March 2003 ... Revised February-May, 2009

This is a revised paper concerning various flathead notes etc. I had scribbled on scraps of paper (my garbage pile) beginning in late 1949. A lot of things have changed since it was first done in 2003. Enough that it sorely needed updating. There are many gear heads that are discovering, or re-discovering, the legendary V8 flathead. One of the intentions of this garbage pile is, hopefully, to be of some help to these new flatheaders as well as us older gearheads. I strongly suggest checking Bill Bentley's Techno site, the early Ford V8 site, and the Fordbarn site. There is a wealth of information available on all of these sites from very knowledgeable and experienced flatheaders. I do not include myself anywhere near any of these people.

Techno Source for the 1932 thru 1953 Flathead Ford

I've separated this garbage pile into main topics (e.g. fuel, engine, gears, ignition, etc.). I've tried to keep things short, but I'm long winded as anyone who knows me will testify. The Ford 6 and V8-60 are not included for the most part.

A couple of other things. At this late stage of my geezer life (and considering the increasing rarity of flathead parts) I find I am no longer interested in wringing the last shred of hp out of a strung-out flathead. Instead, I want a reliable and strong running flathead that's both fun to drive and to work on. The following stuff pretty much reflects this.... fun, exceptional reliability, making good hp and torque, and makes good gas mileage. Please keep these in mind. Please accept my apologies for the various errors..... my spell checker doesn't recognize a lot of words used.

I want to emphasize these are some of my crude methods, thoughts, and just plain dumb reasoning. I have absolutely no intention of attempting to change anyone's mind or methods with what I write or say.

In places, I've tried to explain my reasoning if I thought it might be of some help to others. Much of this information has come from the flathead web sites and I've included the name of the contributor.... if I remembered to record it. Hopefully they won't mind.

Before beginning to revise this pile of garbage, I talked to my very good friends, Bill Bentley and Shelly Kaptain about updating this. Both thought it a good idea. Each has volunteered to put it on their site. This is a HUGE help to me and I cannot thank either of them enough for all the work they each do on their sites for me and other flatheaders.

....rumble seat

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

*********** BRAKES ************

Revised April 27, 2009

LOCKHEED '39 THROUGH '48 FORDS AND MERCS: These brakes were designed and manufactured by Lockheed. Hydraulic pressure expands the wheel cylinder cups, which push the shoes against the drum. The shoes are NOT self-energizing. The Lockheed system is a front/rear shoe design with the bottom pivot for each shoe anchored to the backing plate. This design requires more pedal pressure to stop than self-energizing brakes since they rely solely on hydraulic pressure. The front shoes (primary) do most of the stopping and normally use a longer friction band. The rear shoes (secondary) normally use a shorter friction band.

'39-'48 LINCOLNS AND '49-'53 FORD/MERC: These are designed and manufactured by the Bendix Corp. They are self energizing (often referred to as duo servo) brakes. The self energizing is caused by the two shoes being linked to each other at the bottom, but are NOT attached to the backing plate (like the Lockheed design is). The top of the primary shoe is moved outward by hydraulic pressure from the wheel cylinder to contact the drum. The rotation of the drum "wedges" the floating primary shoe to move it downward. Since the bottom of the two shoes are not anchored to the backing plate, this rotation movement is transmitted through the rear most shoe where it forces the shoe against the drum. This increases braking substantially and decreases brake pedal effort. This results in considerably more braking force than the sheer hydraulic pressure design used in the earlier Lockheed brakes.

The primary of a Bendix system is still the front shoe in all wheels... just like the Lockheed brakes are. However since the Bendix is self-energizing, the rear (secondary) shoe applies much more stopping than the front (primary) shoe does. The secondary shoe now has the longer friction band and the primary now has the shorter friction band. Now the question is: Are you confused yet?

The Bendix brakes adjustment is easier than the Lockheed brakes.

F-100 BRAKES FOR EARLY FORDS: These are Bendix brakes. Conversions require drums, backing plates, and hubs from a '53-'56 Ford F-100. These drums use the same large bolt wheel pattern as the '40 through '48 Fords do. One pair of Timken #14116 inner bearings, one pair of CR Services #15214 oil seals, and both '37-'48 Ford spindles are needed. The '39 through '41 spindles have a round flange and require modifying because the wheel cylinder will not clear the spindle flange. Grind off the top of the flange that interferes with the wheel cylinder. The '42-'48 spindles have a somewhat squarer flange which clears the wheel cylinder and grinding is not required. On both round and square flanges, the new inner bearing has a square shoulder which conflicts with the rounded race on the spindle. Grind the inside of the bearing race to round it slightly so the bearing will fit snugly against the spindle's mounting face. Every thing else bolts together.

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************ CLUTCHES ************

Revised April 11, 2009

CLUTCH TYPE: The flathead V8 came with a clutch originally designed and manufactured by Borg-Warner (B-W) Mfg. The centrifugal weight idea as well as the design was patented by B-W and is known as a "Long" type clutch. Rather than depend solely on spring tension to reduce slippage (like a diaphragm clutch did and still does), they use centrifugal weights to increase tension as rpm increases (the faster the clutch pressure plate spins the higher the engagement tension). Ford used this type clutch into the fifties when they changed to a "diaphragm" clutch to decrease clutch pedal pressure. It's often been referred to as a "soft" or "velvet touch" clutch.

The infamous Auburn clutch. Early day flathead racers swore by the Auburn clutch as the ultimate clutch for racing. These were a very light diaphragm clutch which made shifting at high rpms a breeze. The lightness of these clutches was like lightening the flywheel and helped increase acceleration. Using a Ford "Long" type clutch often prevented shifting at high rpm (the centrifugal weights increased tension so much the clutch wouldn't disengage which left the hapless racer stuck in the lower gear until the rpms dropped). Many flatheaders on a budget simply removed the weights off their Long type clutches with a torch or grinder and went racing! This often resulted in slippage.

LONG TYPE CLUTCH ENGAGEMENT PRESSURES: **At rest, a** stock 9" pressure plate exerts 810 psi. A 10" exerts 1005 psi. An 11" exerts 1215 psi. **From rodnut: These were stock Ford/Merc applications. Ford made special heavy duty clutches for special use...... taxis, police cars, trucks, etc.**

SIZES: Ford used 9"('35 to '40), 10"('41 to '48 passenger car), and 11"('41 to '48 trucks) clutches. As the diameter increases, so does the weight. Increasing clutch weight is the same as changing to a heavier flywheel. The 9" was used into the forties. Then the 10" was introduced and was around to the end of flathead production. The 11" was called a truck clutch, but they did show up in passenger cars from the factory. Guess Henry had a surplus? Using an 11" clutch in early flatheads necessitates removing the crankcase pan to replace it because the opening in the bell housing is too small to permit extracting and/or installing the larger clutch cover and disc. Many truck pans had a removable lower pan section for just this purpose.

Story: Many think a 9" clutch will not tolerate heavy duty use. I ran a 9" in my '48 convertible while in the Navy. The clutch was completely stock except for the pressure plate springs (from a 10"). The 239 inch engine had stock bore and stroke with milled heads, dual Stromberg carbs, a mild cam, and a VERY light steel flywheel. I ran the car at drags several times and street raced it a lot. I flat-towed a full fendered '46 Ford stock car 80 miles to the track each week during the race season for 3 years. It also towed a 26 foot house trailer from the Utah-Colorado border to south of Corpus Christi, Texas.... and back.....

using the same 9" clutch with no problem! I think this pretty much proved to me a 9" clutch will take punishment.

************* PRESSURE PLATES / CLUTCH COVERS ************

GENERAL DESCRIPTION: The long type clutch cover (also called a pressure plate), has 3 release levers that are operated by the throw-out bearing. These 3 levers MUST all be in the same plane (equal height) when the cover and disc are torqued to the flywheel. If they are not in the same plane, the clutch cover will not operate correctly. It'll usually chatter and/or function erratically. The height of the fingers can be adjusted by using a FLAT piece of steel plate (or other non-compressible material) in place of the clutch disc for adjusting purposes. A clutch disc is too soft to use. **(From rodnut on 1/30/03. The thickness varies with the diameter of the clutch. A 9" plate is 0.350". A 10" plate is 0.295". An 11" plate is 0.356".)**   Torque the plate and pressure plate to the flywheel. Measure and adjust the throw-out bearing engagement bolts on the 3 release levers. **(From rodnut on 1/30/03. Height varies according to the size of the clutch. Fingers on a 9" are set 11/16" from the top of the cover to the high point on the adjusting screw. On a 10", they're set 15/16". On an 11", they're set 7/8").**   If they're not the EXACT same height, adjust the bolts on the release levers (tolerance is 0.010"). These are a real bi*** to adjust since they're split and spread apart. I do NOT recommend welding and grinding these bolts. All clutch covers from the rebuilder or new parts manufacturer should come adjusted correctly, but it's a good idea to double-check all of the finger heights. Especially if you've been plagued with clutch chatter or have a strong running mill which will be raced.

INCREASING CLUTCH ENGAGEMENT PRESSURE: Changing the springs in the clutch cover to stronger springs will result in increased engagement tension with a resultant decrease in slippage. Although installing a larger clutch will produce the same result along with the added benefit of more friction material, the larger clutch will also increase the mass of the flywheel/clutch assembly considerably (didn't you just go to a lot of trouble and expense to reduce your flywheel weight?). This is the same as adding weight to the flywheel which will decrease acceleration. Clutch rebuilders stock different strength springs and will replace stock springs with stouter ones during rebuild.... just ask. However, this can be done at home with the help of friends, a long pry bar, and using basic hot-rodder ingenuity. It's a fairly simple process, but BE CAREFUL.... those springs do fly around at about Mach 7 or so..... and have been known to take out windows while in flight!

Or you could just take it to a rebuilder and have him change springs for some minor compensation. Well worth the expense, and you won't have to organize a search party to locate the springs and nuts that flew (including out the window and into the vacant lot next door). Don't forget the engagement effort (pushing down the clutch pedal) increases dramatically and stock linkage (as well as your clutch leg) may need beefing up (I beefed up my linkage after it bent... I never learn easily!). Don't forget to check the height of the three fingers anytime you've been messing with the springs etc.

******************* CLUTCH DISCS *****************

GENERAL DESCRIPTION: Discs use different types of lining materials depending on their intended application. The ones in our flatheads used to use asbestos. Now they use materials which are asbestos free due to health dangers (big brother watching over us?). Too bad because the asbestos provided superior cushioning, smoother engagement, and better wear than the materials we now get. The linings contain metal particles to aid heat dissipation and to increase disc life. The linings have grooves in their faces for air ventilation and to help disperse lining dust. The dust causes chatter and slippage due to it's slip/grab action. The 6 to 9 springs around the disc hub may vary from loose to tight. This does not affect the operation of the disc. Don't be concerned if they rattle when the disc is shaken (not stirred like James Bond prefers). They're there to help absorb shock and engine pulsations.

REBUILT CLUTCHES: When rebuilders are rebuilding clutches, they normally dismantle a bunch of similar type clutches and dump them into their cleaner and sand blaster piles. During assembly they're not particular and use the next part in the pile. Consequently, parts are mismatched, which can, and usually does, result in dreaded clutch chatter.

[Story: On a '75 Trans AM with a 400 inch V8, I replaced <u>SIX</u> rebuilt clutches in 5 days to eliminate a severe clutch chatter. The original clutch did not chatter but got tore off the clutch disc facing in a contest with a 'vette (my daughter didn't win that match but did win the re-match with the new clutch in it). Each clutch was was rebuilt by a different rebuilder. Each chattered so badly I could barely back up (the wheels would actually leave the ground)! Naturally, each rebuilder said it was something I'd done wrong or the car had excessively worn parts (on a 15,000 mile car?). Funny isn't it how it's never their product that's at fault isn't it? One disc was put in and wouldn't even move the car. After I removed it, I discovered the rivets holding the disc hub were sheared in half.... the heads of the rivets were intact and the round sections between the heads were sheared..... consequently the hub just spun! And no they wouldn't pay labor to replace it! Finally went to a NEW disc and NEW pressure plate. Smooth as glass! Understand I was absorbing all labor as well as chasing after parts for each replacement which sure didn't make me a happy camper!]

After this adventure, I use new clutch covers and discs whenever possible. With the passage of time, new ones are becoming harder and harder to find for flatheads. The only recourse is to rebuild worn-out parts. I take the cover and disc to the guy that rebuilds them for me and ask him to tag all the parts and keep them separate for reassembly. He's always happy to do this. That way I know how much chatter a particular pressure plate and disc had to begin with and after it's rebuilt it sure shouldn't be any worse.

******************* PILOT BEARINGS ******************

PILOT BEARINGS: These provide needed support for the front of the transmission's main drive gear. It primarily operates only during engagement and dis-engagement of the clutch. When the pilot bearing becomes worn, it permits the main drive gear to jump up and down in the flywheel, the throwout bearing, and the clutch disc. Not a good thing. This is certain to promote clutch chatter and erratic clutch operation. (Ever wonder what the thrust bearing on the engine crankshaft is subjected to during clutch chatter? Scary!) There are two types of pilots used in the flathead.... bushing and bearing.

Bushing type: These are usually made from “Oilite” (a trade name for porous bronze that is impregnated with oil) and are simply called bronze bushings. Oilite wears fairly fast due to it’s softness and porosity. Ford specifies a maximum wear of 0.006". It’s not uncommon to find some worn as much as 0.080"-0.100"! Many have been beat on so long they’ve become egg shaped. When installing a bronze bushing, lube it with a very <u>thin</u> film of high-temp grease on the inside of it’s bore. Rule of thumb I use is to replace the bushing whenever I am looking at one.

Bearing type: These replace the bronze bushings. Because bearings are made of quality hardened steel they last a long time. Most are a sealed type bearing and come with a little cheap low-temp grease. Generally this thin grease is slung out in to the clutch area the first time it’s used. A cure I use is to remove the soft neoprene type seal on one side of the bearing using a sharp pick tool. I’m careful to not damage the seal since I’ll re-use it. Clean the bearing with solvent and dry it with air and/or heat. I don’t spin it with air since it’ll quickly ruin the bearings and races due to heat generation. I work some (don’t pack it since it’ll just sling it off) <u>high-temp thick grease</u> into the bearing (I use Lubriplate #70 which is intended for wheel bearings, but it’s no longer available.). Reinstall the seal and install the bearing. I do this to every new pilot bearing I put in (OHV and FH). Most bearings treated this way last nearly 100,000 miles. Otherwise the cheap grease they come with is gone quickly and the bearing is soon galled and junk. I prefer bearings over bushings since I’m lazy and don’t want to work on things much anymore.

**************** THROW-OUT BEARINGS ****************

THROW-OUT BEARING LUBRICATION: These used to come packed with a relatively heavy high-temp quality grease. Then manufacturers went to a cheap thin grease and not much of it. Consequently, bearings no longer last. The cheap grease thins from the high temperatures generated in the clutch area and is soon slung out of the throw-out bearing. This not only causes the bearing to run relatively dry, it can also cause grease to get on the clutch and flywheel engagement surfaces which promotes clutch chatter and erratic engagement. One of the added benefits(?) is you get to listen to the throw-out bearing let out a blood curdling howl on cold days and in front of your buddies. Neat! While rotating the bearing slowly you can feel any bearing roughness. New throw-out bearings are lucky to last 15,000 to 20,000 miles before they start their howling act. **<u>(From rodnut: There are two or three different grades of throwout bearings.)</u>**

A cure I use is to grease them myself .... new and used! These can be greased without much effort. I wash the new or used bearing in solvent until I’m certain all of the cheap grease used by the manufacturer is gone. Dry it without spinning it (low heat or compressed air). Drill a single 1/8" hole on the outer edge of the bearing (not in the engagement surface nor in the outer bearing race). This is pretty hard and a good bit is needed. Then I use a needle type U-joint grease zerk adapter and give it TWO shots of high temp grease. Rotate the bearing half way around and give it TWO more shots of grease. That’s all the grease it’ll need for well past 50,000 miles. Rotate the bearing several times to disperse the grease. I plug the 1/8" hole with a <u>tiny</u> sheet metal screw and some red Loctite or solder it shut. Either works. In my Ranchero, I’ve got over 200,000 miles on the same throw-out bearing using this method.... and this is after it first howled.

***************** CLUTCH CHATTER *****************

CLUTCH MARCELS: This seems to be the biggest problem we have with flathead Long type clutches. By far the most critical element of the disc in eliminating chatter is called the “marcel”. This is the term given to the crimped plate, or wafer, that separates the two disc friction linings. The marcel provides the clutch disc with some “give” during clutch engagement. It also helps prevent the disc lining from sticking to the flywheel and/or pressure plate during clutch disengagement. The thickness of the marcel (the distance the marcel keeps the linings separated) will vary depending on the type of use the clutch disc was designed for. Basically the thicker the marcel, the smoother the clutch will be. It’ll also feel softer to your foot. One drawback of a thicker marcel is the increased pedal travel needed to engage and disengage the clutch. Absence of marcel makes the clutch grab and gives a very positive lock up (less slippage with an increased ability to withstand more horsepower).

Marcel thicknesses for different applications:

Drag racing and heavy duty truck clutches usually have 0.000" to 0.010" marcel since engagement needs to be quick and abrupt and chatter is of no concern.

Street/strip clutches usually have 0.015" to 0.020" marcel.

Pure street clutches will use marcels in the 0.025" range.

A super soft clutch often times have marcels in excess of 0.030" to 0.040" thick.

Many newer disc manufacturers are experimenting with new and different materials which are fairly hard and/or stiff. These have a lot less cushion than the old asbestos discs and the manufacturers have increased the marcel thickness to compensate for this. Some stock replacement discs have marcels 0.050" to 0.060" thick! One thing of interest is the use of marcels requires the linings be riveted. If no marcel is used, the linings can be bonded.

PILOT BUSHINGS AND CLUTCH CHATTER: These contribute greatly to clutch chatter. Replacing bushings with bearings seem to help. Also remove all traces of paint, rust, etc. on the mounting faces of the transmission (or bell housing) to engine to prevent misalignment.

TEMP CLUTCH CHATTER FIXES: Understand, the following do not take the place of correcting the problem.... and are merely temporary fixes.

Early transmissions: Squirting some powdered graphite on the clutch disc linings will often reduce chatter. Remove the inspection cover on the top of the earlier transmissions. Depress the clutch pedal to the floor and hold it down with a 2X4 wedged against the seat. Squirt some spray powder graphite (like used in cylinder locks) between the clutch disc linings and their two engagement surfaces on the flywheel and pressure plate. Takes about two squeezes. Repeat this every 90 degrees around the clutch. This would seem like it’d slip bad, but it doesn’t. Many times it’ll completely eliminate clutch chatter. However, if you really go overboard with the graphite, it will slip. This is an old trick I learned while working in a used car lot.

On 8BA transmissions: Loosen the 4 transmission to bell housing bolts several turns. Pry the transmission towards the rear and hold it back with a screwdriver driven between the trans and bell housing. Slip one shim 0.020" to 0.030", or a piece of a cruise dash plaque (they’re 0.030" thick), in between the transmission case and the bellhousing on the lower right corner only. Remove the screwdriver and tighten the trans bolts back up. This will cock the transmission main drive gear in the pilot bearing and will often reduce some clutch chatter for a time. Another used car lot trick.

ENGINE STAY-RODS: These were used up through the '48 engines. They certainly help control clutch chatter. Run 'em if you've got 'em.

CLUTCH CHATTER ELIMINATORS: These came out in the forties and were after market items. They really work on '33 thru '48 cars with their center X frame. And are simple to construct and install. The design uses a "V", a long bolt threaded on both ends, 4 old pin type shock absorber bushings with washers, two nuts for the long bolt, and a stout "S" shaped hook. I didn't include dimensions since you can determine them for your particular car. The following should help you with your design. **Pictures are currently** shown on the Flathead Techno Site.

The front pieces to form the "V" are made from a two lengths of 3/8" X 1" flat stock. The two pieces have to be long enough to reach from the lower two trans bolts to about the middle of the trans. You'll need heat to bend things unless your fingernails are rough from dragging on the asphalt as you walk! Bend both ends of each of the two pieces 90 degrees and drill holes in both bends. The two at the trans should be 3/8" diameter for the trans bolts to go through. Both rear holes need to be the same diameter as the long rod. Attach the two pieces to the lower two bolts of the trans without using bushings. Bend the 2 pieces so the remaining two ends have their 90 degree bends overlap and their holes line up.

The long rod with both ends threaded back a good inch or so has to be long enough to go from the intersection of the two pieces you just installed to the trans and extend to near the front of the X center cross member (6" or so). Put a bushing and washer on each side of the rod that goes through both pieces from the trans and hold these together with a nut. The other end of the rod will get bushings and washers on each side of the "S" shaped hook.

Use a piece of 3/8" flat stock and bend in an elongated "S". Hook one end in the rear of the center X frame member. The S goes from the rear of the X member towards the front of the car. Drill a hole in the other end of the S for the long rod to go through. Install the rod through the hole in the S hook.

Hook everything up and tighten the nuts quite a bit on each end of the long rod. This will virtually eliminate nearly all, if not all, clutch chatter. If you have problem understanding this after going over it while under your car, please e-mail me and I'll see if I can help.

****************** LIGHT FLYWHEELS ******************

LIGHT FLYWHEELS: The "lip" type flywheel used a 9" clutch and weighs 38.7 lbs. They came in all of the early V8's. They are my preferred flywheel because they use the lightest clutch (bet you've already figured out I'm some kind of nut about light rotating mass). Beginning in '35, the pickups and sedan deliveries all used a flywheel without a lip, but still used a 9" clutch. These weigh 34 lbs. They were much sought after for stock cars where rules stipulated flywheels had to be stock. Most other early flywheels, other than the lip type 9", weigh 36 lbs. The 8BA and 8CM flywheels weigh 34 lbs.

Lightening a lip-type flywheel: Machining the flywheel's lip off, chamfering outward from the edge of the pressure plate to the starter ring gear, dishing out the rear of the flywheel to reduce the flywheel thickness, will reduce the 38 lb.

weight of a lip type flywheel to about 20 lbs. Combined with the lighter 9" clutch, they are my preferred combination for a street flathead.

On street machines, flywheel weight is best left at 20 lbs. (A light high boy roadster with a built-up flathead and low gearing would certainly be an exception.) If the flywheel is too light, it’s difficult to launch a heavy car at stop lights without revving the engine considerably. Aluminum flywheels with no steel or brass facing wear quickly and don’t take kindly to clutches being slipped. I don’t use an all-aluminum flywheel (no steel or brass facing) on the street. A steel or brass faced one is less than the 20 lb weight rule I use.

In the early days we all heard and believed the following: “During acceleration every pound of flywheel weight is the same as adding 100 pounds of weight to the car.” Seems to me this would apply to all reciprocating masses like the crankshaft, clutch and flywheel.

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************ COOLING************

Revised April 25, 2009

************* Cooling in General *************

OPERATING HEAT RANGE: Ford shop manuals specify the normal operating range of a flathead is 180-200 degrees F. Great if you're not 5000' above sea level where water boils at 202 degrees F. Sure makes a pressurized system more appealing.

BOILING POINT OF WATER FOR INCREASED ELEVATION: The boiling point of water decreases 2 degrees for per 1000' of altitude. Example: The boiling point of water at 5000 feet in a non-pressurized cooling system is:

$$(2 \text{ degrees})\frac{(5000')}{(1000')} = 10 \text{ degrees.}$$

And (212 degrees)-(10 degrees)= 202 degrees F (remember this is for a non-pressurized system).

EFFECT OF GASOLINE OCTANE ON COOLING: Engines run cooler with lower octane fuel rather than higher octane. (High octane fuel burns slower and causes higher operating temp.)

EFFECTS OF BOILING: Boiling will damage any engine. This is well known. However, we normally only think of cracking or warping problems. But boiling causes other things to happen that we're probably unaware of.

Boiling causes bubbles to form. These are bubbles of steam. These come into contact with the cooling system side of cylinder walls. Because there isn't any cooling in steam, an *extremely* hot spot is instantly created on the cylinder wall. It is very hot and penetrates through the cylinder's wall. When a piston ring passes over such a hot spot, the ring will actually weld itself for a micro-millisecond to the cylinder wall. It doesn't slow the piston's travel and can't be detected at the time, but the mini-weld causes a tiny particle of ring to separate. These minute welds appear as tiny gray shadows on the inside of the cylinder wall. These gray shadows are about the size of the head of a pin. It's not uncommon to see as many as 20 of these per cylinder.

A pressurized cooling system boils at a much higher temperature. This higher boiling point is more difficult to reach which will delay formation of steam bubbles and the resulting gray shadows and ruined rings.

*************** COOLANTS & ADDITIVES *************

WATER VS ETHYLENE GLYCOL AS A COOLANT: Ethylene glycol anti-freeze feels oily to the touch. It acts as a kind of insulator on surfaces it contacts, which slows the transfer of heat from the metal surfaces to the coolant mix. As can be expected, anti-freeze also retains heat considerably longer than straight water. The stronger the mix of anti-freeze the more heat the coolant retains and the hotter an engine will tend to run. A 50/50 mix causes an increased operating temperature of about 15 degrees over straight water. Straight water will absorb and dissipate heat faster and will normally reduce operating engine temperature. Be sure to use a good rust inhibitor.

ETHYLENE GLYCOL IN NON-PRESSURE RADIATORS: Addition of anti-freeze alters both the freezing and boiling points in accordance with the percent of mixture. System pressure and altitude also affect the boiling point, but not the freezing point. Therefore, the following table reflects only the freezing point with various anti-freeze percentages.

% of anti-freeze	freezes @
0%	32 deg. F
39%	-10 deg. F
44%	-20 deg. F
48%	-30 deg. F

FREEZE PREVENTIONS: Running a 40% ethylene glycol mix will give protection to about 10 below zero. Below that temp it will first turn to slush which will not damage the radiator or engine. But if it gets colder than 4 degrees below the protection point, it can freeze and turn to ice. Usually the radiators (engine and heater) are the first to freeze. But there are a few things you can do to prevent it from freezing. The following are not in any order.
Example: Say you stop for the night and the temp forecast is for it to get colder than your anti-freeze protection.

(1)Covering the grill and hood with a blanket (motels get upset with this!) will slow heat loss considerably.

(2)If the temp drop is not to get 10 degrees colder than your anti-freeze protection, run the engine until it's up to operating temp just before you retire for the night..... say around 11 PM. This will usually prevent any freezing until about 6 AM or so.... especially if you've thrown a blanket over the hood and grill.

(3)If the temp is to get colder than 10 degrees colder than your anti-freeze protection, set an alarm clock for a couple of hours after you retire. Start and warm the car for about 5 minutes every two hours during the night. I've done this when temperatures got down to 5 degrees F with no problem.... and I use only water in my flathead! Sure is cold going outside in the middle of the night though (and the bed isn't too warm when you get back either..... which isn't at all bad if there is someone who will warm you up!!

(4)Lay a drop light on the top of the engine. Don't let it lie on anything rubber or on wire insulation. This really helps keep the engine warm. This has an additional benefit. A battery loses about 50% of its power when the battery gets down to zero degrees F. When it's really cold, the oil gets as thick as grease and causes a tremendous amount of drag.... drag a weakened battery sometimes cannot overcome. Result is your engine can't turn over fast enough to start. If the car battery is under the hood, lay the light close to (but not against) the battery to keep it warm.

(5)Guess this as good a place as any to add this. Sometimes the weather at home gets super cold. If it's going to get down to 30 below zero or colder, give it up and add a 55 gallon drum of industrial strength anti-freeze... or load up and head south. Chances are the engine won't start in the morning even with anti-freeze. A drop light or two helps, but the oil gets so cold and the battery so weak, the starter is unable to turn the engine over..... let alone start it. Put an electric hot plate under the pan (not against it, but about an inch below it using bricks etc. for spacing) before you go in for the night. Run an extension cord up to the porch light or outlet and plug it in. In the morning before you're ready to tough out the cold…. Start the hot plate by turning on the porch light (a timer works super). The engine temp instrument will probably be off cold when you go out 15 to 20 minutes later! The engine spins over like its summer time! I've even used BBQ briquettes on stacked bricks for this a few times when there wasn't any electricity, but I'm nervous about fires around a gas engine. Besides, the briquettes are a real bear to get started in the morning when it gets that cold (even a match doesn't want to light!).

Ever blown the top tank radiator seam open while driving in bitter cold weather? I have. Story time: Middle of the night in my '48 convertible and coming home on Christmas leave in December of 1955. Had to come over Donner Pass in CA. It doesn't freeze in sunny CA so my flathead had only water in it. Outside air temp was a mite bit the wrong side of zero. Heater began throwing cold air all at once. The temp gauge had suddenly pegged on the hot mark. It had been on the normal side of the temp gauge like it always was. Pulled over to the side of the road and shut the engine off. Talk about cold! Felt it right a way since all I had were my dress blues. Thankfully I had my Navy Pea Coat. I popped open the hood and shined a flashlight around. Looked normal and no boiling sounds coming out of the radiator!!! Strange… it showed boiling. I gingerly loosened the radiator cap to the first notch to remove the pressure. It had lots of pressure. After releasing it, I removed the radiator cap.... it was barely hot to my hand! Strange. The water in the radiator was full. BUT IT WASN'T BOILING AND WAS ONLY ABOUT 140 DEGREES OR SO!!!! What was going on? Fired it up. Instantly the heater began throwing heat! I made a U-turn..... and watched the temp gauge while driving the 10 miles back to the last town I'd been through. Everything fine until just before the town. Then the heater started throwing cold air and the temp gauge climbed rapidly to hot..... then all hell broke loose...... the top of the radiator tank let loose and radiator water spewed out everywhere and quickly formed ice. Nothing to do, but limp on. There was an all night gas station (this was in 1955 when there were still such things as gas stations with service bays). The night shift kid let me use a shop bay while he looked over the customized convertible and it's dressed-up flathead mill. I managed to talk him into using his acetylene torch (after considerable discussion) to re-solder the top tank back together. I re-filled the radiator with water and started it in the service bay. Ran it for nearly an hour sitting in the bay while we emptied his coffee pot..... nothing happened and the temp stayed on normal. Headed on down the road. About 20 miles later it started to throw cold air out of the heater. Was watching really close and caught the temp gauge when it first came off the bottom end of normal. Pulled over to the side and shut it off. Pulled the cap off. Like before, lots of pressure but the water was full and about 140 degrees to the touch! And, like before, it was <u>full to the brim</u>. Started engine with the cap off. Heater began throwing heat within seconds. Dumb. Sat there with the engine running and the hood open while I smoked a couple of Camels from the ships gyp joint (I still smoked in those days) and thought about the problem. Finally dawned on me (who said smoking is bad?). Got out of the car and grabbed the overflow pipe extension at the bottom of the radiator. Frozen solid! I had clamped a rubber hose extension on the end of the radiator's metal overflow pipe to direct any radiator overflow away from the engine compartment (this was long before there were catch tanks). Condensation from the hot metal overflow pipe combined with the normal radiator puking and collected in the rubber extension tube where it soon froze solid since it was hanging down below the car. Air and water from the radiator couldn't escape which caused pressure to build. The pressure radiator cap opened like it was supposed to, but the pressure vapor couldn't escape. The pressure would continue building and soon the heater wouldn't get any water circulation and it would start throwing cold air. Pressure would build very fast until it got high enough and something had to fail..... like blowing apart the seam of the top tank. Simple cure once you figure things out. Removed the rubber extension and threw it into the cold night air. Started up and went on my way. No further problems except for an occasional blizzard or such. You might want to remember this if you're running straight water and have a rubber extension on your radiator overflow pipe (don't forget tubing for the catch tank) in cold weather.

DISTILLED WATER: I use only distilled water in a cooling system whether using straight water or mixing it with anti-freeze. All tap water contains impurities which will attack cooling system metals.... especially aluminum because it's soft, but it will also attack brass, copper, and zinc. When using plain water, with no anti-freeze, be sure to add a good rust inhibitor.

CHECKING COOLANT FOR RUST INHIBITORS AND THEIR CONDITION: As we all know, anti-freeze never loses its anti-freezing ability. It may get dirty, but it still has the same anti-freeze characteristics as when it was new. HOWEVER, the inhibitors last only a fairly short time. The most common solution to this problem, and I think what the manufacturers want us to do, is to replace the anti-freeze. But why not just replenish the wore out rust inhibitors? Problem is how to determine the inhibitors are no longer active.

Remembering our old high school physics..... Whenever dissimilar metals are immersed in a liquid in motion, D-C voltage will result.... or something along these lines. This will cause softer metals (like aluminum, zinc, brass, and copper) to transfer to harder metals by electrolysis. Inhibitors prevent this by reducing or eliminating electrolysis. Determining the condition of inhibitors can easily be checked using a Volt-Ohm-Meter (VOM). A digital VOM is easier to use than an analog (analog have scales and a needle) for this test. Turn the function selector to D-C volts. You'll be measuring voltages of less than 2 Volts so select a voltage of 5V or less. Hold one of the probes (either one) suspended in the coolant in the top radiator tank. Don't let it contact any metal. Ground the other probe to the metal of the radiator filler or tank. Read the voltage on the VOM. When the voltage exceeds 0.5 Volts D-C, the inhibitors are worn out and are no longer doing anything. Adding a can of rust inhibitor is all that's required. A voltage reading of 0.5 Volts DC or less show the inhibitors are still active and there is no need to replenish them. Remember, anti-freeze never loses its anti-freeze capabilities...... it only looses its inhibitors.

RUST INHIBITORS: There are many brands and types of inhibitors on the market. The one I use is called "No Rosion" and is used by most of the serious collectors of rare and exotic cars (would you believe our flathead Fords are exotic?). Price in the year 2009 is in the $30 range for a half gallon (4 pints), but it is available in smaller sizes. One pint treats a 22 quart system and one treatment lasts 3 to 5 years. It's red in color and is not sold over the counter to my knowledge, **but it is available direct from the manufacturer. Call Jay P. Ross. His cell phone is 847-477-9262.**

**************** PUMPS & RADIATORS ****************

REMOVING/INSTALLING A LOWER RADIATOR HOSE: These are tough because there isn't room to work in addition to the hoses always being stuck tight. Closeness of the radiator outlet and the water pump inlet certainly doesn't help matters either. The close proximity to the radiator fins usually ensure several cuts on knuckles in addition to flattened radiator fins. Using a screwdriver to pry around a stuck hose always ends up ripping the hose and sandwiches a few radiator fins in the process.

A tool I use that makes this a whale of a lot easier is a called a Cotter Pin Extractor. These look like a sharpened screwdriver that has been bent severely by an ape picking his teeth. These tools are very strong and won't straighten out. Each tool manufacturer uses slightly different bends, but any bend works fine. Craftsman and Snap-On are the ones I use. Loosen the hose clamps considerably so they hang on the hose and are not stuck to it. Then work the end of the cotter pin extractor tool in-between the hose and radiator outlet (or water pump inlet). It usually slips in without a lot of problems. Then work it around the hose to break the hose seal loose. Do the same to the other end of the hose. Then use the tool to pry up the ends of the hose and pull on off the radiator pipe or water pump. It makes things a lot easier. Oh yeah, they work great when installing a hose too. I wipe some engine assembly lube around the inside of the hoses to help things slip together easier. Boy am I lazy!

SEALING A LEAK: I've used lots of different things to seal radiators that leaked when racing stock cars. Everything from shredding cigarette tobacco to a half teaspoon of black pepper. Many worked pretty well, but would often clog the radiator if used frequently. Commercial sealers were never available at the track and most failed at sealing anything larger than a small drip. Alumnaseal and Barr's Leak seemed to do the best, but the Alumnaseal really loaded up the cooling system.

Recently I came across BG Cooling System Sealer (part #571). ABSOLUTELY SUPER STUFF! I saw a demonstration where the bottom of a beer can (I volunteered to empty it first) had been punched with an ice pick several times. They filled the can with water and held it up so the water poured out the holes. Then they added a mix of water and their tan colored sealer. The water completely stopped streaming out of the holes in less than 5 seconds!!!! Great stuff. Since it's organic, it doesn't harden in the system and plug things up like some other sealers I've tried over the years. It simply stays in suspension until there is a leak. Another thing I like..... flushing the system flushes it out. It doesn't adhere to the walls of the cooling system. I use it to seal head studs and head bolts when building an engine in addition to sealing radiator leaks on the road. It's so good I carry a can of it in my heap all the time. You never know when a rock or something will cause a leak. Oh yeah.... it will seal blown head gaskets if the hole is fairly small... even though it's not intended for that purpose. Least it did on a friend's blown head gasket. (Wonder if it'll work on a cracked block?)

WATER PUMP REBUILDING:

1) Press the shaft through the pulley from the front. Heating the pump shaft on the pulley side first helps. If it won't press through easily, drill a 3/8" hole (maximum size) down the center of the shaft from the pulley side.

2)Remove the shaft, bushing, and seal from the housing.

3)Press the new impeller onto the new shaft.

4)Press new bushing (or bearing) into the casting.
5)Install the spring, seal, etc.
6)Press in the shaft and pulley from the front.

PRESSURE RADIATORS: Ford radiators prior to 1949 were not designed to operate under pressure. The large top tank wasn't intended to have high pressures and would often split open the seams if a pressure cap was installed. A common flathead rule was: Never install more than a 4 lb pressure cap on an early radiator. Also see the following section on RADIATOR CAPS. Some, like the '40, had a vent line located some distance from the cap which vented the tank. Installing a pressure cap in one of these in hopes of making a pressure radiator system won't do a thing.

WATER PUMP FOR '37-'48 BLOCKS: The pumps to use on these earlier blocks are truck pumps. Regular pumps have bushings. Truck pumps have bearings. Truck pumps have a 5/8" shaft compared to the 1/2" shaft on the bushing type pumps so they can easily be identified. They usually have a double pulley. If you don't want to change pulleys and bore the bushing type pulleys to 5/8", grind off the outer pulley sheave.

WATER PUMP FOR 8BA ENGINE IN AN EARLY FORD CHASSIS: Use '49-'53 truck pumps with a single belt pulley. These have the same motor mounts as the 59AB series water pumps have. These are sealed bearing pumps too. It can't get much better than this.

