

SECTION 3... ENGINE

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**\*\*\*\*\* ENGINES \*\*\*\*\***

**Revised February 14, 2009**

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**..... V8 ENGINE .....**

FLATHEAD V8 FIRING ORDER: 1-5-4-8-6-3-7-2. Passenger (right) side cylinder numbering is 1,2,3,4 from front to rear. Driver (left) side cylinder numbering is 5,6,7,8 from front to rear.

WEIGHT: Ford lists the 59 series flathead complete engine weight at 525 lbs. This is with cast iron heads, cast iron intake manifold, starter, carburetor, fuel pump, water pumps, etc.

**\*\*\*\*\* BLOCKS \*\*\*\*\***

MY BELIEFS REGARDING DIFFERENCES IN 59 SERIES BLOCKS. Let me begin this by stating the following is what I've learned and believe from my association with flatheads.

The 59 series blocks had better quality casting control than earlier blocks. This decreased the number of blocks with excessive core shifts. The following boring limitations are what I use for engines intended for the street.

The 59 series blocks came in '46-'48 Ford and Merc's. There aren't any differences between Ford and Merc blocks during these years. All came with replaceable hard valve seats. There were eight different engine designations to my limited knowledge: 59, 59A, 59AB, 59L, 59X, 59Y, 59Z, and 59ERP.

The 59, 59A, and 59AB usually had no factory relief. These are the softest castings of the 59 series blocks. These will almost always bore to 3-3/8" and still have adequate wall thickness left for street use. These were the most common blocks produced.... which is why they're also the most common blocks still around today. The raised 59 number and letter (if used) are located on the top of the bell housing.

The 59L was thought to be a Canadian truck/bus block, but many were delivered in US cars that came directly from USA factories. Many came with a factory relief and a 3-3/16" bore. However, there are many around with the smaller 3-1/16" bore. I've never tried boring one of these as a 3-3/16" block (to 3-3/8"). I seriously doubt they can be bored this big since the walls would have to be SUPER thick to tolerate boring an additional 5/16"! ~~(From rodnut 1/30/03: These 59L blocks with a 3-1/16" bore can only be bore safely to 3-3/16" +0.60")~~ There is a general belief 59L blocks have thicker walls than other blocks. But, after having seen several 59AB and a 59L blocks cut into sections, and after extensive measuring, I'm convinced all of the 59 series blocks with a 3-3/16" bore were cast with the same cylinder wall thickness. The 59L blocks are harder than the 59, 59A, 59AB blocks with an accompanying increased resistance to cracking and wear. Due to their increased hardness, they will tolerate a bigger bore without cylinder wall flexing than the softer blocks. During the mid-fifties, I bored about a dozen of these to 3-7/16" without any problem... and this was long before sonic testing. The 59L is located on the top of the bell housing and is

raised. Some of them have only a raised 59 number on top of the bell housing with either a raised, or stamped, L on the right side down near the right stay rod boss. These 59L blocks are now scarce, but can still be found if one is diligent and lucky.

The 59Y block was thought to be for industrial applications only. But, like the 59L blocks, many are found in cars from both sides of the Canadian border. These usually came without a factory relief. Like the 59L blocks, a 3-7/16" bore is possible. They are slightly harder than the 59L blocks and, hence, more desirable when building a full house engine or one that will be raced. These exhibit a greater resistance to cracking and wear than the 59L block. The raised 59Y code is located on the top of the bell housing. Some of them have the raised, or stamped, Y located on the right side near the stay rod boss. These 59Y blocks are quite scarce.

The 59X and 59Z blocks were made for military use and came exclusively in military vehicles. Rumor has always held these were cast with more carbon, vanadium, and other hardening elements to meet the more stringent military specifications. I don't know if that's true, but I do know the ones I've seen were VERY hard. I stumbled across my first one in Texas in the early fifties at a wrecking yard. The machinist who bored it to 3-7/16" said he would NEVER bore another one because it ate cutters like they were Snicker candy bars. They are the longest wearing 59 series block and are the blocks of choice. The few I've seen did not have factory reliefs. The 59X and 59Z have their raised 59 identification number located on top of the bell housing like most 59 series blocks. All blocks I've seen had both the X and Z lettering stamped in the bell housing on the right side near the hole for the stay rod. These 59X and 59Z blocks usually bore to 3-7/16" with no problems. Too bad they're now almost impossible to find.

The 59ERP block was made for the European market. The main bearing bores are 0.015" oversize even though the crankshafts are standard Ford 3-3/4" cranks..... they were line bored for thicker main bearings for some reason. These thicker bearings were stock Ford items at Ford agencies way back when. Today, one would probably end up making main bearings, or resort to using shim stock between the block and bearings. There is no physical difference externally between an ERP block and any other 59 block that I've ever found. Like the 59, 59A, and 59AB blocks, these are relatively soft blocks (they may be even softer). I've bored many of these to 3-5/16" and still had plenty of wall thickness left. I've never bored one to 3-3/8", but think they would take it. The 59ERP blocks I've been involved with did not have a factory relief. The top of the bell housing has the normal raised 59-identification code. The ERP identification letters are 1/2" letters stamped in the pan gasket rail near the front of the block on the drivers side. The pan gasket covers the ERP stamping. These blocks are scarce.

