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IH: Oiling & Lubrication - Sub-03J

1957-1976 Oil Pump Performance Modifications

Click Here to view the IH oil pump page for a list of era specific pumps w/ pics and specs in the sub docs at the top of the page.

This is a compilation of mods to the oil pump and breather gear as compiled from XLForum members for 1976-earlier Sportster gear type oil pumps.

The main purposes for any oil pump is lubrication and heat management.
Most all mods on this page were designed, performed and/or otherwise thought of in the racing arena, some out of HD Racing Dept even. They should be viewed as experiments until you perform them yourself and verify the importance or benefit of using/running them.

Any and all modifications to the factory oiling / engine breathing system should be done at your own risk. Stock production / street motors were designed to operate with the parts the factory installed on them. So the oil pump your bike left the factory with should be more than sufficent for your factory motor's needs. However, sometimes performance upgrades to the motor can require upgrades to the oiling system including the oil pump, depending on the intended use. Just be advised that you can sometimes trash an otherwise good motor by performing unneccessary mods that prove to be more harm than good.

The Sportsterpedia is making no claims to success, but to show practices that have been done in the past in the pursuit of less drag on the motor ending in a couple extra horsepower at high RPM. Before attempting any of the mods below, make sure you know WHY you are attempting them before installation proceeds. A change to one part of the oiling / pressure system can bring on consequential issues to other parts of the system.

..... But First.....

Wet Sumping vs Horsepower

In this instance, wet sumping while the motor is not running has not been considered. This is a situation where you pump more oil in the motor than you can pump out (for various reasons) at speed, leaving enough oil unscavenged in the crankcase to get wrapped around and slow the flywheels.

From mrmom9r: [1)]

Even the slightest amount of what we call sumping drives the temperature of the engine and the oil through the roof very quickly. These things require a very specific amount of oil , not a little extra just in case. Once the oil depth reaches the spinning flywheel it is picked up and wound around the crank like maple syrup. That in turn causes more oil to be picked up until we have a ball of oil wrapped around the crank large enough to start dragging on the cases and the " drum brake effect" grows and grows. It's not just a colorful expression to say that you're running with your brakes on , you indeed really are. On the dyno you can hear an engine pull down when it sumps , HP drops , and your cylinder head temps start to climb. As a shade tree example, back in the early 70's a buddy of mine noticed his XLH would spew oil everywhere if you opened the oil tank just after an extended high speed run. The area above the oil filter canister was loaded with pressurized oil. The filter was restrictive enough that the return side of the pump would back up oil clear into the engine. When we removed the filter and canister the bike picked up about 5-6 mph on top and ran noticeably cooler at high speed. Bye bye number 5 plugs , hello # 4's just like a CH. And we haven't even started talking about roller skid. These things are much happier with just a cloud of oil mist for lubrication.

Diagnosing Scavenge Ability

From barefoot: [2)]
If you can get a dangerously low amount of lube in the crankcase, put an add up and all the XR guys will be pounding on your door asking how. Axtell used to run sump-chop dyno runs - like a plug chop. But instead of checking the plugs, you check the oil (by measuring amount of oil you can drain from the crankcase). The least they were able to get (as far as I know, anyhow) was two ounces. If they ever had one bone dry, they'd have been jumping up and down like cannibals at a missionary cookout.

From mrmom9r: [3)]
Checking throttle chop oil measurements is an important step in development. We found that if there's more than 2 ounces of oil in the crank compartment, you're running with your brakes on. Once we'd maxed out breather timing and flow capacity, if there was more than 2 ounces in there, it was time to start jetting down the oil feed from the pump to the crankcase at the cam cover mating surface.

More or Less Oil

From Ferrous Head: [4)]
When discussing modifications to the oiling system, questions need to be answered; What problem are you trying to solve? You can't fix a problem until you can define it. That basically means measurements. The "over oiling" issue doesn't occur in stock engines. No problem to fix. I understand the high revving XR750's encountered a problem at Daytona but is it a real issue on an engine that only runs to 6,000 rpm? And then, only briefly.

From thefrenchowl: [5)]
I hear a lot of complaints from K, KH and early X owners about fouling plugs, excess oil in exhausts etc... I can really say I never encountered such issues on any of my K, KHK, XLH or XLCH over the 40 years I

have rode them so far… And it made no real differences if I use pre-72 or post-72 breather towers… So I ask me why? And the only answer I can come up with is that I always ride them like there's no tomorrow and use all the revs available to me, and sometimes more… To me, it seems that this 750 WL/1000 FL antiquated oiling system only works well above a certain rpm, let's say 4000rpm. The racing oiling problem is another issue, let's face it, a Daytona KRTT revs at 7500rpm and a decent iron or alloy XR 7500 to 9500rpm. So the towers must have encountered other issues over say 6000rpm… Then the real problem boils down that this engine needed a sump from the day one… It only got one circa 1975 on the alloy XR and 1977 on the street Sportsters… So all the mods are really to evacuate as much oil as possible from the crank cavity, not really a problem with the scavenge side of the oil pump…

From mrmom9r: [6)]
In my part of the world the oiling system became a free-for-all once the mini sumps arrived with everyone having their own witch's brew of modifications loosely based on the mini sump instructions from HD Racing. The most popular setup seemed to be eliminating the breather function by various methods; modified 1/4 speed breather drum in 1/2 speed pump, modified 1/2 speed drum, holes in the cam chest floor into the breather passaqe, or any combination of the above. Lots of drainage capacity from sump directly to return side of pump , 1/2' i.d. minimum. Lots of cam chest venting capacity often with one or even two of the big pcv valves that Moroso sold for installing in headers on race cars. That was a fairly common setup that I was familiar with. In drag racing we flirted briefly with it but quickly returned to the simplicity of just not feeding the engine much oil in the first place.

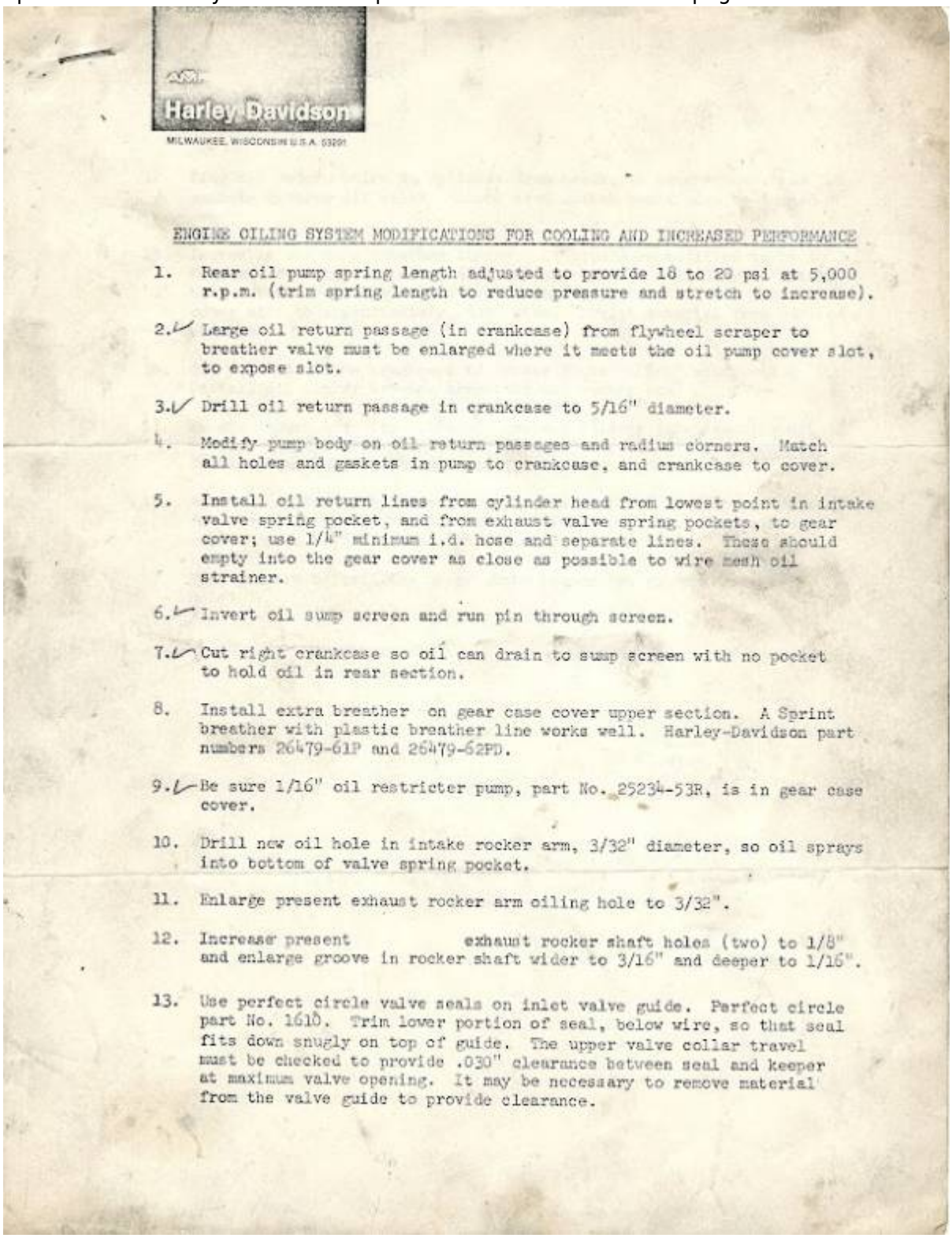
From barefoot: [7)]
Trial and error means bye-bye big end. Everyone gets excited about cams and valves but there's at least as much power and reliability to be gained by getting the lube system right. Maybe more.