CHECKING FOR A PLUGGED RADIATOR: This is from several local radiator shops. Remove the hoses. Plug the lower radiator outlet(s) with your hand or tennis balls. Then fill the radiator. Remove your hand and watch the water as it pours out the lower outlet. If the water comes out of the outlet in a swirl (like a whirlpool), the radiator is flowing good and doesn't need cleaning.
Although the radiator shops around here rely solely on this to determine if a radiator needs cleaning, I have reservations that any test which works can be that simple. It could be open in a few places and plugged in others. I always have the top and bottom tank removed and the radiator cleaned. Just my two cents worth.

RADIATOR FLUSHING: Most of the radiator flushes we get today are too weak to do much of a job. Back several years ago the instructions on the can warned users not to leave the flush in for more than 15 minutes. This was because the flush was potent and would eat holes in the soft radiators. Today's flushes are so weak (thanks again Big Brother) many instructions say to leave it and drive it for 24 hours! The following are listed in accordance to my preference....
(1) After market radiator flushes. There are probably many of these flushes on the market today that do a great job. They're all pretty simple and easy to use. The product I've had the best results with, and the one I use exclusively at this time, is BG Cooling System Flush (part #540). This flushes the system without fear of damage. Just follow the instructions. If you have a good parts house that deals in BG products, they will usually arrange for you to use BG's portable power flush machine at no cost. This really cleans the system quickly and easily.
(2) The following was contributed by NIRVANA on the Flathead Forum on 2/21/01. Distilled vinegar for an approximately 20 quart cooling system. Drain and flush with water. Partially fill the system with water before adding 1 gallon of white

vinegar (vinegar is weak acetic acid). Top off the radiator with more water. Drive for about a week (it's a weak solution). Drain and flush with tap water. Refill with water. Add rust inhibitor. This weak solution will not hurt aluminum, brass, or copper. I tried this and found it worked pretty good.

(3) Oxalic Acid. Oxalic acid powder is available from paint and hardware stores. Warm the engine up to operating temp. Mix 12 ounces of powdered oxalic acid in a quart of water. Pour it into the radiator. Run for about 20 minutes. Drain it and flush it at least twice with tap water. Then neutralize any remaining oxalic acid with ½ glass of powdered baking soda or bi-carbonate of soda mixed with tap water. Run for about a half hour and then drain and flush it with tap water a couple of times. Drain and fill with distilled water and add rust inhibitor.

*************** **FANS** ******************

FANS: Early Ford bulletins specify fans are to turn at 1½ times crankshaft speed to cool better during idle and slow speeds. This is a compromise since turning them faster increases fan noise. Turning them slower than 1½ times crankshaft speed will encourage engine heating at slow engine speeds. Adjust fan speed by changing the fan's pulley diameter. [[[[A puzzlement to me: Why did Ford install fans directly to the crankshaft in '39-'40? This makes for a 1:1 ratio. Is this why these get hot while idling or running at slow speeds?]]]]

FAN BLADES: The number of blades, blade pitch, and blade spacing all affect the amount of air flow.

(1) The more blades the more cooling. Five and six blade fans are found on trucks and other heavy duty applications where cooling is a big concern. Some fans come with the tips of their blades bent forward. The bent tips act somewhat like a shroud in reducing air being slung off the ends of the fan blades. Consequently, they cool better than a fan with straight tips.

(2) Four, five, and six blade fans all come with both equal and unequal blade spacing. Unequal spacing of fan blades seem to cool slightly better than equally spaced blades. A big advantage of unequal spacing is the reduction of fan roar.

(3) Flex blades. These are designed to flatten at speed since fans supposedly don't cool appreciably above 1200 rpm. It's been my experience all engines run hotter at all speeds without a fan. The cheaper after market fans of the stainless steel, or plastic, variety tend to flatten out too soon which results in overheating at anything close to highway speeds. The more expensive stainless fans don't flatten as easily and work better, but I use stock steel ones. I think the stainless varieties get weaker with use and age which leads to premature flattening of blades.

ELECTRIC FANS: Scott Cooling Fans advertise they have 6V, 12V, and 24V fans. 1-800-272-FANS. I've never dealt with them, but would certainly look carefully at amps the 6 Volt fans pull. Probably more than a stock 6 Volt generator will handle when normal loads are considered.

*************** **RADIATOR CAPS** **************

PRESSURE RADIATOR CAPS: For each pound of pressure cap, the boiling point will be increased 3¼ degrees F. Example: A 5 lb cap will increase the boiling point (212)+(3¼)(5 lb) = 212+16¼ =228¼ degrees F. Stock Ford radiators which did not come pressurized from the factory will usually tolerate a 4 lb cap, but many exceptions were discovered when the top tank blew! The large top tanks use thin brass which expands and contracts easily. This can lead to the soldered joints weakening and failing under pressure and elevated temperatures. New after market brass type pressure radiators will usually withstand 10-12 lbs even with their large top tanks due mostly to their improved crimping methods and thicker brass tanks. Aluminum radiators (they're brazed instead of soldered) are commonly built to withstand pressures to 40 lbs.... a lot more than our old flathead head gaskets will usually tolerate.

PRESSURE RADIATOR CAPS FOR '51 FORDS: Ford's '51 model cars increased the depth of their radiator necks for some hokey reason. The '49 & '50 radiators have a shallower neck depth. Consequently if a radiator cap for a '49 is used on a '51 radiator, it will not contact the seat and the coolant will be pumped out the overflow pipe at about the same rate as if the cap was left off. The '51 radiator neck is about 1/8" deeper than the '49-'50 if I remember correctly. Current parts catalogs and computers show the same cap for '49 thru '53 Fords. The best source is an early Genuine Ford parts supplier. Shimming with three layers of rubber "donuts" cut from inner tubes has been used successfully when a '51 cap was unavailable, but is not advised.

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

********* ELECTRICAL ***********

Revised: April 15, 2009

*************************GENERAL*************************

WIRE SIZE FOR 6 VOLT SYSTEMS: If in doubt, use the larger size.

GAUGE	MAX. AMPS	TYPICAL APPLICATIONS
18	5	License plate, dome, glove box, dash lights, & other small loads
16	10	Instruments, radio
14	20	Field wiring, generator ground, heater fan Overdrive wiring, cigarette lighter, tail & brake lights, park lights & misc wiring
12	30	Headlights
10	50	Charging, Amp meter, main supply
8	80	

6 Volt Battery cables should be #1/0 minimum.

HEAD LIGHT WIRING: There are three prongs on either a seal beam or bulb...... two vertically and one horizontally.

Looking at the back of the head light seal beam or bulb at the bare prongs, the top horizontal prong is for the low beam.

The right vertical prong is for the high beam.

The left vertical prong is for the ground.

TEST LIGHT USED FOR LOCATING SHORTS & TESTING CIRCUITS: If it’s a fused circuit, the fuse blows before you can even begin troubleshooting. If you replace the fuse with a piece of copper tubing or a screw, the insulation will begin smoking long before you can trouble shoot the system. Use an old dash bulb and socket. You’ll have to solder a second wire onto the light socket’s metal base for a ground wire. Use the same voltage bulb as the system you’re checking. On both a fused and a non-fused circuit the bulb will limit the current and prevent things from smoking. On a fused circuit, connect a lead to each end of the fuse holder’s contacts. The bulb replaces the fuse but, unlike the fuse, won’t blow or cause a dead short. The current flows through the light to the short (ground) which completes the circuit. As long as the bulb is lit, there is a current flowing to ground and there is a short. If the bulb is not lit, there’s no short. Simple. Beats replacing fuses by the gross or spending a day or so replacing smoked and charred wire looms. Tip: Use a seat warning buzzer off a new car in place of the bulb. Works great when you can’t see the bulb, but with my geezer hearing, I have to stick to the bulb.

ELECTRICAL SHORTS: If your battery keeps discharging or going dead for no apparent reason, there is a good chance there is a short. But how to check for a short and, better yet, how to find it? Partially charge the battery if it's dead. It doesn't need to be anywhere near fully charged. In the following, I'll be using the terms "load side" and "line side". The line side is the side of the circuit that comes from the battery. The load side is the side of the circuit that goes to the light or motor (load).

Checking for a short: Disconnect one battery cable from a battery post (either one works). Lightly touch the inside of the cable's terminal to the post. If there is any kind of spark, there is a short. Sometimes the spark is very faint (a small short) and you can only see the faint blue spark if you shield out all light. If there isn't any spark, there isn't a short. Problem is probably in the battery and/or charging systems. Another means of testing is to hook up your dash test light between the battery cable and the hot negative battery post. If it lights up, there is a short. Often the bulb barely glows which signifies a small short.

Let's suppose there is a spark. How to find it is the next step. I'm assuming there are no blown fuses in the following discussion. There are basically two types of circuits.... fused and non-fused.

Determining if it's in a fused or non-fused circuit: Leave the battery cable disconnected from its hot negative battery post. Hook a dash bulb test light (described in the preceding TEST LIGHT FOR LOCATING SHORTS) between the battery cable and it's negative battery post. Since there is a short, the bulb lights up or just barely glows. This tells us there is current flowing through the bulb to ground (the ground is the short itself). Next we test to see if the short is in a circuit protected by a fuse. With the test light still lit up, watch it while you remove one fuse at a time at the fuse panel. When the test light goes out, the short is in that fused circuit. If the light does not go out after pulling all the fuses, the short is in a circuit that's hot all the time (a non-fused circuit or on the line to the fuse panel).

Fused circuit: If the test light goes out when a fuse is pulled, the short is in the load side of the circuit that particular fuse protects. Push the fuse back in. The test light should be lit. Watch it while you track the circuit between the fuse panel and the load...... jiggling wires and wiring harness as you go. Examine the wiring very closely as you trace it. Often times you'll find the insulation worn through and the bare wire touches a ground. When the light flickers, it means you're very close to the short and should be able to locate it visually.

Non-fused circuit: If the test light does not go out after pulling all the fuses, the short is in a circuit that isn't controlled by a fuse. It's either in:

(a) one of the wires feeding (line side) the fuse panel.

(b) a circuit that's hot all the time. Examples of "hot all the time" circuits are the line sides of; the head light switch, the horn button (switch), brake light switch, the ignition switch, cigar lighter, the starter button, and the dome light switch. Notice all circuits are hot all the time regardless of what position the ignition switch is in (off or on). Also each has a switch in their circuit. The short has to be between the battery and the switch (line side of the switch). The short cannot be on the load side of the switch because a switch that's in the off position prevents current from going to the light or motor (on the load side of the switch).

For both (a) and (b), watch the lit bulb as you examine and jiggle the wiring on the line side of the switch on each of the circuits. When the light flickers, you've very close to the short and should be able to visually find the short.
One more thing: Don't discount a bulb from being the culprit. Even though it works, I replace the bulb first to eliminate the possibility of a dinked up bulb. TIP: Always make sure the bulb or motor is grounded when something ceases to work. You'll find it's often the culprit.

************************ GENERATORS ************************

CHECKING 2 BRUSH GENERATORS & REGULATORS ON THE CAR: A 2 brush system that is functioning properly should show charge somewhere in the 4 amp range when the battery is fully charged. Let's assume the ammeter shows a slight discharge with the engine running and everything else turned off. With the engine running above idle, temporarily connect a jumper wire between the field terminal and the armature terminal at the regulator. This essentially removes the regulator from the circuit. If the ammeter shows charge, the regulator is at fault. If the ammeter shows no charge, the generator is at fault. However, at times the generator may have taken the regulator with it when it failed, so don't rule out this possibility if the generator checks faulty. Note the generator goes to full charge when the field is jumped to the armature.

6V GENERATOR VOLTAGE: Ford 6V two brush generator output specification is 7.2 to 7.5 volts DC (direct current).

POLARIZING A 2 BRUSH GENERATOR: Disconnect the FIELD terminal wire at the voltage regulator. Momentarily touch this wire to the BAT terminal a couple of times. Note: Failure to disconnect the field wire at the regulator (using a jumper wire) could overload the regulator and ruin it.

****************** VOLTAGE REGULATORS ******************

ADJUSTING VOLTAGE REGULATORS: These are touchy to adjust. Barely touching one will make a big change. When looking at MOST regulators (which are mounted on the firewall) the voltage relay is on the left. The amps relay is in the center. The cutout is on the right. Most of the regulators have their terminal stamped.
The cutout should close at about 6.7 volts. Using a good voltmeter on the battery, watch the voltage. It should charge up to 7.3 volts and the voltage relay kick off. The arms the springs are on are bent SLIGHTLY to increase or decrease the voltage or amperage. More spring tension increases the volts or amps. Do the volts first, then turn on the head lights with the rpms up. If the voltage drops below +3 or 4 with the lights on, increase the amps until you get to +3 or 4.
This isn't a five minute job as the components heat up causing the values to change. When the cover is installed, it takes a while before the settings are at their operating temperature. Thanks to GM for this post on March 13,2007.
..
MECHANICAL VOLTAGE REGULATOR ON A TWO BRUSH GENERATOR: All 6V regulators at this time are mechanical to my limited knowledge. Whereas all 12V regulators are electronic (except for a few NOS lingering around). Unlike the electronic type, the mechanical type can be tinkered with and adjusted.

Mechanical type. Often times the points become pitted and stick shut. Disconnect all of the wires at the regulator terminals and dress the points with a point file and check for point sticking shut. There have been times when I needed to know the physical location of the various relays under the cover of the voltage regulator. This info has been needed to coax a voltage regulator into working until I could come up with a replacement (like on the road... or my social security check.

The cutout relay is directly behind the BAT terminal.

The current relay is directly behind the ARM terminal.

The voltage really is directly behind the Field terminal. To increase the output of any of these relays, bend the rest the flat spring lays on upward. This will increase the output of that particular relay. Bending to be VERY minor in nature (less than 0.020"). This doesn't always work, but it's worth a try in an emergency.

************************** BATTERIES **************************

CHARGING OPTIMA DRY CELL BATTERIES: Although special chargers are available for charging these types of batteries, they can be charged using just a standard battery charger. This requires a good battery of the same voltage as the Optima you want to charge.

I always wear protective clothing and good safety glasses when I'm working on a battery. Connect jumpers to the posts of the two batteries in parallel (positive to positive and negative to negative). Connect the battery charger to the good battery and start the charger.

After an hour check the Optima to see if it's warm or hot. If it's hot, there is something wrong with the Optima and you should stop the charging. If you hear gas escaping, stop the charge immediately since the battery could explode.

Once the Optima shows 10.5 volts or higher, the charger will be able to charge the Optima battery by itself. Remove the good battery and hook the charger directly up to the Optima. It should take a full charge or until the charger automatically stops charging. From an article in Street Rodder Magazine written by Ron Ceridono.

************************* STARTERS ***************************

STARTER CURRENT: Starting current on flathead V8's through '48 is 550 amps. Beginning in '49 it increased to 600 amps.

STARTER RPM: Starters spin '48 and older V8 engines 100 rpm at 6V. Starters spin '49-'50 V8 engines 130 rpm (standard transmission) at 6V. Starters spin '51 V8 engines 150 rpm (standard transmission).

8 VOLT BATTERIES: I tried one of these in my roadster when I was having starting problems. Burned out 6V head light and 6V tail light bulbs so fast it was unbelievable! How about 25 minutes for a tail light bulb, 45 minutes for a low beam head light bulb, and 20 minutes for a brake light! Tried adjusting the regulator to charge 8V, but it didn't help. The generator case got hot quickly. I constantly worried about throwing solder off the generator's commentator due to heat. But I sure liked the way it cranked the engine over and the bright head and tail lights. However, I dreaded driving at night since the bulbs burned out so quickly. Finally, after burning out both 6V headlights (brights and dims) in

a 3 hour homeward bound cruise one night (no tail or brake lights after the first hour), I pitched the 8V battery and went back to the 6V. This time I used an Optima battery instead of a lead acid. It's interesting to note a brand new lead acid 6V battery wouldn't crank my souped up flathead after it was up to operating temperature, but the 6V Optima would. However, even it doesn't like turning it over when the engine's got a good heat soak going. See the following for the remedy I use.

PROBLEM: 6 VOLTS TURNS ENGINE OVER SO SLOWLY IT'S HARD TO START : This can often be a problem with our hopped up flatheads. The often drastic increase in cubic inches and accompanying high compression loads down the 6V starter. Newly built engines with tight clearances also have 6V starting problems. A solution I use is adding a 12V battery for balky starting only. The car retains the entire stock 6V electric system. Beats changing everything over to 12V as far as I'm concerned (ever try to find a non-indexed 12V headlight dual filament bulb on the road?).

Two batteries are used..... a 6V and a 12V battery. The car's <u>entire</u> electrics remain 6V <u>including the starter</u>. Even the charging system remains 6V. A 12V battery is added for use only when 6 volts are unable to start the engine. This is an easy cure for a purist plagued with a fresh or tight engine or one that won't (or is hard to) start when hot.

Install a 12V battery somewhere in the vehicle (in the trunk, behind the spare tire, under the floor, etc.). Connect the positive post of the 12V battery to a good ground like the frame using a battery cable. Install a 12V starter solenoid (I used one for a 12V Falcon) close to the 6V starter motor. The 12V solenoid mounting bracket has to be grounded. Connect a battery cable from the negative post of the 12V battery to the post marked BAT on the solenoid. Run two #14 gauge wires from the solenoid location in to the inside of the car. Install a universal type starter button which has <u>two</u> terminals. Connect a #14 wire to each of the starter button terminals. Connect the other end of one #14 wire to the large terminal on the solenoid which also has the 12V battery's negative cable. This will supply 12V to the new starter button. Connect the remaining #14 wire to the left small terminal on the solenoid (the right terminal provides 12V to the coil for starting purposes only and is not used). The only thing left is to run a short battery cable from the remaining large terminal on the 12V solenoid to the starter motor. Both the new 12V cable and the existing 6V cable are bolted, one on top of the other, to the starter motor's terminal. Tighten all connections and you're done.

I use the 6V to start the engine most of the time. But if the engine doesn't start right up, I hit the 12V starter button. *CAUTION: Do not push both starter buttons at the same time since it'll feed 12V back through the entire 6V electrical system… NOT a pretty sight!* The 12V side is a "total loss electrical system" in that it doesn't receive any charge from the car's generating system (6V). I've found a trickle charge overnight once a year keeps the 12V battery functional for the year. A side benefit when using 12V to start is all of the 6V battery power is dedicated to the ignition since none is needed for the starter. Sure makes starting a lot easier and faster.

************ CONVERTING 6V GENERATORS TO 12V ************

I don't understand why flatheaders take their 6V generators to a rebuilder and have them converted to 12V. The charge is pretty high, usually around $100, when you consider only the generator fields have to be changed. The fields from a Falcon/Mustang/Comet bolt up in flathead generator cases.

Like many things Ford did, there always seems to be an exception. If you're using an original '39 or '40 generator, you will have to drill a hole in the case and install a grounded terminal for the new 12V field. Ford grounded these internally during '39-'40 and depended on the generator mounting for a ground. This new external ground terminal will replace the existing internal ground. These '39-'40 generators have only two external terminals instead of the usual three.

I've been told 12V Falcon/Mustang/Comet complete generator cases will interchange with 6V flathead 8BA generator cases by simply grinding a locator pin slot in the 12V case, but I've not done any of these. It's something to look at if you're doing one of these change overs.

A consideration: The armatures for a 12V Falcon/Mustang/Comet and a Ford 6V two brush generator are a one-way interchange because the 6V armature winding uses about twice the size wire as the 12V. The 6V armature works on 12V, but the 12V armature won't work on 6V (the 12V armature wire size is too small for the current the 6V produces). Okay, okay..... there is one more thing when using a 6V armature in a 12V generator.... a 6V armature makes only about 75%-80% of the amperage the 12V armature does because there is one less commentator bar and winding in a 6V armature.

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

*********** ENGINES ***********

Revised February 14, 2009

.... 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 ½" 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 cylinders 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 it 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 you 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-ings 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 rumpity-rump-rump 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 JWL: 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 <u>furthest</u> 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 <u>closest</u> 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.

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

******** MISC. MATH & FORMULAS *******

Revised May 1, 2009

pi = 3.141592227 (rounds off to 3.1416)

GENERAL SPEED/RPM/GEAR RATIO FORMULA:

(a)Calculation of speed:

$$\text{mph} = \frac{(\text{pi})(\text{tire diameter in inches})(60)(\text{rpm})}{(12)(5280)(\text{rear end ratio})}$$

We can rearrange this formula algebraically to arrive at two related formulas. One for determining rear end ratio at a specific speed. And one for determining rpm at a specific speed.

(b)Calculating the rear end ratio required for a specific speed and rpm:

$$\text{rear end ratio} = \frac{(\text{pi})(\text{tire diameter in inches})(60)(\text{rpm})}{(\text{mph})(12)(5280)}$$

(c)Calculating the rpm for a specific speed:

$$\text{rpm} = \frac{(\text{mph})(12)(5280)(\text{rear end ratio})}{(\text{pi})(\text{tire diameter in inches})(60)}$$

Example: Suppose we want to find out the rpm in and out of overdrive at 70 mph. The tires have a 28.2" diameter (Michelin 235/75R15) and the rear end ratio is 3.78:1.

First we calculate the rear end ratio in overdrive. Multiplying 3.78 times 70% will give the ratio in overdrive (both Columbia and Borg-Warner have the same 70% overdrives). This is (3.78)(0.70) = 2.65 in overdrive.

Using formula (c) above: Calculating the rpm at 70 mph out of overdrive (which is the direct drive ratio of 3.78):

$$\text{rpm} = \frac{(70 \text{ mph})(12)(5280)(3.78)}{(3.1416)(28.2")(60)} = 3154 \text{ rpm @ 70 mph}$$

Calculating the rpm at 70 mph in overdrive (the overdrive ratio is 2.65):

$$\text{rpm} = \frac{(70 \text{ mph})(12)(5280)(2.65)}{(3.1416)(28.2")(60)} = 2211 \text{ rpm @ 70mph}$$

TEMPERATURE AND TIRE PRESSURE: For every 10 degrees F change in tire temperature, the tire pressure will change 1 psi. An increase in tire temperature will increase tire pressure, and vice versa, a decrease in tire temperature will decrease tire pressure. Note: this is tire temperature and not air temperature.

TEMPERATURE CONVERSION FORMULAS: (where F is fahrenheit and C is centigrade

$$F = C\left(\frac{9}{5}\right)+32 \qquad C = (F-32)\left(\frac{5}{9}\right)$$

COMPRESSION RATIO FORMULA: Where CR is compression ratio, V1 is the volume in cubic inches of one cylinder, and V2 is volume of one combustion chamber in cubic inches.

$$CR = \frac{(V1) + (V2)}{(V2)}$$

HORSEPOWER PER MODIFICATION, ESTIMATING: The following is from Roger Huntington's "Souping the Stock Engine" which was published in 1950. It makes a lot of assumptions and is somewhat conservative, but at least it gives us some idea as to what to expect for our efforts.

The following are multipliers for horsepower increases per modification:

Special Al heads = 1.08
Additional carbs = 1 per either 3 or 4 cylinders, L head = 1.10
same except OHV = 1.15
1 per either 1 or 2 cylinders, L head = 1.15
same except OHV = 1.20
Hot cam, mild grind = 1.10
super grind = 1.22
Porting, L head = 1.03 to 1.08
OHV = 1.02 to 1.04
Bore and stroking:

The % of displacement increase is: $\frac{\text{new cubic inches}}{\text{stock cubic inches}}$

This is used in the formula:

$$1 + (0.7)(\%\text{ of displacement increase} - 1)$$
$$= 1 + (^{**}0.7)\left(\frac{(\text{new cu/inches})}{(\text{stock cu/inches})} - 1\right)$$

**Use 1.00 in place of 0.7 if bigger valves are used.

Using straight Methanol for fuel = 1.10

An example: A 239 cubic inch flathead V8 has a stock hp rating of 100hp. Modifications are; aluminum heads, dual 2 barrel carbs, 3/4 grind cam, ported/matched/polished, bored and stroked from 239 to 286 inches, increased valve size, and running on gas.

Multiplier for dual 2 barrel carbs on a V8 is 2 cylinders per carb throat = 1.15
Porting is about middle of range. Estimated at 1.05
Bored and stroked (with bigger valves) multiplier is

$$(1)+(1.00)\left[\frac{(286)}{(239)} - 1\right] = (1)+(1.00)[1.20 - 1] = 1 + 0.20 = 1.20$$

And finally:
(base hp)(Al heads)(carbs)(cam)(port/polish)(increase in cu/in.)
= (100hp)(1.08)(1.15)(1.10)(1.05)(1.20)
= 172.1 hp is the estimated hp.

Notice there are no hp multipliers for racing pistons, increased clearances, higher compression ratios, headers, duals, etc..... but this will give somewhat of a rough idea.

CALCULATING CARBURETOR SIZE REQUIREMENTS: Carburetor sizing considers only the engine's bore, stroke, number of cylinders, and the maximum rpm. Note cam, improved breathing, compression, etc. are not a consideration.

Cubic Inch Displacement (CID) is determined by the engine's bore, stroke, and number of cylinders. Rpm is the peak rpm's the engine will turn.

Then the carburetor cfm (cubic feet per minute) requirements are:

$$cfm = \frac{(rpm)(CID)}{3456}$$

Example: Suppose a flathead engine has a displacement of 276 cubic inches and is expected to turn 4400 rpm......

$$cfm = \frac{(rpm)(CID)}{3456} = \frac{(4400)(276)}{3456} = \frac{1214400}{3456} = 351cfm$$

TRANSMISSION GEAR RATIO FORMULA: Use the number of teeth on each gear: Multiply all of the <u>driven</u> gears together. Multiply all of the <u>drive</u> gears together. Then divide the product of the driven gears by the product of the drive gears.

Example. To determine a second gear ratio:

Let N1 be the number of teeth on the front gear on the cluster (driven by the main drive gear). And N2 be number of teeth on the 2nd gear (driven by the 2nd gear on the cluster). And R1 be the number of teeth on the main drive gear (drives the cluster gear). And R2 be the number of teeth on the 2nd gear on the cluster (drives second gear).

Then we come up with the following formula:

$$\text{Overall 2nd gear ratio} = \frac{(N1)(N2)}{(R1)(R2)}$$

Example: Suppose we want to determine the ratio of 2nd gear on a 16/28 gear combination.....

MDG has 16t. The cluster gear has 28t-24t-18t-14t (the second gear on the cluster is 24t). The second gear has 22t.

Then:

N1 is the front gear on the cluster or 28t
N2 is second gear or 22t
R1 is the MDG or 16t
R2 is the second gear on the cluster or 24t

And finally the overall second gear ratio is

$$= \frac{(N1)(N2)}{(R1)(R2)} = \frac{(28)(22)}{(16)(24)} = \frac{616}{384} = 1.60$$

The second gear ratio for a 16t MDG and a 28t cluster is 1.60

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

********* FUEL SYSTEMS *********

Revised February 18, 2009

********** FUEL PUMP & PRESSURE ***********

FUEL PUMP PRESSURE: Stock fuel pump pressure spec's are 1½ to 3½ psi at idle.

FUEL PUMP VOLUME TEST: Fuel pump minimum output is 1 pint of fuel in 30 seconds with the engine idling at 500-600 RPM.

FUEL PUMP VALVE CHECK: Checking the inlet valve in the fuel pump can be done by connecting a vacuum gauge to the fuel pump's inlet side. Start the engine and let it idle. When the vacuum gauge indicates 10in/Hg (Hg is the chemical term for mercury), shut off the engine and watch the vacuum gauge needle. It should not drop to zero for at least 1 minute. If it does, the inlet valve in the fuel pump is leaking and may need replacing, cleaning, or maybe only a new inlet valve gasket.

DECREASING FUEL PRESSURE: Ford recommends lowering the fuel pump pressure by increasing the thickness of the gasket between the fuel pump stand and the intake manifold. This decreases the push rod stroke. About 0.010" increase in gasket thickness lowers the fuel pressure ½ psi. The method I prefer is to use an adjustable fuel pressure regulator between the fuel pump and carb(s).

FUEL PUMP CAM LOBE LIFT: Lobe lift on a stock flathead cam is 0.200". As far as I know, all after-market FH cams have 0.200" lift. Wear limit is 0.180". Since the fuel pump is in constant contact with the lobe, the push rod travel should be within these tolerances.

FUEL PUMP PUSH ROD LENGTHS: There are three lengths of push rods which came in flathead engines……… 7-7/8", 8-7/8", and 10-1/16". The 7-7/8" and 8-7/8" came in '32-'48 engines. The 10-1/16" came in '49-'53 engines.

FUEL PUMP PUSH ROD WEAR: Replace when wear exceeds 0.050". (A seat of the pants rule: as long as there is chamfer left on the both ends of the push rod it is still ok.)

FUEL PUMP REBUILD KIT: I use rebuild kits by NAPCO (Nissan Auto Parts Company, Ltd.) part number #11A-9349. These come with a different designed inlet and outlet valves and newer fuel resistant diaphragms. I find this newer style of valve makes 5+ psi... whereas the stock valves make only 3½ psi (higher pressure helps prevent vapor locks). I recommend using a pressure regulator whenever a fuel pump exceeds 2½ psi. Limiting pressure to 2½ psi will prevent over powering the needle and seat assemblies and subsequent flooding leading to fires. The box say it's for Nissan, Mazda, and Toyota, but years are not shown on the box. Some internal valves use rivets to hold them in place of the screws. I suggest checking which you have before ordering.

FUEL PUMP REBUILD: When tearing a stock pump down, scratch a mark across the joint of the two fuel pump's body halves to orient the halves during reassembly. Then internally, scribe U (up) or D (down) next to the two valves (inlet and outlet) to show whether they're installed face up or down. The same valves are used for both the inlet and outlet valves. These valves are often the cause of low pressure. These kits use material which is resistant to gasoline with ethanol or other junk used these days.

GAS LINE SIZING: The stock ¼" gas line will provide sufficient gasoline for dual carbs for full throttle on all but the wildest street engines.

VAPOR LOCKING: There are many causes of vapor locking. Vapor lock occurs when gasoline in its liquid state gets hot enough to change to a vapor state (all fuel pumps were designed to pump liquid.... not vapor). Locating causes of vapor locking at home is a lot easier than on the road. Often it's caused by several minor things. Don't rule out the gasoline we get today. This stuff vaporizes at a lot lower temperature than straight gasoline did. Most of us have been plagued by vapor lock with our flatheads. Example: One hot day mine was doing it's lack of gas thing. When I got it home, I decided it was time to stop this mutiny. I walked around the back of the car and heard bubbling inside the stock steel gas tank. Could that be gasoline boiling??? I crawled under the car and touched the tank with the back of my hand to feel if it was really bubbling…… and burned blisters on my hand. The tank was nowhere near the exhaust system. Finally figured out the heat was a combination of the trapped engine and road heat under the car. The stock metal gas line was just as hot. No wonder it was trying to take over command of the engine! Replacing the stock tank with either a stainless or new steel tank wouldn't do any good since either would still get hot. So I opted for an after market polyethylene tank. While I was at it, I replaced the stock steel gas line from the tank to the carbs with rubber tubing designed for gasoline. Reason? The polyethylene tank and rubber gas line don't absorb and hold heat like the stock steel stuff did. It's never had any problem since and I've crossed the desert many times during the heat of the day.

I've listed the following checks for possible vapor locking areas in no particular order. I do each and every one when I'm working on a vapor locking problem.

(1)Verify the fuel pump is performing according to volume and pressure specifications. If not, find out why and correct it.

(2)Check the entire length of gas line from the tank to the carb for distance to a source of heat. The absolute minimum distance from the exhaust or any heat source is 5". If it's closer it's probably a main contributor to vapor locking. Do whatever is necessary to get clearance or add an insulation barrier.

(3)Check the stock gas line for heat. Take an hour long cruise on a hot day and then touch the gas line in several places. If it's too hot to touch it's probably vaporizing the gas inside the line.... or trying to. If it's only hot in one section, slice open a length of vacuum hose and slip it over the steel line to act as a heat insulator. Plastic zips will hold the line from sliding.

(4)Check the stock gas tank. Remove the cap and listen for gas bubbling after an hour's drive. If it is, try coating the tank with several thick coats of undercoat. This requires removing the tank to coat the entire tank, but it does help insulate the tank.

(5)Check to make sure the gas cap is vented. All flatheads came with vented gas caps. Verify the vent is not plugged by blowing air through it. If you're using an after market gas tank, it probably has it's own vent system, but verify it's not plugged.

(6)Check the glass bowl on the fuel pump for tightness or for cracks. If not air tight or cracked it'll suck air rather than gas.

(7)Check the flexible line leading into the fuel pump for possible leaks. Best way is to remove it and plug one end with a finger. Suck on the other end to create a vacuum while you wiggle the line around. If you lose vacuum, the flex line has a hole and it's junk. Sometimes these are weakened by engine heat. When you suck on them, they may collapse.... replace it. If on the road, wrap electrical tape around it several times after you get it dry. Often times this will get you home.

(8)If the carbs are super hot it's a sure bet they're getting soaked from the engine, fan, and radiator heat. Check by pulling the top of the carb off before you shut off the engine to see if the gas inside is bubbling. If it is, try adding a couple of extra carb to intake manifold gaskets to act as insulators. For an extreme circumstance, try a 1/4" thick insulator from some non-heat absorbing material like Masonite between the carb and intake manifold.

(9)An electric fuel pump is always a good idea for use as a back-up. Just remember, electric pumps are designed to push fuel.... not pull it. More on electric pumps in the next sub-topic.

Should vapor locking happen on the road during a trip I start trouble shooting by removing the gas cap to verify the gas tank vent is not plugged. Then I bypass, remove, or replace the gas filter(s) with rubber gas line tubing. These not only require fuel pressure to get the gasoline through them, but they also cut down on the flow of gas. And we need all the fuel we can get.

ELECTRIC FUEL PUMPS: These are usually the first line of defense for preventing vapor lock. These should be located as close to the gas tank as possible because they're made to push and not pull. They are very sensitive to dirt etc. Install a good gas filter just before the electric pump's inlet is a good idea. Using an electric pump in conjunction with the stock flathead pump is our normal method of installation. We use a toggle switch to turn on the electric pump when it's needed. Good idea. BUT there can be a problem with this setup. Stock mechanical pumps will not pull gas through most rotary type pumps. BUT they will pull through a pulsating type pump. Reason being, the rotor itself chatters as the stock pump pulls gas through it. This chattering causes the rotor to rotate slightly. The rotating eventually causes the rotor to block the exit or entrance port which stops gas from being pulled by the stock pump. At that point we turn on the electric pump's toggle switch thinking we're vapor locking. The rotor turns which opens the exit or entrance port and the electric pump pushes gas to the stock pump. This makes us think we were vapor locking when we weren't. Often times, we end up running the rotary pump full time since the stock pump is unable to supply gas to the carbs and we think the stock pump is kaput.

(a)One solution is to go to a pulse type electric pump in place of the rotary pump. These are not easy for the counter people to find because their computers go by year, color, and body style only and they have no idea how to identify if it’s a pulse or rotary. These pumps are available if you can find a parts person who knows what they’re doing..... good luck with that!

(b)A second solution. I prefer rotary pumps over pulsating type pumps even if a stock pump can’t pull gas through them. They last a whole lot longer and are more dependable than the pulsating type. So, I add a second gas line just for the rotary pump........ Sounds stupid doesn’t it? It’s a little tricky to describe using only words so stick with me if you’re interested.

After installing the new rotary pump near the gas tank, I install a “T” fitting between the gas tank and the rotary pump. This “T” type fitting will ultimately provide paths for the fuel.....

(1)One for the inlet side of the nearby electric pump.
(2)One for the stock gas line which will go forward to the carbs.
(3)One for the stock gas line coming from the tank.

For (1) above: I run a rubber gas line hose from the right side of the “T” fitting to the inlet side of the electric pump. This supplies gas to the electric pump.

For (2) above: The stock steel gas line is cut about 2" from the tank. Connect the end of the stock gas line (goes forward to the stock fuel pump) to the left side of the “T” fitting using a short piece of rubber gas line hose. This will supply gas to the stock fuel pump using the stock gas line.

For (3) above: Connect a length of rubber gas line hose to the freshly cut stock gas line coming from the tank. Connect the other end to the remaining “T” fitting. Install a fuel filter in this rubber line between the “T” and gas tank. This filters all gas coming from the gas tank.

Next I install a new rubber gas line from the output side of the rotary pump all the way forward to a couple of feet ahead of the driver’s seat. This gas line is routed inside the frame rails to protect it and is secured every 6" or so with plastic zip locks. This line is for gas coming from the electric pump.

I use a gas line selector for an early Ford Bronco. It’s a three-way valve designed for selecting either of the Bronco’s two tanks and has a shut off position which is handy to shut off all fuel to the engine. One selector position is used for the stock gas line which comes from the rear of the car. One selector position is used for the new gas line connected to the electric pump’s outlet. The third and last position is self-explanatory… it shuts off all routes for fuel flow. This selector valve is installed where it’s convenient… like in the floor at the left corner of the front seat. The valve has 3 fittings (two inlet fittings---- one for each gas line from the rear of the car and a third outlet fitting going forward to the stock fuel pump). Blow air through each so you know which is which. All that’s left is to cut the lines from the back of the car to length and connect them at the selector valve. I cut apart the stock gas line going forward to the stock fuel pump. The end of the stock metallic gas line coming from the gas tank is connected to one selector fitting using a short piece of rubber hose. The new gas line from the electric pump connects to a second selector fitting. The third selector fitting is the outlet line to the stock fuel pump (it feeds the stock fuel pump and carbs via a new rubber line which replaces the stock gas line).

When the selector is in the left tank position, the stock pump provides all the gas to the carbs via the stock gas line connected to the left side of the “T” fitting at the tank. When the selector is turned to the right tank position, the electric pump takes gas from the right side of the “T” fitting at the tank and pumps it through the new gas line to, and through, the stock pump and to the carbs. Neither line can divert or pull it’s gas to the other line because the 3-way selector valve mechanically blocks it.

It will be run on the stock pump full time (fuel is pulled through the selector valve by the stock pump). When needed, I turn the selector to the electric pump position and flick on the toggle switch for the electric pump (fuel is pumped forward by the electric pump through the selector valve and then to the stock pump).

Benefits: I use the electric pump for priming the carbs or when I get concerned about a possible vapor lock (like crossing the desert or in a traffic jam).

I also use it when setting the gas level in my two Stromberg carbs. This is great because I don't have to have the engine running and be so concerned about a fire. The electric pump is used to supply gas to the carbs when adjusting gas level (used in conjunction with a squeeze type bulb to suck out excess fuel).