**SLEEVES:** Removing the cylinder sleeves increases the bore 0.082" (0.041" on each side). Ford used to carry pistons with this increased bore.

**CYLINDER WALL THICKNESS:** Ed Iskendarian in answer to a direct question in 1953, stated "..... 0.060" wall thickness is the absolute minimum for hopped up engines." He went on to say "..... anything less usually results in the cylinder walls waving and flexing under heavy use and will cause the engine to come apart." Today, most flathead engine builders say 0.100" is the absolute minimum for normally aspirated street engines. I have no knowledge of maximum safe boring on blown engines. Be aware rust on the water side of the cylinders will eat away some of the cylinder wall which makes for thinner cylinder walls.

**BORING:** I strongly recommend sonic testing when planning on boring in excess of 3-5/16" to verify the absence of core shifts and thin spots caused by rust. This will also help determine the block's safe boring limits. Sonic testing should be done after the block has had as much rust as possible scraped and removed from the water jackets. The rust scales and build up of rust on the water passages may hinder accurate sonic measuring. The cost of machining and prepping a block for a full-house flathead is too expensive and time consuming to chance using a questionable block. By the time it's been hot tanked, acid dipped, magnafluxed, sonic tested, studs removed, bored, valve seats replaced and ground, cylinders honed, crankshaft mains line bored, block ported and polished, relief ground, block resurfaced, and cam bearings replaced, it's just not worth taking a chance on a questionable block. Most of the things that are mentioned above are lost if the block fails after build... and that is BIG BUCKS AND A LOT OF TIME!

**ASSEMBLY OF BLOCK:** Most of us build an engine far in advance of when we're going to install and run it. Many of us use engine oil during engine assembly like we did in the earlier times. Then came special camshaft lube and we began using it on the cam and lifters, but stuck with the oil for the rods, mains, and cylinders. Well, about the time we get around to running the engine, most (if not all) of the oil has dried up and disappeared. Which shouldn't be a problem if we pre-oil the engine before we fire it the first time. But the majority of flatheads are not pre-lubed because their design prevents turning just the oil pump and not the entire engine. Wouldn't it make more sense to use some lubricant that lasts? I used STP for a few years since it would last a few years. Then I tried assembly lube. I think assembly lube is best. It's a grease and not near as messy or sticky as STP. I use it on the lifters, guides, valve stems, all bearings, a few spots on the timing gears, and packing the oil pump drive gears. It won't disappear and is available in handy tubes. I use Lubri-Plate brand assembly lube if anyone is interested. I use special cam lube on the cam journals and lobes as well as on the top and bottom of the lifters.

Pistons, with their rings on, are dunked in a coffee can of motor oil. The cylinders are wiped with motor oil before installing pistons. I know this oil will disappear before I fire the engine the first time, but I pre-oil all engines just before they're fired the first time so don't worry much about it. More on this later. If I know it'll be a few months before I start the engine, I wipe STP on the cylinder walls after the pistons are installed and before I button down the heads. **(From rodnut on 1/30/03... "For faster ring seating, lightly oil the cylinder walls and piston skirts... Leave the ring packs dry... This is recommended by most ring manufacturers..)**

**BLOCK CLEANING:** Cleaning the rust and core sand out of a flathead block is crucial if you don't want the engine to act like a percolating coffee pot..... especially if you're hopping up your mill. It may not have over-heated before rebuild, but often times it will afterwards due to increased friction and more compression. Keep this in mind during rebuild.

There are no big tricks to cleaning blocks..... just plain old dirty work. The tools I use are a compressed air blow gun nozzle with a made-up 1/8" steel tubing about 8" long and a long thin screwdriver. The extension on the blow gun nozzle easily directs compressed air down to the very bottom of the water chambers. With the engine on the engine stand, I use the long thin screwdriver to chip away rusty slag on the inside of the water passages. Especially around the cylinders. It's also used to break loose the sand and rust build-up at the bottom of the water passages. It's common to find the rear cylinder's water passages half full