From needspeed: [8)]
When I was drag racing I knew the value of not having too much oil in the crankcase, so after every run I would decrease the oil feed. The bike ran great until I ruined a set of special pistons from lack of oil. It's hard to know when enough is enough and too little is too little. I guess you have to have some part failures to find out.

Most Pump Mods Are Used in Combination w/ Engine Mods

Most of these mods were dreamed up before the invention of the mini-sump addition to the crankcase. Some of the oiling problems in the crankcase were later solved with the mini-sump engines (1975-up XR-750 and 1977-up production XLs). So to the fact of a magazine article from Custom Bike Magazine from October 1976 “Mini Sump Your Sportster”. In this article are instructions on adapting 1977-earlier Sportster engines with some of the oiling provisions of 1976-later Sportster motors. Case alterations include extending the bottom of the cases and alterations to delete the affects of the timed breather (while physically keeping it) as well as deleting the transfer valve. Oil pump alterations were basically to adapt the -72 production oil pump to the configuration of the 1975 XR-750 oil pump.
Click Here to read the full article in the Sportsterpedia.

Then again, some were advised by HD Racing Department in an overall view of things.
This document, “Engine Oiling System Mods for Cooling and Increased Performance” (date not available), shows many mods for both the case and pump. And these suggestions made their way around the Sportster community and showed up in some of the mods on this page.



Harley-Davidson
MILWAUKEE, WISCONSIN U.S.A. 53201

ENGINE OILING SYSTEM MODIFICATIONS FOR COOLING AND INCREASED PERFORMANCE

1. Rear oil pump spring length adjusted to provide 18 to 20 psi at 5,000 r.p.m. (trim spring length to reduce pressure and stretch to increase).

2. Large oil return passage (in crankcase) from flywheel scraper to breather valve must be enlarged where it meets the oil pump cover slot, to expose slot.

3. Drill oil return passage in crankcase to 5/16" diameter.

4. Modify pump body on oil return passages and radius corners. Match all holes and gaskets in pump to crankcase, and crankcase to cover.

5. Install oil return lines from cylinder head from lowest point in intake valve spring pocket, and from exhaust valve spring pockets, to gear cover; use 1/4" minimum i.d. hose and separate lines. These should empty into the gear cover as close as possible to wire mesh oil strainer.

6. Invert oil sump screen and run pin through screen.

7. Cut right crankcase so oil can drain to sump screen with no pocket to hold oil in rear section.

8. Install extra breather on gear case cover upper section. A Sprint breather with plastic breather line works well. Harley-Davidson part numbers 26479-61P and 26479-62PD.

9. Be sure 1/16" oil restricter pump, part No. 25234-53R, is in gear case cover.

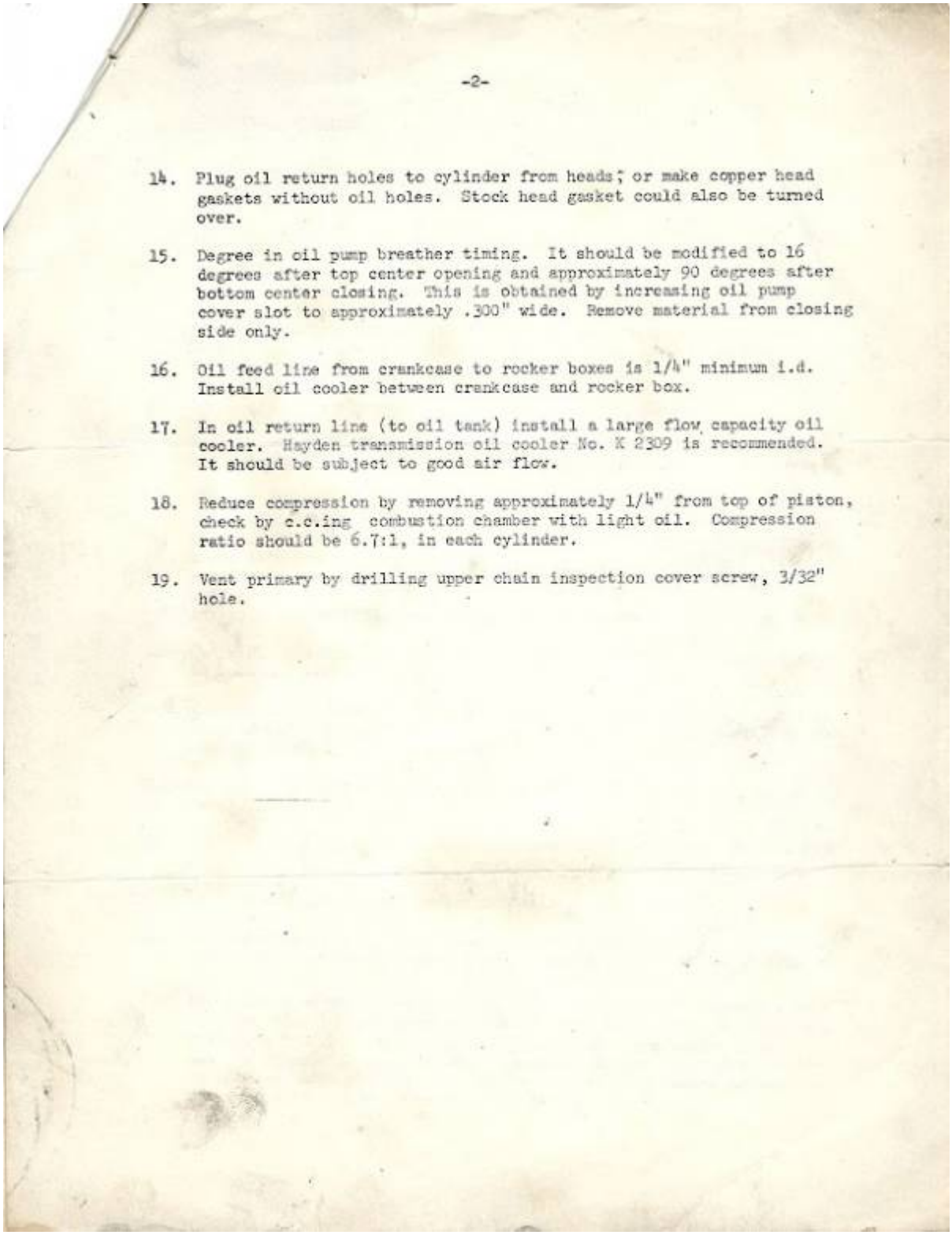
10. Drill new oil hole in intake rocker arm, 3/32" diameter, so oil sprays into bottom of valve spring pocket.