One thing I like is the ability to completely shut off the gas. When I'm on the road I turn the selector to "off" when I park it for the night or leave it unattended for a time. I run the engine until the carbs stumble due to lack of gas. Helps me sleep a little better knowing the lack of gas in the carbs will prevent someone from simply hot wiring the car to steal it. The next morning I turn the selector to the electric pump side and let it refill the carbs before hitting the starter button.

************************* CARBURETION *************************

AIR FILTERS: In early days, most of us ran velocity stacks or Bell chrome air cleaners. The velocity stacks had a screen for a filter. These would keep out a regulation sized bowling ball, but very little else! But they looked great. (A side benefit.... they provided great water injection in a rain storm if you were not running a hood!) The original Bell chrome air cleaners used several turns of a screen mesh for a filter. These cleaners are being repo'd with paper mesh filters and are in demand today, probably because they look cool and old timey. Their design severely restricts air flow in my opinion and causes an overly rich mixture as the engine approaches mid range. This restricts engine performance and can contribute to fouled plugs. One cure is to make your own open-type air cleaner using K&N or other brand of quality filters. These don't filter as well as many gear heads would like, but they don't clog up and cause rich mixtures either.

FUEL PUMP PRESSURE: Ford and Stromberg carbs were engineered to operate at a maximum of 2½ psi fuel pressure which was pretty typical of carb pressure in the thirties. Exceeding this pressure can overload the needle/float system (hold the needle off it's seat) and flood a carb. This results in gas running down the carbs and onto the engine and is probably where the Strombergs partly got their reputation for being burners. The Ford carbs will also suffer from excessive pressure, but are not as sensitive as Strombergs due to better float leverage against the needle and seat. This is the result of Ford's better float pivot design. When the float is set too high, or if the pressure exceeds 2½ psi, or the vehicle is driven off-road, the air horn to main body gasket on both brands of carbs will become saturated with gas. Raw gas and gas vapors will waterfall down the front of the carbs. Notice the proximity of the front of the carb to the generator brushes arcing on the commutator? Picture your engine with hot gas on the front of the carbs and the close proximity of the arcing generator. Scary isn't it? Don't chance it..... limit the fuel pressure by installing an adjustable fuel pressure regulator and setting it to not more than 2½ psi. I prefer the Holley regulator. Note the carburetor designed pressure is less than the 3½ psi Ford specifies for their mechanical fuel pump. Strange Ford engineers knew the design pressure of the carbs, but used fuel pumps that exceeded this pressure... maybe to forestall their tendency to vapor lock?

POWER VALVES: These used to be called the “high speed jet” or the “economizer valve”. Today they’re referred to as “power valves”. When one of these power valves opens, it richens the fuel to air ratio from approximately 14.5:1 to 12.0:1 (about 20% richer). These operate either mechanically or by vacuum.

Ford/Holley carbs use a vacuum type power valve which has a flow restriction downstream of the power valve. This restriction functions like a jet and limits the quantity of gas passing through it. This restriction (referred to as the power valve channel restriction in Ford/Holley carb manuals) is inside the power valve’s transfer passage between the power valve and the main well. It is neither accessible nor changeable as far as I’m concerned. Power valves do not provide various changes in the amount of gas flowing through them.... they simply go to wide open. Our current crop of gasoline will hasten failure. The new power valves must be using some new material since they aren’t experiencing failure from gasoline like the NOS do.

Stromberg carbs don’t have any such restriction in their transfer passages in the main body. The metering orifice in the shell of the brass power valve controls the amount of gasoline.

CHANDLER GROVES/HOLLEY/FORD POWER VALVES: Chandler Grove originally designed and built the two barrel carb for Ford beginning in 1938. After the initial contract term expired, Ford put the carb contract out for bids. Holley won the bid and built them for Ford for a few years. Then Ford took over their manufacturing. All three manufactured carbs are pretty much the same.

As stated in the preceding text, the Ford carbs use a vacuum/spring controlled diaphragm type power valve. These are rated according to the inches of vacuum (in/Hg) needed to open the valve. The chemical symbol for mercury is Hg and is used when measuring vacuum. The power valve opens at low manifold vacuum (engine under power) and closes at high manifold vacuum (engine not under load). Rebuild kits I see these days have power valves rated in the 8-10 in/Hg range. Power valves which open at lower vacuum are available from some suppliers and are a worthwhile investment if you’re running multi Ford carbs. Multi carbs will decrease engine vacuum and often cause the vacuum controlled power valves to open with only the slightest increase in accelerator pedal (especially at altitudes above sea level since vacuum decreases with an increase in altitude). Many of these valves are stamped with their rating. A 45 stamp means the valve opens at 4.5 in/Hg..... an 80 means the valve opens at 8.0 in/Hg. Always install a power valve that is rated lower than the amount of vacuum the engine makes at idle. Should the engine backfire, it will almost certainly rupture a diaphragm type power valve. When running multi-carbs, some rodders remove the power valves completely and plug the holes shut. This will cause the engine to lean out on the top end unless it is re-jetted. Re-jetting 6 or 7 sizes bigger prevents leaning out...... which in turn makes the engine run very rich when operating during normal use (which is most of the time). Some rodders run a power valve in only one of their carbs and have good results. The power valve is located on the underside of the carb’s main body (fuel bowl) casting. You have to separate the throttle body and the main body of the carb to get to it. Checking one of these power valves is only a matter of sucking on the flat side of one to see if the diaphragm is ruptured.

A leaking power valve can trickle gas into the throats of the intake manifold and cause hard starting after sitting for a period. If your car is hard starting (and pukes black smoke out the tail pipe when it finally does start) after being shut off for about a half hour on a hot day, or if it's hard to start after sitting all night, check the power valve to see if it's leaking.

STROMBERG POWER VALVES: Stromberg carbs use a mechanically controlled power valve. It's located in the bottom of the accelerator pump well. These are opened mechanically. They are closed and held shut mechanically by an internal spring. They become operational whenever the flat bottom of the accelerator pump depresses the power valve's pin. This happens only when the accelerator pump is at the bottom of the pump's well (full throttle or very near it). These power valves are made of brass and will not rupture like a diaphragm type power valve. A single metering hole is located in the outer shell of the power valve to meter gas flow. This permits controlling the amount of gas the power valve can deliver by simply changing the size of this hole. It's a lot easier to adjust full throttle gas flow than on a Ford carb. Just solder the hole shut and drill the size hole you want further around the brass power valve (in a new location). Sizing Stromberg power valves isn't very critical since extended periods of WOT (wide open throttle) seldom happens these days (Bonneville?) and decreased vacuum doesn't operate them prematurely.

************************** STROMBERGS **************************

STROMBERG CFM & VENTURI SIZES:

81 rated at 135 cfm. Venturi diameter = 0.812"
97 rated at 150 cfm. Venturi diameter = 0.969"
LZ rated at 160 cfm. Venturi diameter = 1.000"
48 rated at 175 cfm. Venturi diameter = 1.031"

STROMBERG CIRCUITS: The idle discharge circuit operates from idle to 25 mph. The main jet circuit operates from 25 mph to 70 mph. Above 70 mph the power valve works in conjunction with the main jet circuit. Rear end ratio, tire size, and power loading all affect the operational boundaries of the various circuits. Remember the operational boundaries of carburetor circuits overlap.

STROMBERG NEEDLE/SEAT ASSEMBLIES: These were originally a steel needle and a brass seat which made them susceptible to the needle being held off it's seat by grit and dirt… which resulted in flooding which lead to fires. These all metal needle and seat assemblies are sensitive to pressures in excess of 2½ psi. Ken Ct. of the Ford Barn recommends and uses only metallic needle and seat assemblies.

With the advent of the soft tipped needle (Vitom), the sensitivity to dirt and fuel pressure was reduced and flooding decreased considerably. I use only these.

Since the sixties several different designs of needle and seat assemblies have been manufactured. Some are not affected by grit and dirt and many will tolerate higher fuel pressure. I've tried many of them, but end up going back to the Vitom tipped needles in my Strombergs. I've not had a single sticking needle in the past 135,000 miles so why change?

STROMBERG JET, POWER VALVE, AND FLOAT SPECIFICATIONS:

The 81 came on Ford V8-60 engines in '37 and most of '38's. Sea level jetting: main jets #35 and power valve #71. Gas level (not float level) spec is 15/32" ± 1/32" measured from the main bowl casting (fuel bowl) with no gasket.

The 97 came on '36 thru early '38 Ford V8-85 engines. It's identifying number is the same as it's venturi size (97). Sea level jetting is #45 and power valve is #65. Gas level (not float level) spec is 15/32" ± 1/32" measured from the main bowl casting (fuel bowl) with no gasket.

The LZ came on '36 thru early '38 Lincoln V-12 engines. I've lost my notes on these carbs, but I've never run them... probably due to the ready availability of the '97 carb.

The 48 came on '34 & '35 Ford V8-85 engines. It's identifying number is the same as it's stock main metering jet (48). Sea level jetting: main jets #48 and power valve #63. Gas level (not float level) spec is 15/32" ± 1/32" measured from the main bowl casting (fuel bowl) with no gasket.

STROMBERG POWER VALVES: Power valves are numbered according to the numbered drill used when drilling the metering hole located on the side of the brass power valve's shell. Just like numbered drills, the larger the number, the smaller the hole.

Sizes for power valves are:

#61 = 0.0390″	#62 = 0.0380″	#63 = 0.0370″	#64 = 0.0360″
#65 = 0.0350″	#66 = 0.0330″	#67 = 0.0320″	#68 = 0.0310″
#69 = 0.0292″	#70 = 0.0280″	#71 = 0.0260″	#72 = 0.0250″
#73 = 0.0240″	#74 = 0.0225″	#75 = 0.0210″	#76 = 0.0200″

STROMBERG MAIN JETS: A special jet wrench is required to remove or install the main jets. Main metering jets are numbered according to the diameter of the metering orifice. Thus a #45 jet has a 0.045" diameter hole.

STROMBERG JET TUNING: Starting point for tuning a single Stromberg carb: Decrease main jets 1 number for each 2000' in altitude (example: from #45 to #43 for 97's at 4000'-5999' elevation). Increase power valves 1 number for each 2000' in altitude (example: from #65 to #67 for 97's at 4000'-5999' elevation).

Starting points for tuning dual Strombergs: Decrease main jets 2 to start. Then decrease main jets 1 size for each 2000' in altitude. Increase power valves 2 numbers to start. Then increase power valves 1 number for each 2000' altitude.

Starting point for tuning triple Strombergs with progressive linkage: Center carb is sized the same as a single carb. The end carbs are sized the same as dual carbs.

WITHOUT THE USE OF ANY PROGRESSIVE LINKAGE FOR 3 OR 4 CARBS: At sea level. Three carbs start with #43 main jets and #67 power valves. Four carbs start with #42 main jets and #68 power valves.

STROMBERG IDLE MIXTURE SCREWS: These are physically different than the ones used in Ford/Holley carbs. They have a different taper and are not interchangeable with Ford idle mixture adjusting screws (although they will work fairly well). The Stromberg idle adjusting screw's taper extends clear to the threads (the Ford needle taper stops short of the threads).

SETTING STROMBERG FLOAT LEVELS: Dry setting (dry float bowl) is 5/16" from the carb's main bowl gasket surface to the top of the float. This is used when overhauling a carb to initially start and set the idle mixture and rpm.

Wet setting. This sets the gas level correctly by adjusting the float. With the engine idling smoothly, the wet setting is 15/32" (± 1/32") from the top of fuel bowl casting (no gasket) to the gas surface itself. This requires removing the top of the carb and, with the engine running, adjusting the float to the correct gas level. This is dangerous because gas continually spews out around the needle seat assembly and onto the hot engine or near the sparking generator commutator. This provides an excellent opportunity for one to show off their fire extinguisher and fire fighting skills to ones buddies. However, if you have an electric fuel pump you can set them with little fear of fire. You'll need a rubber squeeze bulb to suck out gas. Don't run the engine. Use the electric fuel pump to fill the carb bowls until the float shuts off the incoming gas. Shut off the pump. Measure the level of gasoline and make adjustments to the floats by bending their tangs. When the floats are disturbed, the needles come off their seats which spews more gas into their bowls. Since the level of gas decreases greatly, gasoline will have to be sucked out (use the squeeze bulb) to permit the floats to drop about half way down. Then turn the pump on and refill them until the floats shut off the gas (use the electric pump). Re-measure the gas level. Repeat until you're satisfied both floats are adjusted correctly. **Don't forget to allow 1/16" for capillary attraction.**

STROMBERG ACCELERATOR PUMP CHECK BALL: Behind the center plug in the front portion of the main bowl is a small accelerator pump discharge check valve. This consists of a ball bearing crimped in a removable jet. It seldom sticks and can be checked by shaking it. If stuck, bend the crimp open and push the ball out from the opposite end using a small nail… or just replace it.

STROMBERG THROTTLE PLATES: These have either a slash or half moon stamped on them. Throttle plates are to be installed with their mark down and towards the idle screws.

STROMBERG EMULSION TUBES: Behind the outer two plugs in the front of the main fuel bowl casting are the main jets. Behind the main jets are the emulsion tubes. The main jets have to be removed to get to them. The emulsion tubes extend from the main metering jet to the venturis. These small brass tubes have a series of small holes in their upper regions which may become plugged with varnish and sludge. This will cause poor performance and excessive fuel consumption. The upper tube ends are angled (baloney cut) and extend into the venturies. Sometimes these will come out by pushing them downward.... do not tap on their angle cut as this will ruin the tubes. Removing stuck emulsion tubes is done by tapping threads on the inside of the emulsion tube bottom with a #**6/32** tap. Gently turn the tap in about 4 full turns. A 1½" long #**6/32** screw with a nut and flat washer makes a dandy puller. With the washer positioned against the carb casting, thread the screw into the emulsion tube's threads you just made. Finger tight is plenty tight. Position the flat washer up against the casting and run the nut flush up against the washer. Turn the nut as if to tighten it. This pulls the emulsion tube out easily. This little puller has never failed to remove an emulsion tube for me. Once they're out, clean their outsides with fine steel wool. Then clean the varnish etc. from the tiny holes using a wire or a drill bit with a ** 0.041" diameter (a #59 numbered drill). Use only your fingers to turn the drill bit. Reinstall the emulsion tubes gently by pushing them in with a flat drift punch. Re-install the main jets. CAUTION: Do not tighten main jets excessively. This will cause the jets to crush the emulsion tubes and ruin them. Snug is all that's needed. Should an emulsion tube be crushed, or the tiny holes be crimped shut, it will cause poor performance and excessive fuel consumption. Replacement is the only cure for a deformed emulsion tube. **(From rodnut on 1/30/03. He uses a drill that's 0.040" in diameter..... a #60 numbered drill...... to clean the varnish from the tiny holes. He says a #59 drill is too big.)

REMOVING AND INSTALLING STROMBERGS WITHOUT LOSING MULTI-CARB SYNCHRONIZATION: Leave the throttle bases and linkage on the car by removing the three screws that hold the throttle casting to the main bowl casting. These are all accessible from above. Remove the choke assembly collared screw and the gas lines. Note which carb goes on which base. Lift off the carbs. After cleaning the carbs, just bolt them back to their same bases and reconnect the accelerator rods. Since you've not disturbed the throttle shafts or linkage, the synchronization is the same as before you removed them. Sure helps reduce the hassle when re-building.

************** FORD/HOLLEY/CHANDLER-GROVE **************

FORD CFM RATINGS: Ford/Holley/Chandler-Grove were introduced on Ford V8's beginning in late '38. These were continued in the Fords clear into the early OHV-V8's. The Lincoln/Mercs changed in '49.

Holley 92 (model #92) rated at 142 cfm. Venturi dia. is 0.875"
Holley 94 (model #59) rated at 155 cfm. Venturi dia. is 0.938"
Holley 94 (model #8BA) rated at 162 cfm. Venturi dia. is 0.938"
Holley (Model #ECG) rated at 185 cfm. Venturi dia. is 1.062"

FLOAT SPECIFICATIONS: The dry float level settings for '38-'53 Ford and '39-'48 Lincoln/Merc carbs is 1-11/32" without a gasket. The distance to the gasoline is 11/16" without a gasket. All measurements are ± 1/32".

Lincoln/Mercs carbs, beginning in '49, is 1-5/16" without a gasket. The distance to the gasoline is 5/8" without a gasket. All measurements are ± 1/32".

FORD/CHANDLER GROVE/HOLLEY CIRCUITS: The idle discharge circuit operates from idle to 25 mph. The main jet circuit operates from ** 25 mph to 60 mph. Above 60 mph the power valve works in conjunction with the main jets.

** Remember the power valve becomes operational whenever the vacuum becomes less than the vacuum rating of the power valve. Rear end ratio and tire size affect the operational boundaries of the various carburetor circuits. Remember more than a single circuit is used at times depending on engine demands.

These carbs are extremely simple to work on and rebuild. No special tools are required. About the only problem one might encounter is the accelerator check ball may be stuck. This tiny check ball (about a 1/16" ball bearing) is located in the bottom of the accelerator pump well. It's held in place by a circular expansion spring. Removing the spring will usually permit the ball to fall into your hand when the carb is inverted. If it's stuck, and they do become stuck, turn it upside down on a work bench and tap on the bottom of the carb casting. If it won't come out, soak it in P-Blaster penetrant and try it again. **If you can't get it, drill a 3/32 hole up from the bottom to tap it out. Use a small fishing lead sinker to plug the hole by using a hammer and a drift punch. Then cover it with JB Weld. Let sit over night before using. I've never had one leak.**

JETTING FORD CARBURETORS: Main jets are sized according to their diameter. Thus a #41 is 0.041" in diameter. The newer Holly main jets fit our old Ford carbs and are carried by various speed shops and automotive stores.

Starting point for tuning a <u>single</u> Ford carb: Decrease main jets 1 size for every 2000' of altitude (Example: Change from #50 to #48 if the car's home is in the 4000'-5999' elevation range).

Starting points for tuning <u>dual</u> Ford carbs: Decrease main jets 2 sizes to start then decrease one more size for every 2000' in altitude. (Example: Starting with stock size, or #50 main jet, reduce 2 sizes and then 3 more for if the car's home is in the 6000'-7900' elevation range).

Starting point for tuning <u>triple</u> Ford carbs using progressive linkage: Center carb is sized the same as a single Ford carb. The end carbs are sized the same as dual carbs.

Note that these are starting points only and fine tuning should follow.

WITHOUT THE USE OF ANY PROGRESSIVE LINKAGE FOR 3 OR 4 CARBS: At sea level. Three carbs start with #43 main jets and #67 power valves. Four carbs start with #42 main jets and #68 power valves.

CHECKING FOR MAIN JET SIZE: This is an olde timey method of checking to see if the main jet is too big or too small. Hook up a vacuum gauge to the intake manifold (not the carburetor). Adjust the idle jets so the engine is running smooth as possible. Bring up the engine rpm to 1250 rpms and use a spacer between the idle stop and the throttle linkage to hold the rpms steady.

If leaning the idle mixture screws INcreases the vacuum reading, the main jets are too large. If richening the idle mixture screws INcreases the vacuum reading, the main jets are too small.

REMOVING THE CARBURETOR CASTINGS WITHOUT ALTERING SYNCHRONIZATION: The main body and air horn castings ON Ford carburetors can be easily removed to rebuild the carb's main and air horn bodies without removing the throttle body casting (base). If a throttle body casting is disturbed in anyway, you'll lose the multi-carb synchronization.... and you'll have to re-sync them again. It saves a lot of hassle if you leave the throttle castings and linkage in place and simply remove the upper two castings as one piece.

Remove the gas line and the accelerator pump link. Remove the two screws securing the main casting to the throttle base casting. These are accessible from the top. The slotted screw is not since it's slot faces downward. Use a pair of pliers to remove the slotted screw. Then match the size, threads, and length of the screw to a hex headed bolt. This is used as a replacement for the slotted screw. Remember it's very easy to over tighten the hex headed bolt and strip the threads in the relatively soft carb casting. Snug is all that's needed. Now the main castings of the carb(s) are in your hand and the carb can now be rebuilt or have it's power valve worked on. When you reinstall the carbs on their respective throttle bases, the throttle linkage is still synchronized and you won't have to mess with it.

******************** SYNCHRONIZING CARBS ********************

CENTERING THROTTLE PLATES ON ALL CARBS: Sticking throttle plates make driving multi-carbs unpleasant to say the least. Every time you start out, the plates stick and you have to increase the accelerator pedal to overcome this sticking..... which results in way too much throttle opening and jerks the car (or burns rubber when you're next to a cop). Stromberg carbs seem to have better throttle bores and plates than the Ford carbs and are another reason I prefer them. Most Ford carbs have to have their plates removed and carefully fitted before they cease sticking, whereas Strombergs seldom do.

With the carb off the engine, separate the main body from the throttle body casting. Loosen the idle speed adjusting screw. Close the throttle tightly and hold it shut. Hold the throttle base up to a light source. There should not be any light showing around the throttle plates. If so, loosen the tiny soft brass screws which hold the throttle plates to the throttle shaft. Loosening usually takes only a turn at the most. <u>CAUTION:</u> These are usually staked and are easily broken while trying to loosen them. If they won't loosen easily, try grinding off the sides of the stakes, or squeezing them with pliers.

Once they're loose, hold the throttle tightly shut and tap both ends of the throttle shaft several times. This will center the plates in the throttle bore. Open and shut the throttle several times also helps. Continue holding it closed tightly while you snug down the throttle plate screws. Re-check for light showing around the closed throttle plates. If you can't get them to seal shut, the plates will have to be removed and hand fitted using jeweler files and/or #400 wet/dry sand paper or crocus cloth. This takes a little patience. Throttle plates MUST operate freely and not stick when coming off idle, but must seal tight when shut. When satisfied with their fit, stake the tiny screws or use some green Loctite to keep them from being ingested into the engine (they don't compress worth a hoot!).

USING A SYNCHRONIZER: **I changed from using a Uni-Syn to "Synchometer" carburetor flow meter. I've found the "Synchometer" is something like 10% more accurate than the Uni-Syn. These were posted on the Ford Barn and I neglected to get their name. Sorry. J.C. Whitney has them.**

USING A LENGTH OF HOSE: Before carburetor synchronizers appeared, I used a short length of heater hose as a poor-man's stethoscope. It works, but does take time. I always adjust the idle mixture screws out 1½ turns on each carb at the get-go. Loosen the screws squeezing the arms to the throttle shafts so the throttle shafts can be moved without disturbing moving the arm. Hold one end of a 12" section of heater hose against an ear and move the other end back and forth between the carbs listening to their hiss. The object is to get the carbs to have <u>EXACTLY</u> identical hisses. Keep a slight tension on the throttle shafts of all the carburetors (temporary springs or rubber bands help) and adjust the idle rpm screws until the carbs have identical hisses and are at the desired idle speed. Tighten the screws holding the arms to the throttle shafts. Re-check the hissing to make sure nothing has changed. Please note this will not cure sticking throttle plates and the resultant stick/surge coming off idle. Multi carb installations MUST have the throttle plates centered to eliminate a sticking throttle.

Note. Major changes and/or additions are in boldface font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

*********** GEARS ************

Revised April 30, 2009

******************* TRANSMISSION *******************

DIRECTIONS OF SHIFTING FORK SLOTS: During a rebuild of a '39 and newer transmission, the shifting fork's groove on the low/reverse sliding gear goes towards the rear of the transmission. The direction the second/high synchronizing drum goes is more difficult to explain. The shifting fork's slot for the synchronizer drum is located slightly off the drums mid-point. The longer side of the shifting drum goes towards the front of the transmission. The synchro drum on '38 and older transmissions had the shifting fork slot centered. See IDENTIFICATION OF GEARS further on in this section.

Fork direction: The forks in a floor shift are secured to their shift rail by expanded pins (like a long rivet). These forks can only be mixed-up if the top is dismantled. Record which direction they face before taking the top apart.

However, the shifting forks in a column shift trans simply drop into the shift cover's two selector cams and can easily be mixed-up. The second/high shifting forks pin is centered..... so it makes no difference which direction the fork faces. But the low/reverse (L/R) fork can be installed two different ways. The fork part of the shifting fork is offset from its pin. The side of the fork with the offset goes towards the rear of the trans (this positions the fork's shifting pin directly over the gear teeth on the L/R gear). An easy check to verify these are positioned correctly in column shift transmissions is to put the trans shifting cover in neutral (both balls in their rail's middle detent) and lay the trans on it's side with both the shifting drum and L/R slider gear in neutral. Drop the shift forks into the synchro drum and the L/R sliding gear. Lean both pins of the forks against the lower edge of the shift cover opening. Install the shift cover by directing the fork pins into the cover's selector cams receivers. If everything is correct the cover will slip on easily.

TRANSMISSION POPS OUT OF SECOND GEAR UNDER COMPRESSION: Several things can cause this. I'm assuming the case, top, and forks are not sprung, tweaked, or bent.

(#1) Add an additional rail detent in floor shift transmissions only: Two transmission tops are needed..... a '37-'38 and a '39. Remove the shift rails etc. from a '39 and also from a '37-'38 transmission top. The '38 trans top uses a spring and two short dowel pins with ball shaped ends for the two rails. The ball shaped ends are always engaged in one of the three detents machined in the inside of each shift rail. We need the spring and both dowel pins. The center spring has a stock length of 1.485".

The '39 floor shift top has two flat screw plugs located on opposite sides of the shift tower. Behind each of these plugs is a steel ball and a spring. These engage detents in the outside of the two shift rails. Each of the two steel balls are always engaged in a detent. There is a passageway in the trans top between the two rails that houses a roller type spacer to prevent shifting into two gears at one time. During tear down, remove the roller type spacer in this passageway.... we'll not be using it. The '39 top will use the center spring and two dowels from the '38 in addition to the '39 top's two steel balls and springs.

Stretch the '38 center spring to 1.540" length. On both shift rails from the '39 top, locate and grind new detents 180 degrees (to be on the inside of each rail) from the original detents located on the outside of the rails. These new detents are to be spaced *exactly* the same as the original '39 detents. Check the depth of the detents closely while grinding. CAUTION: Do not grind these detents deeper than the stock detents on the '39 rails. This will make the shifter hang up in gear. It's better to grind them a little shallow to prevent this.

Assembly: The original '39 springs and steel balls go back in their original locations. The stretched '38 center spring and the dowel pins go in the top between the two '39 rails and into the newly ground detents. The remaining assembly is the opposite of tear down. When done, the top will have detents both on the inside and outside of each of the two '39 shift rails.

(#2) Excessive end-play: Check the end-play between the mainshaft's thrust washer type spacer and second gear. This tolerance is 0.004" to 0.008". Add or make a washer type shim spacer to correct.

(#3) Shifting drum: The shape and condition of the engaging teeth on the inside of the synchronizing shifting drum must be wedge shaped in order to engage both the MDG and second gear smoothly and completely. Often the sharp ends of the teeth are worn flat or worn back over half way which prevents engaging second gear correctly. If the sharp ends of the teeth are worn, they need replacing.

GRINDS WHEN SHIFTING INTO SECOND OR HIGH: I'm assuming the clutch is good and adjusted correctly with about 1" free play in the pedal.

Grinding is usually caused by worn brass synchronizer rings rather than the gears. Checking brass synchronizing rings to determine if they're good. The purpose of these rings is to grip the taper on the selected gear (the gear you're shifting into) tight enough to assist the synchro drum meshing with the engaging teeth on the MDG and second gear. There are multiple tiny grooves machined around the inside of these synchro rings. When new, these feel sharp to your fingers. They become worn and dull from use. Lack of sharpness doesn't necessarily mean they're junk, but it does mean they're nearly worn out. Another check is done by measuring the distance between the brass synchro and the gear teeth on a MDG or second gear using a feeler gauge. If this gap is less than 0.020", the synchro is worn out. But the best test I think is to place them on the MDG or second gear and push them against the gear while trying to rotate the brass ring. They should friction-lock tightly on the tapered shoulder of the gear. If they don't lock tight, the synchro ring is shot and needs replacing.

Grinding can be caused by worn teeth in the synchro drum, which engages the second and high gears. These have wedge shaped ends and are on both inside ends of the synchro drum. Also verify the teeth on the MDG and second gears are not worn excessively. [See preceding #3 for more information and possible corrective grinding.]

IDENTIFICATION OF TRANSMISSION GEARS: The '32 thru mid-'35 had spur (straight) cut teeth on low/reverse gears. The cluster gear had both straight and helical cut gears depending on what type of teeth they mesh with. These transmissions used straight cut splines on the mainshaft (the low/reverse gear slid back and forth on these splines on the mainshaft) and is the main difference between a '34 and '36 transmission. The synchronizing drum had a lip at only one end. This lip is to be installed towards the rear. The synchro drum was 1.406" wide. The synchronizers were minimal and pause shifting (pausing momentarily in neutral) was the rule of the day when shifting into a higher gear.

From mid-'35 thru '38 there were only a couple of main changes as far as I can recall. All of trans gears were helical cut which made low and reverse gears stronger as well as being a lot quieter in low and reverse. The mainshaft was changed to spiral cut splines for the newer low/reverse gear to slide back and forth on which improved low gear shifting. The synchronizing drum had the shifting slot in the center of the drum. There is a slight lip on one end of the earlier synchro hubs.... it's to be installed towards the rear. The width of this drum was changed to 1.345". Pause shifting still ruled.

Beginning in '39, second gear and the MDG were changed to work with a new and improved synchronizer assembly. The second/high synchronizer clutch hub, brass synchronizers, and shifting drum were improved considerably and are different than pre-'39. The synchro drum is bigger and is now directional during assembly. The brass synchros are larger. The synchro clutch hub is different, but retains the same miserable ball/springs design the earlier transmissions used. The complete synchronizer drum assembly interchanges from '39 through '53 (column and floor shifters <u>will</u> interchange)..... just be sure to match the width of the slots in the brass synchro rings with the width of the slots in the synchro clutch hub. About '46 they replaced the miserable springs and balls in the synchronizing assembly with flat steel plates.... a HUGE improvement in my book.

CLUSTER GEAR AND MAIN DRIVE GEAR BEARINGS: Needle bearings. The '49 and newer Fords, as well as Mercs beginning in '51, came with loose needle bearings (not caged bearings) in both the Main Drive Gear (MDG) and cluster gear. Some heavy wheel bearing grease will help hold the loose MDG needle bearings inside the MDG during assembly. Keeping loose needles in place in a cluster gear requires a different strategy because it gets rattled around during assembly which causes the small needles to fall out of place. Installing a cluster with needles is a lot easier if a dummy shaft is used in conjunction with heavy grease. Fabricate a dummy cluster shaft by shortening an old cluster gear shaft to 6¼". Then grind down the outside diameter to about 0.740" or so. It doesn't have to be smooth.... rough grinding will work. It has to be small enough to <u>be pushed easily</u> through the cluster gear shaft's hole in the front of the case. Coat the inside of the cluster gear with a big glob of heavy grease. Insert the dummy shaft and install the metal spacer. Then a needle bearing retaining washer on each side of the metal spacer. Install the needle bearings around the dummy shaft (use a small electrician's screwdriver to help line them up and spread them apart). When the needles are all installed around both ends of the dummy cluster shaft, put a needle bearing retaining washer at each end to help keep the bearings in place. Smear some more grease to hold things together. Grease the cluster gear's two bronze washers and stick them on the cluster gear. Leave the dummy shaft in the cluster and lay the cluster in the bottom of the case. Add the steel thrust washer between the rear bronze washer and the case. Leave the cluster gear laying in the bottom of the case while you finish assembling the other gears. After all the rest of the gears and shafts are in the case, lift up the cluster gear and line up the washers and the cluster gears hole in the case. When everything is aligned, install the cluster gear's shaft from the rear towards the front. Then push the dummy shaft out towards the front.

Caged bearings: All Ford/Merc/Lincoln cluster gears and MDG through '48 used caged needle bearings. The '49-'50 Mercs also had caged bearings in both the MDG and the cluster. There are two different lengths of caged bearings (two short and one long). The longer one goes at the rear of the cluster, a short one goes in the front of the cluster gear, and the remaining short one goes inside the MDG.

(From rodnut 1/30/03. Do not use new caged bearings sold by Ford repro parts dealers. The end plates holding the needles come apart eventually. Use only NOS or excellent used ones.)

REAR TRANSMISSION BEARINGS FOR '48 AND OLDER: Using a bearing with a seal on one side will help prevent lubricants from leaking in or out of the transmission. The rear main shaft bearing which features a seal on one side is part #6306-ZZ/C3.

INTERCHANGING CLUSTER AND MAIN DRIVE GEARS '39 THROUGH '50: Both '49-'50 Ford and Merc cluster gears and MDG interchange with '39 through '48 parts. Keep in mind the different diameters of MDG clutch splines when using different years. Use the correct cluster gear bearings, spacers, and bronze washers. Be sure to match the number of teeth on the MDG with the correct number of teeth on the cluster gear as noted below. These combinations HAVE to be as shown. Mixing the gears causes either too much or not enough play between the meshing teeth and will cause the gears to fail quickly. There isn't any interchange with the '51 and newer gears.

Early transmission gears and ratios prior to 1951 Ford/Merc:

25 tooth Lincoln-Zephyr has 19t MDG, 24t second, 29t LR slider, cluster has 25t-22t-18t-14t. Gear ratios are 2.12:1 first gear and 1.44:1 second gear.

26 tooth Lincoln-Zephyr has 18t MDG, 24t second, 29t LR slider, cluster has 26t-22t-18t-14t. Gear ratios are 2.33:1 first gear and 1.58:1 second gear.

28 tooth Ford & Mercury has 16t MDG, 22t second, 29t LR slider, cluster has 28t-24t-18t-14t. Gear ratios are 2.82:1 first gear and 1.60 second gear.

29 tooth Ford & Mercury has 15t MDG, 22t second, 29t LR slider, cluster has 29t-24t-18t-14t. Gear ratios are 3.11:1 first gear and 1.77:1 second gear.

OVERDRIVE TRANSMISSION PARTS: There are no differences between the transmission gears used in an overdrive transmission and a standard transmission (providing they're the same year). The one exception is the main shaft the L/R slides on. This is obvious since the standard trans is considerably longer than the overdrive (it only extends to the front of the overdrive while the standard extends to the front U-joint yoke). Just stick with the same year and you'll be OK.

TRANSMISSION PARTS DIFFERENCES: Shift forks: The '39-'48 second/high shift fork is wider and has a different offset than a '37-'38. These must match with the width of the second/high synchronizer drum assemblies and won't interchange. Grinding the sides of a '38 shift fork to fit a '39 or newer synchro assembly won't work due to the '38 having a slightly offset fork which moves the shifting drum too far forward against the main drive gear and not far enough towards the rear into second gear. This causes grinding noises and the trans will fly out of second gear under <u>both</u> power and compression.

Synchro assemblies: The ‘39 changed synchronizing assemblies and are superior to the earlier ones. The ‘39 synchro assemblies won’t interchange with the ‘38 and older units. Just be sure the second/high shifting fork matches the synchronizer drum assembly (‘38 and older or ‘39 and newer) and you’ll be okay.

MDG & second gears: The MDG and second gears were changed beginning in ‘39 and will not interchange with ‘38 and older. The ‘38 and older MDG and second gear can be identified by their narrow synchronizer band. It’s about half as wide as a ‘39. This narrower band does not extend to the gear teeth like the ‘39 and newer do.

The L/R slider gears are all the same (22t) for ‘39-‘48 transmissions. The exception is the Lincoln L/R gears (24t). The reverse/idler gear is the same for all ‘39-’48 Ford/Mercs/Lincolns.

The L/R slider gear for ‘51-’53 (28t) are different and will not interchange with the earlier L/R gears. The reverse/idler gear (17t) is different for ‘51-’53 and will not interchange with the ‘39-’48 units.

1951 THROUGH 1953 CAR AND PICKUP TRANSMISSIONS: Beginning with the ‘51 Ford/Merc all of the transmission gears were changed and have a tooth configuration of “diamond” or “chisel” shape. This was done to increase their strength. The car trans cases were all 4 bolt square front. None of the gears will interchange with pre-’51 gears. The ‘51 mainshaft’s spiral gear teeth (the low/reverse gear slides back and forth on the spiral gear) has a slightly different twist than ‘50 and older transmissions. This prevents interchanging low/reverse sliding gears with early ones. These ‘51 up transmissions can easily be identified by their diamond (or chisel) shaped teeth. The ’51 and newer MDG can be easily identified by the machined groove just in front of the MDG bearing. Most ‘51 and newer pickup 3 speed transmissions came with the MDG having the early type large diameter clutch spline.

Transmission gears and ratios for ‘51 thru ‘53 Ford and Mercs: 27 tooth Ford/Merc has 16t MDG, 22t second, 28t LR slider, cluster has 27t-23t-17t-14t. Gear ratios are 2.78:1 first gear and 1.61:1 second gear.

UNIQUE CLUTCH BELL HOUSING AND THROW-OUT BEARING FOR EARLY ‘51 MERCS. These are different than any other Merc or Ford clutch/throwout bearing arrangements. The front of the trans cases are the same for all ‘51 -’53 Ford/Merc transmissions (square bolt pattern). No problem there.

In ‘49, Ford changed to a stamped steel fork to operate the throw-out bearing. This stamped steel fork extended through the stamped bell housing. One end of the plate is the fork which engages the throw-out bearing collar. The other end of this steel plate is outside the bell housing and is moved rearward by the clutch pedal mechanism to disengage the clutch. The pivot for the stamped plate is inside the bell housing. It changes plate direction for clutch pedal operation. They also changed to a smaller size throw-out bearing and collar because of their new smaller diameter MDG clutch spline.

But the Mercs didn’t change in ‘49. Instead they elected to stick with the same mechanism as was used so successfully on the ‘48 and earlier Ford/Merc cars. A round shaft extends through the cast transmission case’s bell housing to the throw-out bearing fork. The throw-out bearing fork is pinned on the round shaft. The other end of the round shaft is outside the trans case and has a pinned lever which is pushed forward by the clutch pedal mechanism to disengage the clutch. They also stayed with the larger MDG clutch spline and earlier throw-out bearing.

In 1951 when Ford decided to change the Merc's to the same transmission arrangement the Ford line had been using beginning in '49, the engineers blew it big time. They forgot the difference in the clutch actuating mechanisms. I think they figured they'd just use a Ford stamped steel bell housing to mate the engine and trans together. Then they'd use the Ford stamped steel throwout bearing actuating plate. No problem... or so they thought.