of packed core sand and rust particles! No wonder they run hot. After chipping and scraping, I invert the block so gravity will help me empty the junk. I blow out the passages with the extended tip of the blow gun nozzle. That stuff goes every where and lays a fine film over your cars and shop... fun, fun, fun. Then I invert the engine again and do the chip/blow thing again... and again... and again until there isn't any junk left in the water passages. Then I take the block and have it hot tanked a couple of times at an engine shop. I haul it home and do the chipping/blowing thing again. After getting everything out of the block I can, I haul it to a car parts stripper and have him acid dip it in his heated tank of Muriatic acid (hydrochloric acid or HCl). The block is left in the acid tank for 48 hours before being rinsed thoroughly with water. Then back home and chip it the water chambers again. Then to the engine shop for one last hot tank and flushing. It's now ready for sonic testing and a final magnafluxing before beginning the machine work. It's common to get over a 3 gallon bucket of rust and sand out of the water passages! I've often wondered if the sand consists of factory casting sand or is there some from dipping a beer can into a trickle of roadside water (mud?) to cool a boiling radiator on a hot day. A friend of mine sand blasts his water passages after he's got the chipping done. Boy do they look neat..... like a new block must look. His engines run cooler than mine, so what little rust I leave behind must restrict transmitting cylinder heat. Next time I rebuild mine, he's going to sand blast it (he doesn't know it yet!).

**HEAD BOLTS AND STUDS:** I don't believe in running a tap in the block's head bolt holes to freshen up the threads. I think this causes the threads to become slightly wallowed out and not hold the bolt/stud securely during tightening. I just blow the holes out until I'm ready to install the cap screws or studs.

(a)Cap screws (bolts): I clean their threads on a wire wheel on the bench grinder. Then I run a thread chaser over the threads and dip them in some thin oil before I test them in the block. If the bolts won't run all the way in using only my fingers I work with them before I resort to using a tap. During final installation of all aluminum heads, I use grade #8 or #9 flat washers on all head studs/cap screws. Both sides of the washers get a film of light oil to increase accuracy during torquing. Cap screws get some **Permatex Thread Sealant #59235** to seal the bolt threads. This also helps to assure torque accuracy. Also see HEADS SECTION for discussion on aluminum head installations.

(b)Studs are treated differently from cap screws. I prefer studs, especially when boring big or on engines which will be taken apart frequently. Studs are considerably more work, but I think they're well worth it since they're easier on the block and torque more evenly. I start by cleaning the entire stud on the bench grinder's wire wheel. Then I chase both the NF and NC threads. I wash them in solvent to clean the grit after the thread chasing operation. I run a tap through each used head nut (only on used head nuts) after which the nuts are threaded onto a stud. I run the nuts all the way to the bottom of the stud's NF threads using only my fingers. If they won't go down with just my fingers, I find out why and correct the problem. I want the nuts to torque down smoothly to assure accuracy. I dip the stud's NC threads in some thin oil and screw them into the block. If they go all the way down using only pair of ignition pliers (which are pretty small), the studs are done and ready for installation. If not, I fool with them some until I either cure the bind. One note here.... Check the HEADS SECTION for drilling aluminum heads when using studs.

Final installation of studs is what takes time, but it gives these weary old bones a chance to sit on a board on my trash can for a few hours. Studs often become warped from abuse as well as all the heat/cool cycles they are subjected

to over their lifetime. This causes them to interfere with the head's bolt holes during installation of the head. This contact is responsible for the destruction of untold numbers of heads (aluminum and cast iron) because they soon seize to the head. Making it impossible to remove the head without virtually destroying it. This is the main reason studs have a bad reputation.

First I blow out all the threaded holes to insure there's no debris in the bottom of any hole. I check the studs to verify they're true by rolling them on the bench. I start with the middle two studs. Install the two studs all the way in using just my fingers. Then I try putting the head on to see if either hole conflicts with a stud:

(1) If the stud contacts the head, I remove the stud and re-check it for straightness by rolling it across the bench. If it's warped, I'll set it aside and try another. Sometimes I use a hammer and attempt to straighten them.

(2) After correcting the problem and there isn't any conflict, I remove the two studs without mixing them up and coat the NC threads with a thread sealant like **Permatex Thread Sealant #59235**. This will prevent water from getting past the threads and deters future seizing. ~~\*\*(From rodnut on 1/30/03.... He uses anti-seize on the stud shanks..)~~ Then I install the two studs back into their same holes with my fingers until they bottom. I use a pair of small ignition pliers to finish snugging them down..... I do NOT torque them any tighter (spec for torque is 8-10 ft/lbs if you insist on torquing them). Any tighter and they'll be a real bear, if not impossible, to remove at a later date.

When both studs are installed permanently, I move on to two more studs and repeat the whole process. When you're finished, the head should slide on and off the studs easily. Takes about 4 hours, but is well worth it as far as I'm concerned. When finished, install the head after slightly oiling the NF threads on each stud. Use grade #8 or #9 washers on aluminum heads to prevent distorting the aluminum with a thin oil film on both sides of the flat washers.

**ACORN HEAD BOLT COVERS:** If you're going to use chrome acorn covers over stock Ford head nuts, you'll find they aren't quite as deep as the stock head nuts. This means they hit the top of the nut before they're flush with the head washers. Replacing the head nuts with a new set of grade #8 NF nuts from a bolt supplier will cure this. They are not as thick as the stock Ford ones and the acorns fit flush down against the washers and looks a bit better.

