contact arm. All the sets I have tried have **failed** when the tension was increased to 45. The plastic cracks and breaks. For **these** points, don't crank in any more tension on the spring than you have to in order to run at **your** engine's max RPM. A tension of 39 will let your mag run up to 8000 RPM.
The screws holding the plastic parts on the mag should not be ultra tight. Bring them up in steps to barely tight or you will break a plastic cap. **USE** the tab washers on the Merc mags and set and unset the tabs **carefully with the** correct tool. Use good star loc washers on the FM mags and don't crunch down on the screws too tightly.
Under racing conditions the rotor can drop down on the rotor shaft and hit bottom in the distributor cap, breaking everything. I cut two strips of masking tape 3/32 X 3/4 in. and place them iin a cris cross over the end of the rotor shaft and down the sides equidistantly. When you put the rotor on it will go down fairly hard and this helps keep it from slipping. Clean off the shaft with lacquer thinner

first. You may use loctite but you will have to break the rotor to get it back off later.

Phelon Mags in two cylinder Mercs

The spring arms under the stator plate hold the plate and allow it to rotate for spark advance etc. They also allow the plate freedom to wiggle which affects point gap and spark timing. With any wear at all of the stator plate and crankcase top mag boss, the points are all over the place while you are running fast. NOT good. Racers fasten the mag plate down permanently with metal plates underneath which are cut to fit the offset surfaces. Usually they are bolted thru the stator plate, top to bottom. Keller (Williams Mfg) made plates for this purpose. You can't change the timing-advance for starting up and idling purposes but it's worth it for HI performance in racing.
It is not a good idea to remove material from Phelon flywheels to lighten them. You do NOT want to run any kind of perforated or stamped metal flywheel cranking plate on an open flywheel situation. If you have a gas tank or cowl around them, they are ok but NOT safe for open flywheel running. To run a "kill wire on most phelons you run a wire from each set of points (at the condenser hookup on the points) and tunnel them out thru the mag plate outside bottom via a rubber grommet. Then when you connect the two wires it grounds the points together and kills the spark. **Warning- but not in <u>every</u> style magneto.**

Bendix mags on two cylinder Mercs

The rotor magnet used to get loose on the crank and then the integral cam would wobble the points so bad that the mag would fail. Loctite had not been invented yet. nowadays I would red loctite the rotor magnet on the crankshaft with the powerhead inverted to keep the extra juice from running down onto the top seal and maybe underneath to the bearing. It would be a good idea to set up the whole mag assembly on the motor without loctite first and make sure that the rotors magnet etc. was working a good spark, cause that baby will be hard to get off after curing.
Some of the Bendix mags used set screws against spring plungers to hold the mag plate and provide friction against turning. Every time you advance and retard the spark lever you are wearing out the stator plate and messing up your point timing.

I would turn down the KG7H solid steel racing flywheel to get some weight off it; but not to less than 3 lbs.
Warning - the bendix style square looking flywheels off of fishing motor Mercs etc. **can be dangerous. Do not run without protective gas tank or cowls to cover them up.** They are not as safe and may disintegrate at the higher RPMs.

Timing your Hi Performance Merc

Four cylinder Mark 30H and 55H Mercs - The service manual says .320 inches before top dead center. (.320"BTDC) This is a safe bet especially in a closed up motor. The exhaust heat being retained by the motor parts is a major factor in timing the engine. The earlier you fire the spark, the more heat you are going to put into the piston, cylinder block and crankcase etc. Sooner or later the excess heat starts to cost you H.P. and the extra power you get from higher timing is negated. Taken too far it will burn you a piston.
My super water cooled 30H Mod and 44 Mod run .385"BTDC timing MAX. This is about borderline except on specially setup Hi RPM engines. I think that you have to come up slowly in steps from .320" to find **YOUR** maximum. With any luck it will be about .370" Go up with timing till you stop going faster on extended full throttle, then back down one step and set it there. **Don't get greedy!**
On the other Model two and four cylinder Mercs always **start** with the factory recommendations for timing and go up from there slowly and carefully. They had **good reasons** to set the max timing that they did for each model, and they were correct in their reasoning.
Follow factory proceedures for timing outlined in the service manual. I use a dial indicator for BTDC readings rather than the Merc guages. I hook up my point quality guage to the mag kill nut on the side of the mag. I set the top cyl at .385"BTDC (before TDC) and advance the mag toward the max advance stop screw. The points will break cleanly exactly as the advance arm contacts the stop firmly. This sets your max advance/ wide open throttle point.
Note- On my Mod 30H the throttle cam arm working the butterflys is adjusted to fully open the carb butterflys at about 7/8ths of full stroke on the dead man throttle. This gives me nothing but mag advance on the last 3/4 inch of stroke on my dead man throttle.I can feather the timing and rest the engine a bit while the throttle butterflys are still wide open.

Spark Plugs for performance

Heat Ranges

You want to use the hottest plug heat range that will run in your engine **without** showing signs of overheating on an extended full power run under load. This plug will give you the best torque and peak power. The only way I can *read a plug* is to install a new plug in a pre warmed up engine and go make an extended run at top speed. After a few laps when you near the pits release the throttle and kill the ignition and coast to a sudden stop. **NO** half throttle or idling, you paddle into the pits and immediately look at the plugs. Even then it's not a science so get the folders from the plug manufacturers with pictures on what they should look like.
I try to start with a heat range of about J5 on my Mod with water cooled tuned exhaust. On yours start cold and come up.

Manufacturers and types

I have no preference on manufacturers and generally shop around to find the reach and heat range that I need. Champion doesn't provide a J5J so I look for that gap style and heat range in other brands. I prefer a thin wire platinum tip construction when possible. These fire easier. The Merc mag puts out from 5,500 up to 11,000 volts depending on what condition it is in and the lower range mag needs all the help it can get. Gaps of no more than .025 in. are best and gaps of less than .020 in. will result in very hard starting. I **am** going to try the Splitfire SM30C in my 30H Mod Merc as well as NGK B7S and B8S. New sharp surface plugs fire much easier than older used plugs.

Misc. information

I like the newer 8mm stainless inner wire plug wires available today. The only problem is that the outer insulation is a bit larger than the old 7mm wire and this requires that the plug wire holes in the distributor end cap be bored out slightly. I have made up a tool to do this.
Speaking of end caps- The new (grey) distributor caps are a hair too large to go into the older middle caps. Merc recommends you also buy a new (grey) middle cap to fit. This is $75. and the distributor cap is $65., so *I don't think so....*

Tuned Exhaust Stacks

This will cover systems with tuned megaphone "open" exhausts which are manufactured for Mercury Outboard motors.
In the late 50's and early 60's Quincy Welding and Hubbell manufactured systems with one megaphone per cylinder. About 1965 The Quincy system was changed to a two cylinders into one megaphone style. We call this style a "Converging elbow system". This system and it's earlier Quincy version used an aluminum filler block with the exhaust hole located over the bottom exhaust port in each cylinder. A bit later Quincy changed the exhaust hole locations to "over" the **center** exhaust port. Don't use the wrong filler block in one of these older systems. About 1970 Quincy went from steel to the use of aluminum in their system. The megahone was now aluminum also and a taper fit, held by springs, unlike the previous megaphones which were steel and welded on.
This later megaphone setup is about 1½ mph slower than the previous steel setup due to the minor diameter of the megaphone being too small and resulting in a restriction at the outlet of the elbow where the pipe begins. You need to have a 2 inch diameter at the small end of the megaphone in order to match the elbow outlet. The **updated CMRS**/Quincy exhaust has this correction and more.
There have been and continue to be a number of different systems on the market.
Years of testing has shown the Quincy system is the best for Mark 30H Mod Mercs. The other systems are 1 to 2 mph off the best Quincy. On all the other model Mercury motors it seems there is little difference between the various systems manufactured today. The key is to do a proper installation.

Installation Proceedures

We will start with a new system rather than a used because most used sets have been **botched** ***and*** it is almost impossible to weld a leakproof seam on a used filler block.
I like the Bayer stacks on a "D" Merc 500, 44 c.i.) so we will use them for our example: I always order my Bayer systems **custom** (**without** the elbow stud holes drilled and tapped in the exhaust **plate**) I like to do this myself. The elbows themselves can be 100% finished as well as the other components. We will use the manufacturer's elbow studs, so get them with the assembly.

Filler Block - The under side of any new filler block usually needs modifications to match it to the motor block you are using. I start with a feather cleanup on the ***Top*** side of the filler block on the mill just to get it flat. You don't want to remove more than a few thousands or what ever it takes to make a flat cut that cleans up around all the exhaust holes. If you get carried away and take off too much you will enlarge and distort the shape of the exhaust holes. Some filler flocks are OK as is and some need a cut. Then with the filler block up side down in the mill I take a .030 in. deep cut with an end mill across all the horizontal flat surfaces. The curved surfaces will have to be worked by hand with a big rat tail file or grinder tool as necessary. If you are installing a Bayer filler block into a 4 port cover/old style four cylinder motor block you may have to modify the filler block slightly for it to fit. Note- the CMRS/Quincy system has two different style filler blocks that fit the two styles of motor blocks.
The idea from this point is to take material off the bottom side of the filler block so that it will go down ***below flush*** from the exhaust plate mounting surface. I shoot for .025 in. below flush ***everywhere*** and even when the filler block is moved a bit left and right of where it will set. ***If it sits flush or above flush you might distort a cylinder*** when you tighten the stack plate down or when the filler block expands under heat. Once you get it close you can use masking tape on the bottom of the filler block to find the high spots that need working down. Just put full strips of tape on and set the filler block down into place, then press down on it hard and "scrub" it slightly in place to mark the tape. If it needs more removed, I just do the bottom side flats on the mill again and the curved parts by hand till it goes down in below flush.
Next I fasten the filler block to the stack plate with a couple 10-24 screws. You have to place the screws so that they are not too close to the edge of the filler block and so that they are not too close to any exhaust hole. (See fig.5 "b") Line up the exhaust holes in the filler block with the exhaust holes in the stack plate. The idea here is to align the holes in such a way that you will have to take off the least amount of material from both the stack plate and the the filler block to make them line up perfectly smooth and even later on. Align the holes, clamp the filler block to the stack plate and mark its outline on the underside of the stack plate, exhaust holes and all. Now

unclamp the filler block and locate the two 10-24 screw holes. You also have to stay away from where the elbow studs are to be located later. (look at the elbows to see where they will go approximately). Drill the two holes with a number 25 (tap drill) thru the stack plate. Now align the filler block back on the marks you made , clamp it to the stack plate and drill on thru the stack plate holes 3/8 inch into the filler block. Don't go deeper or you will run into areas where we are going to put water passages in the future. Unclamp the filler block and tap its two holes with 10-24 tap, then a 10-24 bottoming tap. Now carefully drill out the two #25 holes on the stack plate with a #11 (body drill). Depending on whether you use a allen head cap screw or flat head screw you need to counter bore or countersink the head below flush so that the elbow will sit flat on top of the stack plate. Note that you have to have the screw located so that the countersink of the head does not run into the exhaust hole. Remember that later you will ***enlarge*** the exhaust holes as you align and clean up these passages, so allow extra room for that also when you locate the 10-24 screw holes. Now is a good time to hand make your one piece gasket that lies between the stack plate and the motor block/filler block. When you cut the exhaust holes undercut them a bit, leaving a bit of gasket in the hole.
Elbows - Fitting the elbows to the stack plate is next if you have done the custom order suggested. I align the elbows exhaust holes with the stack plate exhaust holes taking into consideration where metal will be removed from the stack plate to align the filler block. The idea is to remove the least amount of material to end up with matching passageways thru all three levels. This is important! Once aligned I clamp the elbows to the stack plate and take a good look at how the elbows are sitting with respect to each other and a generally horrizontal line. Obviously you don't want an elbow mounted at a funny angle and you have to have clearance between the big ends of the megaphones when they are mounted also. If you have to compromise, do it. Now scribe mark the stack plate thru the 5 stud holes that are drilled in the elbows by the manufacturer. With the elbows still clamped to the stack plate I locate and drill a 1/8th in. hole in the top and bottom flange of each elbow thru into the stack plate about ¼ inch. Now remove elbows, marking them "top" and "bottom". Center punch the 10 stud holes precisely on the stack plate, then drill and tap them for the elbow studs that the manufacturer provides.

(if studs are 5/16-18 use an "F" tap drill.) Now re-drill the four 1/8 in. holes in the **elbow flanges** with a #30 drill -NOT the stack plate. Then use 4 Rod journal roller bearings and install them into the face of the stack plate in the 1/8th in. holes. You now have locating pins for your elbows that will keep them centered every time at the same spot. Test to make sure the elbows go on the locating pins ok and then install the studs. Test the elbows again to make sure they will go over the studs. If you haven't screwed up center punching and drilling the stud locations, they will go on ok. Now make a couple gaskets to go between the elbows and the stack plate and undercut the exhaust holes a hair leaving some to trim inside later. Don't make the locater pin holes oversize as they will allow the gasket to shift later after the exhaust hole has been done perfect. Make the pin holes **first** before marking and cutting the rest of the gasket holes and contours.

It's alignment time - Fasten the filler block to the stack plate without the gasket. fasten the stack plate to the motor block with several bolts lightly. Remove the two filler block screws and the stack plate bolts without moving the assembly and carefully remove the stack plate without moving the position of the filler block. Carefully scribe a line top and bottom on the filler block and motor block to mark the exact location of the filler block when it is in its correct position. You may have to realign the filler block using the stack plate again to do it right. I use a **tiny** spot of body filler top and bottom to hold it for scribing.Now you know where to place the filler block and you can look down into the exhaust ports and see where the casting material inside the filler block rough exhaust hole is blocking the smooth outflow from your big Modified ports. I mark areas where material is to be removed and put the filler block into the vice, bottom side to me. You **do not** want to remove any material at all from the exhaust hole where it meets the stack plate, nor even from the top 2/3rds of the hole in that direction. Just remove the excess material in the marked areas on the bottom 1/3rd of the filler block where it touches the motor block and blocks the ports. Keep putting the filler block back into the motor block and aligning it to the marks and remove material all around the bottom edge where the ports are blocked in the exhaust holes. Don't get fancy and do any polishing and smoothing yet. Just remove material only where ports are blocked.