The clutch operating mechanism problem became evident when production of '51 Mercs came up the assembly line. An immediate design change had to be made in the Merc's clutch actuating system in the car (not in the bell housing). But design and setting up automated machining would take time and delay production for some time. Solution? It was relatively easy to cast some bell housings using the early Merc's clutch shaft system but with the newer square transmission bolt pattern. Oh yeah... they had to come up with a different throw-out bearing and collar design too. These changes came only in the very early '51 Mercs and are very rare today. The throw-out bearings are probably still available since they're a bearing, but I'm sure the collars aren't available from any source... new or used. You might want to keep these differences in mind if you're building an early '51 Merc for competition. Of course you always have the option of going to an early '49-'50 Merc...... unless you'll be entering your Merc for concourse judging.

TRANSMISSION ALIGNMENT STUDS: Stabbing a trans into a '49 and newer Ford is tough since there is no center X-member to take the weight while we rest our arms. Consequently, the transmission's weight ends up prying on the clutch disc and often times damaging it. Use two headless cap screws on the two bottom bolt locations in the bell housing. These will support the trans weight and save your arms and your new clutch disc. Just cut the heads off two 3/8" cap screws with NC threads (16 threads per inch) that are 3-3/4" long. They really help. (Tip. I made two smaller ones for my '39 flathead trans. Sure helps this weak old man!)

TRANSMISSION ADAPTERS FOR T-5 OR CHEV S-10 5 SPEED TO AN 8BA: For an adaptor and other specific information contact;

Cornhusker Rod and Custom, Inc.
Dept. RC11
RR1, Box 47
Alexandria, NE 68303 (402)-749-1932

CAD/LA SALLE TRANSMISSION TO A 59AB ENGINE: Use the Cad/LaSalle gear box, a Cad/LaSalle clutch disc, a 59AB Ford pressure plate, a Cad/LaSalle pilot bushing, a Ford throwout bearing, and a Ford flywheel. Flame cut an adaptor from 1/2" steel to adapt the two different bolt hole patterns. Strength of these old LaSalle boxes is the same as the newer Borg-Warner T-10.

************************* GEAR OIL & LEAKS **********************

GEAR OIL/GREASE: Borg-Warner (B-W) manufactured the '49-'53 transmission overdrives. They recommend 30 wt engine oil for lubrication!! Not in my transmission! This may be best for their overdrive, but will surely eat transmissions in hot weather and under hard use. I've used EP-90 gear lube year round in my '66 Ranchero for the past 470,000 miles with not one overdrive gear related problem. In all flathead transmissions with no overdrive, I stick with

EP-90 year round. In rear ends, I follow Henry's recommendations and run straight weight EP-140 in the summer if I'm taking a <u>long</u> trip. Other than that, I just use EP-90 gear lube.

Oil leak areas are where the different cases of a transmission bolt together. This is especially true in an overdrive trans due mostly to Victor brand rebuild gaskets being very thin. Next time try making gaskets out of a grocery paper sack. The sack paper is about twice as thick as the stock gasket and helps seal things up. (From rodnut on 1/30/03. "Go to NAPA and get proper gasket material.")

(Tip. Use some 3M brand #77 General All-Purpose Adhesive on the gasket surfaces.)

One last thing on lube. I know a lot of people are using synthetic gear lube and swear by it. I just end up swearing at it! I've tried it in various years of transmissions and rear ends and found it leaks where non-synthetic gear lube doesn't. Probably leaks because I don't know what I'm doing. I'm tired of having oil spots all over the driveway and garage floor. I don't use it in any trans or rear end I garbage together. (From rodnut on 1/30/03. He uses 75-90 Synthetic Amzoil year round in the trans and axle. He states "There have been no leakages in properly sealed units.".)

GEAR OIL LEAK AROUND CLUSTER SHAFT: Most of our transmissions have been apart many times, and/or have been brutalized during tear down and assembly. The cluster gear shaft's front hole in the transmission case is often wallowed out of round. It may not drip much gear lube, but most will seep heat-thinned gear lube. This may not show up as a drip, but can turn to a mist which gets on the clutch pressure plate and disc and creates clutch chatter. When the trans is pulled, the inside of the bell housing and clutch have an oil film. I used to think the MDG bearing retainer seal was bad, but discovered the cluster gear shaft's hole was worn. Cure? Super simple if you're running a '49 through '53 Ford or late '51 through '53 Merc with a 4 bolt square case. Pick up some gasket paper about 0.025" thick. Make a gasket that is exactly the same as the front of your square shaped trans case. Cut it so it's snug around the MDG bearing retainer. Before you install the trans, use some 3M weather striping adhesive (you may want to re-use this gasket at a later date so don't use anything that turns to concrete) to hold this to the front of the trans. When it's bolted against the bell housing, this gasket will be squeezed between the trans and bell housing and seal the cluster shaft hole.

Large front early transmission cases: These don't have a simple cure like the later transmissions.... least I can't find one. I've tried machining "O" ring grooves on the shaft and in the case. But installing the "O" ring has defeated me..... they simple role out of their groove when the cluster shaft is being pushed or driven through. However, there are two different methods I've used with good results.

(1)This is the best one, but is more work than the second method. Remove the clutch cross shaft to get to the cluster shaft hole. Grind off the end of the <u>front</u> of the cluster gear shaft 0.120". Enlarge the cluster gear shaft's hole in the front of the trans case to 1.000" diameter, but only go 0.100" deep (this will provide a ledge for a 1" expansion plug to rest on). Trans cases are case hardened which makes enlarging the hole tough unless you've got the machinery. I recommend taking it to a machine shop. Pick up a 1" diameter expansion plug. After the trans is assembled, use some oil proof sealer (like #2 Permatex) on the expansion plug and drop it into the cluster shaft hole with the raised side of the plug outward. Now flatten the raised side with a hammer and drift punch or bolt. This causes it to expand and wedge itself tightly against the sides of the hole. Reassemble the cross shaft. Next time you pull the cluster shaft, just use a large drift punch from the rear and drive the shaft forward to pop the plug out. I did this type of seal to mine and the inside of the bell housing is now dusty instead of oily.

(2)The second method. Before stuffing gears into a case, peen around the cluster shaft hole to tighten it up. Invert the case and, using a long drift punch, peen around the cluster shaft hole on the inside of the case. Careful, it doesn't take much to over-peen (this is a word?) it. Too much and the cluster shaft won't go into the smaller hole and you'll end up filing or grinding the hole to remove excess peening. During assembly, I coat the inside of the hole with #2 Perma-Tex. This usually works, but I've had a couple of them seep some... which caused me to go the expansion plug cure.

TEMPORARY REPAIR FOR A REAR END AXLE HOUSING LEAK: A trick I've used several times to cure a leaking axle housing gasket when I didn't have the time or ambition to tear the rear end apart (I'm just plain lazy) is to loosen the axle housing bolts several turns. Then use a chisel or screwdriver to pry the housing slightly away from the rear end housing. It doesn't take much prying since you only need it far enough away to wrap a few turns of string. Use some ordinary cotton string and wrap it around the outside of the axle housing bolts a few times. Re-tighten the bolts. Only takes about 20 minutes. This has never failed to stop an oil leak. And it's a lot easier than pulling the housing clear off to replace the gasket... especially on the road. Even though the axle housing gasket is also a shim used to adjust the ring gear engagement depth, it has never hurt any rear ends I've done this to.

***************** OVERDRIVES ******************

OVERDRIVE SHIFT SHAFT TAPERED PIN REMOVAL: These are tough to find due to caked mud and grease. They have to be removed or the overdrive housing will only move ¼. The housing has to be removed to work on the inside of an overdrive. I have no idea how many drift punches I have broken, bent, and destroyed removing these tapered pins, but it's got to be close to 50! I've resorted to drilling a few out..... which usually ruins the case. My solution is to use a single loose needle bearing for a '49 and up Ford cluster gear. Clean off the area to find the location of the elusive tapered pin. They are usually installed either vertically from the top....or horizontally from the front. Hold the needle bearing with pliers and position it on the correct end to remove the tapered pin. Then beat on the bearing with a large ball peen hammer. Sometimes it takes two or three bearings before it comes out. Just another dumb way I do things.

OVERDRIVE GEAR REDUCTIONS: There are currently several different manufacturers of overdrives for our Fords. I only have knowledge of two and will discuss them.

Borg-Warner made the transmission overdrive for '49-'53 Ford/Mercs and Lincolns. Columbia made a rear end overdrive for '48 and older flatheads. Both have the same reduction ratio (70%). Technically, they're 72.2%, but everyone uses 70% since it's a lot easier on us that ain't so good with arithmetic! Simply multiply the rear end ratio by 70% (0.70) and you have the ratio in overdrive (O'D).

Example. Suppose you're thinking about running 4.11 : 1 rear end gears. And you want to know what ratio it would be in O'D. (4.11)(70%) = (4.11)(0.70) =

2.877 : 1. Simple isn't it? No wonder everyone wants an O'D. The 4.11 gears are a tiger at stop lights and the 2.87 permits running 80 mph for days without injuring your flathead mill. Also the overdrive decreases engine noise, wear, increases gas mileage, and helps our hopped up mills run cooler.

In case you're wondering what rpm you'd be turning at 60 mph in and out of O'D....... With 28" diameter tires and 4.11:1 gears: Out of O'D you'd be turning 3000 rpm at 60 mph and in O'D, you'd be turning 2000 rpm. Just for fun, let's look at 90 mph with the same gears and tires. Out of O'D it'd be turning 4500 rpm and in O'D, it'd be turning 3000 rpm. I've included a formula for calculating rpm and speed in the FORMULA SECTION if you're interested in toying with what gears to run.

BORG-WARNER ELECTRIC OVERDRIVE TRANSMISSIONS. These are the more common of the two types of overdrives I've listed. They were manufactured by Borg-Warner (B-W) and used regular Ford transmission gears with B-W overdrives. They're electrically controlled whereas the Columbia's are vacuum operated. Internally, the balk ring, sun gear, planetary gear (pinion cage), ring gear, and free wheel unit are identical for all early B-W overdrives. This means parts are identical in Ford, Merc, Lincoln, Kaiser, Frazer, Hudson, tri-year Chevies, Studebaker, Nash, and Rambler overdrives (provided they're not a heavy duty 3 speed overdrive). Many of these B-W overdrives, which are left, are 12V. Almost all of the O'D relays (same voltage rating) and most kick down switches work when used in a different breed of car. The governors are the same except for the governor's driving shaft. But these shafts interchange so you can often times use your shaft in another governor when yours goes bad.... which is *really* rare. Just remember there are several parts that <u>will NOT</u> interchange because they were designed to fit a particular make and year of car. An instance of a special piece is the overdrive rail switch on '49 Ford overdrives. This switch is actuated by a shaft that is in a hole in the overdrive adapter housing. This pin is shoved rearward by the L/R sliding gear when the trans is shifted into reverse..... which operates the rail switch.... which opens the governor's ground.... which prevents the overdrive from shifting into overdrive when backing up. '50 overdrives did away with this switch.

Gasket sets for these transmission overdrives are being repo'd, but are scarce. A paper grocery store sack makes better gaskets than NOS ever were. Victor brand rebuild gasket sets are too thin to effectively seal the cases. The sack paper is a tad thicker and seals better. I use 3M #77 All Purpose Adhesive on gasket surfaces to help prevent leaks and to hold the gaskets during assembly.

Solenoids have many different sizes, shafts, and shapes as well as voltage ratings. Often you can combine two different solenoids to make one with little trouble. A stumbling block is the mounting surfaces. On Fords you'll find there are two types of mounting surfaces. One is flat across the mounting surface and the other has a 1/8" step to the mounting bolt surface. They must match the mounting surface of the adapter housing they are bolting to.

Many relays are thrown in the trash when the only problem is a broken wire internally or the points have become pitted. Remove the cover and examine the very fine wire coming out of one of the windings. They are frequently burned in two. Apply a drop of solder to reconnect the two ends and they'll work fine for years. Re-surface pitted points with a point file. Gap is not critical.

OVERDRIVE SOLENOID VOLTAGE CONVERSION ON '49 AND NEWER: Converting from 6V to 12V. Most 6V solenoids have a different engagement shaft (length and/or twist) than a 12V solenoid. This, with the exception of a possible different type of mounting and voltage, is the only difference between a 6V and 12V solenoid. The easiest voltage conversion is to use a 12V solenoid with the same mounting characteristics as the 6V. Exchange the 12V shaft with the 6V. Be sure to mark the shell of the 6V solenoid the location of the flat sides on the shaft. This saves a lot of trial and error during re-assembly. Position the flat sides of the shaft in <u>exactly</u> the same position as they were on the 6V solenoid.

OVERDRIVE SOLENOIDS FOR ‘49 thru ‘51 CONVERTIBLES AND STATION WAGONS: These are different than ones used on the passenger cars due to the design of the frame’s center section. The beefed up frame doesn’t have enough room for the sedan’s solenoid. So B-W used a 90 degree type bracket with an internal cable and located a unique solenoid several inches away. These cable extension pieces are a real pain to remove and/or install in the car (you have to remove the floor carpeting and a plate to get to the bolts). Both of these pieces are <u>VERY</u> rare and <u>VERY</u> expensive if you can find one. However, some “tomahawk engineering” using your basic hot speed-wrench on the center member will make enough room for a standard sedan solenoid. I’ve been told a complete ‘51 overdrive transmission will fit in ‘49-’50 convertibles and station wagons since the ‘51 solenoid mounts slightly different than the ‘49-’50 does, but I’ve not actually done one. It looks as if it will fit but will be an awfully tight fit.

OVERDRIVE TRANSMISSION FREE WHEELING ROLLERS: To assemble these: Use a 1/8" wide rubber band and stretch it around the overdrive’s free wheeling unit a couple of times. This will hold the large steel roller bearings in the sprag clutch as well as provide needed tension to pre-load the sprag clutch. Lift the rubber band and install, one at a time, the individual rollers in their slots in the sprag clutch. When all rollers are installed, rotate the sprag clutch to its loaded position. The tight rubber band will hold the sprag clutch in the loaded position. This reduces its outside diameter so the overdrive’s ring gear will fit down over the rollers. Don’t sweat leaving the rubber band inside the overdrive..... it’ll grind up and mix with the gear oil.

COLUMBIA OVERDRIVES: These are really a two-speed rear end like the ones used in big trucks for years. They’re just not as massive. Since they are rear end overdrives, they actually change the rear end ratio. Because the speedometer drive comes off before the overdrive, the speedometer must change at the same time the rear end shifts in or out of overdrive. This requires a speedometer gear changer that’s controlled by the operation of the rear end. All Columbia overdrives for our flatheads are primarily vacuum operated. The vacuum is controlled either mechanically through ‘41 or electrically from ‘46-’48 (I don’t know about ‘42). The mechanical controls, some of the electrical components, and internal parts are now being repop’d. But they do shrink a credit card quickly. Before you lay out your cash for a Columbia at a swap meet, tear it down and verify the condition of the 15 tooth sun gear as well as other parts. The sun gear is normally cracked or broken. Expect to pay about $175 and up for a used sun gear with no cracks.... if you can find one. They are being reproduced for about $350-$450. If there are pieces which are cracked or broken, lower your bid accordingly. There are several internal pieces that need to be strengthened (welding, machining a tool steel collar, etc.). Sending the pieces to a specialist is well worth the money. Cost to beef these up and get new gaskets and misc needed assembly parts is in the $500 range. These modifications make a Columbia a lot stronger than when they were new.

REAR END CENTER SECTION REQUIREMENTS WHEN ADDING A COLUMBIA OVERDRIVE. The width of the rear end from backing plate to backing plate varies according to the year of the rear end. Nothing new here. The newer they are, the wider they are. Usually it's the axles and housings where all the added width is. But late '32 through '34 rear ends have narrower center sections. And these narrower center sections will not accept a Columbia made for '35 and newer cars (only late '32 through '34 Columbias fit in these older center sections). However, axle housings all have the same bolt pattern and bolt up to any center section. If you're adding a Columbia from a '35 and newer to your '34, you'll have to change to a '35 through '48 center section (they're all the same). Understand center section includes the spider gears, the ring, and the pinion gears for this discussion. But when you go to the later center section, the '34 and older axles will each be too short by about 3/8". Solution is to cut off the ends of two longer axles to the correct length. Machine threads, axle key slot, and taper in each axle. None of this makes much difference if it's going in a high-boy and you don't mind the tires being some distance from the body. One other thing, keep in mind the mounting and angle of the rear radius rods since they vary according to the year of car. I found it's easier to graft a section of the inner overdrive housing to an outer section of the '34 right side housing. This retains the original radius rod mounting, angles, shocks, and brakes. Just shorten the stock right housing so the right housing with the overdrive housing is *exactly* the same length as the original housing was. Be sure to carefully line the two housings up so the radius rods etc. are all located and indexed properly. Cost to do this is usually about $100 and can be done by any competent machine shop.

ALTERNATIVE FOR SHIFTING TRANSMISSION OVERDRIVES. The Borg-Warner transmission overdrive can be shifted out of overdrive <u>without</u> flooring the accelerator to activate the kick down switch. This is neat if you come up on a slick road or downhill and you want to shift it out of overdrive without using full throttle. Just apply a slight amount of power and, <u>very quickly</u>, turn the ignition key off and then back on (as fast as possible). This breaks the overdrive electric circuit and kicks out the solenoid. This puts you in direct drive without the throttle being wide open (a sudden full throttle sure makes for excitement on sheet ice!). Once you're in direct drive (out of O'D) retain the same amount of power and pull the overdrive handle out. *REMEMBER*, anytime you want to move the overdrive handle (in or out), you must be in direct drive (out of overdrive) with some power being applied...... or completely stopped.

SHIFTING THE COLUMBIA OVERDRIVE. We've all heard the two-speed axles shift on large trucks. It sounds like they're grinding themselves to pieces. The Columbia sounds the same and scares me! One way to decrease this grinding is to shift it up into overdrive about 40-45 mph. Makes shifts a lot quieter. It also makes for a lot less wear on the sun gear during engagement.
Also, when you're slowing down for a stop, don't shift out of overdrive until about 25 mph or less. You'll just hear a click instead of gears grinding. This has to be easier on the overdrive unit. I usually just kick the trans into neutral and shift it out of overdrive when I slow to about 20 mph.

******************* REAR ENDS & DRIVE SHAFTS *****************

REAR END GEARS: Many members of the Early Ford V8 Club are super sharp. But I have to disagree with them when it comes to rear end ratios in early Fords. Many say '48 and older Fords came with only 3.54:1, 3.78:1, 4.11:1, 4.44:1, and 4.55:1(?) ratios in 85 and 100 hp V8's. And they back this up with their Ford manuals. While scrounging wrecking yards in south Texas in the early fifties, I came across about a dozen or so early Ford rear ends with 3.27:1 gears! I also found quite a few 4.33:1 ratios as well. All had gennie Ford lettering. It was our belief these came as special orders for large customers. The 3.27's were mostly found in Texas Ranger's Border Patrol '46-'48 cars (must have needed more top end). The 4.33 gears were in factory stripped down Fords made especially for cross country patrolling the huge King Ranch (low end grunt was needed for traversing washes and ravines). These were always in '34, '36, '38 and '39 Ford Phaetons with truck 4 speed transmissions, butterfly fenders, no running boards, with gun scabbards, and super wide (for the time) rims running fairly tall tires. I've never seen, nor heard of anyone who has seen 4.55:1 Ford gears for an early Ford car.

A word of caution, the 3.78:1 (9/34) and 4.11:1 (9/37) both use 9 tooth pinion gears. The pinions are not interchangeable due to different width of gear teeth and pitch. Keep them together with their original ring gear.

9" SPECIFICATIONS: I ran across this table several years ago in a Super Ford Magazine. I neglected to get the name of the contributor, so am unable to give him an "atta-boy".

Measurements are between the mounting faces of the backing plates. Note many of these are performance cars and not you're typical grocery-getter. They came in either leaf or coil springs.

'64-'77 Bronco = 46"
'58-'60 T-Bird = 50"
'57-'59 Ford & Edsel, '63-'69 Falcon, '63-'65 Comet, '67-70 Mustang & Cougar,
'66-'69 Fairlane and Cyclone. These are all 52"
'63-'65 Fairlane & '65-'66 Mustang. These came with either 52" or 54"
'71-'73 Torrino & Cyclone, '60-'64 Ford & Merc (full size), '61-'67 T-Bird. All are 56"
'58-'72 F-100 pickup = 57" ***
'73-'90 F-100 pickup = 58¾" ***

***NOTE: F-100 pickups came with various gear ratios of 3.25:1, 3.40:1, 3.70:1, 3.90:1, 4.10:1, 4.30:1, 4.56:1, and 4.67:1

OPEN TYPE DRIVE SHAFT U-JOINTS: Many early flatheaders have changed to open type driveshafts. Over tightening the U-joint's small "U" bolts can cause destruction of the u-joint's cross shaft and bearings in short order. Tighten the nuts just tight enough to compress their lock washers. Any tighter and it distorts the cup which quickly ruins the needle bearings and wears notches in the cross shaft. This will cause a drive line rumble in the 50 to 55 mph range. I'm nervous the nuts might come loose so I use some green locktite on the bolts after they're tightened.

U-JOINTS FOR ENCLOSED DRIVESHAFTS: These were used in cars through '48. They came with bushings. However, Lincoln used U-joints with needle bearings beginning in '39. As to be expected, they are considered to be better than the bushing type.

Incidentally, grease for the U-joint is a regular question on the early Ford sites. Ford calls for "filling with engine oil and soda soap grease at 1000 mile intervals"...... whatever soda soap grease is and how you fill it since there isn't any hole to pour it in. This mixture must be pumped through the zerk???? (I wonder if a grease gun will pump liquid.) It also states to "never use chassis grease"! I have no idea what to substitute for "soda soap grease". I've always

put 3-4 pumps of chassis grease in whenever I'm greasing a car and haven't had any U-joint problems.

AXLE NUT TIGHTENING. **Tighten axle nuts to 200-220ft/lbs. Then tighten it to the align the next cotter pin hole/slot and install a cotter pin. Caution: Never exceed 275 ft/lbs to align to the next cotter pin hole. After a few hundred miles, I re-check the torque. I think retorquing helps decrease shearing axle keys.**

AXLES FOR '32 THROUGH '48 REAR ENDS: There were different axles used on our flatheads.
(1)Axles for Model "A" thru '32 are the same. These have 24 teeth and use 12 tooth spider gears. In late '32, Ford changed to the '33 style straddle mount pinion. This prevented installing the ring gear on the wrong side of the pinion and having 3 gears in reverse and one gear forward! Ask me how I learned this while still in high school! Sure tore up the front of a '32 coupe!

(2)Axle length of '33-'34 Fords are 1/2" shorter than the '35 thru '41 axles. These have 18 teeth and use 12 tooth spider gears.

(3)Axle length of '35 thru '41 are 1" shorter than the '42 thru '48 axles. These have two different numbers of axle gear teeth:

The '35 thru '38 have 18 teeth and use 12 tooth spider gears.

The '39 thru '41 have 16 teeth and use 11 tooth spider gears.

(4)Axle length of the '42 thru '48 were the longest of the early axles. These had 16 teeth and use 11 tooth spider gears.

Thanks to Bill Bentley (BILLB) of the flathead V8 web site for this information.

ENCLOSED TYPE DRIVESHAFTS FOR '35 THROUGH '48: There were two different driveshaft lengths used from '35 thru '48. The shorter driveshaft was used from '35 thru '40. The longer driveshaft was used from '41 thru '48. In addition there were two types of driveshafts.
A tube type was used on '35 through '38 and uses a 10 spline pinion shaft coupler sleeve.
A solid type was used on '39 through '48 and uses a 6 spline pinion shaft coupler sleeve.
Ford made a 10 spline to 6 spline coupler for mixing pinions and driveshafts. I understand these are still available from early Ford parts dealers under Ford PN 48-4684.
Oddity: Some early Merc's used a one piece driveshaft/pinion that did away with the need for a driveshaft to pinion gear sleeve. Trouble is, you have to replace the entire driveshaft whenever you change or break rear end pinions or driveshafts. Not one of Henry's better ideas in my book. I've only seen these in '39 Mercs but I've been told they also were in some '40 Mercs. All of the ones I've seen were 3.54:1 gears.

REAR END SPECIFICATIONS: Pinion bearing adjustment for all '33-'48 rear ends is 12 to 17 inch/lbs (torque required to turn the pinion with engine oil in the bearings).

A method I picked up stock car racing some 50 years ago is to set the pinion bearing the same way as I set a front wheel bearing. Tighten the adjusting nut and then back it off one flat and secure the jam nut and locking washer. The pinion should turn with no bind and have no slop in the bearings. I still use this method today. The ring gear backlash is 0.006" to 0.010". (From rodnut 1/30/03. Gear backlash tolerances are 0.003" to 0.008". He also advises new bearings are tighter than used ones and setting by hand doesn't work.) Adjust the depth the ring gear engages the pinion gear by adding or subtracting axle housing gaskets (shims). The axles should turn easily with no binds, but not have any appreciably end play.

Pinion adjustment for Model A through '32 non-straddle mount rear ends is 35 to 47 inch/lbs. I adjust these the same as a front wheel bearing. Ring gear backlash is 0.006" to 0.010". Adjust the depth the ring gear engages the pinion by adding or subtracting axle housing shims (gaskets).

Increasing gasket thickness between the Left axle housing and the banjo housing will increase back-lash. Decreasing gasket thickness between the Left axle housing and the banjo housing will decrease back-lash. There are four different thicknesses made by Best brand gaskets and are color coded for ease of use.

White is 0.003" thick.
Ivory is 0.005" thick.
Green is 0.007" thick.
Blue is 0.009" thick.

*************************** SPEEDOMETERS ***********************

QUIVERING SPEEDOMETER NEEDLE. I'm assuming the speedo cable is not too long and being jammed into the back of the speedometer. Quivering is usually caused by the bushing at the back of the speedometer head (where the cable enters the speedometer) becoming dry. Remove the head and drip several drops of light machine oil into this bushing. Rotate it a few times with your fingers and add a couple of more drops. Leave it turned face down for about 15 minutes so it'll soak in. Test it with a drill and a short section of junk speedometer cable. It should no longer shake.

However, if you're lazy like me and don't have the energy to pull the speedometer, disconnect the cable from the speedometer head. Then spray some penetrating oil into and onto the bushing a few times. Test with the aforementioned drill and speedometer cable. It usually works, but I have been known to get oil on the carpet..... oh well... it's just an old Ford! At least that's what my spouse says.

SPEEDOMETER DRIVE GEARS: Note the following is for 28" diameter tires (6.00 X 16). Remember different diameter of tires will probably require a different number of teeth on the driven gear to be accurate.

17t for 3.27:1
18t for 3.54:1
19t for 3.78:1
21t for 4.11:1
22t for 4.33:1
23t for 4.44:1

CORRECTING SPEEDOMETER READINGS: Using the mile markers alongside the interstate works fairly well (they're not real accurate). We need to know how many seconds it takes to cover the mile between two markers. Drive the mile at a constant speed. Do this 10 times using the same mile markers and the same speed. Record each time. Now disregard both the slowest and fastest times. Add the remaining 8 times up and divide by 8. This gives you an average time. This average time to travel the mile is used in the following table:

seconds =	56	58	60	62	64	66	68	70	72	74
mph =	63	62	61	58	56	55	53	51	50	49

(these numbers are rounded off in accordance with standard engineering practices)
Example: Suppose your speedometer shows 55 and you average 58 seconds traversing the mile. Using the preceding table 58 seconds is 62 mph. Now all we need to do is figure the speedometer error.....

(62 actual mph)-(55 indicated mph) = 7 mph error. So you're actually going 7mph faster than the speedometer indicates. Correction methods are discussed in the next paragraph.

The number of teeth on the speedometer drive gear (at the transmission) controls the rpm of the speedometer drive cable... which operates the mechanism in the speedometer head. Nothing new here. To change the speedometer reading we can increase or decrease the number of <u>driven</u> teeth at the transmission quite easily (the <u>drive</u> gear is <u>on</u> the driveshaft). To increase the speedometer reading, decrease the number of teeth on the driven gear at the transmission. To decrease the speedometer reading, increase the number of teeth on the driven gear at the transmission. One tooth change makes a 4 to 5 mph change.

If you can't get it accurate enough to suit you, you can always take it to a speedometer shop where they will test it and correct it. They have small housings with interchangeable gears which fit between the speedometer drive gear and the cable. Cost is usually about $95-$120, but are certified accurate by the shop should you have to go to court for some reason or other?????

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

********** FUEL SYSTEMS **********

Revised February 18, 2009

********** FUEL PUMP & PRESSURE ***********

FUEL PUMP PRESSURE: Stock fuel pump pressure spec's are 1½ to 3½ psi at idle.

FUEL PUMP VOLUME TEST: Fuel pump minimum output is 1 pint of fuel in 30 seconds with the engine idling at 500-600 RPM.

FUEL PUMP VALVE CHECK: Checking the inlet valve in the fuel pump can be done by connecting a vacuum gauge to the fuel pump's inlet side. Start the engine and let it idle. When the vacuum gauge indicates 10in/Hg (Hg is the chemical term for mercury), shut off the engine and watch the vacuum gauge needle. It should not drop to zero for at least 1 minute. If it does, the inlet valve in the fuel pump is leaking and may need replacing, cleaning, or maybe only a new inlet valve gasket.

DECREASING FUEL PRESSURE: Ford recommends lowering the fuel pump pressure by increasing the thickness of the gasket between the fuel pump stand and the intake manifold. This decreases the push rod stroke. About 0.010" increase in gasket thickness lowers the fuel pressure ½ psi. The method I prefer is to use an adjustable fuel pressure regulator between the fuel pump and carb(s).

FUEL PUMP CAM LOBE LIFT: Lobe lift on a stock flathead cam is 0.200". As far as I know, all after-market FH cams have 0.200" lift. Wear limit is 0.180". Since the fuel pump is in constant contact with the lobe, the push rod travel should be within these tolerances.

FUEL PUMP PUSH ROD LENGTHS: There are three lengths of push rods which came in flathead engines……… 7-7/8", 8-7/8", and 10-1/16". The 7-7/8" and 8-7/8" came in '32-'48 engines. The 10-1/16" came in '49-'53 engines.

FUEL PUMP PUSH ROD WEAR: Replace when wear exceeds 0.050". (A seat of the pants rule: as long as there is chamfer left on the both ends of the push rod it is still ok.)

FUEL PUMP REBUILD KIT: I use rebuild kits by NAPCO (Nissan Auto Parts Company, Ltd.) part number #11A-9349. These come with a different designed inlet and outlet valves and newer fuel resistant diaphragms. I find this newer style of valve makes 5+ psi... whereas the stock valves make only 3½ psi (higher pressure helps prevent vapor locks). I recommend using a pressure regulator whenever a fuel pump exceeds 2½ psi. Limiting pressure to 2½ psi will prevent over powering the needle and seat assemblies and subsequent flooding leading to fires. The box say it's for Nissan, Mazda, and Toyota, but years are not shown on the box. Some internal valves use rivets to hold them in place of the screws. I suggest checking which you have before ordering.

FUEL PUMP REBUILD: When tearing a stock pump down, scratch a mark across the joint of the two fuel pump's body halves to orient the halves during reassembly. Then internally, scribe U (up) or D (down) next to the two valves (inlet and outlet) to show whether they're installed face up or down. The same valves are used for both the inlet and outlet valves. These valves are often the cause of low pressure. These kits use material which is resistant to gasoline with ethanol or other junk used these days.

GAS LINE SIZING: The stock ¼" gas line will provide sufficient gasoline for dual carbs for full throttle on all but the wildest street engines.

VAPOR LOCKING: There are many causes of vapor locking. Vapor lock occurs when gasoline in its liquid state gets hot enough to change to a vapor state (all fuel pumps were designed to pump liquid.... not vapor). Locating causes of vapor locking at home is a lot easier than on the road. Often it's caused by several minor things. Don't rule out the gasoline we get today. This stuff vaporizes at a lot lower temperature than straight gasoline did. Most of us have been plagued by vapor lock with our flatheads. Example: One hot day mine was doing it's lack of gas thing. When I got it home, I decided it was time to stop this mutiny. I walked around the back of the car and heard bubbling inside the stock steel gas tank. Could that be gasoline boiling??? I crawled under the car and touched the tank with the back of my hand to feel if it was really bubbling…… and burned blisters on my hand. The tank was nowhere near the exhaust system. Finally figured out the heat was a combination of the trapped engine and road heat under the car. The stock metal gas line was just as hot. No wonder it was trying to take over command of the engine! Replacing the stock tank with either a stainless or new steel tank wouldn't do any good since either would still get hot. So I opted for an after market polyethylene tank. While I was at it, I replaced the stock steel gas line from the tank to the carbs with rubber tubing designed for gasoline. Reason? The polyethylene tank and rubber gas line don't absorb and hold heat like the stock steel stuff did. It's never had any problem since and I've crossed the desert many times during the heat of the day.

I've listed the following checks for possible vapor locking areas in no particular order. I do each and every one when I'm working on a vapor locking problem.

(1)Verify the fuel pump is performing according to volume and pressure specifications. If not, find out why and correct it.

(2)Check the entire length of gas line from the tank to the carb for distance to a source of heat. The absolute minimum distance from the exhaust or any heat source is 5". If it's closer it's probably a main contributor to vapor locking. Do whatever is necessary to get clearance or add an insulation barrier.

(3)Check the stock gas line for heat. Take an hour long cruise on a hot day and then touch the gas line in several places. If it's too hot to touch it's probably vaporizing the gas inside the line.... or trying to. If it's only hot in one section, slice open a length of vacuum hose and slip it over the steel line to act as a heat insulator. Plastic zips will hold the line from sliding.

(4)Check the stock gas tank. Remove the cap and listen for gas bubbling after an hour's drive. If it is, try coating the tank with several thick coats of undercoat. This requires removing the tank to coat the entire tank, but it does help insulate the tank.

(5)Check to make sure the gas cap is vented. All flatheads came with vented gas caps. Verify the vent is not plugged by blowing air through it. If you're using an after market gas tank, it probably has it's own vent system, but verify it's not plugged.

(6)Check the glass bowl on the fuel pump for tightness or for cracks. If not air tight or cracked it'll suck air rather than gas.

(7)Check the flexible line leading into the fuel pump for possible leaks. Best way is to remove it and plug one end with a finger. Suck on the other end to create a vacuum while you wiggle the line around. If you lose vacuum, the flex line has a hole and it's junk. Sometimes these are weakened by engine heat. When you suck on them, they may collapse.... replace it. If on the road, wrap electrical tape around it several times after you get it dry. Often times this will get you home.

(8)If the carbs are super hot it's a sure bet they're getting soaked from the engine, fan, and radiator heat. Check by pulling the top of the carb off before you shut off the engine to see if the gas inside is bubbling. If it is, try adding a couple of extra carb to intake manifold gaskets to act as insulators. For an extreme circumstance, try a 1/4" thick insulator from some non-heat absorbing material like Masonite between the carb and intake manifold.

(9)An electric fuel pump is always a good idea for use as a back-up. Just remember, electric pumps are designed to push fuel.... not pull it. More on electric pumps in the next sub-topic.

Should vapor locking happen on the road during a trip I start trouble shooting by removing the gas cap to verify the gas tank vent is not plugged. Then I bypass, remove, or replace the gas filter(s) with rubber gas line tubing. These not only require fuel pressure to get the gasoline through them, but they also cut down on the flow of gas. And we need all the fuel we can get.

ELECTRIC FUEL PUMPS: These are usually the first line of defense for preventing vapor lock. These should be located as close to the gas tank as possible because they're made to push and not pull. They are very sensitive to dirt etc. Install a good gas filter just before the electric pump's inlet is a good idea. Using an electric pump in conjunction with the stock flathead pump is our normal method of installation. We use a toggle switch to turn on the electric pump when it's needed. Good idea. BUT there can be a problem with this setup. Stock mechanical pumps will not pull gas through most rotary type pumps. BUT they will pull through a pulsating type pump. Reason being, the rotor itself chatters as the stock pump pulls gas through it. This chattering causes the rotor to rotate slightly. The rotating eventually causes the rotor to block the exit or entrance port which stops gas from being pulled by the stock pump. At that point we turn on the electric pump's toggle switch thinking we're vapor locking. The rotor turns which opens the exit or entrance port and the electric pump pushes gas to the stock pump. This makes us think we were vapor locking when we weren't. Often times, we end up running the rotary pump full time since the stock pump is unable to supply gas to the carbs and we think the stock pump is kaput.

(a)One solution is to go to a pulse type electric pump in place of the rotary pump. These are not easy for the counter people to find because their computers go by year, color, and body style only and they have no idea how to identify if it’s a pulse or rotary. These pumps are available if you can find a parts person who knows what they’re doing..... good luck with that!

(b)A second solution. I prefer rotary pumps over pulsating type pumps even if a stock pump can’t pull gas through them. They last a whole lot longer and are more dependable than the pulsating type. So, I add a second gas line just for the rotary pump........ Sounds stupid doesn’t it? It’s a little tricky to describe using only words so stick with me if you’re interested.

After installing the new rotary pump near the gas tank, I install a “T” fitting between the gas tank and the rotary pump. This “T” type fitting will ultimately provide paths for the fuel.....

(1)One for the inlet side of the nearby electric pump.

(2)One for the stock gas line which will go forward to the carbs.

(3)One for the stock gas line coming from the tank.

For (1) above: I run a rubber gas line hose from the right side of the “T” fitting to the inlet side of the electric pump. This supplies gas to the electric pump.

For (2) above: The stock steel gas line is cut about 2" from the tank. Connect the end of the stock gas line (goes forward to the stock fuel pump) to the left side of the “T” fitting using a short piece of rubber gas line hose. This will supply gas to the stock fuel pump using the stock gas line.

For (3) above: Connect a length of rubber gas line hose to the freshly cut stock gas line coming from the tank. Connect the other end to the remaining “T” fitting. Install a fuel filter in this rubber line between the “T” and gas tank. This filters all gas coming from the gas tank.

Next I install a new rubber gas line from the output side of the rotary pump all the way forward to a couple of feet ahead of the driver’s seat. This gas line is routed inside the frame rails to protect it and is secured every 6" or so with plastic zip locks. This line is for gas coming from the electric pump.