**REMOVING STUDS:** There are several methods I've used with varying degrees of success over the years. I continually try new methods whenever I hear of one. Today I use the following. I've listed these in order of success. Just remember to take your time and don't get in a hurry when working on studs..... they'll only break and then you end up with a whole bunch of new troubles. When using a stud puller, I use a torque wrench and limit the torque to 60ft/lbs to keep from breaking studs. In the following, I'm assuming the heads are removed.

~~From Red's Headers on 1/30/03.... Limit removal torque to 75-80 ft/lbs when trying to break a stud loose to avoid breaking it.~~ I'm nervous and limit removal torque to 70 ft/lbs.

Stud pullers. There are a differences in stud pullers. I use a stud puller that grips all the way around the stud (looks similar to a deep well socket). I think these are the best and worth the price. The common cam lock type rotates an anti-slip grooved cam so it contacts and applies pressure to one side of the stud. These are lousy as far as I'm concerned. I can't begin to guess how many studs I've broken in the early days using these pullers, but it's probably in the hundreds!.

(1) Soak the studs with your favorite penetrating oil several times a day for several days. I prefer "BG In-Force Ion-Activated Penetrating oil" (# 438) or "Aerokroil Penetrating Oil" or "P-Blaster Penetrant" in that order. Run a head nut down flush with the stud and hit the top of the stud HARD with a big hammer a few times (like it's a nail you're trying to drive into the block). The impact and vibration will some times help free-up a frozen stud. Now get out the stud puller. GENTLY attempt to tighten the stud first. Then try loosening it. GENTLY work it back and forth... tighten and loosen.... tighten and loosen. The majority of the time if you've soaked them good and worked with them, the stud will come loose. If it won't budge, try soaking it again over night. Don't ever force it unless you're sadistic.

(2) This requires an acetylene torch. Heating the stud alone just expands the stud and does little to loosen them. But heating the boss in the water chamber of the block expands the boss to make the threaded hole larger. Have the stud puller on the stud and ready to use. Light the torch and put it inside the water chamber and heat up the boss... it doesn't have to be red hot... just fairly hot will usually work. As you apply the torch, put a fair amount of strain on the stud puller. It'll usually loosen once you have the boss pretty hot. I've used this method on the last five engines... and never broke a stud... which is amazing for this old geezer.

The above two methods have never failed to remove a stud! Shore makes life easier.

BROKEN STUD REMOVAL: I've listed what works for me when I break a stud. I've listed them in order of my preference.

(1) Electric Discharge Machine (EDM) method. There are machine shops which provide this service for \$25 to \$40 per stud. An electric arc is established between the stud and a carbon electrode. This arc eats away at the broken stud and vaporizes it (so to speak). The arc attacks the stud since it heats faster than the block. The threads in the block are usually not hurt and can be reused. This is my preferred method, but then I'm lazy. I had to have one done in my existing flathead (gave up and tried to force one years ago!)

(2) ~~JWL reports he welds a cap screw onto the top of the broken stud with super results.~~ Wish I could weld that good!

NOTE: The following (3) and (4) methods involve drilling a hole down the center of the stud. Drilling a hole in the center of a stud is simpler if you put a junk cast iron cylinder head on the block and use a bushing (home made) with a 3/16" hole in the head's bolt hole. If you have access to a lathe, you can easily turn out such a bushing or grind a nut will work. This prevents the drill from wandering off center and into the block (shudder). Suggest grinding the top of the broken stud flat (if possible) to further decrease drill wandering. Always use a center punch to dimple the broken stud dead center to decrease drill bit wander.

(3) After drilling the 3/16" hole in the stud and removing the junk cast iron head, use an acetylene torch to heat the inside of the 3/16" hole until the remaining shell of the stud is cherry red (the torch doesn't like this very much and sputters pretty good if the tip is put in deep). Let it cool to the touch. As it cools down, the crud and rust holding the stud will often times loosen and the stud can be removed with an EZ Out. Do not install an EZ Out until the stud is cooled off to the touch. Don't forget..... breaking off an EZ Out is sufficient reason to cry! Talk about a SOB (that stands for Shouldn't Of Been) to remove!!!!

(4) I've done the following, but it sure makes me nervous. Drill the aforementioned 3/16" hole. It has to be centered exactly. Enlarge it to 3/8" with another drill bit. Heat the inside of the 3/8" hole carefully until the

remaining shell of the stud just starts to become red. Then crank up the oxygen using the same acetylene tip and blow the remains of the stud out. Work quickly before the block can heat. This shouldn't damage the block's threads beyond re-use as long as the torch is not directed towards them (corrosion is somewhat of an insulator). Many times it takes a couple of times before the broken stud is blown out. Scares me..... and I'm fearless!