Now screw the filler block to the stack plate loosely with the plate gasket in between. Make sure gasket holes are aligned by installing this assby onto the motor block with most of the bolts. You don't have to tighten it down. Now Tighten the filler block screws. This will assure that the gasket will always line up in the exhaust holes (unless the gasket bolt holes are all cut too large.)

Now bolt the elbows onto the stack plate with the line up pins and gaskets in place. All the components **will always come back to this same alignment** exactly thanks to the filler block screws and elbow locater pins. Now you can take your rat tail file and rough out the exhaust hole passages with everything fastened together. You have four objectives:

1. You want to align the filler block/stack plate and lower part of the elbow by filing down the high spots that don't match.
2. You want to have a fairly symmetrical passageway **and** all four passageways have to be the same (size shape volume).
3. Just as number one and two are accomplished hopefully the last of the rough casting in the low spots cleans up.
4. The is to be **NO** lumpiness or waviness, just a smooth flow outwards, going with the dimensions **and shape** that the manufacturer intended and as small a passage as possible.

This is why I use a big rat tail file - to get a smooth flow outward toward the elbow. Die grinders and burr tools will not give you this desired effect over a large area. Now you must **blend** the bottom area of the exhaust hole in the filler block with the flowed matched surfaces higher in the filler block Rat tail files and maybe a little die grinder here. Make a smooth transition with lots of radius and **don't** hog it. Try not to touch the top 1/3rd of the filler block exhaust hole doing this. Now you can go in the holes with sand paper on a stick or on your finger or maybe a small sanding drum in a drill and smooth it all out. A little sanding drum on the trapped edges of the gaskets is necessary to take the fuzz off them so they don't protrude **Don't get carried away** and don't make the passage too big in the name of **super** smoothness or polish!.

Water Cooling the filler block -

Water cooling the filler block is highly reccommended. There are alternate methods to this one but they all depend upon epoxy holding the filler block in place with no cracks and/or a mechanical seal, bolts etc. This method puts an internal welded water jacket into the filler block that is **always** sealed.

Now that your filler block is matched to the system, the exhaust holes are as large as they will ever be. Eyeball them and see how much material may be removed (to make your water jacket) without getting a punch-thru and a leak into an exhaust hole. You just need to cool the filler block somewhat so that it does not expand much, additionally to keep it from transfering heat into the motor block and case, and to keep the escaping fresh charge cool till it is rammed back into the cylinder.
I mill a channel about 1/8th inch deep into both long sides of the filler block, maybe a little deeper on one side depending on exhaust holes and staying back from top and bottom and side edges about 3/16 in. all the way around. Now I drill three cross holes with a ¼ inch drill (see fig.1) by starting at the bottom of the milled area on one side and **angling the drill bit to come out at the bottom side** of the other milled area, keeping the cross holes as low to the motor block as possible. This is done to cool the right areas and to keep the cross holes out of any of the filler block screw holes you might have in those areas. You can enlarge the middle hole between the #2 and #3 cylinders, but don't get greedy. Now make two side cover plates out of aluminum 1/8th inch stock X 1 in.wide and the other side 1¼ in. wide and cut to length. Scribe where each plate is to be welded in place and marking "outside" and "top" so they will go on the same way. ***with the plates clamped in place***, measure down 3/4 inch from top **of the filler block** on the right side plate (toward spark plugs) and 1 7/8 inch up from the bottom of the filler block on the left side plate and scribe a cross line on each of the plates. On the top right plate measure where the center of the milled passage is under the plate and mark that with a scribe at 90° to the 3/4 in. line. On the left side plate mark where the **top** of the milled passage lies, drop down ¼ inch from there and scribe a cross line. At the center of the two crosses is where we will drill and tap for our 1/8 in. **pipe** threads. (taps can be bought from auto supply etc. and tap drill size is an "R" drill (.339 in.) An 11/32 drill is .344 in. and would give sloppier threads..)
NOTE - sides of filler blocks are not always perpendicular to the face so **adjust the angle** that you drill and tap these holes because you want the threads parallel to the cyl bore centerline. You have to drill and tap the plates **before** welding them to the filler block because the tap would bottom out on the filler block, not threading properly.

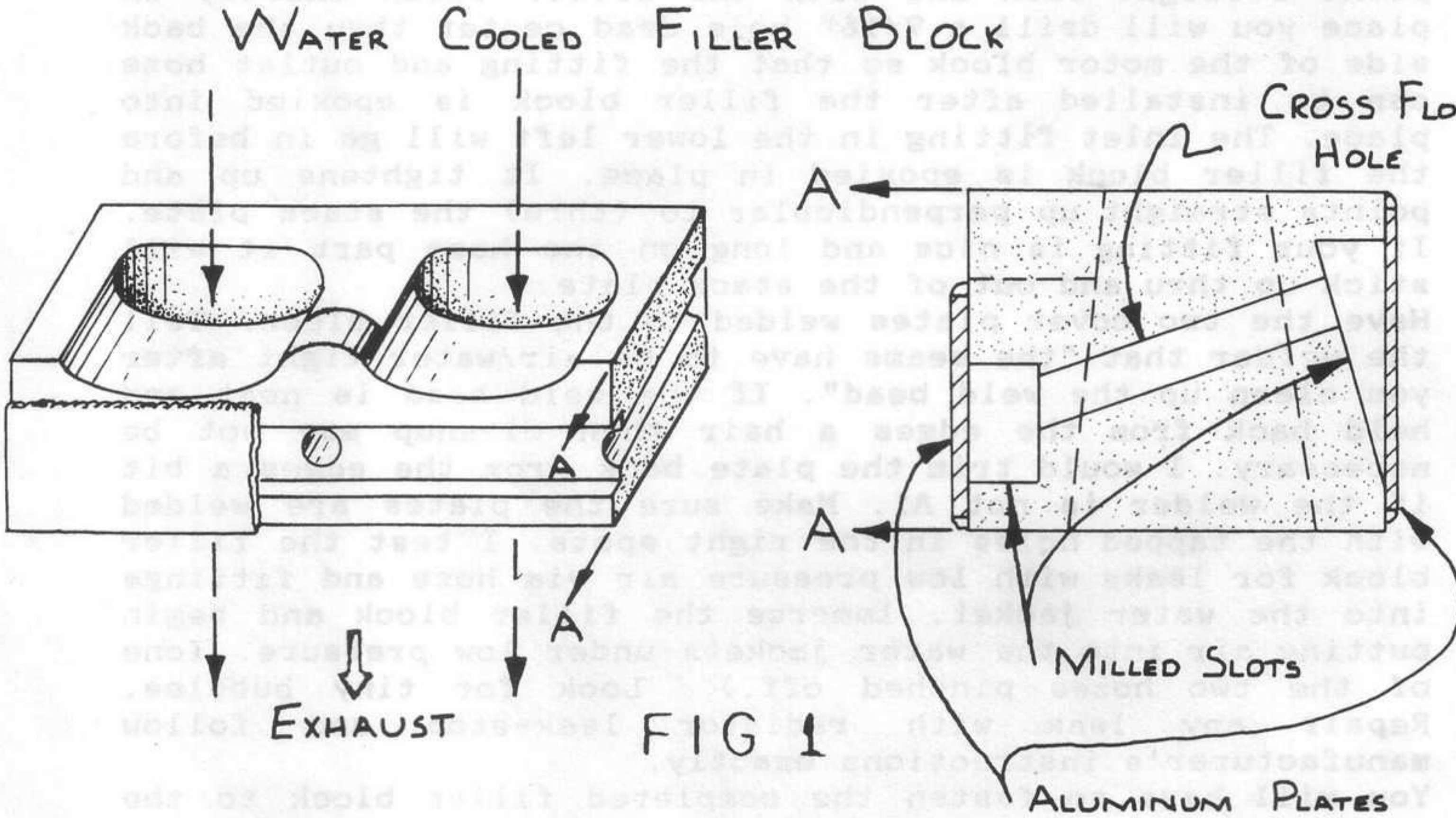


FIG 1

DRILL CROSS FLOW HOLE UP TO HIT LARGE PART OF ANGLED SLOT.

DIAMETER BETWEEN CYL 1 & 2, 3 & 4 : .250"

DIAMETER BETWEEN CYL 2 & 3 : .375"

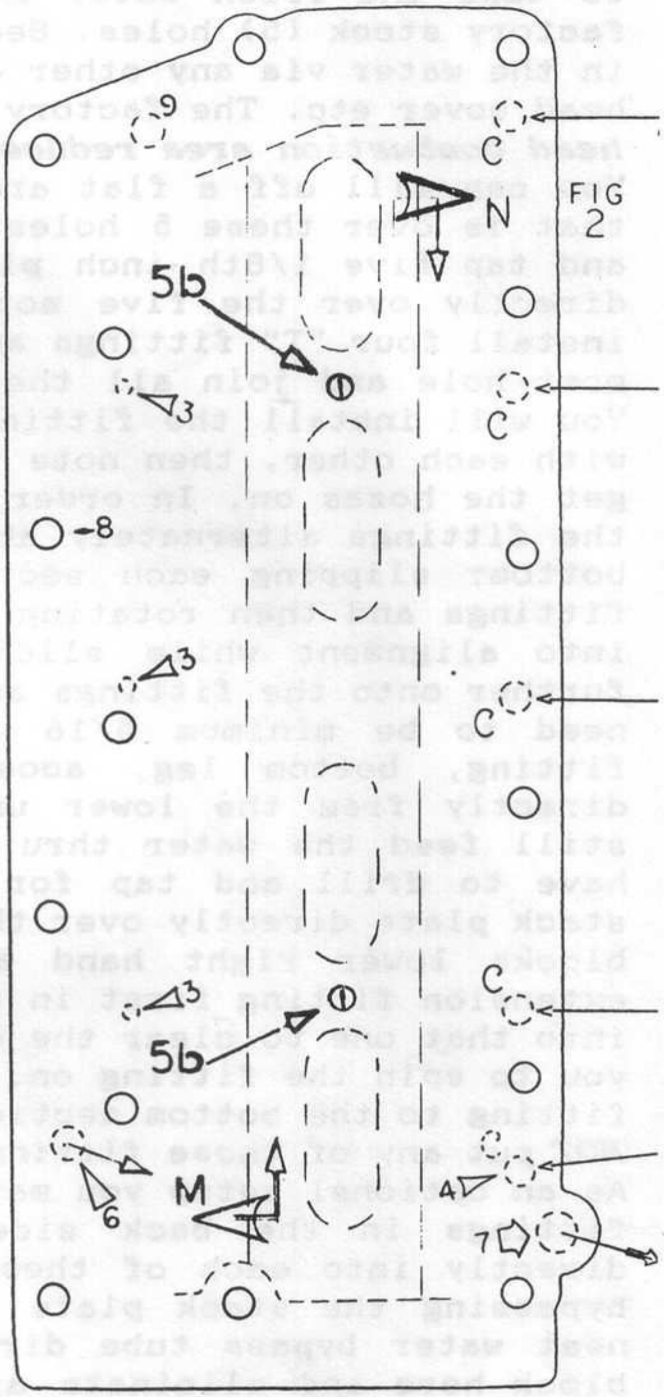
While you are tapping stop every now and then and test the fitting you will use, making sure that it tightens up with only a thread or two protruding thru the plate. You will use a straight fitting in the upper right for 1/4 in. i.d. tubing and a close gaited long nozzel 90° fitting for 1/4 in. i.d. hoze in the lower left. The upper left fitting will point straight back and with the filler block **exactly** in place you will drill a 9/16" hole dead center thru the back side of the motor block so that the fitting and outlet hoze can be installed after the filler block is epoxied into place. The inlet fitting in the lower left will go in before the filler block is epoxied in place. It tightens up and points straight up perpendicular to (thru) the stack plate. If your fitting is nice and long on the hoze part it will stick up thru and out of the stack plate.

Have the two cover plates welded to the filler block. Tell the welder that "the seams have to be air/water tight **after** you clean up the weld bead". If the weld bead is neat and held back from the edges a hair then cleanup may not be necessary. I would trim the plate back from the edges a bit if the welder is not A1. Make sure the plates are welded with the tapped holes in the right spots. I test the filler block for leaks with low pressure air via hoze and fittings into the water jacket. Immerse the filler block and begin putting air into the water jackets under low pressure. (one of the two hozes pinched off.) Look for tiny bubbles. Repair any leak with radiator leak-stop and follow manufacturer's instructions **exactly**.

You will have to fasten the completed filler block to the stack plate (with the 90° fitting temporarily turned back down to clear plate) and mark on the stack plate exactly where it will come thru; then drill a ½ in. hole in the stack plate. you will have to grind or file on it to dead center this hole so that you can get a hoze onto the fitting (after the plate is mounted up) from the outside and wire clamp the hoze. You will also have to grind a small half circle notch in the lower elbow mounting flange to clear the inlet hoze. There is not much room for error in the placement of the fitting nozzel hole. Look at the water jacket edge on the motor block and where the lower elbow flange will go on the plate and see how we are riding the middle ground. The length of the threaded area on the 90° fitting plays a part in this locating proceedure. Cut the stack gasket hole for the hoze/fitting and the lower elbow gasket notch.

Water Systems - You must make up a water distribution tube to take the fresh water into the cylinder block thru the factory stock (5) holes. See Fig 2.(c) You should not bring in the water via any other area such as tapped into the cyl head cover etc. The factory way is best. ***Overcooling the cyl head combustion area reduces Torque & H.P.***
You can mill off a flat area on top the stack plate area that is over these 5 holes in the motor block, then drill and tap five 1/8th inch **pipe** threads into the stack plate directly over the five motor block holes. ***Later*** you will install four "T" fittings and then a 90° fitting in the top most hole and join all the fittings end to end with hoze. You will install the fittings, bringing them into alignment with each other, then note they are too close tip to tip to get the hozes on. In order to get the hoze on, you rotate the fittings alternately about 20 degrees, starting at the bottom, slipping each section of hoze over the pairs of fittings and then rotating them back (together as a group) into alignment while sliding the short sections of hoze further onto the fittings as you progress. Fittings and hoze need to be minimum 5/16 in. i.d. The bottom most "T" fitting, bottom leg, accepts the fresh/cold water line directly from the lower unit. On lower unit setups that still feed the water thru the base of the block you will have to drill and tap for one more 90° fitting into the stack plate directly over the **larger** water hole in the motor blocks lower right hand area. You will have to use an extension fitting first in this new spot, then a 90° fitting into that one to clear the other lower "T" fitting and allow you to spin the fitting on. Next loop the hoze from this 90° fitting to the bottom section of the bottom "T" fitting. ***DO NOT*** put any of these fittings into the plate till later on.
As an optional setup you may elect to install all these same fittings in the back side of the motor block, tapping directly into each of these same inlet holes directly and bypassing the stack plate entirely. Some racers install a neat water bypass tube directly on the back of the motor block here and eliminate all the fittings. If you do this you will have to **vent** the water cooled filler block differently than I described before.
The Quincy Exhaust systems **have** a water bypass tube that works for "C"'s and 40 c.i." D"'s and M58 style 44 c.i. blocks. For the Merc 500's I have to do a custom installation just as described above. Most CMRS/Quincy systems are on CMRS Marine built "C" engines.