I use a gas line selector for an early Ford Bronco. It’s a three-way valve designed for selecting either of the Bronco’s two tanks and has a shut off position which is handy to shut off all fuel to the engine. One selector position is used for the stock gas line which comes from the rear of the car. One selector position is used for the new gas line connected to the electric pump’s outlet. The third and last position is self-explanatory… it shuts off all routes for fuel flow. This selector valve is installed where it’s convenient… like in the floor at the left corner of the front seat. The valve has 3 fittings (two inlet fittings---- one for each gas line from the rear of the car and a third outlet fitting going forward to the stock fuel pump). Blow air through each so you know which is which. All that’s left is to cut the lines from the back of the car to length and connect them at the selector valve. I cut apart the stock gas line going forward to the stock fuel pump. The end of the stock metallic gas line coming from the gas tank is connected to one selector fitting using a short piece of rubber hose. The new gas line from the electric pump connects to a second selector fitting. The third selector fitting is the outlet line to the stock fuel pump (it feeds the stock fuel pump and carbs via a new rubber line which replaces the stock gas line).

When the selector is in the left tank position, the stock pump provides all the gas to the carbs via the stock gas line connected to the left side of the “T” fitting at the tank. When the selector is turned to the right tank position, the electric pump takes gas from the right side of the “T” fitting at the tank and pumps it through the new gas line to, and through, the stock pump and to the carbs. Neither line can divert or pull it’s gas to the other line because the 3-way selector valve mechanically blocks it.

It will be run on the stock pump full time (fuel is pulled through the selector valve by the stock pump). When needed, I turn the selector to the electric pump position and flick on the toggle switch for the electric pump (fuel is pumped forward by the electric pump through the selector valve and then to the stock pump).

Benefits: I use the electric pump for priming the carbs or when I get concerned about a possible vapor lock (like crossing the desert or in a traffic jam).

I also use it when setting the gas level in my two Stromberg carbs. This is great because I don't have to have the engine running and be so concerned about a fire. The electric pump is used to supply gas to the carbs when adjusting gas level (used in conjunction with a squeeze type bulb to suck out excess fuel).

One thing I like is the ability to completely shut off the gas. When I'm on the road I turn the selector to "off" when I park it for the night or leave it unattended for a time. I run the engine until the carbs stumble due to lack of gas. Helps me sleep a little better knowing the lack of gas in the carbs will prevent someone from simply hot wiring the car to steal it. The next morning I turn the selector to the electric pump side and let it refill the carbs before hitting the starter button.

************************* CARBURETION *************************

AIR FILTERS: In early days, most of us ran velocity stacks or Bell chrome air cleaners. The velocity stacks had a screen for a filter. These would keep out a regulation sized bowling ball, but very little else! But they looked great. (A side benefit.... they provided great water injection in a rain storm if you were not running a hood!) The original Bell chrome air cleaners used several turns of a screen mesh for a filter. These cleaners are being repo'd with paper mesh filters and are in demand today, probably because they look cool and old timey. Their design severely restricts air flow in my opinion and causes an overly rich mixture as the engine approaches mid range. This restricts engine performance and can contribute to fouled plugs. One cure is to make your own open-type air cleaner using K&N or other brand of quality filters. These don't filter as well as many gear heads would like, but they don't clog up and cause rich mixtures either.

FUEL PUMP PRESSURE: Ford and Stromberg carbs were engineered to operate at a maximum of 2½ psi fuel pressure which was pretty typical of carb pressure in the thirties. Exceeding this pressure can overload the needle/float system (hold the needle off it's seat) and flood a carb. This results in gas running down the carbs and onto the engine and is probably where the Strombergs partly got their reputation for being burners. The Ford carbs will also suffer from excessive pressure, but are not as sensitive as Strombergs due to better float leverage against the needle and seat. This is the result of Ford's better float pivot design. When the float is set too high, or if the pressure exceeds 2½ psi, or the vehicle is driven off-road, the air horn to main body gasket on both brands of carbs will become saturated with gas. Raw gas and gas vapors will waterfall down the front of the carbs. Notice the proximity of the front of the carb to the generator brushes arcing on the commutator? Picture your engine with hot gas on the front of the carbs and the close proximity of the arcing generator. Scary isn't it? Don't chance it..... limit the fuel pressure by installing an adjustable fuel pressure regulator and setting it to not more than 2½ psi. I prefer the Holley regulator. Note the carburetor designed pressure is less than the 3½ psi Ford specifies for their mechanical fuel pump. Strange Ford engineers knew the design pressure of the carbs, but used fuel pumps that exceeded this pressure... maybe to forestall their tendency to vapor lock?

POWER VALVES: These used to be called the “high speed jet” or the “economizer valve”. Today they’re referred to as “power valves”. When one of these power valves opens, it richens the fuel to air ratio from approximately 14.5:1 to 12.0:1 (about 20% richer). These operate either mechanically or by vacuum.

Ford/Holley carbs use a vacuum type power valve which has a flow restriction downstream of the power valve. This restriction functions like a jet and limits the quantity of gas passing through it. This restriction (referred to as the power valve channel restriction in Ford/Holley carb manuals) is inside the power valve’s transfer passage between the power valve and the main well. It is neither accessible nor changeable as far as I’m concerned. Power valves do not provide various changes in the amount of gas flowing through them.... they simply go to wide open. Our current crop of gasoline will hasten failure. The new power valves must be using some new material since they aren’t experiencing failure from gasoline like the NOS do.

Stromberg carbs don’t have any such restriction in their transfer passages in the main body. The metering orifice in the shell of the brass power valve controls the amount of gasoline.

CHANDLER GROVES/HOLLEY/FORD POWER VALVES: Chandler Grove originally designed and built the two barrel carb for Ford beginning in 1938. After the initial contract term expired, Ford put the carb contract out for bids. Holley won the bid and built them for Ford for a few years. Then Ford took over their manufacturing. All three manufactured carbs are pretty much the same.

As stated in the preceding text, the Ford carbs use a vacuum/spring controlled diaphragm type power valve. These are rated according to the inches of vacuum (in/Hg) needed to open the valve. The chemical symbol for mercury is Hg and is used when measuring vacuum. The power valve opens at low manifold vacuum (engine under power) and closes at high manifold vacuum (engine not under load). Rebuild kits I see these days have power valves rated in the 8-10 in/Hg range. Power valves which open at lower vacuum are available from some suppliers and are a worthwhile investment if you’re running multi Ford carbs. Multi carbs will decrease engine vacuum and often cause the vacuum controlled power valves to open with only the slightest increase in accelerator pedal (especially at altitudes above sea level since vacuum decreases with an increase in altitude). Many of these valves are stamped with their rating. A 45 stamp means the valve opens at 4.5 in/Hg..... an 80 means the valve opens at 8.0 in/Hg. Always install a power valve that is rated lower than the amount of vacuum the engine makes at idle. Should the engine backfire, it will almost certainly rupture a diaphragm type power valve. When running multi-carbs, some rodders remove the power valves completely and plug the holes shut. This will cause the engine to lean out on the top end unless it is re-jetted. Re-jetting 6 or 7 sizes bigger prevents leaning out...... which in turn makes the engine run very rich when operating during normal use (which is most of the time). Some rodders run a power valve in only one of their carbs and have good results. The power valve is located on the underside of the carb’s main body (fuel bowl) casting. You have to separate the throttle body and the main body of the carb to get to it. Checking one of these power valves is only a matter of sucking on the flat side of one to see if the diaphragm is ruptured.

A leaking power valve can trickle gas into the throats of the intake manifold and cause hard starting after sitting for a period. If your car is hard starting (and pukes black smoke out the tail pipe when it finally does start) after being shut off for about a half hour on a hot day, or if it's hard to start after sitting all night, check the power valve to see if it's leaking.

STROMBERG POWER VALVES: Stromberg carbs use a mechanically controlled power valve. It's located in the bottom of the accelerator pump well. These are opened mechanically. They are closed and held shut mechanically by an internal spring. They become operational whenever the flat bottom of the accelerator pump depresses the power valve's pin. This happens only when the accelerator pump is at the bottom of the pump's well (full throttle or very near it). These power valves are made of brass and will not rupture like a diaphragm type power valve. A single metering hole is located in the outer shell of the power valve to meter gas flow. This permits controlling the amount of gas the power valve can deliver by simply changing the size of this hole. It's a lot easier to adjust full throttle gas flow than on a Ford carb. Just solder the hole shut and drill the size hole you want further around the brass power valve (in a new location). Sizing Stromberg power valves isn't very critical since extended periods of WOT (wide open throttle) seldom happens these days (Bonneville?) and decreased vacuum doesn't operate them prematurely.

************************** STROMBERGS **************************

STROMBERG CFM & VENTURI SIZES:

81 rated at 135 cfm. Venturi diameter = 0.812"
97 rated at 150 cfm. Venturi diameter = 0.969"
LZ rated at 160 cfm. Venturi diameter = 1.000"
48 rated at 175 cfm. Venturi diameter = 1.031"

STROMBERG CIRCUITS: The idle discharge circuit operates from idle to 25 mph. The main jet circuit operates from 25 mph to 70 mph. Above 70 mph the power valve works in conjunction with the main jet circuit. Rear end ratio, tire size, and power loading all affect the operational boundaries of the various circuits. Remember the operational boundaries of carburetor circuits overlap.

STROMBERG NEEDLE/SEAT ASSEMBLIES: These were originally a steel needle and a brass seat which made them susceptible to the needle being held off it's seat by grit and dirt… which resulted in flooding which lead to fires. These all metal needle and seat assemblies are sensitive to pressures in excess of 2½ psi. Ken Ct. of the Ford Barn recommends and uses only metallic needle and seat assemblies.

With the advent of the soft tipped needle (Vitom), the sensitivity to dirt and fuel pressure was reduced and flooding decreased considerably. I use only these.

Since the sixties several different designs of needle and seat assemblies have been manufactured. Some are not affected by grit and dirt and many will tolerate higher fuel pressure. I've tried many of them, but end up going back to the Vitom tipped needles in my Strombergs. I've not had a single sticking needle in the past 135,000 miles so why change?

STROMBERG JET, POWER VALVE, AND FLOAT SPECIFICATIONS:

The 81 came on Ford V8-60 engines in '37 and most of '38's. Sea level jetting: main jets #35 and power valve #71. Gas level (not float level) spec is 15/32" ± 1/32" measured from the main bowl casting (fuel bowl) with no gasket.

The 97 came on '36 thru early '38 Ford V8-85 engines. It's identifying number is the same as it's venturi size (97). Sea level jetting is #45 and power valve is #65. Gas level (not float level) spec is 15/32" ± 1/32" measured from the main bowl casting (fuel bowl) with no gasket.

The LZ came on '36 thru early '38 Lincoln V-12 engines. I've lost my notes on these carbs, but I've never run them... probably due to the ready availability of the '97 carb.

The 48 came on '34 & '35 Ford V8-85 engines. It's identifying number is the same as it's stock main metering jet (48). Sea level jetting: main jets #48 and power valve #63. Gas level (not float level) spec is 15/32" ± 1/32" measured from the main bowl casting (fuel bowl) with no gasket.

STROMBERG POWER VALVES: Power valves are numbered according to the numbered drill used when drilling the metering hole located on the side of the brass power valve's shell. Just like numbered drills, the larger the number, the smaller the hole.

Sizes for power valves are:

#61 = 0.0390"	#62 = 0.0380"	#63 = 0.0370"	#64 = 0.0360"
#65 = 0.0350"	#66 = 0.0330"	#67 = 0.0320"	#68 = 0.0310"
#69 = 0.0292"	#70 = 0.0280"	#71 = 0.0260"	#72 = 0.0250"
#73 = 0.0240"	#74 = 0.0225"	#75 = 0.0210"	#76 = 0.0200"

STROMBERG MAIN JETS: A special jet wrench is required to remove or install the main jets. Main metering jets are numbered according to the diameter of the metering orifice. Thus a #45 jet has a 0.045" diameter hole.

STROMBERG JET TUNING: Starting point for tuning a single Stromberg carb: Decrease main jets 1 number for each 2000' in altitude (example: from #45 to #43 for 97's at 4000'-5999' elevation). Increase power valves 1 number for each 2000' in altitude (example: from #65 to #67 for 97's at 4000'-5999' elevation).

Starting points for tuning dual Strombergs: Decrease main jets 2 to start. Then decrease main jets 1 size for each 2000' in altitude. Increase power valves 2 numbers to start. Then increase power valves 1 number for each 2000' altitude.

Starting point for tuning triple Strombergs with progressive linkage: Center carb is sized the same as a single carb. The end carbs are sized the same as dual carbs.

WITHOUT THE USE OF ANY PROGRESSIVE LINKAGE FOR 3 OR 4 CARBS: At sea level. Three carbs start with #43 main jets and #67 power valves. Four carbs start with #42 main jets and #68 power valves.

STROMBERG IDLE MIXTURE SCREWS: These are physically different than the ones used in Ford/Holley carbs. They have a different taper and are not interchangeable with Ford idle mixture adjusting screws (although they will work fairly well). The Stromberg idle adjusting screw's taper extends clear to the threads (the Ford needle taper stops short of the threads).

SETTING STROMBERG FLOAT LEVELS: Dry setting (dry float bowl) is 5/16" from the carb's main bowl gasket surface to the top of the float. This is used when overhauling a carb to initially start and set the idle mixture and rpm.

Wet setting. This sets the gas level correctly by adjusting the float. With the engine idling smoothly, the wet setting is 15/32" (± 1/32") from the top of fuel bowl casting (no gasket) to the gas surface itself. This requires removing the top of the carb and, with the engine running, adjusting the float to the correct gas level. This is dangerous because gas continually spews out around the needle seat assembly and onto the hot engine or near the sparking generator commutator. This provides an excellent opportunity for one to show off their fire extinguisher and fire fighting skills to ones buddies. However, if you have an electric fuel pump you can set them with little fear of fire. You'll need a rubber squeeze bulb to suck out gas. Don't run the engine. Use the electric fuel pump to fill the carb bowls until the float shuts off the incoming gas. Shut off the pump. Measure the level of gasoline and make adjustments to the floats by bending their tangs. When the floats are disturbed, the needles come off their seats which spews more gas into their bowls. Since the level of gas decreases greatly, gasoline will have to be sucked out (use the squeeze bulb) to permit the floats to drop about half way down. Then turn the pump on and refill them until the floats shut off the gas (use the electric pump). Re-measure the gas level. Repeat until you're satisfied both floats are adjusted correctly. **Don't forget to allow 1/16" for capillary attraction.**

STROMBERG ACCELERATOR PUMP CHECK BALL: Behind the center plug in the front portion of the main bowl is a small accelerator pump discharge check valve. This consists of a ball bearing crimped in a removable jet. It seldom sticks and can be checked by shaking it. If stuck, bend the crimp open and push the ball out from the opposite end using a small nail… or just replace it.

STROMBERG THROTTLE PLATES: These have either a slash or half moon stamped on them. Throttle plates are to be installed with their mark down and towards the idle screws.

STROMBERG EMULSION TUBES: Behind the outer two plugs in the front of the main fuel bowl casting are the main jets. Behind the main jets are the emulsion tubes. The main jets have to be removed to get to them. The emulsion tubes extend from the main metering jet to the venturis. These small brass tubes have a series of small holes in their upper regions which may become plugged with varnish and sludge. This will cause poor performance and excessive fuel consumption. The upper tube ends are angled (baloney cut) and extend into the venturies. Sometimes these will come out by pushing them downward.... do not tap on their angle cut as this will ruin the tubes. Removing stuck emulsion tubes is done by tapping threads on the inside of the emulsion tube bottom with a #**6/32** tap. Gently turn the tap in about 4 full turns. A 1½" long #**6/32** screw with a nut and flat washer makes a dandy puller. With the washer positioned against the carb casting, thread the screw into the emulsion tube's threads you just made. Finger tight is plenty tight. Position the flat washer up against the casting and run the nut flush up against the washer. Turn the nut as if to tighten it. This pulls the emulsion tube out easily. This little puller has never failed to remove an emulsion tube for me. Once they're out, clean their outsides with fine steel wool. Then clean the varnish etc. from the tiny holes using a wire or a drill bit with a ** 0.041" diameter (a #59 numbered drill). Use only your fingers to turn the drill bit. Reinstall the emulsion tubes gently by pushing them in with a flat drift punch. Re-install the main jets. CAUTION: Do not tighten main jets excessively. This will cause the jets to crush the emulsion tubes and ruin them. Snug is all that's needed. Should an emulsion tube be crushed, or the tiny holes be crimped shut, it will cause poor performance and excessive fuel consumption. Replacement is the only cure for a deformed emulsion tube. **(From rodnut on 1/30/03. He uses a drill that's 0.040" in diameter..... a #60 numbered drill...... to clean the varnish from the tiny holes. He says a #59 drill is too big.)

REMOVING AND INSTALLING STROMBERGS WITHOUT LOSING MULTI-CARB SYNCHRONIZATION: Leave the throttle bases and linkage on the car by removing the three screws that hold the throttle casting to the main bowl casting. These are all accessible from above. Remove the choke assembly collared screw and the gas lines. Note which carb goes on which base. Lift off the carbs. After cleaning the carbs, just bolt them back to their same bases and reconnect the accelerator rods. Since you've not disturbed the throttle shafts or linkage, the synchronization is the same as before you removed them. Sure helps reduce the hassle when re-building.

************** FORD/HOLLEY/CHANDLER-GROVE **************

FORD CFM RATINGS: Ford/Holley/Chandler-Grove were introduced on Ford V8's beginning in late '38. These were continued in the Fords clear into the early OHV-V8's. The Lincoln/Mercs changed in '49.

Holley 92 (model #92) rated at 142 cfm. Venturi dia. is 0.875"
Holley 94 (model #59) rated at 155 cfm. Venturi dia. is 0.938"
Holley 94 (model #8BA) rated at 162 cfm. Venturi dia. is 0.938"
Holley (Model #ECG) rated at 185 cfm. Venturi dia. is 1.062"

FLOAT SPECIFICATIONS: The dry float level settings for '38-'53 Ford and '39-'48 Lincoln/Merc carbs is 1-11/32" without a gasket. The distance to the gasoline is 11/16" without a gasket. All measurements are ± 1/32".
Lincoln/Mercs carbs, beginning in '49, is 1-5/16" without a gasket. The distance to the gasoline is 5/8" without a gasket. All measurements are ± 1/32".

FORD/CHANDLER GROVE/HOLLEY CIRCUITS: The idle discharge circuit operates from idle to 25 mph. The main jet circuit operates from ** 25 mph to 60 mph. Above 60 mph the power valve works in conjunction with the main jets.
** Remember the power valve becomes operational whenever the vacuum becomes less than the vacuum rating of the power valve. Rear end ratio and tire size affect the operational boundaries of the various carburetor circuits. Remember more than a single circuit is used at times depending on engine demands.
These carbs are extremely simple to work on and rebuild. No special tools are required. About the only problem one might encounter is the accelerator check ball may be stuck. This tiny check ball (about a 1/16" ball bearing) is located in the bottom of the accelerator pump well. It's held in place by a circular expansion spring. Removing the spring will usually permit the ball to fall into your hand when the carb is inverted. If it's stuck, and they do become stuck, turn it upside down on a work bench and tap on the bottom of the carb casting. If it won't come out, soak it in P-Blaster penetrant and try it again. **If you can't get it, drill a 3/32 hole up from the bottom to tap it out. Use a small fishing lead sinker to plug the hole by using a hammer and a drift punch. Then cover it with JB Weld. Let sit over night before using. I've never had one leak.**

JETTING FORD CARBURETORS: **Main jets are sized according to their diameter. Thus a #41 is 0.041" in diameter. The newer Holly main jets fit our old Ford carbs and are carried by various speed shops and automotive stores.**

Starting point for tuning a <u>single</u> Ford carb: Decrease main jets 1 size for every 2000' of altitude (Example: Change from #50 to #48 if the car's home is in the 4000'-5999' elevation range).

Starting points for tuning <u>dual</u> Ford carbs: Decrease main jets 2 sizes to start then decrease one more size for every 2000' in altitude. (Example: Starting with stock size, or #50 main jet, reduce 2 sizes and then 3 more for if the car's home is in the 6000'-7900' elevation range).

Starting point for tuning <u>triple</u> Ford carbs using progressive linkage: Center carb is sized the same as a single Ford carb. The end carbs are sized the same as dual carbs.

Note that these are starting points only and fine tuning should follow.

WITHOUT THE USE OF ANY PROGRESSIVE LINKAGE FOR 3 OR 4 CARBS: At sea level. Three carbs start with #43 main jets and #67 power valves. Four carbs start with #42 main jets and #68 power valves.

CHECKING FOR MAIN JET SIZE: This is an olde timey method of checking to see if the main jet is too big or too small. Hook up a vacuum gauge to the intake manifold (not the carburetor). Adjust the idle jets so the engine is running smooth as possible. Bring up the engine rpm to 1250 rpms and use a spacer between the idle stop and the throttle linkage to hold the rpms steady.

If leaning the idle mixture screws INcreases the vacuum reading, the main jets are too large. If richening the idle mixture screws INcreases the vacuum reading, the main jets are too small.

REMOVING THE CARBURETOR CASTINGS WITHOUT ALTERING SYNCHRONIZATION: The main body and air horn castings ON Ford carburetors can be easily removed to rebuild the carb's main and air horn bodies without removing the throttle body casting (base). If a throttle body casting is disturbed in anyway, you'll lose the multi-carb synchronization.... and you'll have to re-sync them again. It saves a lot of hassle if you leave the throttle castings and linkage in place and simply remove the upper two castings as one piece.

Remove the gas line and the accelerator pump link. Remove the two screws securing the main casting to the throttle base casting. These are accessible from the top. The slotted screw is not since it's slot faces downward. Use a pair of pliers to remove the slotted screw. Then match the size, threads, and length of the screw to a hex headed bolt. This is used as a replacement for the slotted screw. Remember it's very easy to over tighten the hex headed bolt and strip the threads in the relatively soft carb casting. Snug is all that's needed. Now the main castings of the carb(s) are in your hand and the carb can now be rebuilt or have it's power valve worked on. When you reinstall the carbs on their respective throttle bases, the throttle linkage is still synchronized and you won't have to mess with it.

******************** SYNCHRONIZING CARBS ********************

CENTERING THROTTLE PLATES ON ALL CARBS: Sticking throttle plates make driving multi-carbs unpleasant to say the least. Every time you start out, the plates stick and you have to increase the accelerator pedal to overcome this sticking..... which results in way too much throttle opening and jerks the car (or burns rubber when you're next to a cop). Stromberg carbs seem to have better throttle bores and plates than the Ford carbs and are another reason I prefer them. Most Ford carbs have to have their plates removed and carefully fitted before they cease sticking, whereas Strombergs seldom do.

With the carb off the engine, separate the main body from the throttle body casting. Loosen the idle speed adjusting screw. Close the throttle tightly and hold it shut. Hold the throttle base up to a light source. There should not be any light showing around the throttle plates. If so, loosen the tiny soft brass screws which hold the throttle plates to the throttle shaft. Loosening usually takes only a turn at the most. CAUTION: These are usually staked and are easily broken while trying to loosen them. If they won't loosen easily, try grinding off the sides of the stakes, or squeezing them with pliers.

Once they're loose, hold the throttle tightly shut and tap both ends of the throttle shaft several times. This will center the plates in the throttle bore. Open and shut the throttle several times also helps. Continue holding it closed tightly while you snug down the throttle plate screws. Re-check for light showing around the closed throttle plates. If you can't get them to seal shut, the plates will have to be removed and hand fitted using jeweler files and/or #400 wet/dry sand paper or crocus cloth. This takes a little patience. Throttle plates MUST operate freely and not stick when coming off idle, but must seal tight when shut. When satisfied with their fit, stake the tiny screws or use some green Loctite to keep them from being ingested into the engine (they don't compress worth a hoot!).

USING A SYNCHRONIZER: **I changed from using a Uni-Syn to "Synchometer" carburetor flow meter. I've found the "Synchometer" is something like 10% more accurate than the Uni-Syn. These were posted on the Ford Barn and I neglected to get their name. Sorry. J.C. Whitney has them.**

USING A LENGTH OF HOSE: Before carburetor synchronizers appeared, I used a short length of heater hose as a poor-man's stethoscope. It works, but does take time. I always adjust the idle mixture screws out 1½ turns on each carb at the get-go. Loosen the screws squeezing the arms to the throttle shafts so the throttle shafts can be moved without disturbing moving the arm. Hold one end of a 12" section of heater hose against an ear and move the other end back and forth between the carbs listening to their hiss. The object is to get the carbs to have EXACTLY identical hisses. Keep a slight tension on the throttle shafts of all the carburetors (temporary springs or rubber bands help) and adjust the idle rpm screws until the carbs have identical hisses and are at the desired idle speed. Tighten the screws holding the arms to the throttle shafts. Re-check the hissing to make sure nothing has changed. Please note this will not cure sticking throttle plates and the resultant stick/surge coming off idle. Multi carb installations MUST have the throttle plates centered to eliminate a sticking throttle.

Return to Home Index

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

************** HEADS **************

Revised April 30, 2009

TORQUE SPECIFICATIONS ARE LISTED IN THE SPECIFICATION SECTION.

TORQUING HEADS: Use #8 hardness flat washers with oil on both sides when installing aluminum heads to protect the heads as well as increasing torque accuracy. I use them on cast iron head also.

On cap screws, coat threads with a thread sealant (like **Permatex Thread Sealant #5925)** to prevent coolant from seeping up the threads and to deter future seizing. Lightly oil the underside of the heads of the cap screws to increase torque accuracy.

On studs, lightly oil the fine threads and the underside of the head nuts as well as the washers. This will increase torque accuracy.

Initial installation of heads should be torqued in 3 incremental stages (20 ft/lbs, 40 ft/lbs, and final torque). Follow the torque sequence as shown below on 24 stud heads **and 21 stud heads.**

First time engine start up: run engine to operating temp. Shut down and allow to cool to room temp. (Tip: Remove the radiator cap to increase cooling rate) Retorque the heads after it's cool to the touch. I usually let them set overnight.

Then warm engine a second time and repeat the heating, cool off, and retorque drill. (I like to do this three times, but I'm some kind of nut.... at least Billy says I am!)

Run the engine 200 miles and retorque them again after it cools.

Re-torque at 200 mile intervals until they take a set (none are less than the torque value).

Thereafter, re-torque at 6 month intervals.

HEAD TORQUE SEQUENCE ON 24 STUD ENGINES:

20			11		3			4		12			21	
19						1								22
			10							13				
18						2								23
		9										14		
17	8			7	6		5		15		16		24	

HEAD TORQUE SEQUENCE ON 21 STUD ENGINES:

	18		14		4		5		15	19	
12			6			2			7		13
16			8			1			9		17
		20		10		3		11		21	

COMBUSTION CHAMBER CAPACITY. Ford made some pairs of heads with different combustion chamber volumes specifically for the left and right banks. This is also true for some, but not all, brands of after-market heads. IMO this was done to compensate for the different distances between the valves and pistons on the two banks.

This is the result of the angles of the center line of the valves in relationship to the center of the camshaft and block (the two banks of valves are located 49½ and 52 degrees from the center of the cam and block and the 52 degrees is on the left side. [[[[[The center line of the crankshaft is offset to the right side 0.265" from the center of the engine. However, the center line of the camshaft is in line with the center of the engine. This all boils down to different measurements between the valves and pistons on each bank. This positions the valves a little closer to the cylinders on the left bank).]]]]]

Keep in mind Ford tried many different head configurations on production engines over the years. Measuring is the only sure way to determine what volume your particular heads have.

The 81T heads (24 stud) were cast iron and have right and left heads. They were rated at 5.9:1 compression ratio (C/R). Their combustion chambers have 83cc in the right head (part #6049) and 85cc in the left head (part #6050).

The 81AS heads (24 stud) were cast iron and have right and left heads. They were rated at 7.5:1 C/R. Their combustion chambers have 60cc in the right head (part #6049) and 62cc in the left head (part #6050).

The 81A heads (24 stud) came in either aluminum or cast iron. Both were rated the same at 6.2:1 C/R. Both have right and left heads. The aluminum heads have combustion chambers of 82cc for the right head (part #6049) and 84cc for the left head (part #6050). The cast iron heads have combustion chambers of 79cc for the right head (part #6049) and 81cc for the left head (part #6050). Interesting.... same C/R with different cc's.... wonder if flat top versus semi-dome pistons account for the variation?

99AS heads (24 stud) were cast iron and have right and left heads. They were rated at 7.1:1 C/R. The right head (part #6049) had a combustion chamber volume of 65cc and the left head (part #6050) had 67cc.

99T heads (24 stud) were cast iron and have right and left heads. They were rated at 5.5:1 C/R. The right head (part #6049) had a combustion chamber volume of 90cc and the left head (part #6050) had 92cc.

The 59 series heads (24 stud) do not have different heads for right and left banks as far as I know. The spec's I've seen show only one cc measurement..... one size fits all?

Stock heads are usually marked 6050 (or L) for the left head and 6049 (or R) for the right head. But I've seen heads with neither numbers nor letters. The sure fire method is to measure the volume of the combustion chambers in both heads. A quickie method I use (I'm lazy) is to simply compare the depth of the recession for an intake valve in both heads. They'll be different if there is a right and left head. The head with the deepest measurement will have the larger cc combustion chamber and is the driver's side or left head.

One added opinion. There are those who don't use finned aluminum heads saying stock heads will outperform them. If this is true, then my question is why have over 99% of all records set by flatheads over the years used finned aluminum heads? Surely the owners didn't spend their hard earned money to go slower. Just one of my dumb thoughts.

OFFENHAUSER #425 AND EDELBROCK HEADS: I've tried both on my present 59 series flathead. I prefer the Edelbrocks..... even though the majority of go-fasters prefer Offenhauser. The set of Offy #425 heads I had on my flathead had the same combustion chamber capacity in both heads..... no right or left head as far as I could ever determine. But my Edelbrock heads came with unequal capacities (like many stock Ford heads). I checked them over thoroughly but never found any mark to indicate which bank the head's were designed for. There wasn't any literature in either shipping box either. I checked the combustion chamber volume in both Edelbrock heads and then measured the depth of the recession for an intake valve in both heads. As expected, the head that measures approximately 0.030" deeper had the larger cc combustion chamber. The larger cc head is for the left side of the engine (driver's side). Both brands of heads had identical plug thread depth (9/16"). I recessed the plug seats 0.072" on both brands of heads to get 1/2" reach plugs flush with the bottom plug thread. This lowered the plug's ground electrode down into the combustion chambers. The ground electrodes of 1/2" reach plugs would be smashed whenever the engine was twisted tighter than 4000 rpm (this may be mostly due to the block surfaces being decked and milling the heads to get everything as flat as possible). This was true with both the Offy's and Edelbrocks. Eventually, I went back to 7/16" reach plugs to keep from shutting down the plug gaps and/or destroying plugs (interesting.... both brands of heads recommend Champion H-10 plugs with a 7/16" reach despite their plug hole depth of about 9/16".... go figure). The 7/16" reach plugs left two threads in the heads (don't forget I had spot faced them 0.072") exposed to combustion flames and heat. I ground these two threads away to prevent possible hot spots for pre-ignition. The Edelbrock's were purchased new a few years ago and came with heli-coils in all spark plug holes. The Offy heads didn't have spark plug heli-coils**.... (From rodnut on 1/30/03.... He says all Edelbrock heads he sees do not have factory heli-coils in the plugs.** Both brands of heads had the same C/R from the factory. Neither came with smooth or polished combustion chambers.

REWORKING COMBUSTION CHAMBERS: Going through some antiquated notes from early flathead racing days, I came across the reasoning, dimensions, etc. we used to alter combustion chambers for our souped up engines. There were two sets of dimensions and figures..... one for street and one for track. This was done on street engines to lower the compression ratio (C/R) to run other than premium gas (at the time, leaded premium was $0.24 per gallon and leaded regular was $0.22 a gallon!) and to decrease engine heat. But it was primarily done for because it made a noticeable change in performance. I altered my present Edelbrock's using the old notes with a couple of slight modifications. This was done mainly to lower my engine's compression ratio (C/R) from 10.4:1 down to a reasonable level. However, I hoped to increase low-end response and increase upper rpm performance along the way. Quite an order. On my present engine.... boring to 3-3/8", stroking to 4", decking the block 0.006", and milling 0.025" off the Edelbrock heads raised the C/R to 10.4:1. With premium gasoline it would ping hard under even moderate loads at any elevation. I had to add considerable octane boost to each tank of premium no-lead gas and retard the timing even at 5000'. At sea level, I had to double the octane boost additive (expensive) and still had to back the timing off to 1 degree BTDC to keep the mill from cratering itself.

I use a carbide cutter and a die grinder. The grooves in the cutter are dug into a wax candle frequently to keep aluminum grindings from clogging the cutters. It's no fun picking out the tightly packed aluminum that's been forced into the cutting grooves. I laid a used head gasket on the head surface (notice the gasket extends over into the combustion chamber and forms a "cave" back under the gasket when bolted down) to outline each combustion chamber using a felt tip pen. Removing all felt tip pen ink lines defines the limits of grinding to be done. By grinding to these limits I will eliminate the existing pocket that's formed between the head and the block and going back to the edge of the recessed gasket **. This will, hopefully, increase combustion chamber capacity and improve intake and exhaust flow. I want a smooth combustion chamber and to eliminate anything that could possibly lead to pre-ignition or detonation. After grinding all of the areas back to, and including, the felt tip pen lines, the edges of the gasket will be exactly even with the combustion chamber (getting rid of the "cave")...... which should improve combustion efficiency in addition to lowering the C/R.

<u>From rodnut on 1/30/03. and I quote... "I don't necessarily agree with this. If you study a Ford head, especially the low C/R heads, this area is left, and this transfer passage is deepened where it enters the cylinder area. The "neck" formed by the sides of the transfer passage creates turbulence. To lower C/R and improve breathing, just continue this transfer passage into the cylinder area. Ford knew what they were doing."</u>**

I start grinding at the top of the valve pockets to un-shroud them and improve intake and exhaust flow. I grind away the aluminum head material over the valves through the felt tip pen markings (in the range of 0.040" width). Continued grinding away material down the sides of the valve pockets to the mid-point of the side of the valve. At this point I taper the grinding outward to the existing edge (at the "step") of the combustion chamber. The amount needed to be ground outward around the valve areas varies according to whether it's on the intake valve side or the exhaust valve side. In case your interested, past records show grinding the intake side is 0.120" and the exhaust side is 0.065".

The "step" up to the slight dome machined in the head is next to be ground on. My old notes say to eliminate the sharp vertical step (many think this reduced turbulence and flow) by grinding it to a gentle slope whose beginning edge of the slope is closer to the center of the dome. Measure 0.200" from the edge of the step and lay a straight edge across the head. Scribe a line across the four combustion chambers. This line marks the limits of grinding. Beginning at this line I grind towards the edge of the step. I grind progressively deeper as I get closer to the edge of the step to form the desired gentle ramp. This completely eliminates the sharp vertical step.

All that's left is to smooth any rough grind markings and polish the combustion chamber. The polishing helps reduce carbon build-up and is done with a small diameter scotch bright disc on a die grinder. Then I cc all the combustion chambers (using a chemical type burette) in one head and do additional grinding to make all the combustion chambers in the one head <u>EXACTLY</u> the same. Then the same is done for the other head. Remember the right head combustion chambers are to have less cc's (3 cc) than the left head. After grinding, they were 66.0 cc in the left head and 63.0 cc in the right head. As stated earlier, the C/R in my engine was 10.4:1 before grinding. After grinding it's 9.4:1 as near as I can tell (the semi-dome pistons complicate calculating the new C/R by my simple geezer mind). I think this is about the maximum for today's premium fuel and permits normal spark advances. It eliminated the need for octane boosters. Time to do this in aluminum heads is about 6-7 hours which includes cc'ing the heads.

<u>RESULTS:</u> This increased low end response a lot more than I remembered or hoped for. The engine wants to run and turns easier and quicker throughout its entire rpm range. The peak rpm increased some. Gas mileage was not affected as near as I can tell. The performance changes alone were worth every bit of work as far as I'm concerned.

Since then, I've done three other sets of aluminum heads. All of the owners say they're very impressed with the increased low end and mid- range response as well as overall increased performance. **<u>ADDITIONAL NOTE:</u>** **Red Hamilton, of Red's Headers, recommends increasing the space around the top and sides of the valves.**

especially the intake, to improve breathing. He also says removing 0.025" from around the tops of the valves and down the sides to the step will lower the C/R 0.6 points.

PREVENTING HEADS FROM STICKING TO STUDS: Heads sticking to studs is common and is one reason many will not use studs. This discussion talks about aluminum heads, but the same applies to cast iron heads. Aluminum heads seem to be the biggest problem. Both studs and cap screws go through thousands of heat/cool cycles which may cause them to warp. The studs come into contact with the sides of the bolt holes in the heads. Over time they seize to the head which makes it extremely difficult, if not impossible, to remove an aluminum head without destroying it. IMPORTANT: Aluminum heads are soft and will squish under the nuts (or bolts) and be squeezed against the stud. Many use ordinary flat washers to prevent this. But, the ordinary flat washers are so soft they'll squish in to the studs. These are a real bear to remove because they become threaded to the stud's threads and shank and are almost impossible to remove. Solution is to use either #8 or #9 hardness flat washers.

Something I do to reduce head/stud (or bolt) sticking is drill each head bolt hole 1/64" larger in diameter. I've never had any problem with heads sticking to studs since I began this practice. For those who don't want to drill their heads: Try wiping some anti-seize on both on the stud shoulders and inside the head's bolt holes. This gives fairly good results.

HEAD GASKETS: Stock head gaskets can be used for bores up to and including 3-5/16". Anything bigger should use "big-bore" gaskets since the edges of a stock gasket overlap into the bigger bore cylinder area (not a good idea since they shore don't seem to compress wuf a hoot). Stock gaskets are normally fiber with a ring of metal crimped around the cooling holes and cylinders. Big-bore gaskets are **now available in both graphite and copper. I use only copper/asbestos sandwich type gaskets on flatheads no matter what the bore is.** Copper crush gaskets have a crushed thickness of 0.050".