HELI-COILS: I never install Heli-coils for studs/cap screws in specific holes in a block that's going to have a 3-3/8" bore. My reasoning: flathead block decks are fairly thin to begin with. When boring exceeds 3-5/16" some stud holes along the lower edge of the block are getting fairly close to the edge of the big bore cylinders. No problem unless Heli-coiling has to be done to these holes. Drilling the stud holes oversize for a heli-coil makes this separation even less and weakens the deck even more. This will usually cause it to crack down the cylinder wall during head bolt/nut torquing. Heli-coiling can be done to other studs successfully. But we all know which ones will need a heli-coil don't we.. something like Murphy's Law.

\*\*\*\*\* **CRANKSHAFTS** \*\*\*\*\*

CRANKSHAFT MAIN BOLTS: The '49 and up flathead cranks use cap screws on their mains. There are two different types of main cap screws..... shouldered and non-shouldered. The front main cap screws are full shouldered and do not use a lock washer. The center and rear main cap screws are non-shouldered and use lock washers. I use blue Loctite on main cap screws so I can sleep nights.

The '48 and older flatheads use main studs with castellated nuts and no lock washers. Although the studs are usually VERY tight in the block, they have been known to come loose... especially on souped up mills. I don't use cotter pins because when the nut is cotter pinned to the stud, it effectively becomes a cap screw... which can come unscrewed. I safety wire the castellated nuts across the main cap.

CRANKSHAFT MAIN TIGHTENING SEQUENCE: Torque the rear main first. The front main second. And the center main last. Don't forget to check crankshaft end play.

CRANKSHAFT SLUDGE TRAP SIZES ON '49 AND NEWER: Cranks before '49 did not have sludge traps. Cranks with a 3-3/4" stroke have 3/8" outside diameter sludge traps. Cranks with a 4" stroke have 5/8" outside diameter sludge traps. **I tap these and use aluminum socket head plugs available at most speed shops. Be sure to rebalance the crankshaft for the added weight. The Welch type plugs Ford uses have been known to come out and cause a tremendous knock. Talk about scaring the c\*\*p out of you! Ask how I learned this.** A swap meet method used to determine a 4" crank is to insert the tip of your little finger in the sludge trap plug's hole. If it'll fit into the plug, it's a 4" crank. If the sludge trap plug is too small for your pinky, it's a 3-3/4" crank. As always, exceptions to this have been found, but are rare.

TURNING CRANKSHAFTS: Like all Ford parts, the flathead cranks used very strong and hard metal. They can be safely turned 0.050" under on both the mains and rods. Bearings for 0.050" under cranks are difficult to find, but they are around. Floating rod bearings are scarce and more expensive than the slipper

type bearings. I've seen a parts book that listed 0.040", 0.050", and 0.060" bearings for 8CM/8BA engines, but the supplier retired about 4 years ago. Wonder what happened to his stock. Turning a crank in excess of 0.040" under is better than metal spraying a crank or tossing it in the trash... especially if it's a 4 inch stroker.

\*\*\*\*\* **VALVES** \*\*\*\*\*

**CAMSHAFT END PLAY: 0.002" to 0.0004".**

**VALVE LIFTERS:** Lifter radius is ninety-six inches 96" convex! Now that's a big arc. Flat is OK, but NEVER concave because a concave lifter round off cam lobes quickly.

**ADJUSTABLE VALVE LIFTERS:** There is a way to check a Johnson adjustable lifter to verify it'll not loosen in an engine. The clearance adjusting bolt is not to move at less than 5 ft/lbs. **If it's looser, there were replacement adjusting bolts available. It seems the threads in the lifter are a lot harder than the adjusting bolt so the bolt is the only thing which will need replacing. Possibly the computer would help find them.**

**VALVE GUIDES:** Clearance on the early (split type) guides is 0.004". **Split type guides are not to be mixed up... they come in matched sets.** I strongly suggest an upgrade to one piece guides and straight stem valves in 59 series and older engines since they last longer and are easier to install and remove. Chevy valves are longer and must be ground down, but are considerably cheaper.

**VALVE GUIDE RETAINERS:** They should not be re-used as they have a habit of coming loose when you've got your foot in it and are approaching shriek rpm. There are valve guide retainer removal tools that help considerably. Red's Headers has these in stock and are relatively cheap. I recommend purchasing one since it takes a lot of work out of valve removal.

**VALVE SPRING COILS:** The spring end with the close wound coils goes towards the guide (towards the head of the valve) to prevent coil bind.

**VALVE SPRING PRESSURE:** 36-40 lbs @ 2.125" height for Ford & Merc V8 springs. The Lincoln V12 springs were 51 lbs @ 2.125" height.

Shims can be added to stock Ford 36-40 lb springs to decrease the height to 2.000". This will increase the tension to approximately 50 lbs (test each one and vary shim thickness to make them all have the same compressed tension).

**VALVE SEATS:** Replaceable hard seats were standard in all blocks prior to 1951 (as always, exceptions have been found). In 1951-'52 they had hard seats only for the exhaust valves. In 1953 they didn't have any hard seats for either exhaust or intake valves... the seats are the block itself. With only lead free gas available today, I recommend installing new hard seats on both intake and exhaust valves. Especially if you plan on driving your flathead much.