Illustration:



2. C - The factory 5 holes to get water into the motor block.

3. Water outlet holes in Merc 500 style blocks.

4. Water inlet on Merc 500 style block only.

5. Water line from gear housing. Goes to holes designated 2. "C".

5. "b" - Screws stack plate to filler block.

6. Water outlet to filler block water inlet.

7. Water Via LEG and base of motor block goes into "C" holes.

8. Bolt holes for stack plate.

9. Outlet for CMRS special water system.

M. Filler block inlet fitting.

N. Filler block outlet fitting.

Follow the flow arrows from "5" on up into the "C" holes to show how the water goes into the block. We use flex hozes from the gear housing, to get the water up to 5.

On setups using the factory quicksilver down housing or

External cooling -You need to drill and tap three holes for 1/8th in. pipe fittings up on top of the cylinder block. They have to be far enough apart to swing the 90° fittings that go in them. You can run 5/16" copper tubing out of them and run 3 lines. One goes to each stack tube aimed to hit just behind the fasteners on top of each tube. The third goes to another copper tube which will go down to spray water onto the leading faces of the two elbows at a point near the junction of the elbow and its mounting flange, dead center. I restrict the open end of the 3rd tube a little where it sprays onto the bottom elbow and also drill a .080 in. hole in the side of this tube aimed to spray at the same exact point on the **upper** elbow. One last water fitting needs to be drilled and tapped thru the stack plate. At the lower left hand corner near the bottom left of the cyl block exhaust side water jacket, drill and tap a 1/8 in. pipe hole to access water there and promote a little flow. This will be a straight 5/16 hoze fitting and a short 180° loop of hoze goes to the filler block intake located about 2 inches away. Don't make it so short it kinks. On OLD style 4 port cover cyl blocks you must plug the factory outlet hole in the side of this water jacket area where it sprayed onto the bottom exhaust port area.
***NOTE* - On CMRS Marine built engines you will see a different water hookup with many more tubes all over the block.** This is my Two loop, reverse flow CMRS^MOD Water system which will add some H.P. to any engine it's on. The idea is to maintain an ideal cylinder head temp, not too cool or too hot, while keeping the rest of the engine as cold as possible. (The carb has to be warm enough to vaporize whatever you use for fuel of course). The external cooling on the exhaust system is mostly done to prevent horrible burns to your pit crew.
Final Installation of the filler block. I use "SWISS SNOWITE flexible Autobody Filler" stock No.3302. It is a two part epoxy type that holds well and after a seasons running the filler block can be cracked up and out without a crow bar. I don't like **permanent** installations. There are other materials and some people use silicone.
Snowite gets rubbery after a few minutes so you have to have **everything ready** before you mix it. Do a practice run where you *pretend* to put the expoxy on and then put everything into place just like for real. Wrenches, bolts, cleanup rags, cue tips, lacq thinner, slim long blade knife, etc. you will have to have ready at hand.

Hopefully you have your cyl block clean and honed and disassembled. If you are doing this with an assembled powerhead then you must pack the ports with cottonballs, tape the flywheel from turning, and invert the assembly when carving and removing excess epoxy from the exhaust holes. A spray can of contact spray will clean things while inverted. Take the disassembled block and wipe the oil off the cyl walls till they are dry. This keeps epoxy flakes from sticking. I take 3½"X8½" pieces of paper and lay them into the cylinder bores over the intake sides to catch the epoxy falling thru the exhaust ports during cleanout later.
Now fasten the filler block to the stack plate without the gasket. Instead slip a couple .004 inch shims between the filler block and stack plate and tighten them up. The shim need to be clear of the exhaust holes and not get between the stackplate and the cyl block. With **everything** ready, wipe the filler block and motor block joining surfaces with lacquer thinner on a **clean rag** and dry them. Mix the epoxy and **Quickly** spread it onto the bottom surfaces and ends of the filler block liberally. Quickly install the stack plate assembly and bolt it down hard with about half the bolts. Use a ratchet to do it fast! You want to squeeze out **all** the epoxy which has gotten between the stack plate and the motor block just above both ends of the filler block. Within a minute or so the epoxy turns rubbery and almost solid. With a long skinny sharp pointed knife I go into the exhaust holes and carve out all the excess epoxy which has squished out into the exhaust holes. Pick out the big pieces with big tweezers and clean things up inside. Let the epoxy cure, then remove the stack plate bolts and filler block screws. You might have to bump the plate **sideways** to break it loose from the epoxy you trapped between it and the block. **Avoid prying it up** as much as possible. I use a little parting wax on the edges of the cyl block interface to avoid sticking in these areas. Quickly remove the shims which have enabled you to mount your filler block a hair below flush and inspect the filler block/cyl block interface to see if it needs a bit more epoxy to seal all aound the bottom edge on both sides. Pack a little extra epoxy at the top right end of the filler block to "lock" it in place and add more epoxy at the bottom end of the filler block to seal it all in really well. This last area will definetely need this second application. Some people completely seal this bottom of the cyl block off, but I do not. If you get a leak in one of the hoze/fittings inside the stack plate somehow, you want the

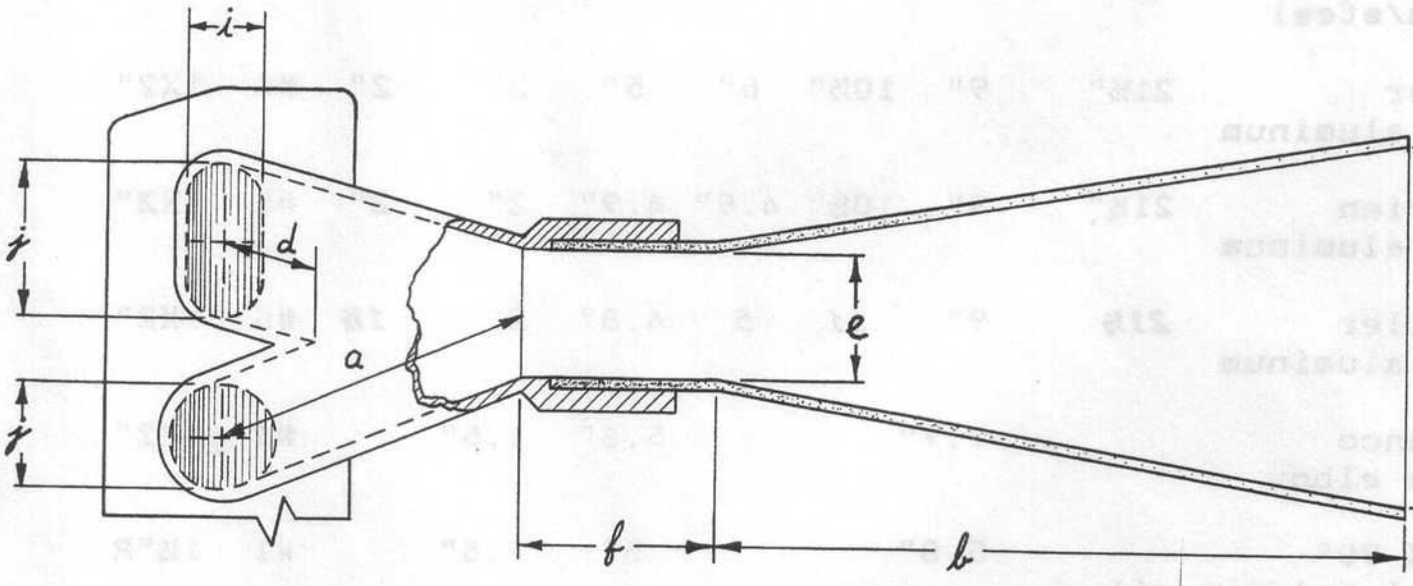
bottom open to drain off the water. (a small 1/8 hole on the Mod leg housing and powerhead to lower unit gasket is necessary to drain this area. Clean any dried epoxy off the Cyl block, filler block face and underside of the stack gasket.
As soon as you get the second coat of epoxy on, quickly put the gasket in place on the cyl block and make sure all the water holes are cut in it. **Then** place it against the underside of the stack plate and again make sure all the water holes are made. You may have forgotten the 1/8th in. pipe hole that feeds the filler block hoze, etc. Now apply a circle of exhaust gasket sealer (copper cote etc.) around each ehaust hole on the filler block face. This will seal the .004 inch gap and hopefully stay flexible etc. At this point you might want to slide the hoze onto the inlet fitting on the filler block and feed it thru the stack plate hole as you lower it into place. If the fitting has a short nipple you might want to wire tie the hoze behind the nipple before the plate goes on. Now lay the stack plate down in place and run the two filler block screws in **finger tight.** Now fasten all the stack plate bolts/allen head countersunk screws whatever and torque them. Wipe the exhaust holes clean of compound and remove the two filler block screws. Clean them and apply medium loctite to their threads and put them back in. **Do not tighten them.** just put them in till they stop and let the loctite retain them; otherwise you will bring outpressure onto the filler block and might pull it loose eventually as the epoxy gets older.
Do it all as quickly as you can. I do not like having the filler block freshly epoxied in without having the stack plated bolted down on top of it.
Now install the water tube "T" fittings etc. and the hozes just as previously described. Install the elbows and then the megaphones and water tubes. I use a little red RTV to seal the megaphones to the elbows and make sure to wipe the inside clean.
Other manufacturer's stack systems will differ from the described Bayer installation. I would install Parker's and Hustler's systems pretty much the same way as the Bayer. You will have to install the water inlet fitting on the Hustler filler block differently however.
If you listen carefully to the engine sound coming from the stacks of some of the winning rigs out on the race course you will notice they have a distinctive "ring". This is due to perfect ports and perfect stack installation.

Stack tube length tuning -
Megaphones provided by manufacturers for their systems come "pretty much" the correct length for Mercury motors and allow for water cooling. If you have highly modified your ports then you might benefit slightly by shortening the overall length of the system.

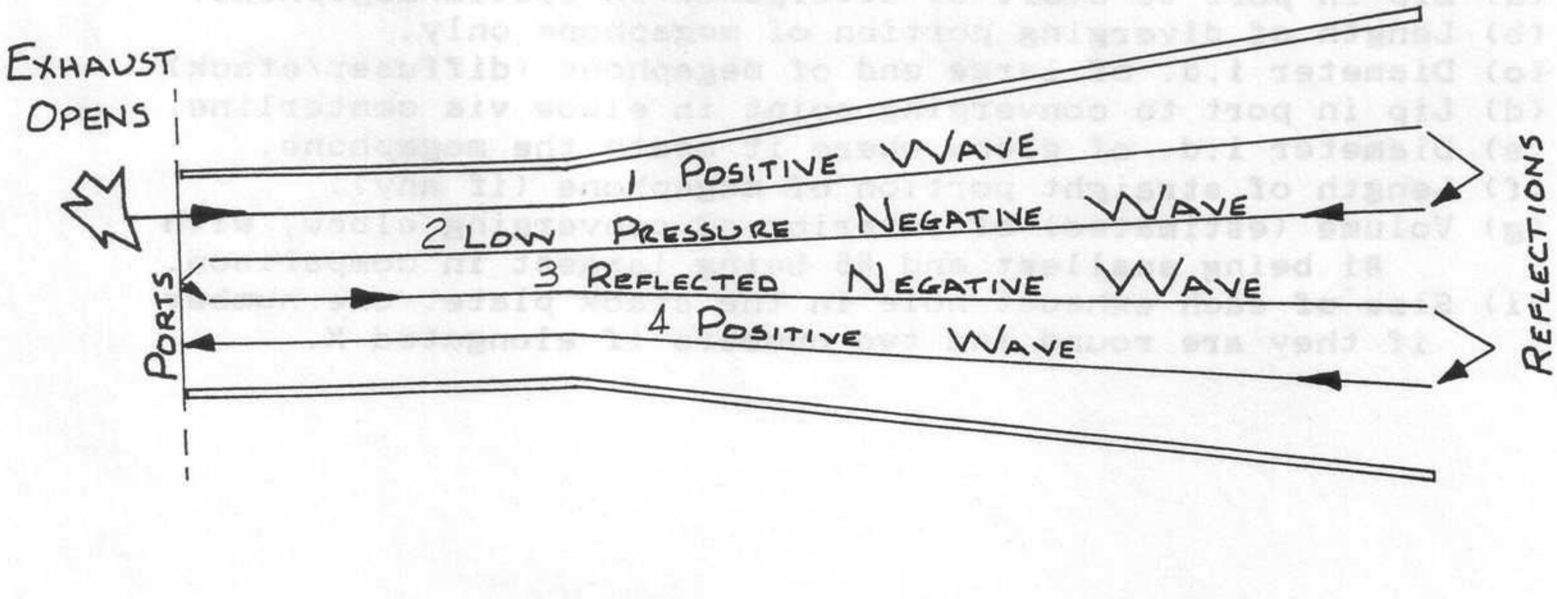
These tuned exhaust megaphone systems all work the same way. When the exhaust port opens, rapidly escaping gasses generate a sound wave at the exhaust ports. This wave travels at the speed of sound to the the megaphone portion where it is changed. At the megaphone this wave is inverted and changed into a ***negative*** wave which reverses direction and races back to the exhaust ports, creating a lower pressure area which helps drag all the exhaust gasses out of the cylinder. This low pressure area will suck the fresh charge right out of the crankcase and up thru the bypass and intake ports into the cylinder (good). At Mid RPMs, it has time to suck a portion of the fresh charge from out of the cyl thru the exhaust ports into the exhaust system! (This is bad)
Your stack megaphone has an angle of divergance, designed by the manufacturer. Any stack tube is a wave inverter. If it has a 2 in. inlet dia. and is only 2 inches dia. at its outlet, then the wave will not invert until it reaches the open end. All the energy will come in one short strong **pop!** With divergance between 6 and 8 degrees however, the inversion process begins at the point of divergance and continues until it reaches the end of the cone. This makes the wave inversion happen over a longer period, lengthening the period of time for the negative wave to be present at the ports. Since the energy is only "X" amount, the strength of the wave is weaker during the lengthened period. The wider the divergance of the cone the less energy is left at the open end to go POP and the more energy is distributed thru the period of divergance. This only occurs within 6 to 8 degree parameters however.
Fortunately this same negative wave again reflects, this time from the exhaust port area, and travels, still as a negative wave, back to the big end of the megaphone once again. In the megaphone it inverts to a **positive** wave and returns back down the pipe to the exhaust port where it causes an area of high pressure. At 4500 to 6000 RPM (depending upon the tuning) this timing is such that the pressure arrives just as the fresh charge is spilling out

into the exhaust area and the exhaust ports are about to close. The pressure wave rams the escaping fresh charge back thru the exhaust ports into the cylinder just as the piston closes off the port on the compression stroke. This makes for very efficient combustion which translates to increased torque/H.P.