11. Enlarge present exhaust rocker arm oiling hole to 3/32".

12. Increase present exhaust rocker shaft holes (two) to 1/8" and enlarge groove in rocker shaft wider to 3/16" and deeper to 1/16".

13. Use perfect circle valve seals on inlet valve guide. Perfect circle part No. 1610. Trim lower portion of seal, below wire, so that seal fits down snugly on top of guide. The upper valve collar travel must be checked to provide .030" clearance between seal and keeper at maximum valve opening. It may be necessary to remove material from the valve guide to provide clearance.

9)



-2-

14. Plug oil return holes to cylinder from heads; or make copper head gaskets without oil holes. Stock head gasket could also be turned over.

15. Degree in oil pump breather timing. It should be modified to 16 degrees after top center opening and approximately 90 degrees after bottom center closing. This is obtained by increasing oil pump cover slot to approximately .300" wide. Remove material from closing side only.

16. Oil feed line from crankcase to rocker boxes is 1/4" minimum i.d. Install oil cooler between crankcase and rocker box.

17. In oil return line (to oil tank) install a large flow capacity oil cooler. Hayden transmission oil cooler No. K 2309 is recommended. It should be subject to good air flow.

18. Reduce compression by removing approximately 1/4" from top of piston, check by c.c.ing combustion chamber with light oil. Compression ratio should be 6.7:1, in each cylinder.

19. Vent primary by drilling upper chain inspection cover screw, 3/32" hole.

10)

1/4 Speed vs 1/2 Speed Oil Pump

From Dr Dick: [11] [12]

The revisions that have occured since 1972 to the XR-750 oil pump makes the statement “XR oil pump”

very vague. The term “1/4 turn” refers to the drive gear and breather sleeve. In this pump, the drive shaft turns 1/4 the speed of flywheels. A production pump turns 1/2 the speed of wheels. There are numerous factors that come to play in what pump or combo of pump parts gets you closest to your build goal. For instance- using a low speed pump pumps less oil. That means less parasitic power loss to drive it and the less oil pumped into motor per rev results in less fluid drag. Conversely oil starvation wears parts. And little oil flow means little oil cooling. Getting 10 miles from a set of pistons in order to squeak out lower et is attractive to a drag racer. Is that kinda thing attractive for a street bike? You gotta decide. The 1/4 speed is not a real option for street machines. Obviously, the 1/4 speed pump supplies enuff oil for a racer to finish races. And it will supply enuff to keep a street bike from freezin up. But it don't have the cooling effect of twice as much oil. It's the 1/4 that's made to order for goin real fast for a real short time.

From needspeed: [13)]
The narrow width of the 1/4 pump slots has more to do with the timing of the slower turning pump than oil and/or air flow through the opening.

Racing vs Production HD Oil Pump Bodies

The same oil pump body (blank) was used on 1952-1976 Production K Model and Sportster motors and 1952-1987 Racing KR, XLR and XR-750 motors.
The major differences vary and can not always be seen or gleened from the outside.
1952-1956 K Model and racing pumps through 1971 had a feed bypass which limits the amount of oil going to the motor.
These pumps can not be used on production model Sportsters even by using a 1/2 speed breather gear without blocking off the bypass.
Contrary to racing ethos, production models NEED that oil for both lubrication and cooling as they sit through red lights and putt at lower speeds.

The 1952-1955 production K Models and 1952-1957 Competition KR, KRTT and KHRTT pump has a vertical feed oil bypass thru the body halyway thru (feed side to the center of the pump) and adjoining a rear ball and spring regulator to only allow a certain amount of oil to the motor. The predetermined excess oil is sent to cam chest through the vertical bypass hole to be scavenged from there through normal route to the tank. The only way to distinguish this pump from the outside is notice the large hex plug on the rear of the pump. This pump will starve a production XL motor at idle-low speeds.

The 1958-1969 KR, KRTT, KHRTT, XLR, XLRTT and 1970 Iron XR-750 pump has a vertical feed oil bypass drilled all the way thru the body to only allow a certain amount of oil to the motor. On the return side is a milled “J” slot running from the vertical hole to the return gears. The center of the vertical hole is adjoined by a rear ball and spring regulator. The predetermined excess oil is sent to the return gears internally and out to the tank thru the normal route thru the engine. The only way to distinguish this pump from the outside is a stamped “R” in the lower outside body. This pump will starve a production XL motor at idle-low speeds.

The 1975-1987 XR-750 pump does not have a feed bypass. But it does have a hose nipple in the rear of the pump just like the -72 production pump does. And that nipple is tied into the return gears instead of

the feed gears. This pump has no external inlet for tank feed oil as required to mount on 1967-up XLH and 1970-up XLCH.

1954-1976 KH and Sportster pumps do not have afeed bypass built in although there were a few different versions of those as well.

What Era Factory Oil Pump Would Be the Most Beneficial on a Street Performance Build

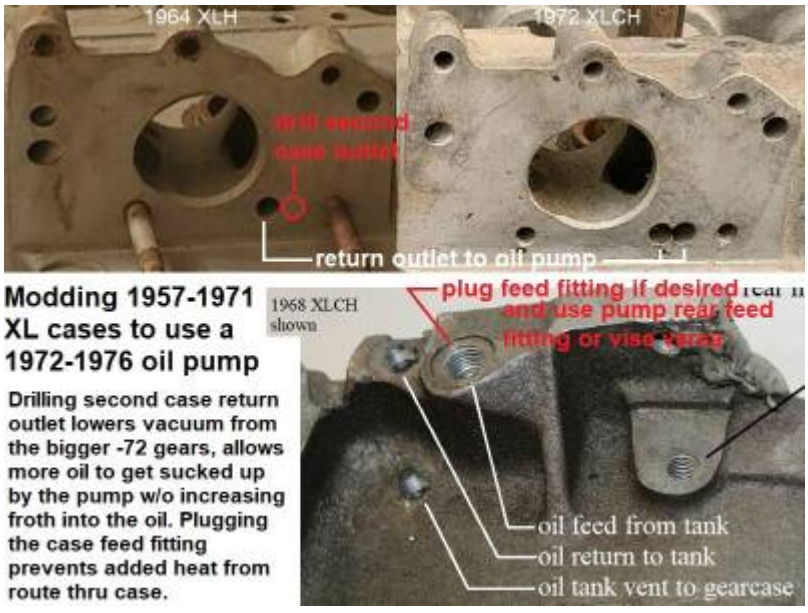
From Dr Dick: [14)]
I like using 72-76 pump. It has the best return to feed volume ratio. To take full advantage, you need to drill the additional hole in the mountin surface of the crankcase like the 72-76 case has. This pump feeds a lot of oil so it's not the setup for all out hp. But that volume means more cooling, best for longevity. Get a complete unit. It will have the breather gear with the big slots. Also gives you the option of not using the (thru the case) feed passage, goin direct to pump like xlh or 72-76. Some feel this is better cause the feed oil don't get preheated goin thru the hot case. I have also built many using the 62-71 and opening the breather slot up or using the -72 breather gear & snap ring. You must install the return gear upside down, so the counterbore for the original half moon retainers is not facing the snap ring when using -72 breather with -62 body & gear set. I think it's also important if using an oil filter that a low pressure return bypass be fitted to keep the restriction down at high rpms. Also note that there is an extra oil return hole from the case to the return side of the pump on a -72 pump that is not there in the '69 case unless you drill it. The benefit of the -72 pump is increased scavenging capacity which helps prevent wet sumping at sustained highway speeds. It doesn't do much if you don't allow more oil to get to it. Many people believe it also has the breather timing of the race pumps but that is not entirely correct. When timed on the mark, they have the opening point of the race pump (15 degree ATDC) but not the closing point. The breather slot needs to be enlarged to achieve a closing of 85 degrees ABDC if you're wanting to match the race pump timing. It's a worthwhile modification when building the motor if you have a degree wheel to verify the results. Otherwise don't worry about it. They're still an improvement over the early pump. The benefits of the race timing are a few free HP, lower oil temps, better fuel mileage and all the things that come from an engine running with less drag.