**VALVE GUIDE SEALS:** Used beginning with the 8BA engines. **I don't use them. Reason being it's almost impossible to move a valve guide in an engine with some miles on it due to it being seized tight in the bore. The guide seal is intended to seal the outside of the guide to the bore. This is to prevent oil from being**

sucked up past the outside of the guide. If oil were being sucked up past the outside of the guide, the guide would pull down easily. Yeah.. like that's ever going to happen. **NO** oil ever gets up past them. I can remember loads of flatheads which left a blue haze behind them and never fouled a plug even though they were using a quart every 30 miles or so. And removing their guides was a real b\*\*\*h.

That being said, if you insist on using them, many top builders use Viton-O-rings in place of the stock ones. They say they don't shrink or harden from heat nearly as fast.

**ADJUSTING VALVE CLEARANCES WHILE ENGINE IS IN THE CAR:** The Ford shop motor manual method for adjusting valve lash will work, but just barely on stock cams. Since most of us run a rumpy-rumpy-rumpy cam, the Ford shop manual method doesn't work very well. Two other methods follow and are not in any order of preference:

(1) Open a valve until it is wide open. Then rotate the crankshaft exactly one turn. This will normally position the lifter for this valve on the heel of the cam. Adjust the valve's clearance.

(2) Red Hamilton, of Red's Headers uses the following method. Use normal rotation of the engine. Adjust the exhaust valve's clearance when the same cylinder's intake valve closes and first touches it's seat. The intake valve's clearance is adjusted when the same cylinder's exhaust valve just begins to open off it's seat.

**VALVE ADJUSTING WHILE THE ENGINE'S ON AN ENGINE STAND:** This is when I prefer to set the valves since I can better see what's going on. There are two methods I use to adjust the valves during engine re-building.

(1) **Degreeing the valves (not the cam). Degreeing the cam using a single exhaust and intake lobe assumes each lobe is EXACTLY the same. I don't find this to be true in very many cases.** Degreeing the valves is by far the most accurate in my opinion. This is done on the engine stand after valves, cam, crank and #1 piston is installed. BTDC is Before Top Dead Center and TDC is Top Dead Center and CW is Clockwise and CCW is CounterClockwise. Bring up #1 piston to exactly TDC. Make and install a pointer near the crankshaft pulley. Install a degree wheel on the crank pulley. Index the degree wheel so the pointer is exactly pointing at 0 degrees and secure the degree wheel to the crank pulley (a couple of strip magnets work). Be careful to not disturb the degree wheel or pointer from this point on.

Example: Let's assume a particular cam's spec for an intake valve to begin opening is 20 degree BTDC. Back off the crank shaft CCW about 30 degrees (BTDC) or so using the crankshaft nut and a long breaker bar. You want to be able to rotate the crankshaft easily and smoothly, so use a long bar or a cheater pipe. Install a dial indicator on #1 piston's intake valve. Turn the crank CW (always turn the crank CW (facing the front of the engine) when setting and checking valve clearances) until the degree pointer is 20 degrees BTDC on the degree wheel. This is when the valve should barely begin lifting off its seat. Adjust the adjustable lifter until the valve moves the dial indicator's needle less than a thousandth of an inch. Time to check it. Turn the crank CCW several degrees before 20 degrees. Now turn the crank very slowly CW while watching the dial indicator closely. The needle should just barely twitch when the 20 degree BTDC mark on the degree wheel lines up with the pointer. If it doesn't, re-adjust the lifter and check again. When satisfied, back off (CCW) the crankshaft until you reach the spot where the lifter to valve clearance is the greatest. This is

determined by trying various thicknesses of feeler gauges while rocking the crank back and forth several degrees. All that's left is to measure the clearance between the valve and lifter using a feeler gauge. This is #1 Intake valve's clearance. Record it for future use as #1 Intake for your records. That valve is done. Now do all the valves. Don't forget to record their clearances as you go..... for your records. After the first couple of valves, it goes pretty fast. I degree valves in a flathead in a few hours after the initial set up.

A real benefit is in the future I need only to re-set the clearances of each valve to the clearances recorded and the valve is degreed. How? I turn the crank so the lifter is the farthest from the valve. Let's assume a particular valve was degreed at 0.011" clearance. Since valve clearance normally increases, we can use a feeler gauge thicker than 0.011" to determine where the lifter is furthest from the valve. Use the thickest feeler gauge that'll slide in between the lifter and valve. Say it's 0.014". With the 0.014" feeler gauge between the lifter and valve, rotate the crank back and forth several degrees until you find the spot the feeler gauge is the loosest. Now adjust this to 0.011" clearance and it's exactly the same as if you just degreed it! Neat... neat! Degreeing valves always results in an increase in horsepower.