Each manufacturer's system has unique features which allow these wave actions to continue thru a moderate RPM **band**. Run RPMs below the band and you are ***off the pipe.*** The more heat the exhaust gases retain thru the system, the faster the speed of sound is within them and the faster the wave speed is going to be thru the pipe. Every 50 feet per second increase in wave speed will move the Exhaust system's powerband up approx 250 RPM.
Physically shortening the overall length of the exhaust system will do the same thing. Leave the temperature and other factors alone and each inch you cut off overall length raises the Exhaust system's powerband up approx 350 RPM.



NOTE: BOTH TYPE EXHAUST PLATE HOLES SHOWN ON SAME FIGURE.



<u>Internal measurements of various manufactured systems</u>
all these are converging elbow, two cyl into one pipe

System manufacturer	overall length	a elbo	b meg	c bell	d web	e i.d.	f lead	g vol	i hole
Quincy 1972 all Aluminum	18½"	7"	10"	4"	4¼"	1.75"	1½"	#2	1.4"
Quincy 1966 all steel	18½	7"	11½"	3.8"	4¼"	2"	0	#2	1.4"
CMRS/Quincy alum/steel	19"	7"	12½"	4¼"	4¼"	2"	0	#2	1½"R
Parker alum/steel	20½"	9"	11½"	4½"	4½"	2"	0	#3	1X2"
Bayer all aluminum	21½"	9"	10½"	5"	5"	2"	2"	#4	1X2"
O'Brien all aluminum	21½"	9"	10½"	4.9"	4.9"	2"	2"	#5	1X2"
Hustler all aluminum	*21½*	9"	*11*	*5*	4.8"	2"	*1½*	#5	1X2"
Labanco alum elbow		7.7"			5.6"	1.5"		#1	<u>.8</u>X2"
1½ X 90° steel welding ell		5.8"			5"	1.5"		#1	1½"R

(O) Overall length - from piston <u>lip</u> in exhaust <u>port</u> to end of system megaphone via centerline.
(a) Lip in port to start of divergance in system/megaphone.
(b) Length of diverging portion of megaphone only.
(c) Diameter i.d. of large end of megaphone.(diffuser/stack)
(d) Lip in port to converging point in elbow via centerline.
(e) Diameter i.d. of elbow where it meets the megaphone.
(f) Length of straight portion of megaphone (if any).
(g) Volume (estimated) of interior of converging elbow, with #1 being smallest and #5 being largest in comparison.
(i) Size of each exhaust hole in the stack plate. one number if they are round and two numbers if elongated X.

Manufacturers list:

Quincy Stacks	Quincy Welding in Quincy, Ill. NO LONGER in a business furnishing these products.
O'Brien Stacks	Harry O'Brien Indpls, Ind. NO LONGER making this product.
Bayer Stacks	Central Marine Co. P.O. Box 32572 Oklahoma City, Ok. 73123 (405) 721-2755
CMRS/Quincy	CMRS Marine 4240 N. S.R. 13 Leesburg, Ind. 46538 (219) 834-4844 Round hole filler blocks for sale and ~~complete systems~~ furnished ~~installed~~.
Parker Exhaust Tim Korcz	~~Bud Parker 2304 Derby Birmingham, Mi. 48008 (313) 649-6662~~
Hustler	Hustler Rce Products P.O. Box 461 Harrisonville, Mo. 64701 (816) 884-4729
AirCone	Aircone Inc. 240 Elliott Henderson, Nv. 89015 (702) 566-1077 Fax 566-0232 Maker of custom cones and megaphones and expansion chambers to order.

Port opening and closing in degrees of crankshaft rotation

Powerhead model	KG4,M30H,M58 & Merc 500	M20H & M55H
Intake opens	116° ATDC	112° ATDC
Intake closes	244° ATDC	248° ATDC
Exhaust open	100° ATDC	98° ATDC
Exhaust closes	260° ATDC	262° ATDC

These measurements are accurate within +-1 Degree and represent ports within stock specification tolerances

Figuring out Exhaust system lengths

specific RPM / 60 = Revolutions in one sec. **5600RPM / 60 = 93.33 Rev Per second**

1 / Rev.Per Sec. = .Seconds per 1 revolution **1 / 93.33 = .0107 Sec.**

	Degree exhaust port closes	**260°**
minus	**Degree exhaust port opens**	**-100°**
	Deg exhaust port open in 1 revolution	**160 Deg.**

Deg Exh port open / 360 = percent of time exh port is open in 1 Revolution. **160° / 360 = .441%**

.Sec.per Rev X Percent port open = .Second Exh port open in one revolution.

.0107 X .441 = .0047 Seconds

Length in inches from port X 2 to point being measured = Distance inches that wave travels to get *NEG* wave (low pressure) back to exhaust port area

18½ in. X 2 = 37 inches.

Length in inches from port X 4 to the same point as before = Distance inches that wave travels to get a *POSitive* wave (high pressure) back to exhaust port.

18½ in. X 4 = 74 in.

Distance in inches / 12 = Distance in FEET. **37 / 12 = 3.084 ft.**

Distance in ft. / Ave. wave speed in feet per sec = .Sec. to return wave over that distance **3.084ft / 1400 fps = .0022 Sec.**

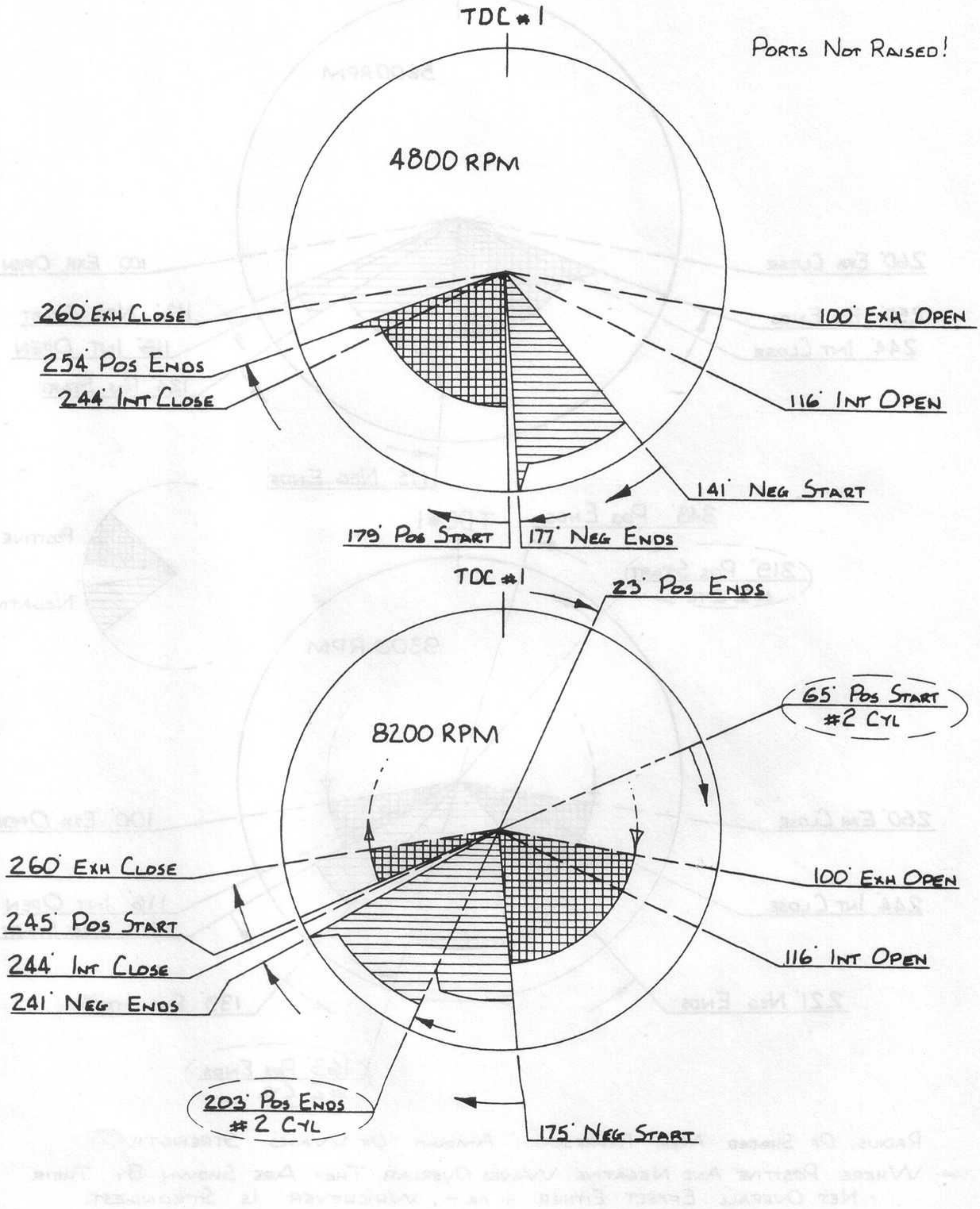
Sec. port open / Sec. to return wave over that distance = percentage of degrees INVERT This FORMULA **.0047 sec. / .0022 sec. = .468%**

Percent of degrees X Degrees Exhaust port is open = Degree where wave returns within that arc area.

.468 X 160 = 74.89 degrees (inside the 160 deg arc)