From mrmom9r: [15)]
I wouldn't get too crazy trying to find 1/4 speed parts. The -72 is a better pump. With only slight modifications, there is no HP difference between them. I have a racing philosophy that has served me very well. K.I.S.S. Keep It Simple Stupid. Basically it means, don't go trying to solve problems you don't have yet. The most valuable commodity you have in racing is time. You will be hard pressed to find enough time to solve the problems you do have and all problems have a time to benefit ratio.

Installing 1972-1976 Oil Pump (Complete) on

1971-Earlier Motors

- The bigger return gears in the -72 pump suck up more oil at a higher suction (vacuum) rate. The faster they rotate, the more vacuum is created.
- As mentioned above, the return hole in the case mounting surface needs to be enlarged with a second hole to lower the added vacuum generated by the return gears. Gravity does little to flow oil through that return hole. The pump depends on suction (vacuum) from the gears AND positive crankcase pressure (piston downstroke) that makes it's way into the cam chest to push the oil in the cam chest sump (below the cam floor screen) to the oil pump's vacuum chamber.
- Lowering the vacuum created from the bigger gears in the -72 pump also allows the pump to suck up more oil without added stress, which lowers the possibility of making froth in the oil due to higher vacuum sucking on the single inlet hole in 71< motors.
- Using pre-72 pumps on pre-72 motors creates a factory designed amount of vacuum on the return inlet of the pump.
  Using -72 pump on pre-72 motors increases the amount of vacuum on the return inlet of the pump (more than the factory designed). This may not be an issue on low to medierate RPM but will most likely be an issue for racing applications.
- Plugging the feed inlet fitting on the top of the case (if you have one) and plumbing the hose to the feed fitting on the rear of the pump takes oil from the tank directly into the pump, bypassing the hot engine case, without the added heat from the case.
- You can always plug the rear feed fitting on the pump and use the feed fitting on top of the case instead (if you have one). You get the same amount of oil from either connection. Gravity only pushes the oil to the return gears. The return gears are sucking on the oil as well. And you'll never pump more oil than can collect in the gears per rev.



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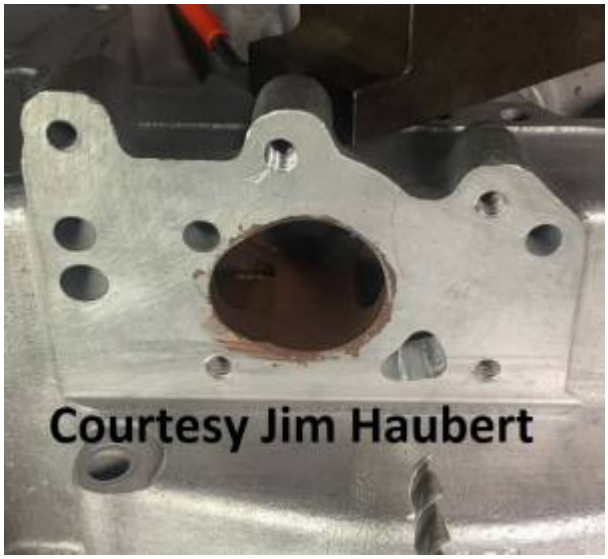


[17)]

1977-Up Gerotor Oil Pump on 1976-Earlier Cases

Below is a reprint from the Custom Bike article “Mini Sump Your Sportster”, October 1976.
Click Here to read that article in the Sportsterpedia.

The gerotor oil pump could conceivably be adapted to 76-earlier cases, but the effort and expense would far outweigh any benefit. Even the XR-750 racing engine conversion to the mini-sump is accomplished utilizing the gear pump. Besides getting into a lot of welding, which could easily wreck your cases due to warpage and much additional machine work, other expensive factors preclude the use of the gerator pump.

For instance, the pumps turn in opposite directions. It seems, on the surface, that by simply changing pinion gears, the correct rotation can be established. Not so. The splined section on the early pinion shaft consists of four splines, one of which is larger than the other three. The 1977 pinion has six equally spaced splines. The 77 pinion shaft will bolt into the 23900-75 flywheel, but then the fun begins. For one thing, the shaft is longer, (necessitating a cam cover bushing modification). The main drawback though concerns the new Torrington bearing in use on the minisump model. Additional machine work will be necessary to fit this bearing into early cases, and the early bearing will not fit the late pinion shaft. So you see, while it is possible to use the gerotor oil pump. It is not practical. But, why sweat it?

From Ivan RoachCoach: [18)]
ANYTHING is possible. A finnish friend recently mounted an Evo Sportster oil (gerotor) pump on an IH. He had to reverse the oil flow direction, switch the entry & exit ports on the pump, mate an Evo shaft to the IH gear and cut out and re-weld a section of frame cradle to do it. But it STILL came out cheaper than ordering a new IH pump and having it shipped to Helsinki.

Pump Body Mods

Cam Cover Mounted Scavenger Pump

From CHOPTOP37: [19)]
The guy who dyno'd my bike has a 88 inch trock bike, 100 hp at the wheel,125 on spray. Obviously he spent years tweaking it and one thing he showed me was it's got an external cam driven oil pump, for scavenge only. I believe it's for the crank case scavenge only. He claims it was a key element in cracking the 100 hp mark.

From Barefoot: [20)]
To be honest, this really is kind of a KR-era hopup. The first XR pumps were just like Sportster pumps but later on they got better. But this is easy for guys to do by themselves without spending a bundle, and it does help. Mert had some cam covers made that had pumps built into them for scavenging. I don't know how many he sold or how much difference they made. When I first put my engine together it had such an oiling problem that I went out and scrounged up the oil pump from a DFV. Was going to just use the scavenge side and put it where the mag goes and run a distributor ... if that didn't fix the problem nothing would. I've read that the Ford four-cam Indy engines had several scavenge pumps and ran several inches of vacuum in the crankcase. My guess is that restricting pressure-side oil in a Sportster is not such a good idea, more for cooling than oiling reasons. Anyway, this is kind of a cute trick and cheap and at one time it was popular with some national numbers. Worked good enough to help win some races, I guess.

21)

Stacking Additional Scavenger Gears

From Barefoot: 22)
Go go buy a new set of pressure gears. What's the face width, a quarter inch? Pick up a little piece of aluminum, the same size as the pump body and maybe an eighth inch thicker than the gears. Blue it, set the pump body on it, scribe a line, rough it out, drill bolt holes and screw it together with body. (Nuts on the far side, this is temporary) Dremel to the scribed shape. Now you're a tool and die maker. Bore two blind cavities in it the size of the o.d. of the skinny gears and aligned with the pump body. Heat the body, remove the stub shaft for the driven gears, replace it with a piece of drill rod the same diameter but a little longer. Now put the fat driven gear on the stub shaft, then the skinny gear (with the scavenge side of the pump facing up.) On the drive side, put the skinny gear then the fat gear. Check the drive key. You only have to drive one gear, the rest will drive each other. Lap everything so there is basically no clearance on the sides of the gears. The thin paper gasket will give you all the clearance you need. Check out your pump carefully and fix whatever it is I just forgot. You now have about 30% more scavenge capability without changing anything major. There should not be a problem with clearance in the frame.

From mct496: 23)
With the small gear slid on first theres still better than half the drive key to engage the large gear. Small gears are .180“ thick drive slot is a fuzz larger but like you said only need to drive one gear. Don't think you can make the gear cavity deeper though the passage out of the pressure side is pretty close.