(2) Visual method. This is done before installing the crankshaft. The cam and all valves are installed. Invert the engine so you can see the cam lobes. Rotate the cam and position the exact middle of the lobe's heel at the lifter. I do this visually. Then invert the engine and adjust the valve clearance according to the cam manufacture's spec's. This is done to each valve and requires a lot of block turning.

LIGHTENING VALVE LIFTERS: This is an old speed secret from the tracks and lakes. After setting the valve clearances, replace the adjustable lifters with stock hollow non-adjustable (solid) lifters. Establish (by grinding the end of the valve) each valve's clearance as you recorded using the adjustable lifters when you degreed the valves. A hollow barrel type lifter is less than half the weight of an adjustable lifter and will help the engine turn more rpms. Also you never have to worry about an adjustable lifter loosening at speed. A good idea if you're running flatout for long periods... Bonneville comes to mind???

\*\*\*\*\* **RODS** \*\*\*\*\*

RODS: Rods through '42 had a journal size of 1.999". Then from '46 through '48 they had a journal size of 2.139". These all used floating type bearings (a single bearing for two rods).

In '49, Ford changed and went with rods which use individual bearings that lock into both the rod and rod cap. They were not floating bearings. Ford did maintain the same diameter... 2.139". These rods have more meat at the big end than the '48 and older rods have. The small end of flathead rods usually fail first.

ROD LENGTH: All flathead V8 rods are 7" long.

CRANK AND ROD COMBINATIONS: A one-way interchange. The early floater type rods with their bearings can be used on 8BA/8CM crankshafts (two oil holes in each rod journal). But the 8BA/8CM rods cannot be used on a '48 and older crankshaft (one oil hole in each rod journal) because the single oil hole would direct the pressured oil between the two individual rod bearings. A two hole rod journal crank ('49 thru '53) when combined with floating bearings and rods makes for a stronger lower end.

~~From JWJ: 8BA rods are not directional and can face either to the front or back of the engine. However, should they have an oil hole which would spray oil towards the camshaft (later 8BA rods should have them), this hole is to face towards the camshaft. The tangs on the insert bearings are not directional.~~  
2/23/08

\*\*\*\*\* **PISTONS & RINGS** \*\*\*\*\*

PISTON CROWN: My 59 no-letter block has Jahn's 3-3/8" three ring solid skirt semi-dome racing pistons. The top of the piston crown is 0.173" above the block's head surface. I believe these figures are the same as stock Ford semi-dome pistons.

RINGS: Ford originally came with 4 ring pistons to decrease excessive oil consumption. Rings contribute the most friction of any engine component. Check the drag on one piston in a cylinder using 4 rings and then again after removing 1 oil ring. Amazing! Increased friction causes a build up of heat as well as a reduction in hp. The added friction of the 4th ring causes an engine to run hotter... something we really don't need in our flatheads. To overcome friction requires hp..... hp I'd sooner be using for fun things. Why not change and run 3 rings which have 25% less drag than 4 rings do? Makes sense to me. Recent engines normally have only 3 rings and they last well past 100K miles.

RING GAPS LINING UP IN A ROW: A common mis-belief is "..... the gaps of all of the rings in an engine will line up at regular intervals of revolutions." Notice the way this is always stated, it is all rings in the engine and not just a single piston. The probability of 32 ring gaps (8 cylinders with pistons having 4 rings each) lining up in an 8 cylinder engine at the same time are more than astronomical. (Consider a ring gap of 0.014" and assume each ring rotates 0.0001" per revolution. Now how many revolutions would it take for the 3-3/16" diameter ring gap to rotate enough to line up with a neighboring ring... especially if they're both rotating in the same direction and with the same amount of travel. Never?) I do not believe this ever happens... even on a single piston. Why? What makes a ring actually rotate? I'm certain it's not magical or mysterious, but is strictly mechanical. My reasoning: The rings rotate as they track in the angular circular scores in the cylinder walls. These circular scores are made by the abrasive stones during cylinder honing. The circular scores should be nearly identical at the top, middle, and bottom of a cylinder since the power hone was moved up and down at a fairly constant rate in the cylinder. Each ring in the cylinder rotates exactly the same number of degrees upward and downward because they travel in the same angular scores going up as they do going down (they rotate back and forth with equal amounts of score slippage). Seems to me that after completion of an upward and downward stroke the ring gaps would be in exactly the same position as they started. If, and this is a hell of a big if, the rings' gaps actually do line up it would seem to me all of the rings would have rotation limited to one direction only and would each have a different degree of rotation. And how would this be accomplished? Beats me. So, I seriously doubt all the ring gaps ever line up. If they did, the engine would smoke so badly and for such an extended length of time (considering the time it would take for the rings to rotate enough so all of the gaps were no longer lined up), the exhaust would be a heavy blue smoke. Wouldn't air pollution be dramatically increased during these extended periods when the gaps were all lined up? And finally, if all the gaps do line up at regular

intervals, why do ring manufacturers make such a point of staggering ring gaps during rebuild?