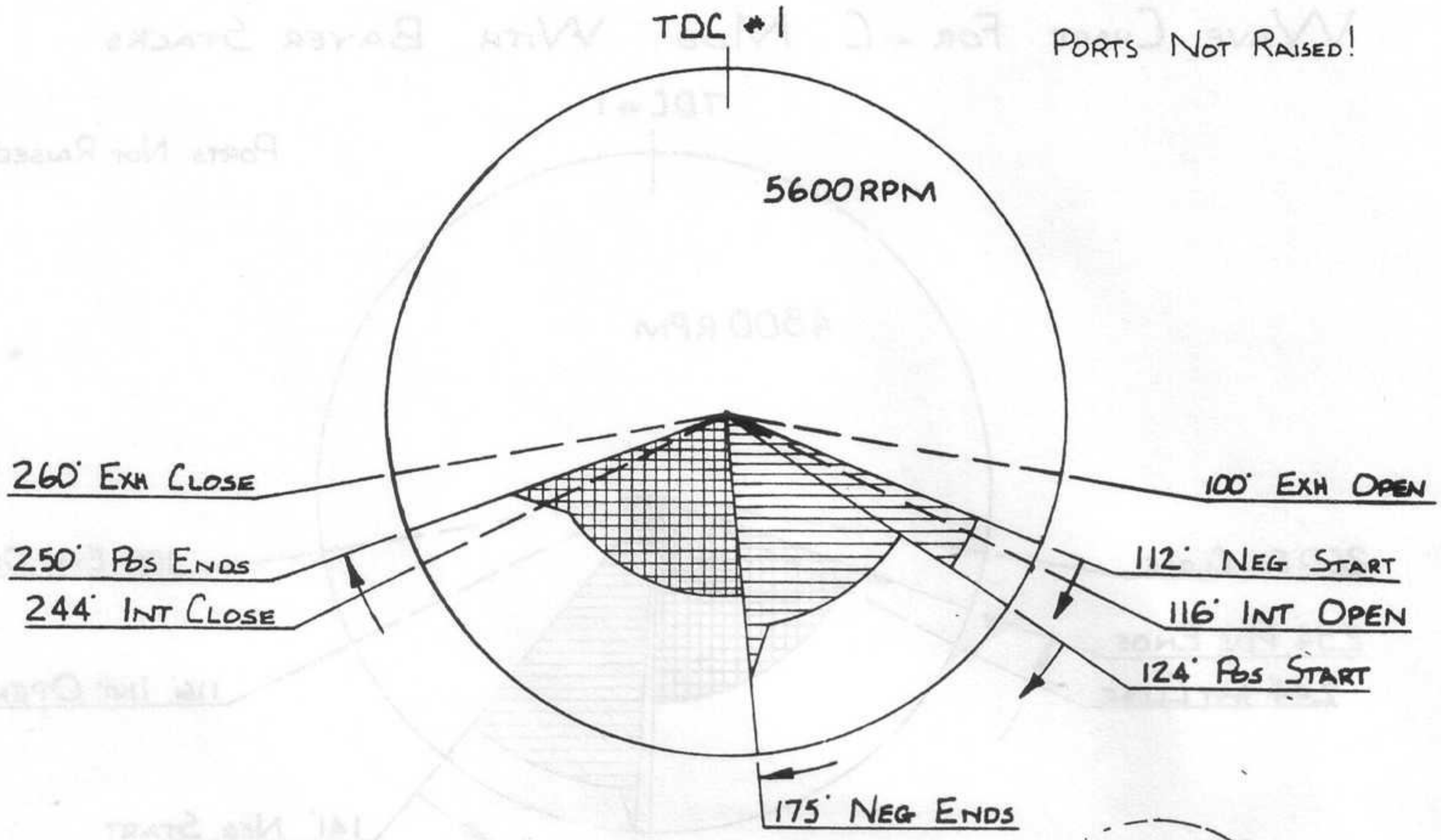
Wave Chart For C Mod With Bayer Stacks

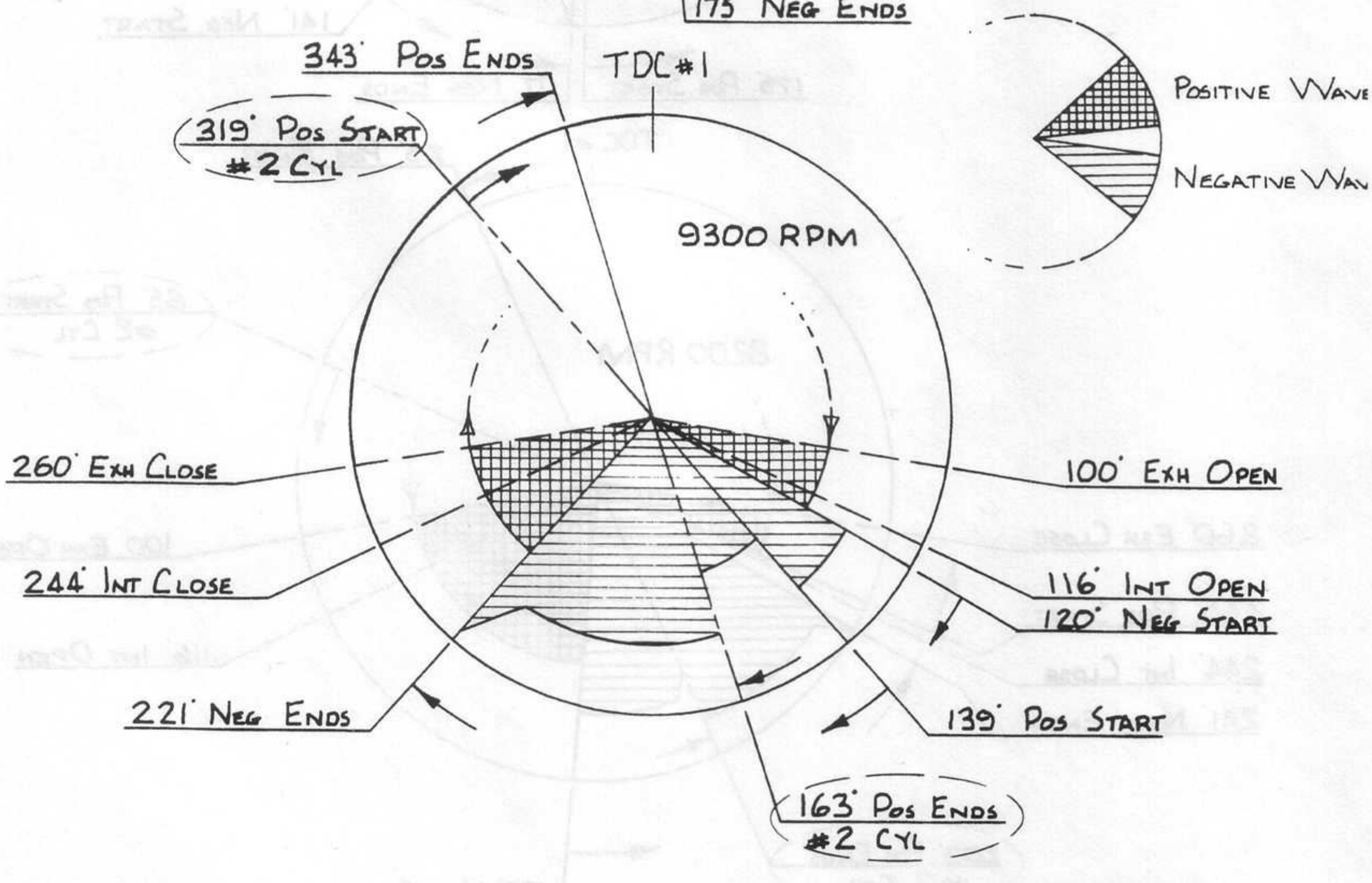
Ports Not Raised!



Same Notes From Previous Page Apply Here

Wave Chart For C Mod With Quincy Stacks





Radius Of Shaded Area Represents Amount Of Wave's Strength.

Where Positive And Negative Waves Overlap They Are Shown By Their Net Overall Effect Either + or −, Whichever Is Strongest.

At Higher RPM's Cylinder #2 Has An Overlapping Influence On #1. Its Positive Start & Stop Are Shown In Ovals Above To Help Differentiate It From Those Of Cylinder #1

Chart Refers To Waves Of And Degrees Rotation From TDC Of Cyl #1

Assembly of your Hi Performance 4 cyl Mercury

You should have the Mercury Marine Outboard service manual (#90-25500)and know everything in it about assembling your motor powerhead. They have it right and I use the Mercury ring compressors (#C91-31461A2, $64.15 per set) to install the pistons in the cylinders.

Here are some extra tips to help you:

I recommend the ring compressors because you can damage the rings by forcing them into the bevel as you *jam* the piston into the bore. It is important that the top outside edge of the rings remain sharp and undamaged.

I setup the crankshaft end play shimming **before** installing anything onto the crank. Just set the crank into the end caps and install on the block/case without the front crankcase. Even up on the amount of shims top and bottom and come down with both ends until you get about .012 in. total end play with the end cap bolts tight. In order to simulate the front case half/end cap bolts being installed I put a long clamp from the top of one end cap to another and draw it up tight a bit. This *usually* brings the end play down a bit to .008 in. Sometimes not; so play with this till you get your .008" or so. (This end play always seems to get less once the engine is fully assembled, so I go for max end play which is .008 to .012 inches.) Now that the end play shims are set, you can assemble the components onto the crank.

Just before assembly time, I clean out the cylinders with clean rags and very lightly oil them with Outboard motor oil. Then wipe the other parts of the block and crankcase halves with lacquer thinner on a clean rag to make them ready for loctite products. I have a boat trailer hand winch on the CMRS workbench and a pulley overhead. I set up the crank in a powerhead stand in the vice and install the ring compressors, using the "straight" one on the #2 cyl. I hang the crank assby from a horizontal cross bar supported by a rope from the pulley/winch system and position the block underneath the hanging pistons. It's a simple matter to lower the crank assby a couple "clicks" at a time while the pistons slide in. I keep the hanger rope tight and don't let the crank settle into position. This way I can "spin" the cages while I apply some Loctite to their outer surfaces. How much loctite depends upon how worn the cages and the block surfaces are. **Don't** get any loctite on the reeds!

I then quickly apply a lite bead of GEL-SEALII (OMC # 327361) a loctite product that seals metal to metal to the end caps and the crankcase half surfaces. (note you should **NOT** use gasket sealer or silicone on the crankcase half surfaces. It is too thick and will actually not allow the case metal surfaces to contact each other, making the linebore "holes" for the cages and end caps too big.) Now position the cages and centermain over the pins and let the assembly down the last ½ inch into the block.

With the cages down on the pins you still have to make sure they are perpendicular to the crank. I have a hardwood dowel that is shaped to go into the reed cage intake. (fig. 9.) I gently tap straight down with a heavy hammer on the dowel which is placed against the cage center inside. This drives the cage against the block squarely, making it perpendicular. If you have a worn cage pin hole and there is slop over the pin location you will have to make sure the cage is not only perpendicular but **centered** as well. I **temporarily** push the end caps all the way in and fasten each with one bolt. I check for cage centered by measuring off the crank cheek on each side of the cage to get it even. (on some cranks you use a .290 drill as "go" and a .295 drill as a "no go" guage between the cheek and the cage. After centering, then finish off with a tap downward and a final side distance check. (You had better check for this sloppy condition prior to assembly on the crank and if you have slop then practice this proceedure before you apply loctite and get into the final assembly. You don't want the loctite to cure out before you are done.) You <u>do not</u> line up cages in 4 cylinder motors by making their intake lips match the intake manifold lips on the front case half.

Pull the end caps back out a half inch and bring the shims out with them, then set the front crankcase half onto the block and push it down in place. Install the centermain and reed cage bolts with tab washers just with your fingers. Push the endcaps back in the last ½ inch in toward the crank and install the end cap bolts with lock washers, just finger tight. Now **quickly** install the case bolts and nuts. Follow the tightening proceedure described in the Merc manual. **Leave the block horizontal on the work bench.** Do **NOT** move it from horizontal till **ALL** the bolts are torqued everywhere or you might touch a cage reed stop with a crank cheek and knock the cage over a bit. As quickly as possible I use an air operated socket and some end wrenches and get the case bolts to snug. Then I snug the end cap bolts. The centermain and cage bolts get checked to make sure they stay finger loose **and in place** during the whole process. Go back in sequence and tighten the case bolts and then tighten the end cap bolts. Now finger snug the cage bolts and center main bolt. Now torque the case bolts, then the end cap bolts. Leave the cage and center main bolts turned in all the way with fingers only and leave the loctite around the cages set up to cure before tightening the cage and centermain bolts. If you have an old worn cage and block you could otherwise pull the cage out of center by tightening up the cage bolt prematurely. I would use red loctite on an old cage assembly.

Assembly of your Hi Performance 2 cyl Merc

Again I refer you to the Mercury Service manual for lots of good info first. There are a few things that may be done differently.

I do not use an arbor press to put things together. I use gas flame heat to locally heat aluminum parts (150° to 200°F.) and slip them together. Heat your crankcase to remove and install the crankshaft. First you should check your reed cage bolt hole **and** the crankcase bolt hole inside the case for **burrs** and sharp edges. slightly chamfer the interface area or you might drag a nasty groove inside the case during assembly.

The seal inside the bottom main bearing housing should go in with the lips **facing in** toward the case. If you are going to idle around off plane a lot with a closed up motor then install it like the factory says.

Mercury says most crankcases will use a .005 in. shim in top under the bearing. Some of the racers did not install a shim there on late model 20H parts. They did all their shimming from the bottom. You really **don't** want to put the crank/cage assby in and out and in, etc. If you don't have a machine shop - everything milled square and true case and block then here is the next best proceedure. Heat the case, quickly line up the crank with the cage hole in line with the bolt hole in the case. Quickly set the assby down into the case without rotating out of alignment. The top and bottom lips of the cage ought to be equidistant in the case intake manifold **and** the cage bolt should go in just with fingers. This **ain't** easy! If you don't do it right the first time it will have to be heated to get it out so you can do it **again**. **DO NOT** pry on or beat the cage lips trying to move the cage!

General Section   Mod Mercs

Four Cylinder Merc Flywheels - Newer style crankshafts with the large taper can mount up the flex plate flywheels off the later model mid size Mercs. **Everything** unbolts and leaves you with a tiny 1½ lb flywheel just a couple inches in diameter. You can make an aluminum crank plate (for rope starting) that fits or some of the engines even have a steel rope plate that you can use. Lots of the Merc 500's had this setup. You don't need much of a flywheel for 4 cylinder engines.

Four cylinder End caps - In Modified most racers lathe turn the crankcase end caps to get rid of the externals. This makes it easy to change timing belts and to mount the powerhead onto fabricated motor legs. I like to pick top end caps without the slot holes inside (solid). The latest styles large taper crankshafts had an **extra thick** top journal (.100 inch thicker) and counterweight which required the use of a slightly thinner top end cap that matched. I like to pick the lower end caps that had **TWO** seals rather than just one. I still mount the inner seal lip in and the outer seal lip facing down/out.

Four cylinder mag hangers - The old original mag hanger brackets were two kinds. One had brass tabs and the other had steel tabs holding the top bearing. The tabs also held the unit together and when the tabs failed the unit drops and this can cause your throttle (swing mag Mark 55H setup) to lock up. The brass tabs were failure prone in racing. Once the tabs start to bend open you cannot bend them back without soon breaking them. Prevention is the cure. **Keep the mag hanger greased** (zirc fitting) to prevent bounce. I even shim up under the mag actuator plate to take just a little of the bounce out of the mag assby. Many racers who do not have the 30H and 55H cowl throttle components have gone to the later style mag hangers which are good. They operate with mag advanced and locked there and I do not like that setup. Use factory parts to swing the mag with the throttle if you can. The older two piece mag shafts will not go into some of the late model Merc magnetos. some of the later one piece shafts were different lengths, so pick the right length and test it out on all your mags to make sure it will go in. Some do, some don't. The 4D-3 mags on up gave this problem.

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Down Housings / Motor Legs

Merc Quicksilver Downhousings are just fine for stock racing motors. The 30H Leg will be strong enough for Modified power heads also. The 40 c.i. D leg is eventually going to fail when used on a Modified powerhead with tuned exhaust. The A-B Quicksilver leg seemed to be ok with Modified powerheads but you need to watch them all for stress cracks.

Aftermarket "Legs" have been made for MODs since the 60's. *Most* of them do not accommodate motor exhaust. They were mostly fabricated steel pipe and plate housings that did not need a lower adaptor for the gear housing. Quincy made hundreds of these.

For the last 20 years the "Bayer" cast aluminum housing (for regular transome height two and four cylinder Mercs has been the state of the art. These use a lower "Bayer" adaptor plate to accept Merc gear housings.

During the same period Bud Parker Housings have been offered in fabricated steel for regular transome heights and lately in the shorter 9½" transome height that MODs have gone to.

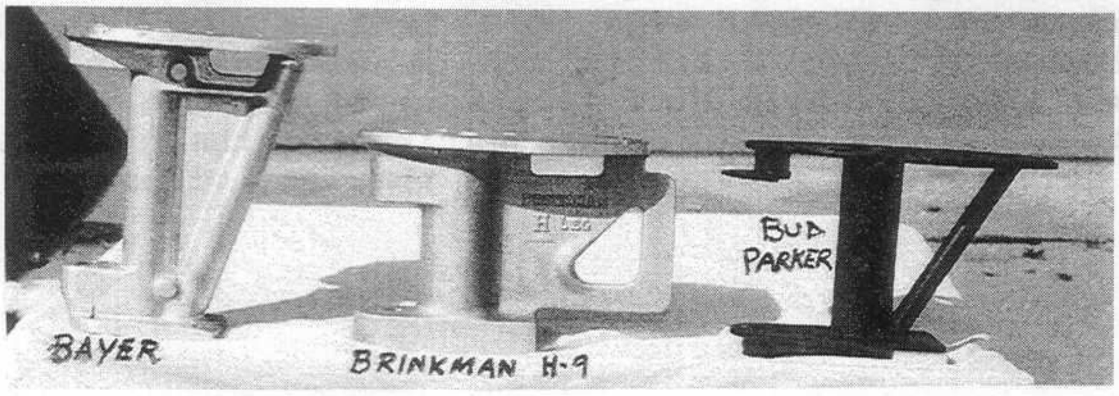
Snyder's Hustler Co. makes a cast alum downhousing that accommodates exhaust. A-one size fits all- short housing.