Barefoot: 24)
You may have to relieve the key so it only drives one gear ... memory ain't that good but I don't think the

keyways are timed to the teeth, so you could end up with two gears fighting each other if they are both keyed. Just have to try it ...didn't seem to be a problem since the body is aluminum and the thing is full of oil anyhow. If you want to do it really right, should probably put a pair of small dowel pins in between the body and the new bottom cover to make sure the cavities stay lined up. The bolts aren't a tight enough fit to make sure it all stays perfect. With the gears in there they'll sort of line up naturally but doesn't hurt to make sure. Yeah, in the past we had more time than money. The other nice part is, AMA tech inspectors never caught this and 99% of your competitors didn't figure it out either. So now I let the cat out of the bag, all the fast KR guys are going to be pissed at me.

Reducing Feed Gear Width

From Dr Dick: [25)]
The feed gears can be be reduced in width to pump less oil into the case instead using a 1/4 speed drive gear. I have used it but I found that there was a quick and dirty way to get to the same place. Simply put; install a restrictor on the supply pump output. Then install a pressure sensitive relief valve that either returns excess oil to the tank or back to the supply side inlet. Mount it where the oem oil pressure sender was normally located.

Restricting Feed Oil to the Motor

From Dr Dick: [26)]
You can install a restrictor on the supply pump output. Then install a pressure sensitive relief valve that either returns excess oil to the tank or back to the supply side inlet. Mount it where the oem oil pressure sender was normally located.

From mrmom9r: [27)]
Checking throttle chop oil measurements and it's an important step in development. We found that if there's more than 2 ounces of oil in the crank compartment you're running with your brakes on. Once we'd maxed out breather timing and flow capacity , if there was more than 2 ounces in there, it was time to start jetting down the oil feed from the pump to the crankcase at the cam cover mating surface.

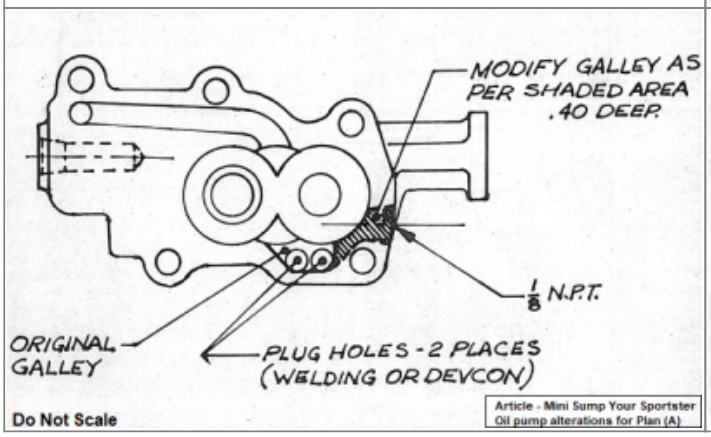
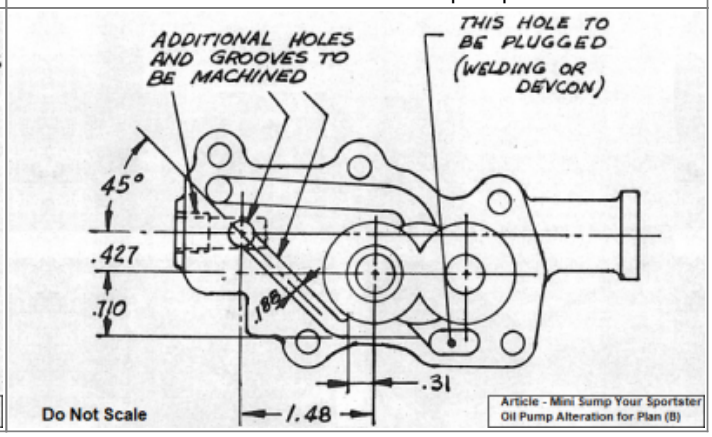
From needspeed: [28)]
I've never used the pinion shaft restriction approach. At one time I was using 1977 crankcases with the gerotor pump. The passage where the oil pressure switch would go was drilled and tapped for a jet. The jet location was in far enough that it restricted the feed oil before it went up into the engine. So all I had to do was remove a pipe plug, change the jet and replace the pipe plug.

From chevelle: [29)]
The cam cover passage restriction may be a compromise, but I'm sure he came to that conclusion from years of experience. The way I was shown was to use .090” pinion shaft restriction jet and then run one single feed line from the case rocker feed to the rocker boxes then split (tee) to each box. Use the second case rocker feed to bleed extra unnessary oil back to the oil tank. This way, using restriction sleeves in hoses it's possible to restrict and adjust the amount of oil going up to rockers and residual oil gets returned to tank. The pinion shaft jet is adjustable also, by drilling to appropriate sizes. My builder

said he came to a happy medium for oil restriction and reliability at .090“ the hard way, trial and error is costly, but to push the boundaries sometimes it's the only way.

Adding a Return Port on the Oil Pump

This mod is suggested in the Custom Bike article “Mini Sump Your Sportster”, October 1976.
Click Here to read that article in the Sportsterpedia.
The purpose was to create an alternate external return inlet on the pump to allow for direct connection to a mini-sump mod discussed in the article. The article was based off trips to HD Racing Department in the interest of adopting the 1975 XR-750 mini-sump concept to 1976-earlier cases. The article discusses 2 different ways (plan “A” and plan “B”) to put a return line inlet on production model gear pumps. Both methods below also require additional alterations to the cases further discussed in the article to achieve the desired outcome.

This is plan “A”. There were no additional instructions.	This is plan “B”. There were no additional instructions. This method mimics the 1975 XR-750 pump.
	

Different iterations of this mod are listed below.

From Dr Dick: [30)]
All the return oil must end up in the cavity below the round screen in the cam chest. Ehat's where the pickup is for the return pump. Gettin all oil there without suckin up hp is the racers holy grail. So what your mod should help is movin any avalible oil w/o unnecessary restriction. Some guys feel the case return passage is too resrticted especially if the drilled passages dont intersect cleanly. So they drill an tap the pump body for a fittin port that goes directly into the return side pump. Now the case passage isn't used (blocked off). A hose goes right from the return pump to the tank.

From mrmom9r: [31)]
The (feed) oil inlet in the back of the pump body began in 1967 on XLH models and on all in 1970. The real reason for it was the electric starter took up the space that the inlet into the cases used to occupy. It is a popular mod to drill and tap for the return to come from the back of the pump as well. It's kind of a delicate job as the room for it is limited. The claimed advantages are the oil spending less time in the hot cases and a little more free flowing return to the tank. I've had them both ways and found no performance advantage.

This can be done on any 1952-1976 oil pump and was done on the -72 pump below. The left fitting is the

factory feed nipple and the added right fitting is the additional return nipple.

32)

Porting/Polishing Pump Body

While porting the internal ins and outs sounds like a productive endeavor, it's actually counter-productive to the MoCos design.
(matching resistance from pump to tank and vice-versa)
Take any factory unmolested gear pump body (including KR, XLR and XR-750 pumps)and look at the surface of the ins and outs (both feed and return). You'll see they have a rough surface (as cast) for the oil to travel across. The rough surface creates a resistance to flow, or makes the oil have to work to get across to the other side. So why make it harder for oil to travel across the pump? Porting the aluminum in the pump allows oil to flow faster (only in the pump). It does nothing to make oil flow faster through the hoses to and from the oil tank. And it could (most likely will) alter the pressure to and from the gears as well. While stating this position, it is also worth noting that HD Racing Department at one time did create a document of Engine Oiling System Modifications for Cooling and Increased Preformance in which one of the suggestions is to “modify pump body on all return passages and radious corners. Match all holes and gaskets in pump to crankcase and crankcase to cover”. However, it does not say to polish the feed or return channels in the pump.