BLOWN HEAD GASKETS: If you're having problems blowing head gaskets, you might want to try something the stock car guys do. They coat both sides of the head gaskets with Permatex Ultra-Blue Silicon. The Ultra-Blue has more silicon than regular blue gasket maker. This permits head movement during the frequent expansion and contraction of the head and block. Just smear a thin skim over both sides of the gasket. Install the head as soon as possible... don't wait for the stuff to "skim". I do this to the copper head gaskets on my flathead as a matter of course. The stock car guys also do this when re-using a head gasket. I've tried re-using head gaskets (copper big-bore head gaskets cost about $35 each!) a few times with Ultra-Blue with good results.

ANTI-SEIZE COMPOUND: Always put anti-seize compound on any spark plug or fitting that threads into aluminum, copper, or brass. Especially true when using cad plated spark plugs (Champion for instance) in aluminum heads. These will seize very quickly without anti-seize (cad plating and aluminum are dissimilar metals and form electrolysis). It doesn't take very long until the plug and the aluminum head becomes one piece... or seem to. Then when you remove the plug, the plug threads come out with the plugs..... and you get to show your heli-coil installation skills. Simpler to use anti-seize to prevent problems and prolong the life of the heads considerably. This stuff is available from any parts store for a couple of bucks.

INSTALLING GENERATOR MOUNTS & OIL FILTERS ON FINNED HEADS: These can be a real chore to install without ruining or grinding off some fins. I use coupling nuts and studs. If you're running cap screws instead of studs, I recommend using studs where the generator or oil filter will sit.

Let's assume there are 3 mounting holes on the generator mounting bracket or oil filter. Replace the three cap screws with three studs. These don't have to be turned down much..... just snug will do just fine. Most times you can locate 3 old FH studs which have about two inches of fine threads. Cut the studs to used just the threaded ends. If you can't find long enough threads, use studs and extend the fine threads by using a die on them. Place a grade 8 flat washer on each stud to protect the aluminum head. Install 3 coupling type nuts (they're over twice as deep as a head nut) and torque them down. Install the cut studs in the top of coupling nuts. Put on grade 8 flat washers followed by the generator mount and then follow with grade 8 flat washers. Install 11/16" head nuts and tighten down. The 11/16" head nuts don't have to be torqued down. The coupling nuts tolerate 60 ft/lbs of torque even though they're only a grade 5. They take a 5/8" socket so there is plenty of room between the nuts and the fins. Makes for a neat and simple installation.

DETERMINING COMPRESSION RATIO: The method I've used is a formula using cubic centimeters (cc):

$$\textbf{Comp. Ratio} = \frac{V_1 + V_2}{V_2}$$

Where V_1 is the displacement of one cylinder in cc's.
And V_2 is the space in the combustion chamber in cc's.
And one cubic inch equals 16.387 cc
(Note: The dome on the top of a semi-dome piston has a volume of 5.66cc. This is a stock bore and semi-dome.)

COMPRESSION RATIOS: For non-relieved blocks. The following is from Offenhauser and are their head identification numbers. These identification numbers indicate the depth of the valve recessions in the heads combustion chamber.

BORE	STROKE	DISPLACEMENT	#425	#400	#375	#350	#325
3-1/16	3-3/4	220.92	7.1	7.6	7.9	8.5	9.2
3-1/16	3-7/8	228.28	7.2	7.7	8.2	8.8	9.5
3/1/16	4	235.648	7.4	7.9	8.4	9.0	9.8
3-3/16	3-3/4	239.312	7.4	7.9	8.5	9.2	9.9
3-3/16	3-7/8	247.288	7.7	8.2	8.8	9.4	10.2
3-3/16	4	255.272	8.0	8.5	9.0	9.7	10.5
3-3/16	4-1/8	263.24	8.2	8.7	9.3	9.9	10.8
3-5/16	3-3/4	258.48	8.1	8.6	9.1	9.8	10.6
3-5/16	3-7/8	267.096	8.3	8.8	9.4	10.1	10.9
3-5/16	4	275.712	8.6	9.1	9.7	10.4	11.3
3-5/16	4-1/8	284.328	8.8	9.3	9.9	10.7	11.6
3-3/8	3-3/4	268.376	8.3	8.8	9.4	10.1	10.9
3-3/8	3-7/8	277.328	8.6	9.1	9.7	10.4	11.3
3-3/8	4	286.272	8.9	9.4	10.0	10.7	11.6
3-3/8	4-1/8	295.20	9.1	9.6	10.3	11.1	11.9

HEAD FLOW RATES:

HEAD MFG.	DEPTH OF VALVE POCKET	FLOW RATE
**stock Ford	?	86.6
Offy #375	0.375"	84.0
Offy #425	0.425"	86.0
Edelbrock	0.375"	80.3
Navarro	0.450"	88.2
Kong	?	81.9
Baron Street	0.500"	90.3
Sharp	0.420"	82.9
Motor City	0.570"	92.4

**Stock heads after engine modifications of: 0.375" cam lift, 1.72" diameter intakes valves, 1.5" diameter exhaust valves, race “D” ports, 1/8" relieved, but with no pop-up or high-domed pistons. (I don’t know what number heads were used.)

COMPRESSION RATIO CHANGE WHEN RELIEVING BLOCK: Edelbrock literature says factory relief decreases compression ratio ½ point.

COMPRESSION INCREASE WHEN STROKING CRANKSHAFTS: Edelbrock literature states the compression ratio on a flathead increases 0.3 of a point per 1/8" stroke increase.

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

************ IGNITIONS ************

Revised March 11, 2009

Flathead engines do not require as much initial advance as OHV engines. The flathead's incoming fuel/air mixture has considerably more turbulence than an OHV due to the many turns and sharp bends the fuel/air mixture makes getting into the combustion area. Consequently the mixture ignites easier and burns faster and more uniformly than an OHV.

************* SPARK PLUGS **************

NEW PLUGS FOUL AND MISFIRE: Plugs are a continuing problem with our flatheads. It's not uncommon to put in new plugs and have them foul the within a few days. It used to be a set of plugs would last for years. We'd clean them by scraping the carbon off the porcelain and down into the plug well. If we knew someone who had a spark plug cleaner, we'd get them to sand blast the plugs. The plugs would then be almost as good as new.

Not anymore. It's quite common to put a set of new plugs in and start a cold engine and let it warm up with the choke pulled out enough to slightly bring-up the rpms. After a few short trips, the plugs begin mis-firing. No matter what you do (including winding your mill out until the engine is about to sweat oil) they continue to mis-fire. Sand blasting in a plug cleaner often only helps short term.

Champion H-10 plugs were the ones Ford used in his engines beginning in the mid-thirties. But this plug no longer lasts like they used to (what does?). I don't know whether it's the gasoline we get or the plugs are poorer or both, but whatever it is, it sure is tough on plugs.

What many of us have done is to change brands along with plug heat ranges in an effort to find a cure. See chart below for the most often used plugs as reported by members of the www.flatheadv8.org/phpBB/ and FordBarn

Champion	**Motorcraft**	**Autolite**	**NGK**
***H-8**	**AL5**	**215**	**B6L**
***H-9**	**AL7C**	**216**	**---**
H-10 (844)	**AL9**	**497**	**B4L**
***H-11 (512)**	**AL11**	**218**	**---**

Good luck on finding these heat ranges in Champion.

OIL FOULING PLUGS: For ANY stroke engine. Ever had an engine that oil fouled the plugs? Often times your intentions are to rebuild it, but just don't have time right now. Or you've broken rings on a trip and just need to nurse it back home. Here's a trick I learned going round and round in circles in Texas back in the early fifties. At that time, flatheads ruled even though they all loaded up their right bank's plugs because of oil flooding the cylinder walls in the corners. We all ran plugs that were as hot as we could find………usually 3 to 4 steps hotter on the right bank, but still have problems coming off the corners.

The pistons on the right bank were taking a beating on the long straightaways on ½ mile tracks from the increased heat (oil burns hotter than gas).

Then a really sharp old timey mechanic I worked with showed me a neat trick. After performing his simple modification, the plugs wouldn't foul no matter what was done to them! He showed me on a plug tester a new plug would break down at the very best less than 140 psi. Any one of his modified plugs would fire well past 200 psi (which is all the air pressure we had)! And they'd fire soaked in oil, water, gas or any combination thereof!

The plug doesn't need to be new..... just as long as it'll fire under compression (a tester will show a blue spark if it's good). I don't even bother cleaning them. Heat range doesn't matter either. The ground electrode is the one we'll be messing with. Cut this back far enough so it clears the center electrode and can be bent down to aim right at the side of the center electrode. I use a hacksaw to cut the ground electrode, but diagonal cutters and a file have worked in a pinch several times. Bend the ground electrode so it faces <u>directly</u> at the <u>side</u> of the center electrode. Just be sure there is a gap of about 0.020" or so minimum. That's all there is to it. A drawback is it's relatively short life. As the electricity arcs, it eats away the ground electrode until the gap gets too wide for the spark to jump. Usually 0.075" or so. Then the plug is junk. The plugs usually last a couple thousand miles on the street before the gap gets too wide to fire.

Story time again: The first time I tried these plugs at the Corpus Christi, Texas ¼ mile asphalt race track, I used a mix of H-10, H-11, and H-12 plugs only because they happened to be in the handful of plugs I grabbed out of the trash barrel. At the track, the other racers wanted to know why the different heat ranges. Seems they'd noticed right away that our engine wasn't blubbering like theirs in and off the banked turns. All of theirs used half of the straightaway before they would clean out. Ours was crisp whenever it was punched. I told them the cylinders had gotten all screwed up and we had to use different heat ranges just to get it to run at all (first liar doesn't have a chance bench racing). Then each week I'd mix the plugs and put them in different cylinders. I even mixed in some AC, Autolite, Lodge, with the Champion plugs every week or so. Then I'd switch them around to different cylinders. Sure had them going. I was very careful when I had to pull a plug at the track. They didn't find out about the cut plugs until near the end of the next season!

INCREASING PLUG GAP: Increasing gap from 0.025" to 0.045" will slightly increase low end engine torque.

DECREASING PLUG GAP: Decreasing gap from 0.025" to 0.020" will slightly increase upper rpm's.

*********************** STOCK DISTRIBUTORS ***********************

EARLY MODEL FRONT MOUNTED DISTRIBUTORS: All of the '48 and older Ford distributors are removed from the engine whenever work is required.... even something as simple as adjusting their points. The distributors are identified by their case (model number). Model 40A was used on '34 Fords. Model 40B was used on '35 Fords. Model 68 was introduced on '36 through '41 Fords. They did make a major internal change beginning in '37 and through '48. A different breaker plate was introduced in '37 to provide more advance with resultant increased performance. Previous to '37, the advance was 15 through 17 degrees. In '37 the new breaker plate increased advance to 21-24 degrees and is usually referred to as an 11A breaker plate. Distributor case identification numbers were changed in '42 to 21A and again in '46 to 59A.

The model 68 distributor is often referred to as the helmet type because of it's appearance. All point adjusting is done through the two side distributor cap openings.... which is a pain at times. The model 68 breaker plate assembly was used thru '36. Spec's are 15-17 degrees mechanical advance at 3000 rpm. Initial advance spec was 4 degrees BTDC (Before Top Dead Center). If setting points using a feeler gauge, set new points at 0.015" and used points at 0.013". Condensers are being repo'd in the USA for these distributors. The plug wires are bent and trained around the inside of the two caps to get to their correct terminal. Then the caps are assembled. Hopefully, the plug wires stay plugged in, but it's impossible to verify because of the design. If they didn't you'll have a miss and you'll get to take it apart again. Now isn't that special? Should a rotor or points fail, the distributor has to be removed and taken apart.

From '37 thru '41, this same helmet type design was continued except it now used the new 11A breaker plate assembly. Their identification number was changed to 11A. The new breaker plate assembly has a much better ignition curve with more advance and is preferred by most tuners over a model 68. Point adjusting is still done through the side openings. Spec's for these breaker plates are 21-24 degrees mechanical advance at 3450 rpm. Initial advance specification remains at 4 degrees BTDC. If setting points using a feeler gauge, set new points at 0.015" and used points at 0.013". The plug wires in the caps have the same problems as the Model 68 distributors. Like the Model 68, if the points or rotor fail the distributor has to be removed and torn down.

In '42, Ford changed the distributor housing design and used an identification number of 21A. It no longer used the same housing as the previous helmet models. Instead the housing is flat with the point adjustment/replacement completely exposed, and easier to work on, once the single front mounted distributor cap is removed. It used the same 11A breaker plate. However, the distributor cap is unique in that it resembles a crab.... hence it's nickname "crab distributor". The rotor is unique as well as are the distributor cap holding clips. This is the most widely used early Ford distributor since it's easy to change and adjust points. AND one can easily see and/or feel if the plug wires are snug in their distributor cap terminals. Spec's are the same as for all 11A breaker plates..... 21-24 degrees mechanical advance at 3450 rpm and 4 degrees BTDC initial advance. If setting points using a feeler gauge, set new points at 0.015" and used points at 0.013".

From '46 thru '48, Ford retained the exact same distributor as in '42, but changed the identification number to 59A. However, the cap, rotor, and the cap clips were changed for some reason or another (they returned to one of Ford's poorer ideas). The distributor cap has two "ears" at the top with a single hoop type cap clip. Each ear holds the wires from the ear's side of the engine. Spec's are the same as previous 11A breaker plates..... 21-24 degrees mechanical advance at 3450 rpm and 4 degrees BTDC initial advance. New points spec's are 0.015" and used points are 0.013".

'49 -'53 RIGHT SIDE DISTRIBUTORS: These use a balance between the carburetor venturi velocity and a coiled type tension spring to advance and retard the timing. Only carburetor venturi velocity is connected to the distributor.

Their design is such that only a single vacuum line from a single carburetor runs to the sealed diaphragm on the distributor housing. The diaphragm connects to the breaker plate by a short linkage. There are coiled tension springs are also connected to the breaker plate to resist vacuum force to retard the spark advance.

When the carburetor velocity exerts enough force to operate the diaphragm to overcome the spring tension, the diaphragm operates against the breaker plate and increases the timing. When the velocity is low enough so it cannot operate the diaphragm, the tension springs take over and retard the timing.

For those interested in increasing the rate of advance, replace the springs with some with less tension. Reducing the maximum amount of advance can be done by installing an eccentric washer on the breaker plate to limit the amount of plate travel. Such a washer should be located adjacent to the bottom of the condenser. NOTE: This was copied from one of the flathead sites on 12/6/2006. Over the years it's become crumpled and I was unable to see who submitted it. I apologize and hope he doesn't object to this valuable information being included in this paper. …rumble seat

DEGREES OF ADVANCE ON 11A DISTRIBUTOR PLATES: On 11A breaker plate distributors, the stock specification for the mechanical advance begins at 400 rpm. Keep this 400 rpm in mind when you're setting the timing with the engine running. Maximum total advance (initial plus centrifugal) is 24 degrees at 3000 rpm (including the 4 degrees initial advance). Remember these spec's are crankshaft degrees.

INITIAL ADVANCE SPEC'S: Ford spec's call for an initial (or static as it's sometimes called) advance of 4 degrees BTDC at idle (this would be less than 400 rpm since the mechanical advance begins working).

DIRECTION FOR ADVANCING TIMING: Initial advance of a distributor mounted directly to the front of the cam ('48 and earlier V8's) is done by rotating the plate lockdown screw the same direction as crankshaft rotation. Ford spec's state each mark on the early plates is 2 degrees. **The plate has a total of 7 marks spaced 1/16" apart.**

VACUUM ADVANCE: For '48 and earlier distributors. Engine vacuum operates a "brake" to limit the amount of advance generated by the centrifugal weights. When engine vacuum drops, the vacuum brake spring overcomes the vacuum which is holding the "brake" away from the rotating centrifugal advance mechanism. This spring pushes the brake against the centrifugal weight advance mechanism. As can be visualized, the stronger the spring, the sooner the brake is activated and the sooner the centrifugal advance mechanism stops any further advance. This effectively limits the amount of advance. This is adjusted by means of an adjusting screw and it's locking nut located in the distributor's tower. To increase the amount of advance, decrease the spring tension by unscrewing the adjusting screw. After setting the timing, any pinging (detonation) is eliminated by screwing this adjustment downward.

********************** MALLORY DISTRIBUTORS ******************

Initial advance on Mallory distributors for '48 and earlier V8's is done by rotating the distributor housing in the direction of crankshaft rotation. **There are two Mallory distributors for the 42-'48 Fords. The early, or old, ones are an inch thinner than the newer ones. If you're running a dedicated fan belt from**

the crank pulley to the fan pulley itself (like a '48 has), you'll have to use the older distributor since a new one will be in the way of the fan belt. The new ones stick out about one inch further than the old ones do.

MALLORY DUAL POINT DISTRIBUTOR: Mallory dual point distributors use the same distributor for both 6V or 12V. The only difference between a 6V and 12V point Mallory distributor is the coil's input voltage. The points and condensers are the same for both voltages.

MALLORY POINT SPEC'S: Set the point gap at 0.022" for each set of points. Of you using a distributor machine, set each set of points at 26 degrees with a total of 33 degrees.

MALLORY COIL: Mallory has dual voltage (12/6V) 40,000 volt coils, #29217. I've had no experience with these coils. Mallory does not list a 6V coil. I still use NOS 6V Mallory coils (voltage resistor not used). I get these from Bert's Model "A" Parts in Denver, CO @ 303-293-3673 for about $24, but their stock is running low.

MALLORY CONDENSER: Condensers are neither polarity nor voltage sensitive (same for both 6V and 12V). A Mallory Tech Advisor said to go to a condenser with 0.32mfd (micro farad) rating if you're going through a lot of condensers. Most point condensers are rated in the 0.24mfd range (ones for 1968 Chryslers with 318" V8 engines are rated at 0.32mfd).

Currently, Mallory condensers are rated at 0.26mfd. (Ford condensers for the 8BA work even though their rating is less..... rated from 0.21 to 0.25mfd).

The early Mallory brass shelled condensers are 1-1/16" diameter by 1-7/8" long. These are rated at 0.34mfd (they're stamped on the bottom). They also made one with an aluminum shell rated at 0.25mfd.

An interesting side note: I've noticed my flathead starts faster with a higher rated condenser, but it's harder on point life.

CONDENSER CAPACITANCE AND IT'S AFFECT ON POINTS: When changing to a condenser with a different mfd rating, expect to shorten point life because of increased pitting and burning. If the condenser has too little capacity, the grounded point will have a pit burned into it. If the condenser has too much capacity, the insulated half of the point will have a pit burned into it.

MALLORY PARTS: Stock Ford crab caps fit perfectly and are less money and last considerably longer. The same points were used in most early Chev dual point distributors so they're still around at swap meets from time to time. Condensers for **'49-'66** Ford point distributors work fine. Rotors for the early style (thin) distributors are unique. They have a large insulating disc to prevent shorting to the shaft. However, a rotor for the newer style (thick) Mallory distributors work after a few simple modifications. Measure the depth of the early rotor and grind off the excess of the newer rotor. Put the insulating disc off the early (thin) rotor on the modified newer (thick) rotor using some silicone.

MALLORY INITIAL ADVANCE SETTING: Mallory distributor on '48 and earlier engines. Position #1 piston at TDC (Top Dead Center). I file three marks at 11/64" intervals on the mating surface of the Mallory distributor and make a slot on the timing cover so the timing cover mark will line up with the bottom mark on the distributor's mating surface. The 11/16" spacing gives 4 degrees between each mark. Then lining up the top mark is TDC. Second mark is 4 degrees BTDC (Before Top Dead Center). The third mark is 8 degrees BTDC.

Most street flatheads seem to like something around 4 degrees initial advance. For an initial setting, rotate the distributor until the middle mark on the distributor is aligned with the timing gear mark. This is 4 degrees initial advance. To increase the advance, rotate the distributor in direction of crankshaft rotation. I fine tune the initial advance using the vacuum gauge method listed later on.

MALLORY DIST. SPRINGS: Their spring/advance kit comes with 9 springs: 1 Purple, 2 Pink, 2 Gray, 2 Brown, and 2 Orange.

The Mallory distributors for the 59 series (Mallory YH distributor) flathead come with 1 purple and 1 brown spring.

The purple spring is termed two stage because the slope of it’s advance curve changes about 1500 rpm. If a purple spring is not used, the distributor single stages and will have erratic performance at low RPM. Note that a single stage setup can have different colored springs, but NOT a purple one. The purple spring is loose when installed and it doesn’t become a primary factor until about 1500 RPM. Full advance should be no later than 3500 RPM for good top end power.

As stated earlier, Mallory delivered these YH distributors with a purple and brown spring. I retain the purple spring, but change the brown spring to an orange spring (for the 5000' altitude I live in). This starts advance about 200 RPM sooner (@800 RPM) and reaches maximum advance at a higher RPM than the purple/brown combination.

MALLORY ADVANCE LIMIT ADJUSTMENT: The number or degrees of centrifugal weight advance is adjusted by rotating the advance plate located under the breaker plate. You’ll have to remove the breaker plate to get to the centrifugal weight advance plate. Notice the adjustment plate has two elongated slots with a bent tab sticking upwards through each slot. Note these elongated slots are of different length. THIS IS VERY IMPORTANT. Position the distributor in a vise with the flat side (which indexes the rotor) facing you…… this is VERY IMPORTANT since it positions the two elongated slots correctly to adjust the advance. On ’48 and older front mounted distributors, the distributor shaft turns counter clockwise when looking at the rotor end of the distributor shaft. With this rotation, you set ONLY the left side. Note the right side’s elongated gap is longer than the left one.

Loosen the two screws (usually Torx head) which holds the adjusting and advance plates. When loose, they allow the plate to rotate to set the gap between the bent tab and the end of the elongated slot. This gap determines the amount of mechanical advance.

Various gaps and resultant degrees are:

0.144” gap results in 16 degrees

0.162” gap results in 18 degrees

0.181” gap results in 20 degrees

0.201” gap results in 22 degrees

If you don’t have a narrow feeler gauge to stack various feelers to arrive at the thickness needed, measure something else.. like an allen wrench. They’re usually pretty close. Just a suggestion. NOTE: This was taken from a Mallory tech sheet. I have tried to contact them several times to obtain their permission to use it, but never got any of my calls returned.

MALLORY 12V UNILITE DISTRIBUTORS AND VOLTAGE SPIKES : Mallory is aware of voltage spikes and their destruction of electronic parts. They have a filter (part #293521) to prevent these voltage spikes from getting into the electronics. An electronic whiz I know says the use of a wire high tension coil conductor on electronic distributors will injure/destroy most electronic ignitions.... use a carbon/graphite for the coil wire. This is what Petronix now says to use with their electronic distributors...... after I went through about a half dozen of these in a 12 month period! And no, I don't use electronic distributors. I want to be able to repair a distributor on the road rather than call for the local "Happy Hooker" tow trucker.

************************** **MISC. IGNITION** *************************

VOLTAGE RESISTORS: These consist of a winding of a high resistance (nichrome) wire wound around a porcelain type insulator. This reduces the incoming 6 Volts to between 3 to 4-1/2 Volts (early Ford literature states it's reduced to 4-1/2 Volts). The thinking at the time was this decreased voltage would increase the life of the distributor points by reducing arcing. And with the difficulty in replacing the distributor points in these front mounted distributors, it was a very good idea. But it required a special 4-1/2 Volt coil.

Bypassing, or removing, this resistor from the circuit overloads the internally wound primary circuit in the coil and causes premature coil failure. However, it's quite common to bypass these resistors when racing to increase the spark being delivered to the spark plugs. Because the car is moving (more air circulation around the coil) and combined with less idling, the coils were less prone to overheating and melting their tar insulation.

When the '49 was introduced, Ford discontinued the voltage resistor for their newly designed ignition system and began using coils rated at 6 Volts.

I'm sorry I don't have who submitted this to the FB site around Dec. 12, 2006. Please accept my apologies.

ELECTRONIC DISTRIBUTORS: I neither run nor recommend these since I experienced failures with several 6V Petronix units on my flathead in less than one year. Flathead Jack, in his new parts book, states he has carbon fiber core coil wires in stock that will protect electronic distributors (now I find out!). If you're running an electronic ignition, I'd sure investigate further into these. (Sure beats having the ignition crap out in the middle of rural Kansas on a Sunday morning in a 3.20" downpour...... been there 'n' done that in my roadster and no side curtains! And yes, I've been drier in the middle of a swimming pool!)

RADIO STATIC. There is an old time method used to reduce radio static in engines running '42 and newer distributors (coil is not mounted on the distributor). The high tension wire from the coil to the distributor cap is what we're concerned with. Tie an overhand knot (the first step in tying your shoes) in the wire, Pull it pretty tight and then use electrical tape to keep it from coming undone. Often times the wire must be replaced with a longer one. Then just plug it back in. Simple.

SETTING INITIAL TIMING USING A VACUUM GAUGE: I use this method on all 4 stroke engines (OHV and flathead). Vacuum varies with the amount of advance... nothing new here. Vacuum also varies from engine to engine even though they're manufactured by the same company. It'll vary as modifications are made and according to the condition of the engine and quality of gas. We can use this vacuum reading to set the initial timing quite accurately.

Connect a vacuum gauge to the intake manifold vacuum (not to the carburetor vacuum). Watch the vacuum reading and advance or retard the distributor to obtain the maximum vacuum reading. When it shows the maximum amount of vacuum, retard the distributor until vacuum drops 1" from the maximum reading. Tighten the adjusting screw. This is the maximum initial timing the particular engine and it's various engine modifications will tolerate. **On pre-48 distributors, I remove the fan belts so the fan and water pumps won't turn and slice off my hand while I'm turning the distributor. You have to work fast since it'll heat up in a minute or so.**

SETTING INITIAL TIMING ON 59AB AND EARLIER DISTRIBUTORS USING A STRAIGHT EDGE: The following works, but it's a mite confusing until a person gets the hang of it.

Mechanically setting a two hole Ford/Merc distributor. Remove the distributor's condenser. Set the point gap. Connect one lead of a battery powered test light to the terminal for the small coil wire. Ground the other lead of the test light to the distributor case. Measure 3/8" from the topmost edge of the driver's side distributor's mounting bolt hole to a straight edge held against the wide side of the distributor's drive offset tang. This should position the tang so it's at the 10:00-4:00 position with the wide side being closest to the coil wire terminal. Rotate the timing adjusting screw slightly until the test light just flickers without moving the distributor drive. The driver's side breaker points should just be breaking contact (starting to open). Remember, only the driver's side points control the timing. Back off the distributor drive (counterclockwise) and verify it is just breaking open when the tangs 3/8" measurement is reached. Adjust as necessary. This is 4 degrees BTDC. Always rotate the distributor drive clockwise as viewed facing the back of the distributor. (Told you it was confusing... or did I just make it that way?)

SETTING TIMING USING #1 CYLINDER: This is only if you've already established #1 piston's TDC. With #1 piston at TDC, remove #1 plug wire and position it so you'll be able to see a spark jump. I suggest you remove ALL of the plug wires since you'll have your hand in the fan area. Turn ignition key on. Watch for spark jump as you advance (move the advance plate in direction of crankshaft rotation) the distributor by moving the advance plate screw. When the spark jumps, it will then be timed to fire at TDC. On all '48 and earlier front mounted distributors, advance is always in the direction of crankshaft rotation. Ford spec's say each mark on the distributor plate is two degrees. Set advance at 4 degrees (two marks) initial advance.

DEGREES OF INITIAL ADVANCE: From JWL on 11/22/00. "Most modified flathead engines perform best with between 4 and 8 degrees initial advance and a total of 22 to 26 degrees. Light cruising can use up to 30 degrees total. These spec's are at sea level." Thanks to JWL for this tip. People I've talked with say his engines run really hard.

Bob McKay, of Speedway Motors, recommends setting distributors for 22 degrees total advance @ 2500-3000rpm. He says this is the maximum advance and shouldn't be exceeded on street engines.

THE THREE DIFFERENT TYPES OF ADVANCE: Total advance is the total degrees of initial (static) advance, plus the number of degrees of centrifugal weight advance (mechanical), plus the number of degrees of vacuum advance. Initial advance is the amount set by rotating the distributor point plate on 59AB distributors (or the complete distributor on 8BA and most OHV engines). Centrifugal advance is controlled by the distributor's internal weights, springs, and stops. Vacuum advance is controlled by the engines vacuum and a vacuum advance mechanism.

Example: An engine which has 12 degrees static advance, 15 degrees centrifugal advance, and 17 degrees vacuum advance has 12+15+17=44 degrees total advance.

On '48 and older Ford V8 distributors, there is no vacuum advance per se. Engine vacuum (intake manifold vacuum, not carburetor vacuum) and a spring, are used to control a brake that limits the centrifugal advance mechanism. Some flatheaders disconnect the vacuum line and are happy with the results (the spring pushes the brake against the centrifugal advance mechanism constantly and slows or stops centrifugal advance). I prefer to have the vacuum connected as it increases gas mileage.

DETERMINING THE DEGREES OF VARIOUS TYPES OF ADVANCE: There are several methods to determine the degrees for each type of advance. The method I use requires the crank pulley be marked off in degrees (or else use a degree wheel) to ±10 degrees TDC on flatheads (-10 to +20 on OHV), a dial type power timing light (these have a control on the back of the light to adjust delay in the firing of the strobe light), and a vacuum pump. The dial type timing light gives you the ability to move the strobe timing flashes around without actually changing the timing. The vacuum pump permits you to apply measured vacuum to the distributor vacuum control. Using these tools and common sense we can use the degrees marked on the crank pulley to accurately measure and determine each of the distributor's different advances. The following example is for an engine with a vacuum advance system like an OHV, but is also used on pre-'49 Ford engines by ignoring vacuum advance.

With the engine idling and the timing light hooked up, set the dial on the timing light to 0 degrees. Point the strobed beam at the timing mark on the crank pulley (we've all done this on various engines). The number of degrees on the crank pulley is the number of degrees of initial advance... let's say it's 8 degrees for example purposes. With the strobe light still flashing on the crank pulley, increase the engine speed until the timing mark on the crank pulley ceases to show any increase. Now, without changing engine rpm, turn the dial on the back of the timing light until the strobe light shows it firing at TDC. Check the number on the rear dial of the timing light. This is the number of degrees of centrifugal advance less 8 degrees of static advance. Let's say the dial was rotated 22 degrees. The distributor has 14 degrees centrifugal advance (22 less 8 is 14 degrees).

Mallory and stock Ford pre-'49 distributors do not have a vacuum advance and the following is not needed. With no vacuum advance to be concerned with, the total advance is initial plus centrifugal. Or in the preceding example, 22 total degrees advance.

On engines with vacuum advance (and most OHV engines), we can determine exactly how many degrees the vacuum advance makes easily the vacuum pump and timing light. Let the engine return to idle and connect a vacuum pump to the distributor advance diaphragm fitting. Adjust the dial on the timing light so the timing marks show it's firing at 0 degrees. With the engine idling and with the strobe light flashing on 0 degrees on the crankshaft, pump the vacuum pump to around 20 inches Mercury (Hg) or whatever vacuum your engine has at your altitude. This will operate the vacuum advance fully. The vacuum needle has to remain at 20 in/Hg while you rotate the dial on the timing light to make the strobe light show it's firing at 0 degrees. Read the dial. This is the amount of vacuum advance. Let's say it's 22 degrees. Total advance for this particular engine and distributor is:

8 degrees + 14 degrees + 22 degrees = 44 degrees total.

Let's use a Ford OHV 289 engine for further talking. They like not more than 35-36 degrees advance without the vacuum advance. When the total advance (including vacuum advance) exceeds 36 degrees, it's not a cause for worry because vacuum advance only occurs when high vacuum conditions exist.... like under de-acceleration or cruising..... and won't cause detonation or pinging. Vacuum advance mostly affects only gas mileage. Most OHV Ford small blocks run great with 55-58 degrees total advance.

DETONATION OR PINGING: Detonation is the uncontrolled burning of fuel mixture during combustion. It can lead to pre-ignition, "running-on", burned pistons, cracked piston skirts, deformed piston ring grooves, broken ring lands, broken rings, and engine over heating. At times it's hard to hear light detonation due to road noise etc.(and my old age). However, detonation will leave its mark on the inside of the spark plugs. This appears as a dark brownish colored ring around the inside porcelain. It'll be located about 2/3 of the way down the inside of the shell. Flatheads will usually ping after being souped up. If severe, it can be heard during full throttle acceleration above 35 mph in high gear. Richening the fuel mixture, increasing the gasoline's octane, lowering the compression ratio, retarding the timing, and/or changing to colder plugs will help eliminate pinging.

On stock 59AB distributors: Increasing the vacuum brake setting drastically (screw it nearly all the way down) will usually eliminate pinging but with an accompanying sacrifice in performance and gas mileage. This restricts the centrifugal advance. I prefer to restrict the amount of centrifugal advance on these early distributors by changing springs and/or altering the stops in the distributor. This requires a distributor machine to get accurate results. Most of these mechanisms have become worn out over the years and permit excessive advance.

On Mallory distributors, they use adjustable stops to limit the amount of centrifugal advance in addition to springs with different tensions. These are a breeze to set without the need for special equipment. This is discussed earlier in detail in the Mallory section.

SETUP TO USE A TIMING LIGHT ON '48 AND EARLIER: I establish and mark #1 piston's TDC on the crank pulley during engine rebuild for future reference.

Make a permanent pointer (not wire since it's easily bent) and attach it securely to one of the right side water pump bolts. Locate the tip of this pointer close to the crankshaft pulley sheave. Keep in mind when making the pointer and determining it’s location, it has to be visible when the engine is in the car. This is tough in some of the deeper engine bays like a ’37-‘38 Fords.

To establish #1 cylinder TDC (Top Dead Center): Install #1 piston and bolt a piece of ¼” thick steel strap across the top of #1 cylinder. Rotate the crank until the piston hits this stop. Mark the position on the crank pulley directly under the pointer using wax pencil or soap stone. Then rotate the engine in the opposite direction until the piston again hits the stop. Again mark the position on the crank pulley directly under the pointer using chalk or soap stone. Measure the distance around the pulley between these two marks. Divide this in half and file a notch in the crankshaft pulley sheave (paint it white). Rotate the pulley until the white mark is directly under the pointer. This is #1 TDC. Beginning at this point, file two additional marks (and paint them too) clockwise on the crank pulley at 11/64" intervals. Each mark represents 4 degrees advance. You can now use a timing light to set the initial timing providing you don’t move the timing pointer or change pulleys.

TIMING MARKS ON CRANK PULLEYS: Determining spacing around the crank pulley. Measure the outside diameter of the crank pulley. Circumference (C) is the distance around the outside of a circle and is always measured in the same unit (inches) of measure as the diameter (inches). There are 360 degrees in a circle and pi is 3.1416. We need to figure the number of inches in a degree:

$$\text{Circumference} = \frac{\text{(pi)(diameter in inches)}}{\text{360 degrees}} = \frac{(3.1416)(d)}{360}$$

Assuming a front crank pulley diameter is 5". Then using the formula above:

$$C=\frac{(pi)(d)}{360} = \frac{(3.1416)(5)}{360} = \frac{15.71''}{360} = 0.0436''/\text{degree}$$

Since it’s nearly impossible to make accurate marks that close together (using my usual rock and bent screwdriver method), I use the 0.0436"/degree and calculate a distance between marks I can see:

(5 degrees)(0.0436")= 0.218" or 7/32" between marks.
Or (4 degrees)(0.0436")= 0.170" or 11/64" between marks.
Or (3 degrees)(0.0436")= 0.130" or 1/8" between marks.
Or (2 degrees)(0.0436")= 0.087" or 11/128" between marks.

Mark the pulley with what you figure you can best read starting at TDC. I usually use 4 degrees or 11/64".

****************************** COILS ****************************

COIL POLARITY: Should a coil be connected wrong, the coil’s output will be decreased 14% at idle. As rpms increase, the coil output will decrease to 30%. Resulting in hard starting and poor engine performance.

Some coils are marked + and - instead of bat. and dist.

If you’re running a positive ground system (like our 6V flatheads had stock), the ignition switch to coil wire connects to the - terminal (or bat terminal) on the coil.

If you’re running a negative ground system (like 12V Fords came with), the ignition switch to coil wire connects to the + terminal (or dist. Terminal) on the coil.

COIL TESTING USING OHMS: Primary and secondary coil windings have different resistances. These can be tested with some degree of accuracy using a VOM. Each is tested differently.

Primary resistance. Most genuine 6V Ford coils have a primary resistance of 0.7 to 0.8 Ohms. To check the primary resistance of a genuine stock 6V coil at 75 degrees temperature, connect one lead of a VOM (Voltage/Ohm Meter) to the ignition switch terminal of the coil and the other to the distributor terminal of the coil. Set the selector to ohms (resistance). Read the meter. If this test is not within these limits, the coil is bad or getting weak and needs replacement.

Secondary resistance. Most genuine 6V Ford coils have a secondary resistance between 6500-7500 Ohms. To check the secondary resistance, connect one lead of the VOM to either the distributor or ignition switch terminal. Insert the other lead down inside the coil tower and make contact with the metal in the bottom of the tower. Set the selector to ohms (resistance). Read the meter. If this test is not within these limits, the coil is bad or getting weak and is need of replacing.

Note specifications are for genuine Ford coils <u>only.</u> Each manufacturer has their own values for their coils.

CURRENT DRAW FOR AFTERMARKET COILS: The current draw of a 6V rated coil should be less than 7-8 amps with the engine running (no resistor in the circuit or inside the coil).

CURRENT DRAW FOR STOCK FORD COILS: The current draw for a 4.0V rated coil should be 2.8 amps with the engine running. This is for a stock Ford ignition system using the stock resistor.

*************************** CONDENSERS **************************

CONDENSER RELOCATING: Relocating the condenser takes all the fun out of removing or replacing a condenser on a blistering hot stock distributor on a hot day crossing the desert (ask how I know).

Relocating condensers for easier replacement on front mounted distributors with isolated coils ('42-'48 models). Remove the condenser from the distributor and relocate the condenser's lead to the small terminal on the coil that connects to the distributor. Ground the condenser shell by screwing it to the coil mounting bracket. This will receive cooler air than when it was on the front mounted distributor and increase it's life and performance. The increased distance will change the condenser's capacitance slightly, but not enough to make any difference that I've been able to determine. Relocating the condenser can also be done to the helmet type distributor with a little thinking and using a condenser with a pig tail (like one used on an 8BA distributor). This is especially true for Mallory dual point distributors since the condenser on these puppies is located at the very bottom of the front mounted distributor (sounds like one of Ford's better ideas, doesn't it?) which means you have to remove the distributor to replace the condenser.