CMRS Marine makes a cast aluminum Leg that runs on a 9 inch transome and uses the lower "Bayer" adaptor plate for several different makes of gear housings. It has capability to mount the powerhead in **reverse** 180° position to get the weight into the boat and keep the stacks dry on a low transome setup. CMRS H9 Housings can be mounted either on the M55H type 7/8 in. swivel pin or the 1 inch swivel pin (Co-Pilot type, M55, M35A,M75) Mercury swivel brackets.

Addresses for all these are the same as in the Exhaust Stacks manufacturer's listing.

All these Legs use an upper adaptor plate (stock 55H lower cowl, or a Williams type plate, Bayer spacer plate etc.) Some of these internally transfer the cooling water to the powerhead and some require a seperate flex hoze for that function.

Manufacturer name	transome tall 14 in.	9½ in.	Adaptor needed top	bottom	transfer water
Bayer	yes	no	yes	yes	yes
Parker	yes	yes	yes	no	yes
CMRS Marine	no	yes	yes	yes	NO
Hustler	....No	info....	.....	.....	.....



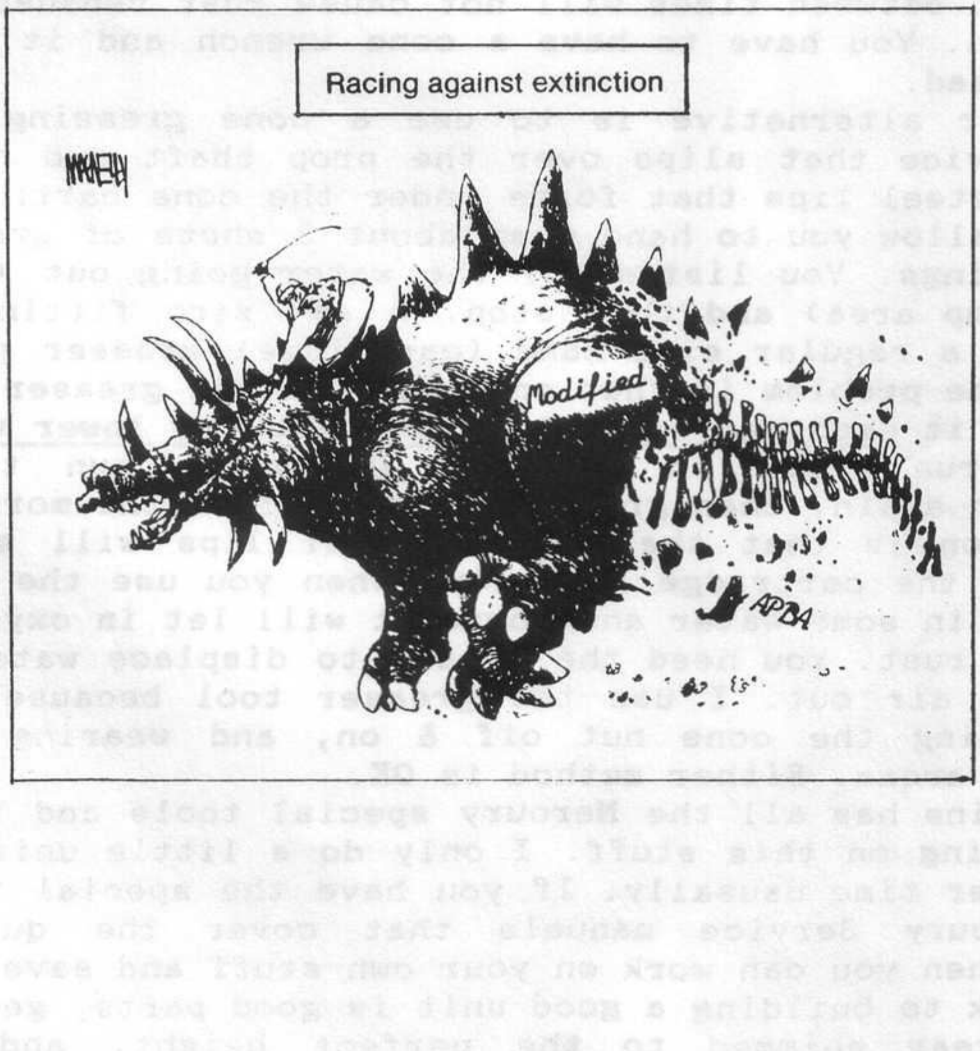
Lower Unit Gear Housings, Merc Quicksilver

The Merc "foot"- The 1950 foot, A-B or D, had a solid bronze bushing tail cone. You should NOT install roller bearings in these solid one piece cone nuts.
The 16:21 ratio gears for the 20H may be used in any of the MOD A-B-C class units. The old A-B gear cases needed relief work inside to make room for the new prop shaft gear. The **very first** 16:21 gear sets had very short teeth and would not last long on the 20H. They updated the gear set with a better longer tooth pinion and prop gear which made them last longer.
The use of 16:21 on the 30H began in N.O.A. AmPRO (gas Mod) about 1966. Immediate improvement was seen in the runabout class. The hydro's will run better with gears also but **not everybody** agrees. CMRS Marine began to have difficulty with lower units as the C engine was improved. Fresh gear cases and parts were necessary and I finally had to have the Prop gear and propshaft (EDM) beam bored all the way thru for a full length gear pin. They bored the hole and lapped it to the exact pin diameter. I use a near hard pin made from an "AN" series aircraft bolt. Basically any pin that you use as a good shear pin will do it. The Merc factory pins were "too" (too small in dia., too short and too hard.) Once I had spun a prop gear on its shaft I would get an all new shaft and gear set because the spun ones would never hold again in a MOD C, even with a new full pin. Use the older tiny tooth gears and spun gear/shaft assemblies in closed up A-B motors; they are OK for that.
Some of the white painted Mercury foots and most all of the black painted foots came pretty much "as cast" The leading edge of the skeg, especially at the root, was blunt and it may or may not be perfect centered up. When they are run over 64 MPH speed on a race boat you may encounter handling difficulties, depending on the boat and the setup. *Sometimes* it is the fault of the gear housing being blunt and not centered. The water doesn't know which side to pass on and runs alternately left right with the boundary stream. Some racers set up a surface plate and scribe a dead center line on the leading edge of the skeg (and torpedo nose) and then *work* the skeg to a sharper edge on this line clear to the root. I always will do a little radius afterward and not have a sharp edge. It will bite you later if you don't.
CMRS has mandrils that go into the bearings of the drive and propshaft holes on the gear case. Then they get clamped into

V Blocks on the surface plate and the gear case is held horizontal for scribing with a machinist height guage.
Some MOD racers also mill the sides of their gear housings flat somewhat to thin them a bit and help kill some lift. I had a collet mandril made up that fits the propshaft main ball bearing hole. This holds the unit for equidistant measuring and while milling flat(s) on the sides of the torpedo.
If you run your rig with the whole torpedo in the water at lower speeds then you don't have to worry about any of this.
Cone Greasing - The worst area for bad maintenance is the Cone Bearing cartridge assembly. You have two choices if you run your motor. Take the Cone nut off at fairly short regular intervals of running and grease the bearings with good grease. If your seals are good then any water that creeps in between times will not cause rust because of lack of oxygen. You have to have a cone wrench and it's a **left hand** thread.
The other alternative is to use a **cone greasing tool.** A small device that slips over the prop shaft and has sharp precise steel lips that force under the cone cartridge seal lip and allow you to hand pump about 3 shots of grease into the bearings. You listen for the water going out (into the water pump area) and then stop. A 45° zirc fitting on the tool and a regular size hand (cartridge) greaser pump will do it. **The problem is** that once you use the greaser tool you **must use it each and every time you get the lower unit wet.**
If you run early in the day and won't run till late afternoon again, then grease the cone after the morning run. The reason is that the precise metal lips will make tiny nicks in the cartridge seal lips when you use the tool. It will let in some water and worse it will let in oxygen later to cause rust. You need the grease to displace water and to seal the air out. I use the greaser tool because I don't like taking the cone nut off & on, and wearing out the threaded areas. Either method is OK.
CMRS Marine has all the Mercury special tools and **then some** for working on this stuff. I only do a little unit work in the winter time ususally. If you have the special tools **and** the Mercury Service manuals that cover the quicksilver stuff, then you can work on your own stuff and save money.
The trick to building a good unit is good parts, getting the pinion gear shimmed to the perfect height, and special tools. I use a slide hammer puller to remove the prop shaft assembly rather than the Merc tool. Get the Merc manual!!

16:21 Gear Sets

Gear sets	Pinion gear teeth length	Pinion gear teeth width	prop gear teeth Length	prop gear teeth width
Original old set	10/32" X	1.5/64"	7/32"	X 1/32"
replacement sets	12/32" X	1/32"	8/32"	X 3/64"
Mid-1970's sets	12/32" X	1/32"	10/32"	X 3/64"*
Late 80s thru 94	measure them			* flat top



Breaking in your fresh built Mercury

Brand new Mercury 44XS - Out of the box new. For stock racing I would disassemble it and clearance hone the rods and possibly the center main race. I would chamfer the ports, cut +.015 rings down to custom fit and crosshatch hone the bore; **then** reassemble it for break in.

Breaking in a brand new motor is a series of events. You have to break in rings to bores by **wearing** off microns of metal surfaces. You "break in" new pistons by a heating up cooling down **de-stressing process.** During this initial phase you **don't** want to high Rev the engine and you **don't** want to load it (as in a full throttle turn or too high pitch on your prop).

Rings - If you fit butt gaps way down you have to keep the combustion temperature down with lower timing. Just put enough easy time on the engine to wear them in a bit. I figure about 20 minutes with my setups with a test wheel and then plane it off and run easy for another 20. That does it for the rings and they will hold optimum for a couple hours and then start going down. Keep track by compression checks thru the season. If you have used teflon piston skirt treatments or other similar products then the rings may never break in right.

New Pistons - I start the engine up with a test wheel on it and run easy for a few minutes till the engine is warmed up all the way, then shut it off and let it cool **completely**. I do this at least three complete cycles to get the stresses out of the pistons **and conform them to the cylinder bores.** If you have nice straight bores and the piston fit is tight then the cylinder will keep the piston round. If you have an egged bore and/or sloppy loose fit then the piston will take whatever shape it wants to as it cools. After a few times thru the process the piston is done de-stressing and it keeps that shape, round **or** egged. One exception - if you **over**heat the engine at any time due to water pump failure etc.,then the bore will probably be egged and the piston will also be egg shaped at the skirt. Keep track of minutes running to calculate for rings break-in time as you start and stop.

Keep in mind if you add extra oil to your gas "for break-in" that you **have to richen up** your Hi speed adjustment and low needle. The extra oil displaces gas and this means less cooling effect. I just run my regular 14 oz. per gal. oil mixture and richen up needles to"an occasional burble"point.

Modified to Alky Technology of the late 50's & early 60's

I did not race this kind of equipment, but I have most of it in my Outboard motor Collection. For the Antiquer and the curious I offer the following:

Hubbell "Wildcat" extra reeds KG7H - In addition to head pads, Hubbell installed extra reeds on the **outside** of the intake bypass tunnel on the block. They let in extra air and if you enrich the high speed needle setting, your small AJ carb'd KG7H would go faster. A larger carb would have been better, but was not "legal" at the time.

Quincy "MUMPS" gravity tank 20H ALKY Conversion - Open exhaust, Head padding, Porting, Quincy gravity gas tank on the motor, Carter Carb and Mumps were included in the package. The **Mumps** consisted of an intake manifold attached to the case front where the carb used to be. The Carter carb bolted onto that. A straight thru passage conveyed the air from the carb to the reed cage. Additionally there were two reeds top and bottom on this passage leading to seperate chambers. Each of these slot chambers were vented into a rectangular hole thru the front of the crankcase top and bottom. It was like adding two extra reeds per cylinder. **If** the stock cage was restricting flow there **could** be improved performance.

O'Dea "Red Head" Alky 20H - Consisted of a **cast iron** 20H cylinder block with a removable aluminum head and an open exhaust stack. Also included were brackets to mount either a KG gas tank or install 20H Cowls. The port dimensions were the same as on the stock block. I bought mine from Pep Hubbell who bought it from O'Dea to "see how good it was on the Dyno" "No improvement", says **Hub**...

CYL Head PADDING - Some pretty crude, some were much more sophisticated with pads matching the tops of custom piston deflectors. All originally designed to **reduce C.C.s at TDC.** More modern pads for **gas** burners would **exactly** match the Merc piston deflector on the exhaust side and be placed to give a squish area of .040 to .055 inches between piston and cyl head/pad. They would be very costly!

They cut a hole in the solid Merc head on intake and/or exhaust sides and inserted the pad; then welded it from the outside. If you try to burn gas in one of these, be careful with timing so as not to burn a piston. I wouldn't do it.

Crankcase Padding - This was done even after tuned stacks came along. Pads were added to the entry area of the bypass

port tunnels on four cylinder blocks. They filled the "dead areas" where the crank cheeks were blocking flow anyway. (This is the area I **utilize to advantage** by grinding away a portion of the obstructing crank cheek). *To each his own.*
For the **two cylinder** Mark 20H people *someone* made up some **"tight crankcases"**. These had a narrower rod channel inside the case and more material near the entrance to the Bypass port tunnel. This was not an improvement and anyone using one of these cases usually opened up the area at the bypass entrance back to stock or even a bit larger.
Crankshaft Padding and counterbalancing - This usually consisted of welding a couple .100 inch thick plates to the insides of the counterweights on each cylinder. There was just enough room for the rod and this padded the case as well as "counterbalanced" the crank.
Quincy 3RD Porting - Consisted of a port in the rear side of the reed cage, thru a hole in the motor block between the two cylinders served by that cage. This hole came out thru the side of the block into that area between the two bypass port tunnels. From this area they then drilled a 90 degree cross hole dead center between the two cylinders which broke thru cylinder walls of both the bores. **This** was then a mutual piston port, operated by the piston skirts. The height of the port was of course critical.
Quincy "Looper"- Made by Quincy Welding, this Alky burner used the Merc Crankshaft assembly and rods. Reed cages by Quincy were slightly improved over Mercs. The block and case however was a loop scavenged design which had two exhaust ports per cyl, one on each side, and piston ports to augment the cages along with the 4 intake bypass ports, two per side. There were two exhaust stacks per cyl which were shared by the adjoining cylinder also. 20H Carter carbs modified to alky and fitted with "overflow" fuel bowls completed the picture. They made A-B-C-D "E"44 & 6 cylinder F versions of this design. The F's could run about 100 MPH.