From Ferrous Head: [33)]
Carefull analysis will show that the real problem is failing to move the oil quickly enough. Not that the volume is too high. Removing the oil from the cases is the right answer to the over oiling issue. Not restricting the supply. Have a look at the time and effort OB expended on just doing that. Polishing the inside of the cam chest and removing the sludge trap and inverting the oil screen. All aimed at moving the oil through faster. He wanted it outside the engine transferring all that waste heat into the atmosphere.

- **Polishing the feed and return paths**: no gains with possible side effects.
    1. Feed side:
       If you can polish the long oil inlet path (without making the path bigger), then the vacuum

from the gears on the feed side may snatch up the oil (already in the pump) without sucking oil from the hose at the same rate. Basically oil could flow faster from the (slicker inlet surface to the gears) than from the (more restrictive internal hose surface to the inlet). This could lead to sporadic air bubbles dropping out of oil suspension internally, less oil deleivery along with the possibility of cavitation of the pump at high revs.

2. Return side:
   If you polish the long outgoing oil path (without making the path bigger), then there doesn't appear to be any immediate harm. That does nothing to improve the flow to the tank though since you are also dealing with the friction of the hose which negates any porting to the return path in the pump. Oil moves smoother from the gears to the hose and rougher as oil moves through the hose to the tank. What is the gain? There may be a slight loss of pressure through non-resistance in the pump. The rougher path increases the pressure at which the oil starts out in the pump. With the pump being the source of pressure, decreasing pressure in the pump also decreases pressure through the hose to the tank and slows down oil delivery. Any added second longer that hot oil stays in the pump increases the heat on the oil and pump body.

- **Porting the feed and return paths**: no gains with probable side effects.
  1. Feed side:
     Making the long inlet wider/deeper reduces the vacuum pull on the hose from the tank. It may have little affect at idle but could lead to oil starvation at higher revs. If you port the short outlet area near the gears (without making the hole bigger) you lose that tiny “shelf” which acts as a backstop and helps usher oil into the feed hole. Making the outlet hole bigger slightly reduces outlet pressure inside the pump and consequently to the motor.
  2. Porting the return side:
     Making the long outgoing oil path wider/deeper reduces the pressure put out by the return gears and slows down the oil traveling to the hose and then tank. With oil staying in the pump longer, it also allows the hot oil to stay in the pump longer which increases the heat on the pump body. What is the gain? If you port the area around the return inlet hole at the gears, that could lead to faster sucking on the oil there and slower on the actual inlet hole just as in the long feed path. Making the inlet hole bigger on pre 1972 pumps negates some of the vacuum that the return gears create. You think, but the -72 pump has 2 return inlet holes so what's the big deal? The -72 pump has bigger return gears and makes more vacuum than previous year pumps. So the bigger gears compensate for the double barrel holes. Why did the MoCo bore that second hole? If thinking seriously about it, the 1 single inlet hole is big enough to suck a whole lot of oil into the pump without falter. But with the bigger return gears in the -72 pump making more vacuum, they also stand the chance of choking down the incoming feed oil on high rpm. Not enough to choke it closed but surely enough to slow the flow at a percentage of rpm. So the double barrel holes relieve some of the added vacumm on the gears so flow is not impeded.
  - **If you clearance and polish the gears in the pump they leak a bit more**. [34)]

This is not "constructive porting". This ensures that (A) suction toward the gears is reduced (slows flow in, especially on higher rpm) and (B) pressure toward the tank is reduced (slows flow out).

Timed Breather Mods

Adding a Second Window in Tower Housing

This mod is suggested in the Custom Bike article “Mini Sump Your Sportster”, October 1976.
Click Here to read that article in the Sportsterpedia.
It's purpose is, from the article, to obliterate the timing feature of the oil pump and punch holes in the cam wall to breath thru (like 77-up cases).
Along with this mod is suggested to alter the oil pump to scavenge the new mini-sump that is included in the overall case modifications.
HD racing dept advised to drill a 1/2” hole through the timing slot of the inner housing “sleeve” and continue that hole thru to the other (front) side of the sleeve. Drilling the hole this way will guarantee the

valve will never be closed no matter what position the breather gear is in.

From mrmom9r: [35] [36]
Milling another slot on the opposite side of the housing that the breather drum rotates in to blow across the drum as well as up into cam chest doubles the blown area both on upstroke and downstroke. I have cut a mirror image slot in the breather sleeve, removed the screen and enlarged the drain opening to the gear case from the cavity with great success. It does tend to blow more oil out the breather (1-1/4“) exiting at gen location. Many people have told me it doesn't work/can't work but I went faster with it. Maybe because I turned my motor tighter than most, but it worked for me. This was a drag racing application and I never concerned myself about how much oil was in the puke can. I always felt the more the better, after all my goal was getting oil out of the motor- I didn't care how. BTW this requires porting the breather passage from the crankcase as it now becomes the restriction. I should also mention I was using the XLR (8-ball) crankcase breather valve which is a one way breather that allows air intake to the crankcase on the upstroke of the pistons preventing oil from being sucked back into the crankcase from the breather passage.

(Do not use on street engines)


[37]


[38)]

Altering Breather Timing

See the link at the top of this page to a list of year specific oil pumps and information:

This XLForum thread is very enlightning on the workings of the breather valve:
https://www.xlforum.net/forum/sportster-motorcycle-forum/sportster-motorcycle-era-specific-and-model-specific/ironhead-sportster-motorcycle-talk-1957-1985/122424-breather-diagrams

From Hippysmack:
For all the different combinations of breather window timing, there is a reason why the window was cut just so deep/wide, wherever the end result landed. Below are some of the best reasons for changing window size. That says nothing to exactly what size is best for any application. These are primarily mods done in the interest of freeing up drag on the flywheels due to exceess oil left below the wheels to end up wrapping the wheels and slowing the motor and/or less drag on the pistons as a result of vacuum created by the pistons on upstroke. None of this section has anything to do with what might be a good or bad idea for a street motor. So take all of this as RACE ONLY and only perform any of these at your own risk. The best way to actually know the opening and closing times of your breather is to use a degree wheel. Don't count on the little dot and notch method from the factory. Or else just use factory parts. And the best way to judge if a mod works properly is through dyno testing of the results. Else you have no real claim for results. **Widening the breather window (or otherwise using the -72 breather gear) on a 1971-earlier pump should help to remove more oil from the crankcase to the (oil trap to cam chest). But it does nothing to move oil from the cam chest to the oil tank.** You'd be assisting the crankcase scavenging but not the cam chest scavenging (loading up the pump return side with more oil at once than it was designed to handle). That is why the complete -72 pump is so much better since the return gears were made taller to move more oil out at the same time that it moves more oil out the crankcase with the wider breather window. The -72 pump is engineered / balanced to assist both the crankcase and the cam chest at the same time.

From mrmom9r: [39) 40) 41)]

The shallow sump,timed breather system comes from the aviation world of old. Piston driven aircraft had to be able to evacuate the oil from the crankcase regardless of engine attitude and that system does that. At the time Harley adapted that system they were copying the highest engine technology of the day. They just took too long to abandon it as technology advanced. The added sump system was brought into production to eliminate the need to time a breather to save time on the assembly line. Documents from HD Racing from the period show no HP gain between the 2 systems when the breather is PROPERLY timed (which didn't happen a lot). I know that every time you make the breather opening bigger and the timing longer, you go faster. Closing at BDC eats HP through pumping loss. When the capacities of the two systems are balanced, the engine gets a lot happier. If the crankcase inhale is greater than the exhale, I've just created a pumping loss. If the crankcase exhale can out flow the inhale, I've left HP on the table. They figured out pretty quickly that it could be left open longer with no negative effect thus reducing that loss. I'll just say,keep increasing the area of the window and drum opening and it is possible to open it as early as 5 after and it doesn't seem to care much about when you close it, 85-90-220-221 whatever it takes. I should add that all of this is with a huge (3/4” minimum) cam case vent. You will not record any increases blowing thru the little steel tube stock vent. This a drag race only application vented out the generator hole. These are race only specs. Do not try on your street bike as there are several other modifications that have to accompany these specs that are not appropriate for the street. The benefits of altering breather timing are a few free HP, lower oil temps , better fuel mileage - all the things that come from an engine running with less drag.