WEAK OR BAD CONDENSERS: When condensers go bad they will often cause an engine to run poorly when the engine approaches operating temperature. Usually the coil is blamed when it's the condenser. A new coil may seem to cure the problem, but often it will only be a temporary cure. Try replacing the condenser first and it's a lot cheaper too. I carry a couple of spare condensers in the car.

CONDENSER VOLTAGE/POLARITY: Condensers are neither voltage nor polarity sensitive. This means a condenser for a 12V system (either positive or negative ground) works just fine on a 6V system (either positive or negative ground)..... and vice versa. Just watch the mfd (microfarad)rating of the condenser and you'll be okay.

CONDENSER FAILURES & VOLTAGE SPIKES: High rate of condenser failures can often be traced to voltage spikes. These spikes get inside the condenser and quickly short through the mylar insulation (they used to use wax or oil soaked paper) which separates the turns of foil. This predominantly occurs only on engines running 6V generators (not alternators nor 12V generators). The 6V generators will produce voltage spikes in the range of **150-155 volts D-C** for a micro-second or so. These can be detected using an oscilloscope. The condenser shell used to be anodized to prevent these voltages from penetrating the shell. But the EPA no longer permits this (big brother protecting us again). Instead the manufacturers are spraying a thin coat of insulation (something that doesn't last long when subjected to stray voltages, engine vibrations, and engine heat). These voltage spikes can get into other electronics (radios etc.) and cause problems.

TESTING CONDENSERS: CAUTION: To prevent damaging the Volt-Ohm Meter (VOM) internally always discharge a condenser (by shorting it's wire lead to the condenser's metallic shell) BEFORE connecting either VOM lead to a condenser. .... From Fred on the Flathead Forum 6/15/99. "Use an analog type (not digital) volt-ohm-meter (VOM). Set the VOM on its most sensitive continuity setting. Touch the black VOM negative lead to the body and the red VOM positive lead to the wire. The meter needle should quickly show an increase in resistance before dropping back to zero. This indicates a good condenser. If it shows continuity through the condenser, or falls very quickly, the condenser is bad. If you're having trouble only when the engine is up to temperature, heat the condenser with a hair dryer until it's too hot to touch and repeat the test."..... I use this test frequently. You just have to be fast. If you miss the first part (the needle moves quickly), let the condenser set a little before you try again.

CONDENSER AVAILABILITY AND QUALITY. Condensers are being reproduced in the USA for '32 thru '41 distributors as well as '49 thru '53 models.

Condensers for the '42 thru '48 models are not being made in the USA. These are being made mostly in Argentina and are junk. They're stamped Argentina in very faint gray letters on the butt end of the condenser. Don't waste your money and time on these (I've experienced about 70% failure rate right out of the box!). You're better off to use a used USA made condenser for '49 thru '66 point distributors. With a little thinking you can bolt these up in the stock location. NOS condensers aren't much good either due to their age and being bounced around. Newly manufactured USA condensers are your best bet.

FORD/MERC CONDENSER CAPACITANCE: Stock Ford condensers for '32-'41 are rated at 0.33-0.36 mfd (microfarads). For '42-'48 they're 0.25-0.32 mfd. For '49-'53 they're 0.21-0.25 mfd. (For Mallory condensers, see earlier in this section).

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

******** VARIOUS NOTES **********

Revised April 30, 2009

REMOVING A BOLT OR NUT WHICH HAS HAD RED LOCTITE: These are tough enough when you have room to heat them. But many times an open-flame cannot be used due to the close proximity of heat sensitive materials.

Try adding a drop or two of more red Loctite to it. Let it soak for a five or so minutes. The fresh red Loctite will be drawn to the previous and hard Loctite. It'll soften it and it will usually come loose easily.

A machinist friend uses WD-40 to loosen any Loctite. He says it works every time. I've not tried it for some dumb reason.

MAGNETIZING A SCREWDRIVER: This works neat when you're on the road and you drop a nut somewhere down an abyss in your engine compartment. The only thing needed is a 12" or so length of insulated wire and a screwdriver.

Strip back the insulation on each end about a quarter inch. Wrap the insulated section around the steel shank of the screwdriver 3 or more times. Ground one bare end of the wire to the ground post on a car battery (voltage doesn't matter). Now scratch the other bare end of the wire a few times across the hot battery post. You're done. The magnetism will last for several months.

DEMAGNETIZING A SCREWDRIVER: Sometimes we need to demagnetize a screwdriver or a pair of needle nose pliers. All that's needed is a soldering gun. When the tool is small (like a screwdriver), insert it as far as possible between the top and bottom heating elements. Without allowing the tool to touch either heating element, pull the soldering gun's trigger and very slowly withdraw the tool. Don't stop withdrawing the tool until it's about 2 feet from the soldering gun. Check for any residual magnetism. You may have to repeat it a couple of times.

You can also magnetize a tool by holding the tool in between the two copper elements and pulling the trigger. This pulls the tool hard towards the copper elements and you'll have to hold the tool firmly to keep it from contacting either of them. (This tip was submitted to the MSN web by Joe W. on 9/21/00.)

CHARGING A NI-CAD BATTERY: Nickel-Cadmium (Ni-Cad) batteries are rechargeable. They take on a "memory" as they're used and recharged. With each use the battery life becomes less and less. Confused?

Maybe it would be clearer if we think of the memory as a series of spikes which increase in length with use and recharging. There are two rows of these spikes facing each other and the distance between these spikes is the battery life. The battery life lessens as the spike gaps decrease. Eventually the battery has only a few minutes of life after charging for some time and the tool becomes all but useless. Widening the gap between the memory spikes restores the battery close to it's normal life span.

Use a 12V battery charger (regardless of voltage of the battery or battery pack) to destroy the spikes by "shocking" them. An example is probably the easiest way to see what I'm trying to say.......

Suppose we have a battery powered screwdriver that only turns a few seconds before it dies. Take it apart to remove the battery pack. Plug the 12V car battery charger in, turn it on, and set it to charge 5 to 10 amps. Hold one charger lead against one terminal of the battery (or battery pack). Either terminal is fine. Now scratch the other lead from the charger a few times across the other terminal of the battery (or battery pack). Reassemble the screwdriver and use the drill's own charger to charge it for a few hours. If it won't take a charge, the pack is damaged mechanically and junk. I've been using the same battery pack on my screwdriver for over 15 years. A word of caution. This is for Ni-Cad rechargeable batteries only. <u>DO NOT ATTEMPT ON ALKALINE OR STANDARD ZINC BATTERIES WHICH COULD EXPLODE.</u>

LEAKING VACUUM HOSES: Ever had a split end on a vacuum hose? You know if you cut it off, it'll be back in a day or so because of the aged and hardened hose being stretched over a fitting. It's only a short time before you end up replacing the entire length of hose (not my kind of fun) because it's nowb too short from being cut so often.

A solution I use. Pick up an assortment of electric shrink tubing from your local Radio Shack. Cut the split part off the tubing and slip on a short piece (about 1/4") of shrink tubing over the freshly cut end. Slip the tubing back onto the fitting and use a match, or heat gun, to shrink the shrink tubing tight around the hose. This is a permanent cure and will last for years. If the vacuum hose is too short to trim off the split end, cut a longer piece of shrink tubing (about ¾") and slip it over the split end of the hose. Reinstall the split hose back onto the fitting. Slide the heat shrink tubing up to cover the split and overlap it on to the fitting itself about an eighth of an inch. Now shrink it with heat. This will form a leak tight seal between the hose and fitting.

TIP: When installing new vacuum hoses and you want to prevent splits later, install heat shrink tubing at time of installing the new tubing. Beats messing with them later.

BALL BEARINGS: All ball/roller bearings manufactured throughout the world are sized using the US measuring system. The bearing races, balls, and rollers are all the same regardless of where they are manufactured. This sure is a big help to people like me who misplace a single ball bearing (so we'll know right where it is when we're ready for it..... yeah, right!). Usually, it's always late at night or on a Sunday after every parts house in the universe is closed. Scratch around your used parts and find a complete bearing which has the right size ball bearings. Use a hot wrench to cut off the outer race to get to the balls. I save what's left in a box for the next time I need one.

CLEANING CLEANING SOLVENT (Boy does that read stupid or what!): The solvent in these tanks seem to get dirty quickly. It's now about $5.60 a gallon! A trick I've used for a few decades is to add water to the solvent tank. My cleaning tank barrel holds about 22 gallons. I put in 7-8 gallons of water (sometimes with soap added) and 10 gallons of solvent. The water is a lot heavier and instantly separates and settles on the bottom of the barrel. My pump is suspended several inches below the top of the solvent. As the pump agitates things during solvent pumping the solvent circulates and contacts with the water. The water absorbs the dirt (to make mud?) and it settles to the bottom of the tank. This helps keep the solvent cleaner longer. This should prove just how cheap I am!!

Another method to clean solvent is to use some floor-dri or kitty litter (they're about the same for this purpose) in a large coffee can or such. Fill the coffee can with the floor-dri of your choice. TURN ON THE PUMP before you jam the flex nozzle down to the bottom of the floor dry. As the solvent travels up through the floor dry, dirt and grease will be absorbed by the floor-dri. Let it run for about 10 minutes or so. WARNING: <u>DO NOT</u> shut off the pump while the nozzle is still in the floor-dri. It'll suck the stuff back and into the pump. Then you get to take the pump apart and clean it.... ask me how I found this out... and how many times I've forgotten to do it over the years!

TIP: Use the soaked floor dry to clean the garage floor really good. Just scrub it in with a broom and sweep up. Then wash the floor down with water and a squeegee. Works for me.

GASKET HOLE CUTTERS: Cutting a hole in a gasket is easier if you use a sharpened piece of tubing or pipe. Grind the outer edge of the pipe so it's chamfered. Make it flat across the bottom and as sharp as you can. I use a fairly fine wheel on my bench grinder.

PULL HOOKS: Use old choke, throttle, or overdrive handles with a piece of the broken pull wire still attached. Bend as needed. Great when trying to fish out something.

TAPS AND DIES: Many times I don't have the right tap or die I need. There are a couple of things that have worked fairly well for me.

Taps. Get a bolt (grade 8 are best) with the right size and threads and grind (I use my bench grinder since I'm a slob) 3-4 slots about 1/2" up opposite sides of the threads. These slots function as cutters in restoring damaged threads.

A die is even simpler. Keep a selection of castellated nuts (these have slots for cotter pins) of various sizes and threads on hand. Grade 8 are best, but any will usually work fine. Invert these to restore damaged threads on bolts.

Cutting oil helps when repairing or making threads or sharpening knives or box cutters (dry wall knives). (You do need to keep your Buck knife sharp for the Saturday night dance, don't you?)

IGNITION KILL SWITCH: Most of us already have a method of shutting off the electrics in our flatheads. For those who don't....

Intercept the smaller wire between the coil and distributor and cut it in two. Splice a long piece of wire to each end. Run both of these wires to the inside of the car. Connect these to a toggle type switch that you hide, but where it's handy to reach.....like in the ashtray or under the dash. With the switch in the off position, the engine cannot be started. It's also great keeping the coil from putting out sparks when running a compression check, a fuel pump test, or adjusting the wet gas level setting in our Stromberg 97's.

REMOVING DUST WITHOUT WASHING THE CAR: If you have a dark black (dark black.... what would be light black... gray?) hot rod, you know how it is always seems to be dusty and looking dirty. Each time you wash it, water gets in the seams which hastens rust. Washing takes considerable time....something we may not have if we're going to a cruise-in.

A solution I use is a moistened towel in place of washing the car. I fold it into a pad about a foot square and then mist it with water from an old Windex spray bottle or such. Then I fold the towel onto itself so the two misted sides press against each other. I press these together a couple of times and then open the towel so the misted sides are now out. This disperses the droplets of water and evens out the mist on the towel. Then I wipe the car down. Takes about 5 minutes and it looks like I just washed it. Best part is I'm not getting water into the seams. It's fast and a lot less work than washing the car. If you're plagued with harsh water, mist it with distilled water.

(From rodnut 1/30/03. He uses the California Duster and really likes them. He's used one for years with no problems.) I've used these but found they slightly dull my paint. I think the wax on them coats the paint surface. This dullness eventually requires re-buffing to restore the gloss. They seem to work better if the paint is hot.

FENDER COVERS: These things are great, but they sure like to slide around and fall off. I picked up a four (2 for each fender cover) strong magnets at the hardware store (old speaker cones work great too). I use them to keep the covers from sliding around or falling off the fender.

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

************** OIL **************

Revised April 29, 2009

OIL CAPACITIES: '48 and older...... 5 quarts with no filter
'49 thru '53....... 4 quarts with no filter

(All Ford Shop Manuals & Motors Manuals show these capacities.)
I have no problem with the capacity for the '49 and newer engines since their dipstick shows full with 4 quarts (no filter). But the '48 and older capacity shown in the shop manuals generated a problem area for me. My '46 engine's dipstick shows full with 4 quarts of oil (no filter). I figured the dipstick and dipstick tube were mismatched or I had a reduced capacity pan, so I didn't give it much thought and have been running 5 quarts (no filter) which puts the oil level a quart above the dipstick's full mark.

One day I was talking with an Early Ford V8 Club member with a low mileage '46. It has the untouched original 59AB engine. It's never been apart or worked on except for a single tune up and routine maintenance. We checked his dipstick and tube against mine. Both dipsticks and tubes are identical. His dipstick shows full when he puts in 4 quarts (no filter) during an oil change, so both oil pans are the same. Since then I've checked a dozen or more 59A engines. They all use the same dipsticks and tubes as mine. All show full with 4 quarts (no filter). Going back in my mind to the '48 convert I bought in '52 (with 12,000 miles), I can remember it took 4 quarts (no filter) for an oil change. This put the oil at the full mark on the dipstick.

RECOMMENDED OIL WEIGHTS: Ford engines '48 and older: SAE 10 below zero, SAE 20 below freezing, SAE 40 above freezing, and SAE 50 above 90 degrees F. The dealer memo this came from states these are daily high temperature readings. I've been told, Ford recommends the same for all '32-'53 flathead engines, but I've never seen that in Ford print.

OPERATING OIL TEMPERATURES: Minimum of 200 degrees F. Maximum should not exceed 250 degrees F (oil breaks down).

OIL PRESSURE: Oil pressure spec for early '48 and older engines is 30 psi @ 30 mph. For late '48 and newer engines it was increased to 57 psi. at 40 mph. Current performance flathead professional engine builders recommend pressure in the 80 psi range for hopped up street engines. Full race engines require more pressure due to their increased clearances and need pressure in the 100 psi range.

******************** OIL PUMPS ******************

OIL PUMP ID: "Long body" pumps were used from '36 thru early '48. Late '48-'53 Ford/Merc's went to the "short body" pump. These have higher pressure, a relief valve, and a different pickup screen than the previous long body type. These came with straight cut gears in late '48-'49 which Ford rated as 60 psi pumps. In '50 they were improved by changing to helical gears and Ford increased their rating to 80 psi.

OIL PRESSURE RELIEF SPRINGS IN SHORT BODIED OIL PUMPS: The relief spring spec's for the NOS short bodied pumps is 78-87 oz. @ 1.380" length.

As far as I can determine, Mellings is the only manufacturer of flathead stock oil pumps. They are the short bodied style with helical gears. Their relief spring is 2-1/16" long. Since stretching an oil pump's relief spring will increase oil pressure, I stretch them to 2-1/2" length to increase the oil pressure about 15 psi.

OIL PRESSURE RELIEF VALVE SPRING IN '48 AND OLDER ENGINES: The oil relief valve is located in the front of '48 and older engines. It has a steel dowel with a ball on one end, a coil spring, and a retaining bolt. The relief valve spring length and strength was calibrated to open at 25 psi. It's open when the oil pump makes any kind of oil pressure at all. The round ball has a flattened spot to by-pass a small quantity of oil when the ball is on its seat in the block. The stock spring length is 1-5/16". My notes from the old days showed we stretched these to 2-1/16" to increase oil pressure to 40 psi.

PLUGGING THE RELIEF VALVE IN EARLY '48 AND OLDER ENGINES: On my current engine, I'm running the newer "short" bodied pump with it's own relief valve. Because the stock relief valve in the valve chamber is no longer needed, I removed it and tapped and plugged the hole with a socket type screw and Loctite. It has not caused any problem. Many times I've heard that removing this relief valve would result in a huge oil leak which would reduce oil pressure and cause the mains and rods to starve. Maybe this would happen if the hole weren't plugged.... I don't know. But this is supposed to cut off all oil to the timing gears and cause them to fail due to lack of oil. I don't believe this for a moment. Oil is constantly being splashed and thrown on these gears by the spinning crank in sufficient quantity to more than adequately lubricate these gears. Also, how can plugging this hole cause problems since 8BA engines do not have such a hole and they get oil their timing gears? My engine has 65K miles with its relief valve hole plugged.

OIL PUMP PRIMING DURING ASSEMBLY: To assure the pump will pick up its prime, remove the bottom plate and fill the gear cavity with petroleum jelly. If too thick grease is used it could possibly plug the internal oiling system as it is pumped. If too thin grease is used it could drain off of the gears and could cause an air-type lock. Petroleum jelly works for me.

However, there are times when a pump refuses to pick up a prime. Remove the oil filter pressure line at the back of the block and use a drill driven oil pump to pump pressure oil into the block (see the next section for making such a pump). If this doesn't work, the pump will have to be pulled and filled with petroleum jelly.

(JWL on the Flathead Forum in the year 2000. He removes the timing gear cover and the timing gear. He made an adapter that fits into the slot of the cam and uses a reversible ½" drill to turn the cam, which will turn the engine's oil pump. He turns it backwards to fill the oil pump's gear cavity.)

************** OIL SYSTEM, SEALS, ETC. *****************

PRE-OILING: It’s a good idea to check the engine for possible oil leaks before installation. Also, an engine should be pre-oiled just before they’re fired the first time. On OHV engines we use an old distributor shaft and drill to turn the engine’s pump, but this won’t work for a FH. So I made a primer out of some pieces of junk.

I used a 2½ gallon bucket, a length of 1" wide strap iron, an old Ford 6 oil pump with it’s drive shaft (nearly any oil pump works), a few fittings, a couple of small hose clamps, and about 4½' of ½" clear plastic tubing (to verify visually oil is being pumped through the hose), and a ½" reversible drill.

The strap iron is laid across the bucket and the ends are bent down over the edges of the bucket and held in place by a couple pair of vice grips. I bolted the oil pump to the center of the strap iron using another piece of strap iron to lower the pump into the bucket. The oil pump’s pick up screen is about 1/8" off the bottom of the bucket. The outlet of the pump got an adaptor fitting for the clear tubing. I used a similar fitting in the back of the block where the oil gauge sender goes and clamped the clear plastic tubing around both fittings. I installed a mechanical type oil pressure gauge in the block to see how much oil pressure the pump would make (40 psi). All in all, it took about 40 minutes to locate the junk and jury rig things. The oil pump’s drive shaft is turned by a reversible ½" electric drill.

Leave the plug out of the oil pan and position the bucket directly under it. Dump in a few quarts of oil in the bucket and start the ½" drill. When it’s turning the right direction it’ll bog down quickly (within a few seconds) and the oil will be pumped through the clear tubing and into the engine. It’ll be pumped through the engine and drain back into the bucket.... where it’ll be picked up and circulated through the engine again.

The last thing I do before starting a new engine is pre-oil it even though I did this while the engine was on the stand (sure don’t want a dry start on a newly rebuilt engine). I pre-oil it for about 5 minutes.

INSTALLING A ONE PIECE OIL PAN FRONT SEAL. Bad part of these seals is you have to remove the pan, crank pulley and timing cover to get to them. A good thing is only the “O” ring needs replacing when reusing one. New ones cost $0.40 each. The oil seal is usually still good.

To install: The lip (sharp edge) of the oil seal is directional and goes toward the rear of the engine. The aluminum adaptor installs with the oil drain hole at the bottom and facing towards the inside of the pan so oil will drain back into the pan instead of all over your front cross member and garage floor. Apply high temperature silicone sealer to the mating surface of the seal. Put some around the O-ring. Load up the groove the stock rope seal fits in with some silicone sealer before you install the oil seal adapter the final time.

(1/30/03 Billy, of the forum, caught an error in this garbage concerning my use of the term silicone. I’d always pronounced it sili<u>cone</u> (like a cone used for scoops of ice cream), but had always spelled it sili<u>con</u>. The pronunciation was correct, but the spelling sure wasn’t. Billy pointed out the differences. Silicon is the element (chemical symbol is Si) and is a dull brownish powder or a steel gray crystalline mass. Whereas silicone is any of various compounds containing a silicon-carbon bond and is used in lubricants, insulation resins,

waterproofing materials, etc. Silicone is what we commonly use. Thanks for the education Billy.)

STOCK REAR MAIN ROPE SEAL: **From rodnut 2/25/01. "Soak for 2 hours in oil. Install by using the curved portion of a large socket wrench or pipe to roll it into place. Use a SHARP utility knife and trim the ends 1/16" proud. Trim a bevel on 3 sides (not on the crankshaft side) of the ends on both top and bottom rope seals to prevent the material from being crushed between the block and cap. Apply a dab of silicone RTV sealer on the ends of the seal before assembly"**

If you can't find stock rope seals, try a Ford Tractor agency. They're the same as used in Ford Fergies and they always have them in stock. They're cheaper than from a Ford car dealership, too.

OPTIONAL REAR MAIN ROPE SEAL: Rope seals are used for front and rear mains on '83 Buick 3.8 liter V6 engines. These work as rear main seals on flatheads. They use newer technology and are not soaked in oil before installation. The front and rear have different cross sections. The rear ones have a rectangular cross section with rounded corners. The front ones have a round cross section. The rear (rectangular) ones work best, but I've used front ones when I didn't have any rear ones with no problem. The rectangular ones are not truly rectangular but have one side slightly longer than the opposite side (like a trapezoid). The long side of the rope seal should be installed towards the inside of the engine. Fel-Pro makes a rear gasket set #BSS13044-2. It takes two sets since one rope seal is not long enough to do both the top and bottom halves of a flathead's rear main. Measure the length needed and trim away the excess with a utility knife. The length should be not be trimmed proud like the stock rope seal (see the preceding topic). When installing the seals, rotate each one so their joints are about ½" up inside their receivers (this makes their ends NOT aligned with the joint where the main cap meets the block). Dab a glob of silicone RTV sealant where the two seals meet up inside the receivers. The only lubrication needed is a generous wipe of assembly lube on the seal where it contacts the crankshaft.

Tip: Engine rebuild kits come with a complete set of gaskets. These 3.8L GM gasket sets have both lip and rope seals for the front and rear mains. Engine builders use the lip seals and pitch the rope seals in the trash. I've asked a rebuilder here to save these for me. They're free too.

OIL DISTRIBUTION TUBE PLUGS IN 59 SERIES BLOCKS: Rear uses the flat bottomed threaded plug. Front uses the plug with the extended tit.

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

********* MISC. SPECIFICATIONS *********

Revised May 1, 2009

V8 FIRING ORDER: 1-5-4-8-6-3-7-2
6 CYLINDER FIRING ORDER: 1-5-3-6-2-4

MODEL NUMBERS.

'32 is model 18
'33 is model 40
'34 is model 40
'35 is model 48
'36 is model 68
'37 is model 78 (V8-60 is 74)
'38 is model 81A
'39 is model 91A
'40 is model 01A

*************** V8 TORQUE SPEC'S ***************

HEADS: nuts on studs: **aluminum = 45-55 ft/lbs
cast iron = 55-60 ft/lbs
cap screws: **aluminum = 45-55 ft/lbs
cast iron = 65-70 ft/lbs
**NOTE: When using a solid(no asbestos sandwich) copper shim type head gasket, torque aluminum heads to 60-70 ft/lbs.

Head fasteners should be torqued in 3 stages. Divide the torque specification by 3. This is the recommended torque increase per stage. Example: Suppose a torque specification is 65 ft/lbs. Dividing 65 ft/lbs by 3 is roughly 22 ft/lbs. This rounds off to 20 ft/lbs. Stage 1 torque is 20 ft/lbs. Stage 2 torque is 40 ft/lbs. Stage 3 torque is 65 ft/lbs.

HEAD STUDS: 120 in/lbs (or 10 ft/lbs)

SPARK PLUG GAPS, V8 or SIX: '37-'41 is 0.025"
'42-'51 is 0.030"
'52 is 0.035"

SPARK PLUG TORQUE: 14mm in Aluminum heads, 20-24 ft/lbs.
14mm in Cast Iron heads, 24-28 ft/lbs.

INTAKE MANIFOLD: aluminum = 300-360 in/lbs (or 25-30 ft/lbs)
cast iron = 420-480 in/lbs (or 35-40 ft/lbs)
NOTE: Torque in two stages.

CLUTCH PRESSURE PLATE (COVER) = 240 in/lbs (or 20 ft/lbs)
NOTE: Torque in 4 stages.

FLYWHEEL = 65 ft/lbs
NOTE: Torque in 3 stages.

MAINS: nuts on studs = 80 ft/lbs ('48 and older)
bolts = 100 ft/lbs ('49 and newer)
NOTE: The tightening sequence is REAR, FRONT,and CENTER.
NOTE: The mains started using bolts beginning in '49. The two shouldered bolts (no lock washers) are used on the front main. The two remaining mains (center and rear) use lock washers on their cap screws.
NOTE: Torque stages to be in fourths (see head torque at the beginning of this page).

RODS NUTS: Self locking nuts torque to 40-45 ft/lbs. Torque in 2 stages.
Castellated nutm torque to 45-50 ft/lbs. Torque in 2 stages.

CAMSHAFT TIMING GEAR = 240 in/lbs (or 20 ft/lbs).
NOTE: Torque in 2 stages.

********* STOCK V8 CLEARANCES **********

ALLOWABLE CYLINDER COMPRESSION VARIATION: All cylinder compression is to be within 15%. This is comparing the highest reading to each of the other readings. None can exceed 15%.

Example: On a particular engine, the highest reading is 110psi. In this instance the lowest permissible reading is (15%)(110) = (0.15)(110) = 16.5 psi. And 110 – 16.5 = 93.5 psi. In this example, if any cylinder has less than 93.5 psi, there is a mechanical problem and the engine will not perform well.

VALVE & PISTON CLEARANCE TO HEAD = 0.060" minimum

FUEL PUMP LOBE LIFT: 2.000" lift with ±0.180" Measure either the lobe or the fuel pump push rod.

CAM BEARING CLEARANCE = 0.002"

CAMSHAFT: Standard camshaft journal size is 1.796" to 1.797". Maximum wear limit for stock bearings is 1.795". Undersize journals are available 0.10", 0.020", and 0.030" under.

RING GROOVE CLEARANCE = '35 thru '48: 0.0015"-0.003"
'49 thru '53: top ring 0.0015"-0.003"
lower rings 0.001"-0.0025"

RING END GAP: All engines. 0.004" per inch of bore

ROD END PLAY = '35-'41: 0.006"-0.014"
'42-'48: 0.004"-0.008"
'49-'50: 0.006"-0.014"
'51-'53: 0.006"-0.020"

ROD BEARING CLEARANCE: ‘35-‘48: 0.0017"-0.0036"
‘49-’53: 0.0005"-0.003"

MAIN BEARING CLEARANCE: ‘35-’50: 0.000" thru 0.003"
‘51-’53: 0.001"-0.002"

CRANKSHAFT END PLAY: ‘35-’53:   0.002"-0.006"

FAN BELT TIGHTNESS: Ford says to adjust so the belt has ±½”. My personal thought is this puts a lot of pressure on the water pump and generator bushings/bearings. I set mine to ±¾”. Just my opinion.

Note. Major changes and/or additions are in bold face font. Contributions by web members are underlined with dots and credit given when known. Minor changes, usually just wording, are not drawn attention to by any special font.

********* SUSPENSION & STEERING *********

Revised April 27, 2009

ALIGNMENT SPECIFICATIONS: Note the following specifications are not for radial tires.

(Radial tires for one of our straight axle Ford cars are usually aligned with 0 degrees camber, 6-8 degrees positive caster, and with 1/8" toe-in.)

years	Caster degrees	Camber degrees	Toe-in	King pin Inclination
'33-'34	+4-1/2 to +9	+1/4	3/32"	8 degrees
'35-'36	+6-3/4	+5/8	3/32"	8 degrees
'37-'48	+6-3/4	+5/8	1/16"	8 degrees
1949	-1/4	+1/2	1/8"	5-¼ degrees
'50-'51	-1/4	+1/2	3/16"	5-¼ degrees
1952	-1/2	+1/2	3/32"	5-¼ degrees

STEERING BOX LUBRICATION: Most guys I know use SAE 160 in their cars year round… and then complain about how stiff it turns in the cold. My old worn-out Hudson steering box leaks. So I use a 50/50 mix of STP and EP 90 year round in it. Doesn't leak as much and seems to reduce the turning effort a tad.

Some guys use chassis grease. I don't think it's a good idea since the steering gears squeeze the thick grease out from between the gears. Which is pumped out of the fill hole in the vented plug, around the sector adjusting screw, out the bottom of the steering box, and around the pitman arm seal. Since the gear teeth squeeze grease out from between them, it appears to me that the teeth would most likely getting adequate grease. However, later steering boxes recommend chassis grease, so I'm probably all wet...again! Confusing, isn't it?

SHIMMY ELIMINATION: From a 1936 shop bulletin.... and this is a quote: "Low speed shimmy is usually caused by under inflation or looseness of wheels, wheel bearings, spindle bearings, tie rods, drag link, steering gear or spring mountings.... in conjunction with too much caster or toe-in. Low speed shimmy is often caused by the same conditions that cause high-speed tramp. Either too much or too little may cause low speed shimmy, whereas only too little caster will cause high speed tramp." Notice there is no definition of what speed high or low speed is. But they define wheel tramp as ".....synonymous with high speed shimmy" and discusses this in terms of "....oscillation frequencies" having to do largely with runout, balance, and toe-in. Can someone explain the difference, in layman terms between shimmy and tramp? And their definitions? I always thought they were the same! Caster is discussed as "....having a stabilizing effect" on all of this.

To increase caster temporarily (like to check to see if it cures a problem), use two rubber ball inserts on the wishbone with longer bolts. Test drive slowly to see if this makes a difference.

CORRECTION OF SHIMMY: Ford shop memos issued during the early thirties state more caster and/or increased front tire pressure are ways to eliminate shimmy. And they had hard rubber tires. It would appear radial tires can contribute to shimmy and bump-steer.

HUDSON/TERRAPLANE (GEMMER II & III) STEERING BOXES: These are superior to the Gemmer I steering boxes Ford used in their ‘32 thru ’36 cars. Both Gemmer II and Gemmer III turn a lot easier than the Gemmer I used on our early Fords. The Gemmer II is the same as the Gemmer III except for the worm/sector shaft adjuster. The Gemmer III features an external worm/sector adjustment whereas the Gemmer II has an internal worm/sector adjustment. Hudson used Gemmer steering boxes with a side fore/aft pitman arm (like ‘32-’34 Fords used) from ‘34 thru ‘37.

The Gemmer I was used in ‘34 thru ‘36 Hudsons & Terraplanes.
The Gemmer II was used exclusively in ‘36 Hudson DeLuxe cars.
The Gemmer III was used in *** ‘37-’5? Hudsons & Terraplanes.

*** Beginning in 1938, Gemmer changed their steering box for all Hudson/Terraplane cars. They retained the side fore/aft pitman arm, but inverting their steering box reverses the internal gearing. To my knowledge, the gears (not the housings) are the same in all Gemmer III boxes. They changed to bell crank drag link system. If a ‘38 or newer steering box is used in a ‘32-’34 Ford with a push/pull drag link, turning the steering wheel clockwise (for a right turn) makes the car turn left! A pretty good theft deterrent but hard as hell to drive. This means only the ‘37 and older Hudson steering boxes work without adding a Hudson bell crank system. A friend didn’t know this and put one in his MoPar hot rod. He wiped out two trash cans, some of his freshly sodded lawn, and almost took out the edge of his garage..... and all in just one trip to the corner and back!

Both the Gemmer II and Gemmer III steering boxes are easy to install in ‘32 through ‘34 Fords. Enlarge the pitman arm-housing hole through the frame rail (the Hudson pitman arm housing is about 1/8" larger than the Ford). Sharpen up your basic hot wrench, or use grinding stones, and enlarge the hole 1/8" starting at the top of the existing hole. Taper it both ways until it becomes tangent at 90 degrees from the top. Only two of the three steering box mounting holes line up. One additional hole has to be drilled through the side of the hard frame.

Pitman arms. The Hudson’s are the same size and spline as the ‘34 Ford as well as an early sixties Mustang/Falcon/Fairlane. These pitman arms are all an inch shorter than the ‘34 Ford which helps reduce steering effort. The Mustang pitman arm has a tapered drag link end in place of the ball/socket end used on the ‘34. Great if you’re interested in changing to tie rod ends on the drag link.

Steering shaft. The Hudson steering shaft is longer than the Ford. It’s the same diameter. The Hudson shaft is splined whereas the Ford is keyed. Modify as needed. (I cut a section out of the middle, sleeve, pin, and weld the two together.) Cutting new threads after shortening and machining a keyway is neater, but I do sloppy work. The Ford headlight basket on the end of the steering column bolts up to the Hudson steering box by adding a couple of 1/4" flat washers as spacers.

SPINDLE FLANGES DIFFERENCES: The ‘37 through ‘41 Fords have a round backing plate mounting flange and use a short (5.5”) king pin. The ‘42 through ‘48 have a square backing plate mounting flange and use a longer (6.0”) king pin. Both have the same diameter of king pins (0.813”).

KING PIN THRUST BEARINGS: These fit between the axle and the spindles. They are positioned on the axle so they're between the axle and the spindle. The thrust bearing has one surface, which rotates. It faces up against the spindle.

BEARING TYPE KINGPINS: These replace the stock bushings with caged needle bearings, but are pretty pricey. They greatly reduce steering effort and should last well past 100,000 miles. These are a straight bolt up installation and require NO machine work, grinding, or drilling. Basic hand tools are all that's required. Super simple to do. The hard part is removing the stock king pin and bushing. Once that's done, I have the bearing type king pins installed in about 1½ hours. These are available from:

Stainless Steel Brakes.
11470 Main Rd.
Clarence, NY 14031
Tech line: (716)-759-8669
Roger Mets: 1-800-448-7722

ARM TYPE STOCK TYPE SHOCKS: To soften the ride, turn the adjustment screw counter clockwise. An old trick we used on worn out shocks or to make one stiffer for competition use was to replace the fill plug with a grease zerk. Then pump the shock full of chassis grease and run 'em.

Hi. Long time since I've been on the site. Kind of busy........

Had a b***h of a summer. Went all the way through the engine, transmission, steering. and roadster during last winter. Replaced anything showing wear. Checked everything out so as to not have any problems on a couple of trips I had planned for the summer.

June rolled around and I loaded the car for the LA Roadster show on Father's Day. Left early on a Tuesday morning since I wanted to get to Ontario a day or so early. Decided against taking the usual side roads and stick to the Interstates. Stopped the fist night in Green River, UT. Left out early the next morning figuring I'd spend the night in Vegas. Yeah....right!

Cruising along about 70 mph in overdrive and not a care in the world. It was late in the afternoon and I was about five miles outside of St.George, Ut. This is about 20 miles from the SW corner of the state. Suddenly, and I mean SUDDENLY, a loud WHAM and the rear of the roadster lifted clear off the road about 6". This was followed by all kinds of LOUD noises and grinding emitting from the rear end. The speedometer was bouncing all over the place and the engine wasn't putting any power to the rear wheels. Just what I wanted. Shifted it out of overdrive and the speedometer steadied at 55 mph or so. So the problem was back of the transmission because the speedometer is at the rear of the transmission. Touched the gas and the hammering and no power being delivered began again. Let off the gas and the hammering got worse! Pushed in the clutch to shut down the noise. Found if I BARELY (less than 1/8") touched the gas or let off that amount it wouldn't hammer.

Coaxed it into the edge of St. George. It was a little before 5:00PM. Got a motel and checked the rear end. Nothing visual found. Pulled the Vacuum cannister.....nothing wrong there. That would be too easy. Checked the rear end lubricant....right on the full mark and very hot. Called Billy Pupo in CA to see if he could give me any clues. No anwer. Made four phone calls in an hour....no answer and never did returned any of my calls.

Spent a restless night trying to figure out what had happened. Usually when a Columbia lets go, you still have low range. Not in this case. Low range still worked...but just barely. Made a U turn early morning and started limping for home. Long way to go with a sick car.

Found if I took it easy, I could coax it up to 55 mph but it would take over a mile to get there. Downhills were out since I couldn't use any compression. So I'd put the transmission into neutral and coast down the hills. Not much coasting with the lack of streamlining in a '34 Ford. Stopped at Richfield, UT for the first night. I was really beat...driving a crippled car on a lot of shoulder wore me out. By this time, the most I could coax out of the roadster without hammering and tearing up more parts, was 45 mph and this would take over a mile to obtain after stopping.

Left out before daybreak. I had hoped the roadster would heal itself over night....it didn't! Gradually I was able to creep up to 40 mph. As the hours passed, the 40 mph slowly decreased. Stopped at a motel near the UT/CO border late the second day. Thankfullly the engine ran cool the whole time. Left early the third day. With any luck, I'd make it home late that day.....like that was going to happen with my luck.

The speed gradually decreased as the day wore on. Soon it was down to 35 mph and dropping.faster. Made it to Silt, CO and had to stop for gas. Little problem getting started again. Finally limped to the entrance to the I-25 (about a 1/4 mile from the station). It was down hill so I had some help. Gradually accelerated as much as I dared..... 14 miles later I was clear up to 25 mph! I had two big hills to climb over the Continental Divide and I knew for sure I wouldn't be able to even make it 1/10 of the way up the first one. I stayed on the right road shoulder and limped along. Near Glenwood Springs, CO there was single lane construction both directions. Not a problem....except for the #%@$# Toyota SUV slowing down to less than 10 mph for the two mile construction zone, I could barely hold the 10 mph by the time the stupid driver got his head out of his a** and sped up.