This was a great era of racing the Modified Mercs that ran Alcohol fuel from about 1952 thru 1969, and continues today for the gas burners in two major Modified National Clubs.

American Power Boat Ass'n 17640 E. nine mile road
East Detroit, Mi. 48021 (810) 773-9700

American Outboard Federation ~~1002 Foley~~
~~Iowa Park, Tx. 76367~~ →

Corrections

and additions to the 1994 manual

Page 3, number 5.* Add to bottom of page a note -

*Note 180 grit is my choice for crosshatch when using the good old tin coated Merc rings. For other rings, softer and/or various materials and/or coatings, follow ring manufacturer's recommendations, usually for a finer grit.

Page 17, 4 Cyl 44 c.i. Merc 500 Blocks-

More numbers : 831-4989/black, 831-2750/silver

Page 26, line 23 -

increasing is wrong, change to "decreasing".

page 53, bottom 1/3rd

Epoxy for filler block "SNOWITE" is NLA. Pick a good polyester body filler and try it.

page 59, middle -

~~Bud Parker~~ phone number, change ~~area code~~ to "~~(810)~~" ~~248~~

Page 60, add to bottom of page, formula, plus wording -

Deg. within arc + Deg. Exh port opens = Deg. from TDC where your wave returns.

74.89 deg. + 100 deg. = 175 degrees!

"and since this measurement was the end of the megaphone this is the degree where your neg wave ends for this series of measurements and values plugged in for our example."

page 76, bottom of page -

AOF address now

" 4201 Indian Boundary Rd. Center Point, Ia. 52213"
phone (319) 849-1022

PAGE 77 BOB GRUBB 610 948 8855

CORRECTION Page 2

page 1. Piston clearances for 44 c.i. Merc. NEW pistons need MORE clearance. Suggest .0075 COLD F.B. & .009 HOT Filler block. *Some* people have reported sticking the new Keystone ring pistons at tight clearances....

Page 25. "C" Merc porting. Rules changes allow lowering of the C1 measurements on Exhaust ports. You can't go more than .035 in. toward the crank on the center port without UNcovering the crankcase at TDC... CMRS now does a port job similar to the look of the Merc 44. Call for specifics.

Page 59&69. Stacks and Motor Legs made by Bud Parker- Bud has retired and Tim Kurcz has taken over. (248) 684-7430 shop & 5579 home. 1640 Heather Lane Milford, MI 48381

*Mercury Outboard Service manual, 1964 and previous, is #90-25500 order at Mercury (414)929-5110 or Bob Grubb's. You need one for the basics not covered in this manual.

For Quicksilver or Speedmaster Lower Unit repair/building I go to Steckbauer Speedmaster Service 1571 Westhaven Circle Oshkosh, WI 54904 (920) 231-1149

For Cylinder Boring & Rod Honing I go to Ruck Machine 1268 Glane Court Oshkosh, WI 54901 (920) 233-3833

Bob Grubb Marine has MANY parts for the Mercs plus services and reproduction parts. 1368 Meadowbrook Rd. Pottstown, PA 19464 (610) 948-8855

Page 30. reed cage side of crankshaft counterweight can be beveled at max 45° up to min angle 26° The crank HAS TO BE turned by hand just 200 deg rotation to do less than 45 deg angle like on drawing.

page 77 .Reeds for the Mercs can be had at BOYESEN (get single stage 44XS). RD# 1 Box 862 Lenhartsville, PA 19534 1-800-441-1177 except in PA 1-215 756-6818 (-4102 FAX)

Make all these CHANGES by hand on the designated pages right now to avoid errors.

Information

If you do not have the Mercury Outboard Service Manual 1964 and previous, I strongly suggest you consider getting one. Cost is about $30. and they take plastic. The manual covers all models including the racing 2 and 4 cylinders motors. It covers from the powerhead down to the lower units. The parts number for the manual is #90-25500 So dial 414 929-5110 and ask for "lisa".

For Quicksilver lower unit **repairs** and setups I would use:

Steckbauer Speedmaster Service 1571 Westhaven Circle
Oshkosh, Wisc. 54904 414 231-1149

For Cylinder **boring** and rod honing I go to:
James Ruck 1268 Glane Court Oshkosh, Wi. 54901 414 233-3833

Bud Parker provides many shop services besides making the stacks and motor legs. Occasionally you can get him to make full carburetor butterflys for about $7. each.

Dudley Malone, Central Marine has, besides the Stacks and long motor legs, many used Mercury motor parts. These are reasonably priced. Dudley also provides many shop services for Merc owners.

Bob Grubb has many Mercury motor parts from the 50's era, some new, some reproductions. He has new Merc 2 cylinder gaskets now. 1368 Meadowbrook Rd. Pottstown, Pa. 19464
215 326-8437

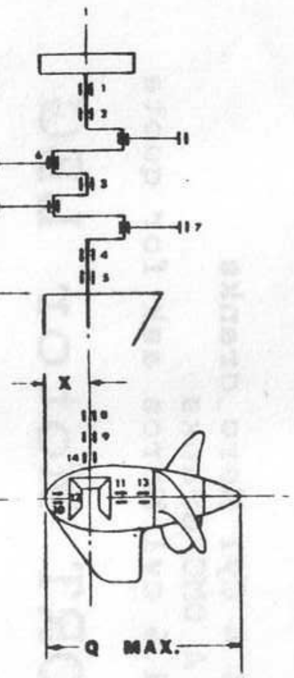
MERCURY

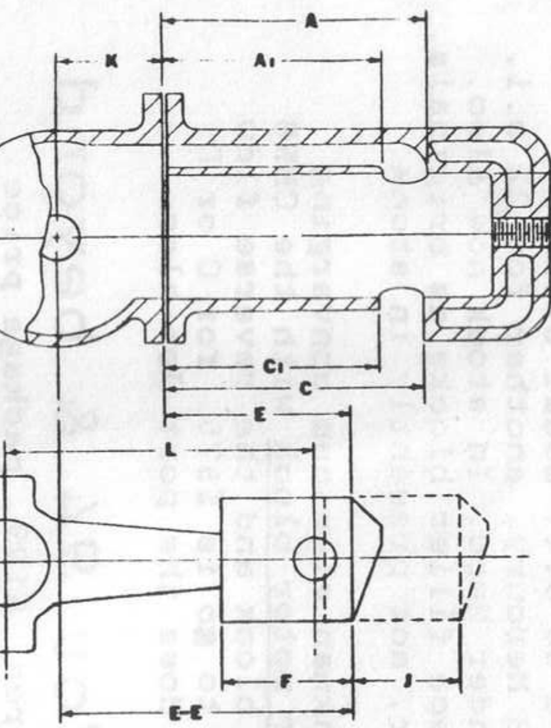
STOCK OUTBOARD MOTOR SPECIFICATIONS

MAY 31, 1971

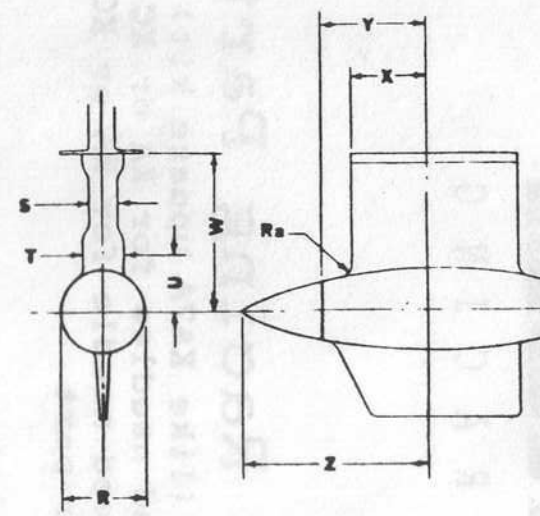
ENGINE MODEL	MARK 5, KF-5 & MARK 6	MERC 60	KG-4	MARK 30H	MARK 75H	MARK 20H	MARK 58H	MARK 40H KG-9 & KG-9H KF-9 & KF-9HD	MARK 55H	MERC 350 STANDARD LOWER UNIT
CLASS AND DISPLACEMENT	J-7.2	J-7.26	A-14.85	C-29.7	F-59.4	B-19.8	E-43.8	D-39.6	D-39.6	36-32.55
1 NUMBER OF CYLINDERS	2	TWO	2	4	6	2	4	4	4	TWO
2 GEAR RATIO	16-21 OR 13-21	16-21 OR 13-21	15-15, 16-21	15-15, 16-21	14-14	15-15, 16-21	14-14	14-14	14-14	13-24
3 MINIMUM COMPRESSION VOL. IN c.c. OF ONE CYL. TO TOP OF SPARK PLUG HOLE	9	9.0	14.2	16	20.5	17	22	22	20.5	31.0
4 CARBURETOR: MODEL NO. TILLOTSON UNLESS OTHERWISE SPECIFIED	MARK 5 KF-5: AJ-30A AJ-23A AJ-30B; MARK 6: AJ-30BX AJ-46A	KB-6B KB-5A	AJ-29A AJ-40A AJ-29AX AJ-41A AJ-32A AJ-47A AJ-36A AJ-50A	AJ-49A AJ-51A	KA-3A KA-6A	CARTER N-2150S 15/16 VENTURI DIA. 1 5/16 THROAT DIA. KA-7A	KA-7A	KG-9 KF-9 KG-9H KF-9HD AJ-33A AJ-31AB AJ-31A AJ-31AC MARK 20H 1004B AJ-33A AJ-31A	CARTER N-2557S 15/16 VENTURI DIA. 1 3/16 THROAT DIA. KA-7A	KC-9A
5 TYPE OF LUBRICATION		ALL MERCURY	ALL MERCURY MOTORS USE GASOLINE MIXED WITH PETROLEUM MOTOR OIL							
6 1/64 GASKET A	1.316±.010 1.321±.030	NO GASKET	2.181±.010	NO GASKET	NO GASKET		NO GASKET	NO GASKET	NO GASKET	NO GASKET
1/32 GASKET A		2.938±.010	2.196±.010	4.007±.010	4.067±.010	2.256±.010	4.007±.010	3.886 or 4.007±.010	4.067±.010	4.213±.010
1/64 GASKET A_1	1.074±.030		1.514±.010	3.355±.010	3.329±.010		3.382±.010	3.324±.010	3.329±.010	
1/32 GASKET A_1		2.532±.010	1.530±.010	3.355±.010	3.329±.010	1.531±.015	3.382±.010	3.324±.010	3.329±.010	3.494±.010
1/64 GASKET C	1.652±.030		2.395±.010	4.221±.010	4.281±.010		4.221±.010	4.221 or 4.105±.010	4.281±.010	
1/32 GASKET C		3.095±.010	2.411±.010	4.221±.010	4.281±.010	2.471±.010	4.221±.010	4.221 or 4.105±.010	4.281±.010	4.551±.010
1/64 GASKET C_1	1.231±.030		1.733±.010	3.690±.010	3.543±.010		3.596±.010	3.543±.010	3.543±.010	
1/32 GASKET C_1		2.689±.010	1.747±.010	3.569±.010	3.543±.010	1.750±.015	3.596±.010	3.543±.010	3.543±.010	3.832±.010
E	1.250±.020		1.720±.020			1.720±.020				
E-E		2.687±.010		3.534±.015	3.534±.010		3.534±.010	3.534±.015	3.534±.015	3.692±.010
F	1.687±.010	1 11/16±1/32	2 1/4±1/32	2 1/8±1/32	2 3/16±1/32	2 3/16±1/32	2 3/16±1/32	2 3/16±1/32	2 3/16±1/32	2 3/8±1/32
G	1.750 +.005 -.000	1.750±.003	2.112±.002	2.112±.002	2.441±.002	2.440±.002	2.563±.002	2.441±.002	2.441±.002	3.000±.003
J	1.500±.005	1.500±.004	2.125±.004	2.125±.004	2.125±.004	2.125±.004	2.125±.004	2.125±.004	2.125±.004	2.300±.004
K	1.437±.010		1.814±.005	NONE	NONE	1.814±.005	NONE	NONE	NONE	
L	2.625±.005	2.625±.006	3.719±.006	3.719±.006	3.719±.006	3.719±.006	3.719±.006	3.719±.006	3.719±.006	3.719±.006
N	4 1/2 DIA. PORTS	4 ROUND PORTS 1/2 DIA.	8 OVAL PORTS 1 x 5/8	8 PORTS 1x5/8 or 1 7/32x5/8	8 OVAL PORTS 1 x 5/8	8 PORTS 1x5/8 or 1 7/32x5/8	8 PORTS 1x5/8 or 1 7/32x5/8	8 PORTS 1x5/8 or 1 7/32x5/8	8 PORTS 1x5/8 or 1 7/32x5/8	8 OVAL PORTS 1 7/16 x 3/4
QUICKSILVER LOWER UNITS UNLESS OTHERWISE SPECIFIED Q	9	9	11 1/4	11 1/4	15 3/4	11 1/4	13 1/2	12 1/2	12 1/2	15 1/4
R	1 11/16	1 11/16	2	2	2 1/8	2	2 1/4	2 1/4	2 1/4	3 11/32
S	13/16	13/16	7/8	7/8	1	7/8	1	1	1	1 11/32
T	N	NO DIMENSION								1 11/32
U	N	NO DIMENSION								2 7/16
STANDARD / LONG V	11 55/64, 11 29/32 OR 10 55/64	19 3/32±1/16	19 3/32, 21 3/32 OR 24 3/32±1/16	17 1/16±1/16	16±1/16	19 3/32, 21 3/32 OR 24 3/32±1/16	17 1/16±1/16	17 1/16, 20 1/16 OR 23 1/16±1/16	17 1/16±1/16	24 3/16±1/16 29 3/16±1/16
W	4	4	4 1/2	4 1/2	5	4 1/2	4 1/2	4 1/2	4 1/2	6
X	1 17/32	1 17/32	2 23/32	2 23/32	3 1/2	2 23/32	3 1/16	3 1/16	3 1/16	4 1/16
Y	1 29/32	1 29/32	2 31/32	2 31/32	4	2 31/32	3 5/16	3 5/16	3 5/16	= X
Z	3 1/16	3 1/16	4 3/4	4 3/4	7 1/8	4 3/4	5 1/4	5 1/4	5 1/4	= X
Ra	3/8	3/8	1/4	1/4	3/4	1/4	1/4	1/4	1/4	NONE
7a PISTON MATERIAL		ALL MERCURY	ALL MERCURY MOTORS HAVE ALUMINUM PISTONS							
b PISTON WEIGHT WITH RINGS, WRIST PINS AND FASTENINGS	3 3/8 oz. MIN.	3.3 OZ. MIN.	6 oz. MIN.	6 oz. MIN.	7.5 oz. MIN.	7.5 oz. MIN.	9.1 oz. MIN.	8 oz. MIN.	7.5 oz. MIN.	13.5 oz. MIN.
c WEIGHT OF CONN. ROD WITH BEARINGS IN BOTH ENDS AND WITH THRUST WASHERS	2 7/8 oz. MIN.	2.2 OZ. MIN.	5 5/8 oz. MIN.	6 3/4 oz. MIN.	6 3/4 oz. MIN.	6 3/4 oz. MIN.	6.5 oz. MIN.	6 3/4 oz. MIN.	6 3/4 oz. MIN.	7.7 oz. MIN.
d WEIGHT OF FLYWHEEL	3 1/2 LBS. MIN.	4 lb. 8 oz. MIN.	3 3/4 LBS. MIN.	1# 12 oz. MIN.	28 oz. MIN / 36 oz. MIN	4 1/2 LBS. MIN.	1# 12 oz. MIN.	4# or 3# 6 oz. MIN.	1# 12 oz. MIN.	8 LB. 9 oz. MIN.
BEARING SPECIFICATIONS 1	9103PP	BR-121610	B1412X or 7173CT			R.B.C. #SJ-7185		105K		SJ-7214
2	B-128X	204K	205K	206K	206K	205K	206K	105K or 7206W	206K	6206
NOTE: 3	BR	NONE	BLOCK	ROLLERS	ROLLERS - BOTH CENTER MAIN BEARINGS	ROLLERS				ALUMINUM REED BLOCK
OTHER STANDARD MAKES OF 4	B-118X	204K	205K	206K	206K	205K	206K	511K or 7206W	206K	6206
BEARINGS OF EQUAL SIZE AND 5		NONE		NONE				511K	NONE	
EQUAL QUALITY MAY BE 6	23 ROLLERS	23	28 ROLLERS	25 ROLLERS	25 ROLLERS	25 ROLLERS	25 ROLLERS	25 ROLLERS	25 ROLLERS	32 ROLLERS
SUBSTITUTED. 7	17 ROLLERS	17	22 ROLLERS	22 ROLLERS	22 ROLLERS	22 ROLLERS	22 ROLLERS	22 ROLLERS	22 ROLLERS	25 ROLLERS
8	201K	201K	S-7	#466306	6204	S-7	S-8K	S-8K	S-8K	6204
9	B-912X	B-912X	GB-912	GB-912	GB-1112	GB-912	GB-1112	GB-1112	GB-1112	GB-1416
10	B-87X	B-87X	GB-98	GB-98	6204-C3	GB-98	GB-1112	GB-1112	GB-1112	CONE-14138 CUP-14276
11	5-8K or R-12	5-8K or R-12	9104K	9104K	GB-1212	9104K	9105K	9105K	9105K	9107K
12		NONE			NONE					GB-1212
13		NONE			NONE					GB-1212
14		NONE			NONE					
8 NO. AND SIZE OF EXHAUST RELIEF HOLES	4-1/8" DIA.	CAST SNOUT	10-5/32" DIA	CAST SNOUT	CAST SNOUT	10-5/32" DIA.	CAST SNOUT	BRASS SNOUT	CAST SNOUT	2-HOLES 1 1/16 x 19/32
9 REED STOP HEIGHT	7/64	7/64	5/32	5/32	5/32	5/32	5/32	5/32	5/32	3/16