RING GAP POSITIONING: Piston thrust. This is the direction the piston head is being thrust or "pushed" during combustion. Ring gaps should not be positioned on the thrust side of the piston because the thrust side of a piston head receives a lot more pressure and heat during combustion. Should a ring gap be located on the pressure side, the increased heat and pressure (sharp corners at the ends of the rings heat quicker and hotter) will cause the ring gap to vary and affect the amount of ring tension against the cylinder wall. Piston thrust can easily be determined if we think of it as being the leading edge on the top of the piston head during the cylinder's combustion cycle.

Example: A flathead V8 engine crankshaft rotates clockwise when viewed from the front of the engine. Then the thrust side on all 4 piston heads on the drivers side of the engine will be the side of the piston head furthest from the block's intake manifold surface. The thrust side on all 4 piston heads on the passengers side of the engine will be the side of the piston head closest to the block's intake manifold surface.

Having determined the piston thrust, the ring gaps are positioned as follows. Starting with the bottom ring.....

(1) Oil ring expanders: This goes on first and the ends of the expanders are not critical in location. Position as you will.

(2) Oil ring:

On 3 ring pistons, the gap is to be located at the center of the opposite side of the piston thrust.

On 4 ring pistons, position the gap of the two oil rings 45 degrees fore and aft of the center of the opposite side of the piston thrust.

(3) Oil ring segments (2 per oil ring):

On 3 ring pistons, the gaps are to be located ½" from the oil ring gap. One fore and one aft.

On 4 ring pistons, the gaps are to be located ½" from the their oil expander ring gap. Each oil ring will have it's two segment rings located fore and aft of it's gap. Also see the following section SEGMENTED OIL RINGS.

(4) Bottom compression ring: Gap to be located directly over the wrist pin towards the front of the engine.

(5) Top compression ring: Gap to be located directly over the wrist pin towards the rear of the engine.

SEGMENTED OIL RINGS: Would you believe a steel segment ring is directional? They are! They have an up side and a down side.... they're just not marked by the manufacturer for some reason or another.

Determining which side is up and which side is down is a pretty neat thing to show your buds. Place one of these thin rings between the bottommost joint crease of your thumb and the uppermost joint crease of both your index finger and middle finger (with the gap positioned either forward or backward). Now squeeze your thumb and fingers towards each other to force the ring to bend. The ring will bend either up or down an inch or so (the bend will be opposite the gap). For this discussion, let's say the ring bends upward. Flip the ring over and try it.... now it bends downward! It will bend only ONE way! An engineer with Perfect Circle Ring Co. told me (way back when) it's because the way the molecules arrange themselves during manufacturing. The upward bend is always towards the top of the piston. This applies to all segment rings. Doing this will help seat the oil rings quicker and they'll perform better.

WRIST PIN CIR-CLIPS: The openings face towards the top of the piston unless the piston manufacturer states differently. Some have their own type of wrist pin keeper and positioning.

WRIST PINS: Stock wrist pin diameter is 0.7501" thru 0.7504".

REMOVING WRIST PINS: Remove the wrist pin lock. Drop the piston in a pan of 200 degree water for a few minutes will ease removing the pin. Use a large drift punch to gently tap them out.

OFFSET WRIST PINS IN PISTONS: These are usually offset 0.050". This cocks the piston in the correct direction when combustion begins to help reduce piston rocking (sometimes called piston clatter) and to increase piston stability. Ford decided on this for his new V8 to help quiet it. As we all know, as horsepower is increased, piston clatter increases dramatically. Piston clatter sounds similar to a very faint rod knock and is most noticeable when the engine is pulling hard. Pistons with offset wrist pins have a front and rear. These pistons are marked to face the front of the engine in some manner (usually by an arrow, stamped FRT, or with a notch in the outermost edge of the piston head). If there isn't any mark denoting front, the wrist pins are located dead center (no offset) and the pistons are non-directional as to front and back. These are often called racing pistons since offsetting wrist pins decreases horsepower slightly and race engines aren't concerned with increased piston clatter.

FREEING UP A FLATHEAD ENGINE FROZEN WITH RUST: When the engine is in the car and you can't budge the crankshaft, I do the following. I'm assuming the heads are off. Soak the pistons, cylinders, lifters, etc. with penetrating oil several times a day for a few days. Jack the car up a foot or so off the floor. Use a breaker bar and a cheater pipe (a few feet long) on the front pulley bolt. Position this pipe against the garage floor on the passenger side so lowering the car will tighten the pulley's bolt. We want to use the car's weight to put a constant strain on the bolt to turn the crankshaft. Lower the car down until the pipe contacts the floor. Continue lowering the car until the car's weight is pressing downward on the pipe. Chalk a reference line on the pulley and block so you can tell if the crankshaft pulley moves. Leave everything as is and check on it from time to time over the next couple of days. Bet you'll find the crank pulley has turned... unless it's one big block of rust. If necessary, reset this as needed until the crankshaft can be turned with a wrench.

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