From thefrenchowl: [42)]
The factory found, with race engines on the dyno, that the late closing breather gives the most average vaccum (cycle is vaccum /pressure etc as pistons rise and fall). Also found on the dyno, the best race engines were the ones with the most average vaccum, all other things being equal. The KR, XLR and XR all had the late timing from the start, but with 1/4 speed pumps. Obviously, these are the race engines, higher revs... However, Sportster and K/KH engines tend to wet sump at low revs, so use all the revs at your disposal. I can't see the point of plodding along at 3000rpm with a Sportster.

Some specs and instructions for timing race engines below: Click on any pic to enlarge.
The diagrams show how to mod pre-1971 towers to the later H-D specs. [43)]
And looking at the dates, they weren't intending these to apply to the -72 breather gear.

From thefrenchowl: [44)]
It's not too easy to mod the early gears to later specs, it's heat treated steel, bloody hard!!! Good machinist required!!!
(modding the housing is easier with it's softer material)

Here is a compilation of timing specs for various performance bikes. Click on pic to enlarge:

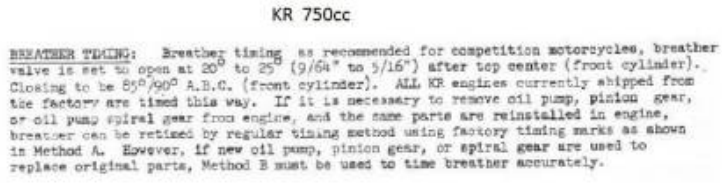
1970 iron XR 750cc

OIL PUMP & TIMING:

MEASURE OIL PUMP PRESSURE WITH OIL HOT (140°F) AT 5000 RPM. MAX. 10 PSI. BREATHER VALVE TIMING IS MEASURED IN RELATIONSHIP TO FRONT CYLINDER

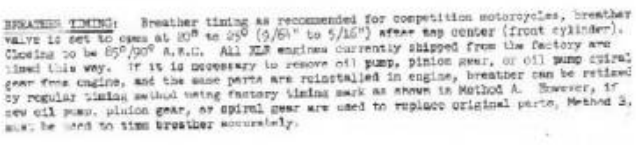
OPENING 16° - 20° A.T.D.C.
CLOSING 80° - 85° A.B.D.C.

KR 750cc



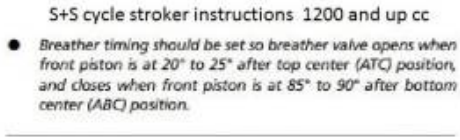
BREATHER TIMING: Breather timing as recommended for competition motorcycles, breather valve is set to open at 20° to 25° (9/64" to 5/16") after top center (front cylinder). Closing to be 85°/90° A.B.C. (front cylinder). ALL KR engines currently shipped from the factory are timed this way. If it is necessary to remove oil pump, pinion gear, or oil pump spiral gear from engine, and the same parts are reinstalled in engine, breather can be retimed by regular timing method using factory timing marks as shown in Method A. However, if new oil pump, pinion gear, or spiral gear are used to replace original parts, Method B must be used to time breather accurately.

XLR 900cc



BREATHER TIMING: Breather timing as recommended for competition motorcycles, breather valve is set to open at 20° to 25° (9/64" to 5/16") after top center (front cylinder). Closing to be 85°/90° A.B.C. All XLR engines currently shipped from the factory are timed this way. If it is necessary to remove oil pump, pinion gear, or oil pump spiral gear from engine, and the same parts are reinstalled in engine, breather can be retimed by regular timing method using factory timing mark as shown in Method A. However, if new oil pump, pinion gear, or spiral gear are used to replace original parts, Method B, must be used to time breather accurately.

S+S cycle stroker instructions 1200 and up cc



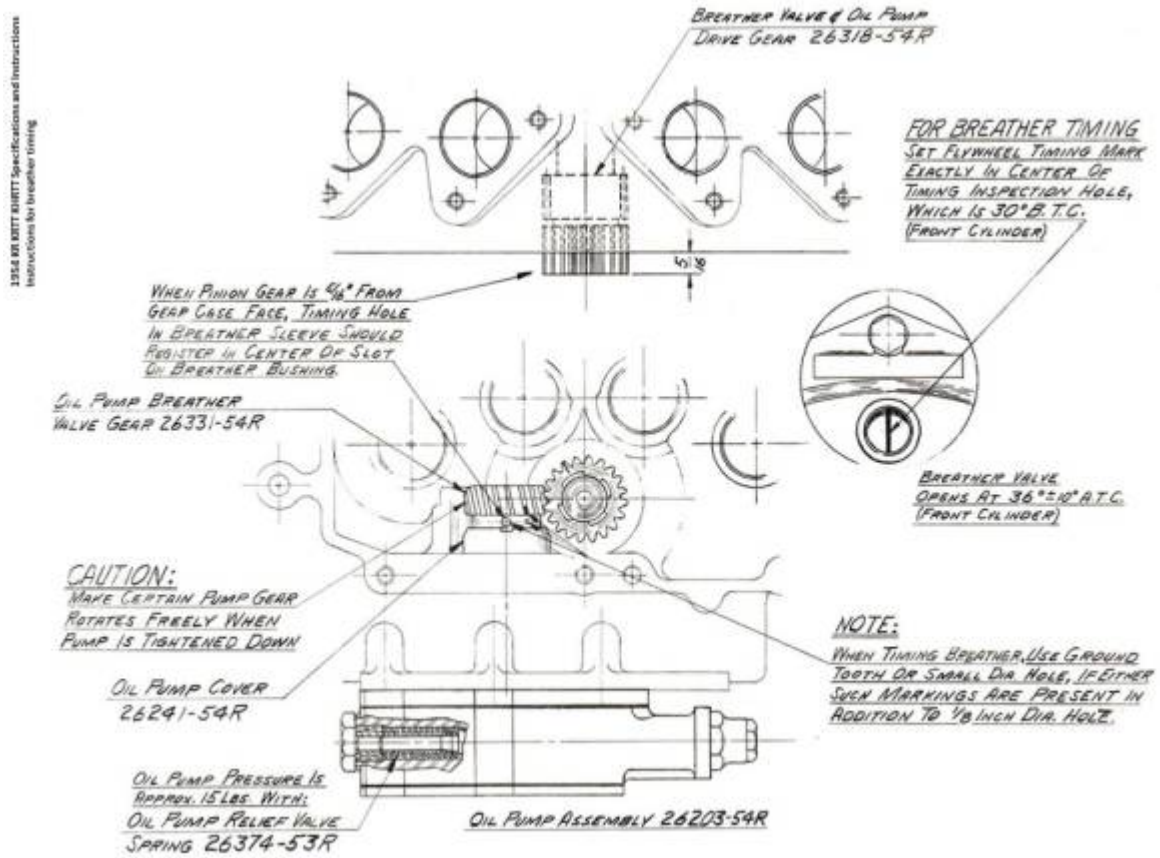
- *Breather timing should be set so breather valve opens when front piston is at 20° to 25° after top center (ATC) position, and closes when front piston is at 85° to 90° after bottom center (ABC) position.*

1000cc

The timing of an unmodified breather on a '72-'76 1000 ironhead is very close to the HD racing spec of opens @ 25° A.T.C. and closes @ 85° A.B.C.