Limped through the town of Glenwood and started up the canyon. Speed now as down to 10 mph and falling fast. A mile into the canyon it shuddered to a stop. Had to use the engine starter to get it off the road since I couldn’t push it. State patrol came by and stopped. Called a car hauler and they stayed there and directed traffic around my car. Nice people.

Car hauler loaded me aboard and took me a half mile to No Name rest stop. Unloaded me there....and collected $230 cash. Not nice people. Called a friend in Denver and told him where I was and what had happened. He gulped his coffee down and hooked up his race trailer and drove the 160+ miles to haul me home. Got home about 5 PM. Once home we had to jack up the rear of the car and pull it into the garage by the jack.

Pulled the rear out and tore it down the next day. Everything inside was junk. Everything was burnt badly with grease burned into the metal. Only two minor pieces were stil good in the entire rear end. The ring and pinion were chipped and galded. The axle bearings were scorched badly. All the bearings in the rear end were scorched and galded. The plantary gear had no teeth left. The OD pinons (3) which held the planetary gears were gone. The plate that had been reinforced with weld had failed and one of the three corners lifted up and the gears would not mesh with the drum gear. One of the pinions was less than 1/4" diameter in one spot and was 1/8" longer than the other two. Tore heel out of everthing.

At times limping towards home from St. George, UT the rear end would lock up and the rear of the car would elevate a few inches off the ground.. The sudden loud noise coming from the rear end would startle me since nothing I could feel would forecast this…...other than accelerating or de-accelerating at too fast a rate. So I drove slowly and was careful on the accelerator for over two days. Boring! Each time it would get airborne, it would make the roadster accelerate a mile or so slower. I was sure I was on the verge of becoming a permanent speed-bump in the shoulder of the interstate by passing traffic. After getting it towed home from Glenwood Canyon in CO, we had to tow it back to the garage and use jacks to get it in the garage. Everything in the rear end was locked up and refused to move. The three of us couldn’t move it by hand. I was wore out since it was after 5:00 PM when we got home on June 18, Friday. It had been a tension filled trip home.

Tore it down the next morning, Saturday, June 19. It was burned and damaged beyond belief. Everything inside the rear end and housings were burnt black from the heat boiling the rear end grease. The cooked black stuff would only come off with a lot of sandblaster time. I could see damage to nearly every piece there was.

The cause of it coming apart, was part #A-21….the differential support hub and washer assembly. When building a Columbia, this is one of the pieces which is made “bullet proof” by reinforcing the factory weld. This is re-welded since the factory weld is on the flimsy side and welding makes it stronger (at least it’s supposed to). This part locates the planetary pinions (3 of them…part #A-26) and the 3 planetary pinion gears …. Part #A-26) in correct relation to the drum or part #A-24.

The weld on the #A-21 failed which caused one of the pinion shafts which hold and align the pinion gear (part #A-21) to bend upward about a half inch, which allowed the pinion on that shaft to climb out from the outer gear hub….. which caused the excess heat as it turned (or tried to) turn the part #A-40 when the teeth between the two gears both were torn up. It cooked the grease and destroyed the entire rear end. The pinion for that shaft had broken teeth and the pinion shaft looked like a crooked cigar…..it was worn half way through and bent like a crooked branch or cigar.

After accessing the damage I had Jim Nielsen contact J. Conley in CA. He only deals in Columbia overdrives and has nearly every Columbia part one might need. Jim Nielsen has some used parts and between him, Conley, and a good friend Bernie we were able to replace nearly everything damaged or burned in the rear end an overdrive. I found some USA Timken bearings in town. All bearings and bearing races (except for the axle bearings) were replaced with new Timken bearings.
The list of parts which were new or reconditioned I got from Conley were:
A-2 housing oil seal
A-7 differential carrier oil baffle
A-8 differential carried bearing cup
A-17 differential outer case assembly
A-20 differential outer case bearing cone
A-21 differential support hub and washer assembly
A-24 differential case and internal gear assembly
A-25 planetary pinon gear (3)
A-26 planetary pinion shaft (3)
A-27 Sun gear
A-28 side gear thrust washer, brass, (1)
A-29 differential side pinion thrust washers (4)
A-30 differential spider cross shaft (1)
A-32 synchro clutch assembly (drum, lower washer, hub, spring, shoe, Teflon lining, upper washer)
A-33 drive clutch
A-34 stationary clutch
A-35 upper oil baffle
A-36 lower oil baffle

The small end of the Ford pinion gear was chewed up pretty good. The ring gear has some galling on the teeth.. The rear end gears were a 10 spline, 3.78:1 rear end ratio. I searched among all the guys here in town for the 10 spline 3.78 gears which are for a ’36 with a tube ’34 driveshaft. No one in town had any 3.78 gears. Plenty of 4.11, 4.33, 4.44, gears and even a couple of 3.54 gears with the correct splines. Found one which had a chipped tooth on the ring gear that was about 1/8” long….. probably from being dropped in the past. But a whole lot better than what I had. Paid $125 for it and put it in.

Total cost so far just for parts was $2400 including bearings etc.

Finally got all the parts and got a friend, Bernie, who is an expert on a Columbia overdrive to put it all together on Friday, July 2.

Ron Holleran in VT had asked if I could be there for his garage bash in Chester, VT and time was running short. Ron had said it would be a two to three day get together with Ford Flathead people. At least that’s the way I remember it. I said I would try to make it but that was before everything turned to crap going to LA.

Got up early on Saturday morning, July 3, to put the rear end in the car. Got it together at 5:00 PM. Took it for a ride. No noises either from the rear end or the used ring and pinion. Tried shifting into Overdrive….like that's going to happen with my lousy luck. It wouldn't shift at all. Drove it back home after trying it several times. Called Bernie and told him the bad news. He came over right away with a friend named Doug who drives a patina '36 Ford. Neat car and he's BIG dude. Bernie went for a ride and tried shifting it.. After some deep thinking he said he was sure he knew the problem. I was completely worn out from too many hours and hard work in the garage over the week getting ready for my trip with a busted roadster. I told them I wouldn't be able to work on it until the next day. I was just too beat. Talk about good friends….. The two of them pulled the overdrive side loose and Bernie, somehow, was able to remove the clutch and synchronize assembly with just the axle housing pulled back a few inches. I have not idea how he did it or got it back together. I handed them whatever wrenches they needed since I was wasted and out on my feet. Three hours later they had it all back together. Two of the parts (A-35 and A-34) had been reversed during assembly. Probably due to phone interruptions since both Doug and Bernie are really good at helping others.

Took it out for a drive about 9:00 PM. Shifted like a clock. I shut off the garage lights and drug this old geezer body into the house.

Woke up Sunday…still completely worn out. This old age sucks big time. Decided I had to take it easy for at least a full day before leaving for VT or I wouldn't make it. Took it easy all day.

The next morning, Monday, I left early. Shifted good and no noises. Life is good….at times.

The second day, Tuesday, in the early afternoon, I had stopped for gas in MO. The transmission or clutch acted up. It wouldn't shift without double clutching It felt like I was trying to force shift it without a clutch. The next gas stop it shifted just as it always did. Odd. Something strange was going on in the transmission or clutch. It would shift funny off and on the rest of that day. That night I checked the grease in both the Columbia and transmission, Both were full and dribbled out when I pulled their check plugs. I adjusted the clutch outward in case the new clutch disc (put in the rebuilt the engine in January) was just getting worn in or something It wasn't smooth like it should be. But the next day it shifted good all day. Strange but it gave me something to think about. Maybe it was just wearing in.

The rebuilt engine was running really good and pulling hard. I always check the mileage in the first few tanks of gas. I noticed the first two tanks of gas were in the usual 21-21.5 mpg range. The third tank suddenly dropped to 19 mpg and got steadily worse and finally settled down to 18 mpg. I attributed it to running about 10 mph faster than usual. Thought about it and blamed it on the tremendous lack of streamlining on the '34 Ford! Should have thought harder about it and come up with the real reason.

Ran into some really bad weather and stopped early afternoon for the day. Each day I would get up early and drive late….running in the 75 to 80 mph range. In CN I checked the grease in the overdrive and the transmission. No drips or signs of leakage. Both trickled out their check plug when I pulled them. Was making good time on Thursday and was close to the border of north MA. I'd make it to Ron's sometime around noon on Friday. The shifting started messing up again. Nothing to do but keep going and look at it when at Ron's.

Then things turned grim again. Running about 75 mph on a split lane 4 lane highway near the MA/VT border in the right lane. Semi passed me on the left running about 85 mph. He was closely followed by two cars running a tad faster than 85 and real close together….. getting lined up to pass the semi. The semi was about 6 car lengths in front of me….and still in the left lane. He put on his right turn lights and began to change lanes.

He was barely in my lane when his right front tire blew sending rubber and rim everywhere. This turned his rig sideways…..the whole two lane road was suddenly taken up by the sliding semi and trailer. I slammed on my brakes extremely hard…harder than I think I ever had used any brakes…..there didn't appear anyplace to go but hit the semi trailer.….both road sides had corrugated guard rails for as far as I could see. There simply was no place for me to go. I was sliding side ways….trying to get stopped. The two cars behind me had nailed their brakes too…the two cars beside me were slow in reacting. The semi rolled over onto it's side….sliding along pretty fast…with the top of the semi and tractor towards me. The two cars which had been in the left lane plowed into the top of overturned trailer with their tires smoking. I could see around the semi now that I was closer and saw a brief break in the right guard rail. I was still sliding towards the right with all four locked up when I saw it.

I don't remember much of what followed. I guess I let off the brakes and was able to point the sliding roadster into the guardrail break…or something like that. I just don't know. I went into the bar ditch about 15' or so, and then turned sharply left because of an upcoming gully. I was still doing about 50 mph or so when I got back on the road….. sliding side ways onto the asphalt. Scared me! The two cars who had been behind me both plowed into the roof of the semi trailer. I didn't stop, but I did slow down. I was shaking for sure. I still have no idea how I got through it. But it wasn't through…………….

An hour later, I got on the brakes for a needed gas stop….and to clean out my britches. The brake pedal was mushy and close to the floor. I'd have to look at it tomorrow/ The brakes got steadily worse… big surprise!. The pedal was soon on the floor It was near 4:00 PM when I limped into Chester, VT. I had driven the last 60 miles without any brakes other than the emergency brake and downshifting the transmission. I was beat and decided to grab a motel (the only one I saw in the thriving metropolis of Chester VA) and call Ron to tell him I'd see him the morning.

Checked the master cylinder. It was bone dry. Drove to a restaurant to get something to eat…using just the emergency brake. The inside of the left rear tire was covered in brake fluid. I blew a wheel cylinder missing that semi. No big problem….. at least I thought so at the time. Little did I realize there weren't any wheel cylinders for my heap in the entire area!!

Well I missed Ron's get together completely. He said he told me it would be Friday only and I had missed it. It was over before I even got close! It was now Saturday morning.

So I missed the whole deal. Called Ron and got directions to his house Saturday morning….like that did much good. Finally called him and had him stand by the road to his diggin's. I had driven right past his place at least four times! He said he lived on a mountain top…..VT calls their mounds, mountains. I was looking for something like one or two thousand feet high above the roadway.

On the way to Ron's I drove into Chester and found a gas station open. Most stations and all parts houses are either closed or open only until noon on Saturdays in VT! He didn't have any cans of brake fluid for sale. But he scrounged around and came up with a half empty small can he filled out of his brake bleeder and gave to me. I filled the master cylinder and pumped the master cylinder about 8 times and let it set a minute. Then did it again. If you're filling a master cylinder after replacing the master cylinder or replacing the line close to the master cylinder, try filling and pumping the brake pedal as I just described. The majority of the time, the air will bleed back into the master cylinder and give a firm pedal. Saves bleeding the brakes. The filling station operator had never heard of such a thing. He was impressed with the way us decrepit old geezers do things the easiest way.

Went out to breakfast with Ron….he had a bowl for his eggs, hash browns, and bacon….which he stirred up! We returned to his shop and garage to repair the wheel cylinder. Nice shop with some good machinery. Several experimental intake manifolds and things laying around from the day before.

Repairing a blown wheel cylinder is a simple job….if you've got the tools and parts. Cleared a spot in the garage and pulled the back half of the roadster inside the open garage area. The left side, where the wheel cylinder was blown, was about 2' from the shelving on the side. Tight quarters but I would have the wheel off and get some added room that way. Jacked it up and put it on some stands in the rear. Pulled the left wheel and asked Ron for a wrench for the axle nut. He didn't have any wrench that big! He did come up with a large pipe wrench. I have always disliked using pipe wrenches on good bolts and nuts……they destroy the nuts so a 12 point wrench will not fit the nut…..especially since Doug (he's a BIG, strong dude) had tightened it to 275 ft/lbs !!!! And so it began…….the wheel cylinder from hell.

Asked Ron Halloran for his wheel puller to pull my right rear wheel. He didn't have one. Now that's a puzzle….. How can anyone who has messed with these flatheads for as many years as Ron has, not have a wheel puller. He raced stock cars for years. Said he never needed one. I remembered Don Davis, a friend of mine in Denver, had come across one he hadn't used since his high school days and had offered it to me to carry in the roadster saying it didn't take up much room. I had thrown it in just in case before leaving home. It didn't look like the pullers I had used for the past 50 years or so, but I had no choice but to try it. It took a ¾" wrench so I wasn't expecting much out of it. The damn thing worked better than my expensive one back home! It was rusty from sitting in the corner of his garage for over 40 years, but it really worked neat. So I got the drum off. The wheel cylinder was sopping wet from DOT 3 brake fluid as was everything. Wiped the worst of it up.

Pulled the wheel cylinder which took some time due to the rusty brake line. I had to unscrew it all the way with an end wrench. Damn rust. I dismantled the backing plate and took the wheel cylinder apart. The back cup had tilted sideways when I slammed on the brakes. Probably because the shoe wasn't adjusted as tight as the leading shoe for the forward cup. Cleaned the wheel cylinder and all of the parts with some gas and wiped of the backing plate. Washed the brake shoes as good as I could using up the last drop of Ron's lacquer thinner.

Asked Ron if I could borrow his brake cylinder hone. Said he had one but they had cleaned up the shop for the bash a few days before and he didn't know where to look since his grandson had helped him clean the shop and put things out of sight. After some extensive looking we gave up. It was about noon on Saturday by this time. Everything in the way of automotive in the area was closed. Ron got on the phone and called around. Called one of his buds and he had one. But it was about 20 miles away.

Now, Ron has no car or truck. He can't see to drive, so why have one? Makes sense to me. But how was I going to get the wheel cylinder honed when the hone was 20 miles away. Groan!!! He called his grandson who lived a quarter mile away. His father offered to loan us his pickup truck. Nice truck. I just hope no one I knew saw me driving it….. it's a Chevy! Drove to borrow the use of the hone. He let me hone it while he watched. Nice shop and in the middle of a Ford truck restoration. Drove back to Ron's and got there about 2:00 PM. Put the cylinder back together using some brake fluid and the same cups and pistons. Got under the car and started the three bolts which attach the brake cylinder to the backing plate. Didn't tighten them until after I got the brake line started. Assembled the shoes…they had dried out by then. Not real good, but as good as I could have at the time. They'd dry out before long on the hot road home.

Now all I had to do was attach the brake line. Yeah….like that's ever going to happen in my life time! I had to use an end wrench to turn the fitting from the start. I struggled with it for over an hour with no luck getting it started, but I did manage to cross thread it pretty good. Decided to call it a day and try to find a new ¼" brake line the next day…Sunday. Went to the motel and crashed early.

The next morning I called Ron. He had been on the phone looking for a brake line, a brake cylinder, or a parts house that would be open or from a friend. Finally got a lead from a buddy of his about BEST parts would be open at 10:00 for a couple of hours. Got back in the truck…it sure drove nice… and drove the 27 miles or so to the parts place It was a tad after 10:00 when we got there. I asked for 5' of ¼" steel brake line. I nearly fainted when they went in the back and came right back with one!!!! It had fittings on both ends…one standard length and the other the long length variety. Bought it and some brake fluid and drove back to Ron's.

Had to cut the too-long line about 4" and put a double flair on it. Ron had several Flaring tools and pieces. But they didn't work worth a hoot. Finally figured out it was the worn corrugations on the inside of the tubing holder were letting the tube push through. Used a different tubing holder on the next one. Worked good enough for me since the new brake line was almost too short now!

Ran a few spare fittings in and out the wheel cylinder. It was as good as it was going to get…not good but would probably work with some encouragement. Crawled under the heap and screwed the normal length fitting right in at the front with no problem. I had chosen to use the long fitting on the rear because of the tightness of the area in regard to the wrench. Wrong decision….as I soon found out….oh well…everything else lately had been a wrong decision.

I started to screw the long fitting into the stripped wheel cylinder. It refused to start no matter what I did. The threads were so bad I had to use a wrench from the very start. I used every trick I knew for well over an hour before I finally got it started straight…..or thought I had! It went in about two turns pretty easy…then began tightening up. Damn rust. I was using a Snap-On end wrench out of my roadster and I was soon on the verge of spreading it apart I was pulling on it so hard.

"I wish you had a line wrench" I said to Ron…cussing a lot.

"I've got one." He brought it to me. I looked at it and said "Craftsman. Don't you know better than to buy cheap tools?" I put the wrench on the fitting. The rusty steel line would still wiggle when I tried to move it…indicating the line was not tight yet. I beared down on the line wrench. Got about a quarter turn on it and the line was almost tight enough in the fitting. Finally! Applied more pressure to the line wrench. I could feel it getting soft. Nothing to do, but keep going. Got another eighth of a turn the line was barely loose now. Just a little more. Beared down on the wrench….and felt the wrench go soft. The jaws on the Craftsman line wrench had spread just enough so the jaws rounded off the fitting just enough so the wrench slipped part way over the fitting….and then slid outward toward the wheel….essentially jamming in the wrench against the wheel tight and the other end jammed against the fitting. Used a 3' pry bar with no help and a lot of other things. None helped.. Worked over an hour on it with no change. I couldn't budge the stuck wrench. Finally I came out wiping my hands…cussing pretty good by this time.

"Ron. I can't get it to budge in any direction." There was no way I could get the wheel cylinder on the bench since the wrench was jammed against the backing plate and wheel.

"Just leave it there until you get home," he said.

“Can’t do that. The wrench won’t let the rear wheel be mounted. It rubs hard against the sidewall “ I thought about plugging the left rear brake line and running on three wheel brakes, but the car would be unpredictable with just three brakes.

“Let me see that torch.” I said to Ron. I fired it up and cut the wrench right where it would clear the brake drum. Took maybe a minute.

Put the wheel on and bled the brakes. NO LEAKS! Finished putting my tools away while Ron put his away. Fired the roadster and tried out the brakes on his front lawn. Worked good. I looked like a pig pen….but then I usually do when I’ve been working under a car. It was late in the day and I went back to the motel and worked on getting clean. I crashed early again.

Up early and picked up Ron for his “bowl” breakfast. Then we toured some of the covered bridges and took some pictures. Ron sure knows the area and it’s beautiful county for sure…..now if they just had a 23/7 parts house or two and some old Ford parts.

Left for the trip home on Monday, July 12. The sun was warm and it was partly cloudy. The roadster was running great and the overdrive was shifting pretty well. Nice day for a cruise in a top down roadster with a sweet running flathead. The pipes were rumbling just enough to enjoy. Life is good.

I was cruising along about 75 or so when I came upon road construction (or should that be destruction?). Posted 45 mph so got off the gas and slowed down to 45 mph in overdrive. The traffic cones narrowed. They were the barrel type with sand in them to keep them from being blown over. I was behind a furniture delivery van with duals. He had cut in ahead of me just as the cones began narrowing. His right rear dual clipped a cone and sent it spinning and it began wallowing around. It wallowed back towards me….no place to go. It hit the right corner of the front bumper and bounced up on the outer right front fender and rebounded off. It wasn’t through yet. It hit the driver side door of a parked car…………..a state patrol car! Groan big time. It was parked beside a sign which said to the effect “Hit a worker, Go to Jail for 15 years, $12,000 fine, and loss of license”.

That’s all I needed. He jumped in his patrol car and lit the tires up. I pulled over at a wide spot in the median. He pulled in behind me. He came stomping back…his ticket book in hand. To say he was mad is a gross understatement.

He lit into me like a drill sergeant. He took my driver’s license, my insurance card, and my car registration. He was shaking he was so mad. I asked him if he was going to go after the truck that caused the wreck. Well, he didn’t believe me. It took me over an hour to convince him I had been hit by the barrel. And not that I had hit the barrel. Then he got started on the sign and was thinking of taking me in to jail and prosecuting me for hitting his car. More talking. Finally he said he wouldn’t write me up if I didn’t notify the insurance company. I assured him I would repair the split fender and the bumper myself with out notifying the insurance company.

He looked at my license plate. It's a 1934 Colorado plate. Now he's going to write me up for illegal registration. So I hand him the paper with the state seal on it stating I can run the license plate under the year of manufacture state law. He had never heard of such a thing. So I had to explain the law and how it applied only to certain cars and conditions. Finally he said I could go…..after he wanted to look over the car and the engine. I can go that. It wasn't long until I was underway. What a trip this was getting to be!

Stopped that night and checked the overdrive grease again. Still full and no signs of any leaks. At least it was doing good, although it still was missing shifting into overdrive more and more frequently. And the clutch and/or transmission was acting up.
Called Bill Bentley (Ford site web master) on Wednesday morning when I got near his diggins' outside Grand Junction, MI. Arranged to meet him outside a roadside café so he could lead me to his house. I could easily get lost going to or leaving his house. Followed him to his home. Beautiful place. Front looks out over a lake and the surrounding hills are thick with foliage. Neat garage and a '37 pickup and his '37 coupe. Both are great cars, but his health is preventing him from working on the pickup and doing some things he wants to do.

Used his garage to add some insulation to the roadster floor since I was getting a lot of outside air coming through to the inside. It helped quite a bit. Then we spent the day mostly talking and just kicking tires. He's not doing real well with his breathing.
Spent the night with Bill and Lu, his wife. There aren't any motels for maybe 50 miles from his place. Got up and left for the road the next morning, I was running out of time. Car felt better without all that cold air in the early mornings and hot air the rest of the time.

I was tired of the long days and shut it off early that day. As usual, I got a room first and unloaded luggage. Then I would wash the car. Then shower and go to eat. Then back to the motel for the night. Some routine, but it works for me…old geezer that I am.

Got up the next morning and drove into OH and met some old friends from Denver. Spent the next three days with them. Had a great time Went to a destruction derby one night….hadn't done that in years. Lots of fun. I even worked on their Chevy a little! Left out of the morning of Sunday, July 18 for home. I had a very important doctor's appointment for Tuesday morning, July 20. It was for a diabetes study I was on. I had to be there and with the way things were going I drove late that night and got up early on Monday, July 18…… about 100 miles east of Kansas City. Drove long and hard…not stopping unless I had to…or the roadster needed gas. Some of the time the speedometer was sitting on 85 mph. That old car and I don't much like it at that speed, but then we're both old geezers. I arrived home that night ….after 8:00 PM.

I was beat. 5700 miles round trip. Not the farthest run, but one I had more trouble on. July 21, Wednesday, two days later the roadster is all cleaned up and the oil has been changed and a grease job and the brake cylinder and brake line had been replaced.. Nice day when I woke up. Decided to take the roadster to breakfast. Fired right off. Was just cruising about 35 mph traveling north on Kipling street to meet the guys for coffee.

Crossed Colfax Avenue and heard a really loud noise. The clutch had come apart. Called Larry Christensen for help. He's one of the guys who meet for breakfast most days of the week. He got his dually and his trailer and loaded me up. Hauled my roadster home. We pushed it back into the garage since I had to pull the rear end out. Called Ron who lives on my block and he came and said it wasn't much of a job to repair the fender and pull out the bumper. And he would get it done in the next few days….like that is EVER going to happen.

Pulled the rear end. Pulled the transmission. Everything looked normal. However, the junk in the bell housing sure didn't look good. Lots of bent springs, pulled and bent dowels which ripped through the steel (?) disc that locate the anti-chatter springs etc. The fiber disc didn't show any damage. Damn Chinese clutch I had bought at a swap meet from a guy who swore it was NOS. Best I never see him again!

Decided while the rear end was out, to look at the Columbia and see how the new parts were fairing Pulled it apart… and nearly puked! Burned bad again. Scored parts etc. Now it gets to the bad stuff…………….

Sat in the middle of the floor examining the carnage. Nothing to do but try to figure out what caused the Columbia to get so hot.

The bearings weren't hurt for the most part…..just a couple needed replacing. There were metal-to-metal contacts on nearly all of the rotating parts. Some were real bad, but some were barely scratches. All of the Teflon cushioning pads (about ¼" x 1" x 1/16" thick in size) in the clutch were non-existent…. I found one sliver about the size of the flat spot on a wooden match. All of the rest of the Teflon had melted and was mixed in with the grease! Takes a lot of heat to melt this stuff…or so I've been told.

Bernie and I hauled all of the pieces out to Jim Nieslsen….the parts house guy who ordered all of the stuff. He knows Columbia overdrives as well as anyone. Went over each piece looking for the reason for the heat. When it's looked at with an impartial eye, you'd say it was run out of grease. But anyone who knows me, knows that's not going to happen. Nothing else could have caused so much heat unless something inside wasn't machined to the correct size or some manufacture flaw that we couldn't find. We all know the chances of a manufacture admitting they were wrong. Kept it at Jims for a few days to think about things. Several phone calls were made to Conley.

Finally boxed up all but the housings, and shipped it to Conley. He examined it and said I had run it out of grease….that it wasn't anything he had or hadn't done. He said I had so much rake on the car that the rear end leaked grease down the driveshaft and into the transmission……that's where the grease went. Odd, that had never happened in 180,000 miles and I had replaced the driveshaft seal and bushing in Jan of this year. I run sealed bearing in the back of the transmission to prevent this. He said to buy a special seal and adapter made in Texas which would fit between the driveshaft and the pinion shaft. $110 more. Ordered one. When it came here it was the wrong one. Two phone calls later, the guy said it had been his error. So back it went and it took two weeks for the right one to get here. More delays. Conley was asked to check everything out and send back whatever parts we needed to make it right.. This was about July 28.

Meantime I had Jim looking for a NOS or new 9” clutch disc for the car to replace the cheap Chinese junk. I swear I will NEVER use any Chinese crap in my cars!! I couldn’t believe when Jim came across both a NOS 9” disc and pressure plate. The throw-out bearing was getting a tad rough so I took out the plug I had put in it and shot it with two shots of grease. It should last another 100,000 miles with no noises. Spent nearly a week searching for the clutch and disc.

Meantime, nothing was heard about the overdrive. Called him and he said everyone there said I had run it out of grease. Yeah…..right. He said he had to do the Early V8 annual meet in St. James, UT and would get mine done after the meet was over. Three weeks later another call made. He was just going to start on it! Funny how long it takes to get something done….except when you’re doing it for someone else.

Put the new clutch in and put the transmission back in. Repaired a few things that had bugged me on the trip since I couldn’t drive the roadster. At least it was something to do. Not a problem really… I had my ’66 Ranchero to drive while the roadster was down. Good idea…not.

The weekend after I blew the clutch, I drove the Ranchero out to look for at a 9” clutch a good friend of mine had. When I left there, I backed it up to turn it around…….just like I always did. Except this time I hit a pole with the left rear corner of the truck! Neat…just one more damn thing! Drove it home and called Ron. He came over and said it wasn’t much and he could straighten and paint and finish it in four days….yeah…right. Like any body/paint man ever met a target date. He started it a few days later. Today is December 1 and it still isn’t done….and neither is the roadster fender!!!! I guess I just expect too much.

Time passes. During this time, I replaced the tired and worn out insulation in the roadster. I made a new floor board that wasn’t broken in two pieces. Fits nice and should reduce engine and outside heat/cold. Fixed some other things that needed fixing. Didn’t last long in the garage each day.

Finally got the overdrive parts October 12….. along with a nice bill! No allowance for anything! That surprised Bernie, Jim, and me…….I thought sure he would at least pay shipping one way at the very, very least. But no…and no discount for anything. He told Bernie on the phone he had put it all together and then took it apart to be sure everything was right. Shipped all of the pieces back to us. Had another NEW sun gear….saying the one that was in it was damaged and couldn’t be used. He sent the old Sun gear back to me. I have to tell you…..I’ve built a lot of rear ends and transmissions using a hell of a lot

worse gears than the sun gear was…..@ $250 I would have probably used the rough one.
Parts list
A-5 & A-23 set of locks
A-20 differential outer case cone
A- 8 differential outer case bearing cap
A-15 & A-26 pinion shaft and gear (3)
A-3 special gasket for overdrive housing (1)
A-50 assortment of rear end housing gaskets
A-32 synchro assembly kit
A-27 Sun gear
A-12 bushing
Labor and repairs to A-17 & A-25
Freight and insurance to CA
Freight and insurance to CO
Total = $765. Not counting the miscellaneous things like grease, gasket sealer, a new axle bushing end and another new rear wheel bearing which ads up.

Good, now I can finally get the roadster back together and get on Ron's butt about the paint. But Bernie had to visit family in the Dakotas for a little over a week…..then he had to finish the floors in his basement conversion….so that took almost a week….and then it's Veterans' Day, etc. etc. During this time, I had the flu and a GD cold that I couldn't get rid of. Spent nearly 3 weeks in a chair flipping channels… my favorite thing!

Then Bernie calls. He just noticed the rear axle bearing race on the driver side housing is getting bad. Take it down to have a new one machined on. Leave it off at Jim's Thursday about noon. I'm told it'll be ready that afternoon. Drive to Jims at 4:00. He didn't get it to the guy in time. And he doesn't work Fridays or Saturdays! Another delay! Finally get it late Monday afternoon.

Bernie becomes available. Things are looking up!!!! Except I'm sick enough that I can't stand and help put it together. So he puts it together at home while I try to get better at home. Three days go by and I call him mid-morning. He was just about finished with it and would finish it that that morning. An hour later he calls……Conley had shipped us a thicker Sun gear…….so thick the axle will not go through it. Bernie has to dismantle most of the overdrive to get it out. The Sun gear has to be machined , or the axle machined, or the correct Sun gear is needed. I'm not interested in having special axles that have to be machined. Like that would be available in VT on a Saturday afternoon! Or machine out the Sun gear. I've heard the reason Deats made thicker ones was he didn't want to get involved in heat treating to the old standards. If that's true, then machining the inside would weaken it.

Called Conley. I'm sure he thinks I'm switching parts since John Deats made some thick ones and machined down the axle diameter. He says he's never had a Deats sun gear and wouldn't use one if he had it. More phone calls follow. It takes a week before he gets around to shipping another one. Bernie puts the overdrive together. This time everything fits right. Finally! Jim ships the thick Sun gear to Conley.

Bernie brings the overdrive out Monday, November 15. Begin to put the rear end pieces together…. Like the driveshaft, backing plates, e-brake, wheels, housing, etc. One morning I ask Doug if he's available. He comes down and helps me shove the driveshaft in. Sure is nice to be healthy and strong. We work about 3-4 hours and have almost all of the work done. After lunch I call it quits. I'm wore out. I'm still sick so can't work much…like a few hours a day…and skipping days frequently.

Finally I get better and manage to get it together on November 22 . A week to put a rear end in! Ridiculous!

Started it up while on the stands. Ran it at 20 mph in high gear to circulate the new EP 90-140 gear oil Then shift it into overdrive. It shifts in and out of overdrive smoothly with no balking or anything. Finally! I take it out for a test run. Sweet. No noises. BUT it's not going out of overdrive… at least it doesn't feel that way, but I'm only doing 30 mph and can't really tell. Cold out so drive it home and park it. Maybe tomorrow I'll feel like checking the vacuum connections. And taking it out and driving it faster to determine if it is shifting.
Total cost thus far for the overdrive is roughly $3400. Sure makes a five speed look attractive.

So there you have my crappy summer. No wonder I'm tired after reading all of this. Now if it just works!

Welcome to this website attending to preserve an American Legend compiled from a knowledge base collected from over 70 Years of experimenting, modifying, and just plain improving the

Ford Flathead V8 - 1932 thru 1953

Today is 7/11/55670... So, Good luck to all of you doing it and our thanks to all that have done it ..!

This site only contains reference information and will only publish photos relevant to a discussion. ***EMail*** any requests or timely suggestions to its custodian.

Most of the material has been gathered from posts on various Flathead Forums. Authors' credit to material posted on this site is noted when available.

Engine Building	Fuel Systems	Electrical Systems	Transmissions, Axles, & O/D's
Head Preparation	Carbs and Intakes	6V to 12V Generator	Flathead Transmission A to Z
Lifter Adjusting	Intake Manifold Heat Riser	Trouble Shoot Charging System	Pulling Rear Hubs
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Melling High Volume M15?	Carburetor Myth's	6 Volt Electrical Tips	Pre'49 Carrier Bearing Adjustment
Heads, a commentary by rumbleseat	Carb Jets & Power Valves	12V Boost for a 6V System	9" Rear End Measurement
Oil Priming A Rebuild	Fuel and Carbs	Field Diagnostic Tool	Retro 4 Speed Trans to 8BA
Sealing Headbolt Leaks	Fuel Pump Repair	Temperature Gauge Diagnostics	49/'50 vs '51 Transmission Gear Compatibility
Popup Pistons	8BA Multi Carbs W/Stock Advance Distributor		F1 Differential Adjusting
Crank Shaft Sludge	Uni-Syn Discussion	Converting 6 Volt Radio to operate on 12 Volt	Zephyr Gears and Compatibility
'Valve Seats & Leaded Fuel		12V to 6V Stepdown	Jumping Out Of 2nd Gear?
Adjustable Cam Gear	Indentify Your V8 Carburetor	**Oil Filters and Lube**	Borg Warner/Muncie 4 Speed Transmission
A lesson in Porting	Stromberg 97 Carburetor Specifications	Oil Filter Discussion	Axle Nut Torque
Fitting Floater Inserts	Holley 94 Carburetor	Engine Oil Weight Opinions	Lapping Hub to Axle

	Specifications		
Coolant Leak		95% Oil Filtering	Trouble Shoot Overdrive
Retro 4" Crank to 59 Block	**Useful Stuff**	8BA Low Oil Pressure	Determine Rear Gear Ratio
Valve Spring Pressure	Calculate RPM/Gear Ratio	Flathead Oilflow	Clutch and Pressure Plate
Unstick that Setup Flattie	Formula to Estimate Peak HP	Full Flow Oil Filter	Dropped Front Axle
Rear Main Sealing Solutions	Flathead Towing	Bill Mumaw's Oil Filtering System	R & R 37-48 Drive Shaft Center Bearing
Valve Seals on Intakes	Conversion Tables	**Brakes & Suspension**	**Ignition Systems**
Cam Grind-A Detailed Primer	Loctite Applications	Camber/Caster Adjusting	8BA Mallory Dwell Setting
Piston Dome	Paint Prep Tips	More on Camber/Caster	Mallory Mechanical Advance
Blowby Discussion	Chemically Remove Rust from small parts	Steering Wheel Removal	Pertronix Ignition - Yes or No?
49 - 53 Bellhousing Compatable ID	Bending Steel Tubing	39-'42 Brake Adjustment	Timing 8BA Mallory Electronic Distributor
49-53 Head Bolt Tightening Sequence	Clutch Spring ID	Mustang Disc/Drum M/C A Discussion	Locating Top Dead Center
FOMOCO 1937 - 1948 Engine Repair Manual	Tire Talk	Install F-1 Brakes on Early Spindles	Bill Mumaw's 59A Electronic Conversion
Compression Ratio Chart	Coolant & Corrosion	ID Front Spindles	Timing The 59AB
Claying Piston/Valve Head Clearance	Conversion Formulas for Gear, RPM, MPH, Tire	**Overdrive Information**	32/48 Timing Fixture Don't Need'em!
Installing Windshield Wipers in a '36 Pickup	Building A Clutch Anti-Chatter Assembly	Columbia Overview	HEI Distributor Conversion
ID 4" Mercury Crankshaft	Build a Timing Fixture	Columbia Installation #1	Condensers, a discussion
Cylinder Sleeve/Liner	Radial VS Bias Ply Tires	Columbia Installation #2	37-51Distributor Specs
49-53 Water Pump Rebuild by Dave O'Neil	Dashboard Wood Graining from 40Fred	Mitchell Overdrive	49-53 Distributor Specs
49 EBrake Paw Repair by Dave O'Neil	Joe Abbin's Compression Ratio Chart	49-53 OD Wiring Diagram	
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Ford Raw Material Chart	How To ID 4" Merc Crank	T5 Transmission Swap by Flat Ernie	
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Complete Torque Specifications	ID Ford Rearends	T5 Transmission Rebuild	

French Flatheads

French Flathead by Jens Munk

French Flathead Commentary

39-41 Heater Wiring

Differentials .. How they work

F1 Column Shift Rebuild

Printable Degree Wheel

Death by Oil

Mighty Wiper Installation

Printable Degree Wheel

6 Volt Starter Rebuild

Build a 12 Volt Flathead Starter

6 Volt to 12 Volt Bulb Chart

49 Truck Accessory Catalog

35-40 Frame Planograph

Convert Generator to Alternator

Rumble Seat's Flathead Tips, a chronicle of over 60 years improving Flathead performance

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Here's Ford's own promotional film from 1932; the first copy, shown and being stamped by Ford himself, now rests in The Henry Ford museum in Dearborn, Mich.

1932 Ford V8 Promotional Film

The results were revealed in 1932, when Ford announced the new engine and a new model, which was soon simply known as the Ford V-8 as well.
Ford's V8 engine became the big bang of American hot-rodding — cheap, powerful and easily modified — and is still used in one form or another around the world.

Please visit the following Flathead Links

Flathead Ford V8 (1932 thru -1953) ... Early V8 Club of America ....

Ford's Flathead V-8, the Engine That Gave Birth to Hot Rodding, Is Back in Vogue, and Here's Everything You Need to Know About It.
By Marlan Davis, Photography by Marlan Davis, The Manufacturers

Flathead Myths courtesy of Tony Baron ... Flathead History Lesson courtesy of Charlie Clark

Ford Flathead V8 - The Flathead Guide of Death

Flathead expert or novice, this publication should be included in your library. Learn What Works, Why It Works and How It Works ...

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***In the words of Fred Offenhauser..... 'There are street rods and there are hot rods.
Street rods have a Chevy up front and a can of wax in the back.
Hot rods have a flathead up front and tools in the back.'***