STOCK OUTBOARD MOTOR SPECIFICATIONS





R, S, T, U AND W ARE MINIMUM DIMENSIONS.



THE DIMENSIONS GIVEN IN THE SPECIFICATIONS FOR R AND S REPRESENT THE MINIMUM SIZES TO WHICH THESE SECTIONS CAN BE REDUCED CONSISTENT WITH STRENGTH. TO GUIDE A.P.B.A. MEASURERS IN THEIR WORK, THE FOLLOWING TABLE GIVES THE NOMINAL SIZES TO WHICH THE QUICKSILVER UNITS ARE ACTUALLY CAST AND RETAILED. VARIATIONS OF APPROX. 1/32" ARE POSSIBLE IN CASTING PROCESS.

CLASS	"R"	"S"
J	1 3/4	7/8
A	2 1/8	1
B(20 H) & C	2 1/8	1
B(25 H)	1 3/4	13/16
D	2 3/8	13/32
F	2 1/4	13/32

WHEN MEASURING A, A₁, C AND C₁ INCLUDE COMPRESSED GASKET THICKNESS.

A, A₁, C AND C₁ DIMENSIONS ARE MEASURED FROM THE CRANKCASE SPLIT ON ALL MODELS NOT SPECIFYING A "K" DIMENSION.

DIMENSION "N" REFERS TO NUMBER AND SIZE OF REED PORT OPENINGS IN REED BLOCK.

KF-9, KF-9H.D. AND KG-9 FLYWHEEL WEIGHT (d) OF 3 LBS. 6 OZ IS WEIGHT OF FLYWHEEL USED WITH AUTOMATIC REWIND STARTER.

A NEEDLE ROLLER BEARING REPLACES THE BRONZE BUSHING FOUND IN THE REAR END OF THE OLDER UNITS.

ELECTRIC STARTING AND GENERATING EQUIPMENT IS OPTIONAL ON 75-H.

PRODUCTION SETTINGS FOR REED STOP HEIGHTS ARE AS FOLLOWS: (SEE SKETCH)

CARBURETOR MODEL NUMBER	VENTURI DIA.	THROAT DIA.	CARBURETOR MODEL NUMBER	VENTURI DIA.	THROAT DIA.
AJ 46A, AJ 308X AJ-57A	17/32	3/4	KA-3A, KA-1A KA-7A, KA-2A	1	1 1/8
AJ-30A, AJ-30B KB-6A, KB-6B, KB-7B	17/32 or 9/16	3/4	AJ-29A, AJ-40A KB-9A	3/4	13/16
AJ-41A, AJ-49A, AJ 51A AJ-32A, AJ-33A	13/16	15/16	KA-6A	1 1/16	1 1/8
AJ-29AB, AJ-29AC, AJ-47A AJ-31AB, AJ-50A, 1004-B	7/8	1	KC-9A	1 3/16	1 1/4
AJ-29AX, AJ-31A AJ-36A	3/4	7/8	KD-2A, KD-5A WMK1, WMK1-0-1	1 1/4	1 3/8
AJ-23A	5/8	3/4	KC-5C	1 1/16	1 1/4

CMRS
MARINE RACING

Tillotson Carb Racing Parts

KA and KC longer nozzles (like KA7A update kit)
Racing adjustable hi speed needles for KA or KC
Seat for adjustable hi speed needle for KA or KC
$6.50 per part

Quincy Exhaust Filler Blocks

Merc 4 cyl.	$48	specify new/old style block and c.i.
Merc 6 cyl	$66.	60 & 66 c.i. model blocks
Merc 2 cyl	$30.	A and B Mercury, another for 22 c.i.
Merc 650	$66.	4 cylinder Merc. In stock now also.
Merc KG9&M40H	$52.	Two piece filler blocks as originals.
Merc 1000		Custom order, not presently in stock.

A Complete custom Quincy Brinkman aluminum converging exhaust system <u>**fitted to your motor block**</u> with the CMRS water cooled jacketed filler block and the reverse flow complete water system, ready to go is $675. for C or D. $125. **OFF** this price If CMRS does the port Job also.

MOD Porting for 94 & beyond

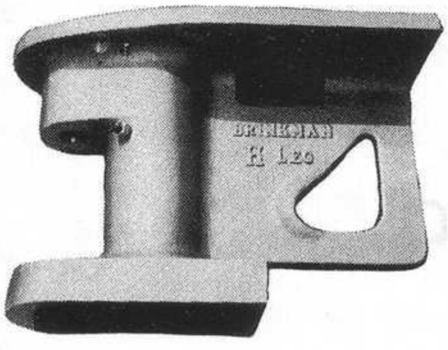
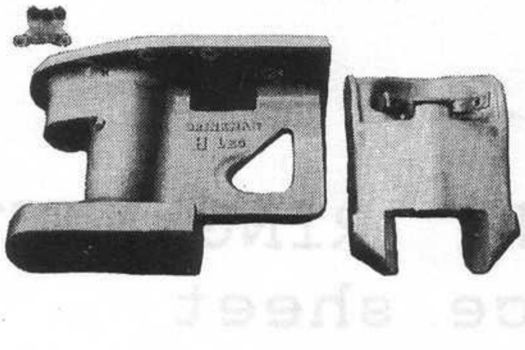
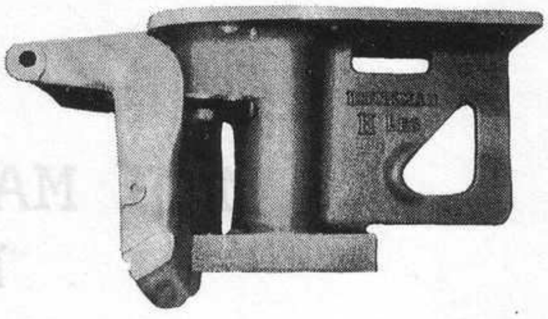
For C-D & E 4 Cyl Mercs $199. package price
Includes angle mill porting,special chamfer job on all ports, texture hone and crosshatch and block cleanup. The same porting for everyone, nothing held back. For 2 cyl and 6 cyl Mercs and **Formula A OMCs** ask for a quote.

Crankshaft Beveling

$250 for C-D-E 4 Cyl Merc cranks
$100. for Form A OMC cranks
for 2 and 6 cyl Mercs ask for quote

CMRS H9 SHORT Motor LEG

Leg is for approx 9 inch transome, cast aluminum 1 piece
Regular **or Reverse** powerhead mounting capability
$345. mounted to your swivel & ready to go
This is a package price and you get the following:
Your choice of:

Drilling choice, contd..
Powerhead plate drilled for C-D Merc, E 44 c.i. Merc/44XS, 6 CYL Merc,75HP 3 Cyl OMC, 45SS OMC or even 25 OMC
Stainless solid swivel pin
Bottom of H9 drilled and tapped for your Bayer Adaptor plate or a Konig foot bolt pattern. (A bayer plate will be necessary to mount most gear assbys.)
CMRS will cut and machine your swivel to fit the H9 leg and mount the assby and set up your co-pilot plate in working order.Then cut the top plate casting for your powerhead, with or without provision for steering bar mount.
Legs may or may not be in stock all the time so advance order is a good idea.

Flex-Hone cylinder Hone Dealer

Hones in stock for sale
1 3/4 in. thru 3¼ in. dia. in several grits each

Special sizes and special grits may be ordered and prices are reasonable.

Antique Outboard Piston Rings

1 1/8 thru 2 15/16 in. diameter rings in std and various oversizes. widths from 3/32 to 1/8 in. with a very few sizes in 1/16 and 3/16 widths. Most rings are $2. each plus postage $2. per order. Have 2 3/4 in. in standard, +20, +30 & +60 oversizes, mostly 1/8 with a few 3/32 widths.These fit the C's and F's.

Condensers

Left and right strap and bigger double strap condensers for outboard motors. Big condenser has double nut for wire to attach to condenser. 50¢ each cheap!

Cone Greaser tools

grease your lower unit cone without removal so you don't wear out the threads etc. $35. plus $3. postage

CMRS Marine

4240 N. S.R.13 Leesburg,In 46538
219 834-4844

CMRS MARINE RING FITTING
Price sheet

I will cut your oversize rings down and custom fit to bores +-.0004 in., cut the pin cuts and stone the burrs. Rings will be individually packaged and marked as to which cyl bore and what ring groove they go into. Cost is $5.00 to custom fit your ring, per ring, not including the price of the ring. Add shipping costs etc. Currently available 44XS piston rings, +.015 and +.030 oversizes if furnished by CMRS cost you $2.25 each.

YOUR Bore	RINGS FOR SALE if NEEDS rings	fitted by CMRS for:
standard 44ci	+15 44XS	stock or MOD
+15 bore 44ci	+30 44XS	stock or MOD
+15 40ci D &B	+28 Hastings	$4. per ring. limited sets
+30 40ci D &B	+38 Hastings	These for CMRS built motors only Supply limited
+30 A/C Merc	+34/+39 rings	Sets of 12 un fitted and NO pin cuts $40. per set. only 6 sets 30+ C Merc
30+ A/C Merc	+38 perf circle FOR SALE AS IS NO fitting necessary to purchase these	Rings with inside bevel They will wear a bore faster. $1.80 per ring, no limit. No pin cuts.

Before fitting rings I will measure your bore with a dial bore guage. Bores +-.002 are Not worth fitting. Bores +-.001 cannot be fitted as close as near perfect bores which are +-.0002 in. If you want a cyl profile chart it will cost $3. per cyl bore profiled.
If your cyls are not fresh honed, I can crosshatch hone them. Cost $2. per cyl bore plus $6. per block cleanup.
DO NOT clean your block with solvents or dip tanks!! Send your disassembled, clean block with ONLY outboard motor oil (prefer mineral) on cyl bores. NO grease, Lubes,NO WD-40, NO 3in1 oil, just outboard oil please. There will be a charge if I have to clean the block to work on it.

CMRS Marine 4240 N. SR13
Leesburg,In 46538 219-834-4844

"Outdated Advertising"