45)

1954 Racing Specs and Instructions



1954 KR KRTT KHRTT Specs

1961 Competition Racer Specs and Instructions

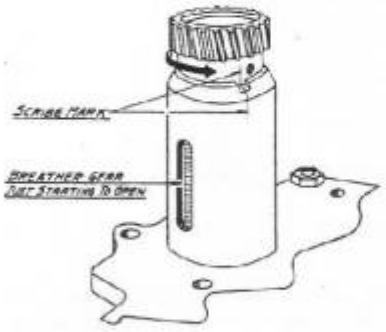
From 1961 KR KRTT XLRTT Specs and Instructions pg28.
Instructions to convert XL oil pumps to racing specs.

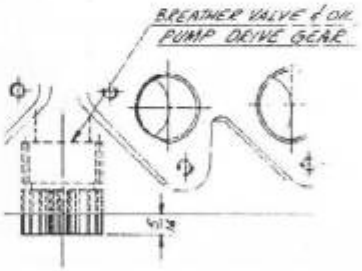
A 1/4 - speed oil pump, part number 26203-54RA, and drive gear, part number 26318-54R, may be installed in place of the 1/2 - speed oil pump.

Caution: This oil pump will have lower oil pressure and should only be used for maximum performance (racing only).

Oil pump timing should be checked as follows:

Before installing the oil pump turn the gear counter clockwise until sleeve hole passes slot in pump body. Scribe mark across sleeve and body at slot when next opening in sleeve STARTS to open (use a .002" shim in opening). See illustration.



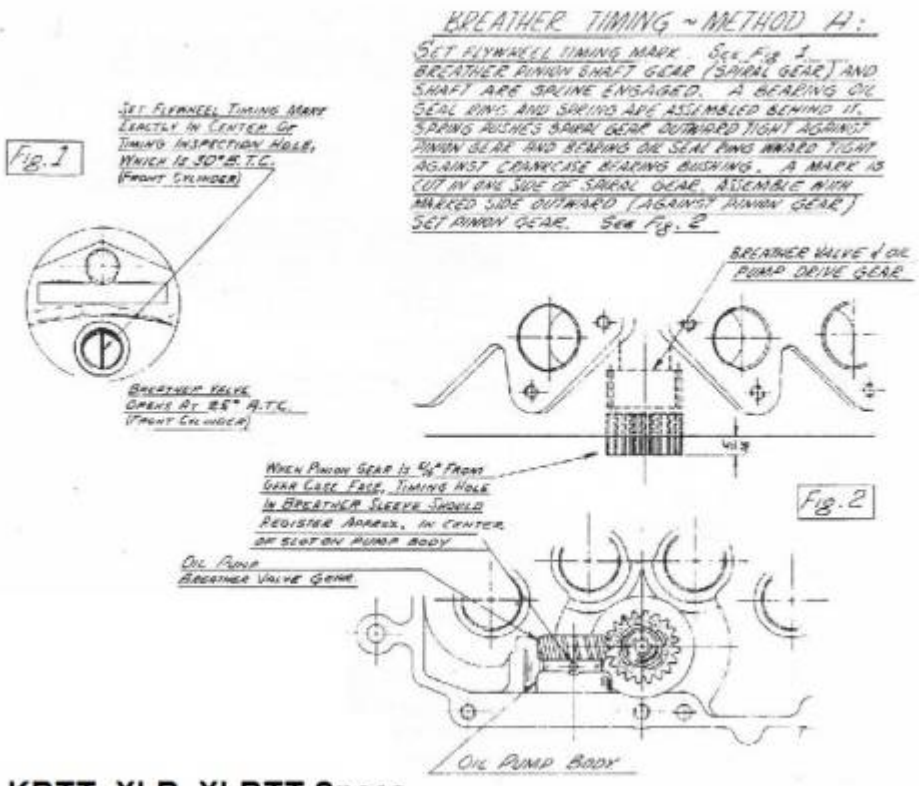


Set the front cylinder at 25° A. T. C. Install the oil pump, engaging the proper gear teeth to line up the scribe marks when pinion gear is set 5/16" from gear case face.

For Racing XLs only

NOTE: If marks do not line up material may be ground off the pinion gear o: shims, part number 18268-48 may be used between the gears.

1961 KR KRTT XLRTT Specs and Instructions pg 12
In structions for breather timing using Method "A"



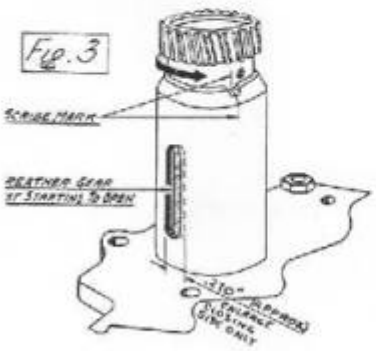
1961 KR, KRTT, XLR, XLRTT Specs Method "A"

1961 KR KRTT XLRTT Specs and Instructions pg12
Instructions for breather timing using Method "B"

BREATHER TIMING - METHOD B

BEFORE INSTALLING OIL PUMP TURN GEAR UNTIL SLEEVE HOLE PASSES SLOT IN PUMP BODY. SCRIBE MARK ACROSS SLEEVE AND BODY AT SLOT WHEN NEXT OPENING IN SLEEVE STARTS TO OPEN (USE .012" SHIM IN OPENING). See Fig. 3

Fig. 3



IGNORE FLYWHEEL TIMING MARK. SET FRONT CYLINDER PISTON 9/64" TO 3/16" (85°) B.T.C. INSTALL PUMP-ENGAGING PROPER GEAR TEETH TO LINE UP SCRIBE MARKS WHEN PINION GEAR IS SET 5/16" FROM GEAR CASE FACE.

IF MARKS DO NOT LINE UP:

- SLEEVE MARK SLIGHTLY TO RIGHT OF BODY MARK - GRIND STOCK FROM ENGINE SIDE FACE OF PINION GEAR OR USE NARROWER PINION GEAR.
- SLEEVE MARK SLIGHTLY TO LEFT OF BODY MARK – USE AT. No. 18268-8B (.015" THICK) WASHER BETWEEN PINION AND PUMP DRIVE GEARS, OR USE WIDER PINION GEAR. BREATHER VALVE SHOULD CLOSE AT 85° B.B.C. TO OBTAIN THIS TIMING, ENLARGE THE OIL PUMP COVER SLOT BY FILING THE CLOSING SIDE ONLY TO DIMENSION SHOWN.

1961 KR KRTT XLR XLRTT Specs
Method "B"

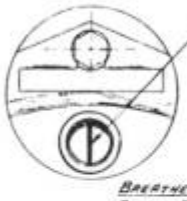
1963 Competition Racer Specs and Instructions

1963 KR KRTT XLRTT Specs and Instructions pg9
Instructions for breather timing (song Method "A"

BREATHER TIMING ~ METHOD A:

SET FLYWHEEL TIMING MARK. See Fig. 1
BREATHER PINION SHAFT GEAR (SPIRAL GEAR) AND SHAFT ARE SPLINE ENGAGED. A BEARING OIL SEAL RING AND SPRING ARE ASSEMBLED BEHIND IT. SPRING AUSHES SPIRAL GEAR OUTWARD TIGHT AGAINST PINION GEAR AND BEARING OR SEAL RING INWARD TIGHT AGAINST CRANKCASE BEARING BUSHING. A MARK IS CUT IN ONE SIDE OF SPIRAL GEAR. ASSEMBLE WITH MARKED SIDE OUTWARD (AGAINST PINION GEAR) SET PINION GEAR. See Fig. 2

Fig. 1



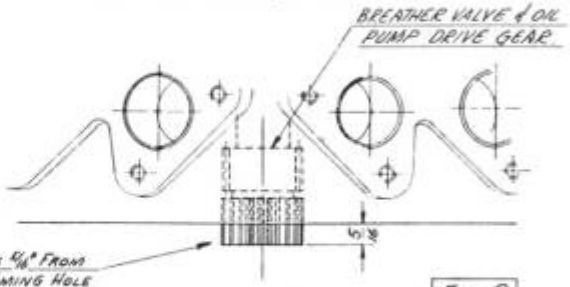
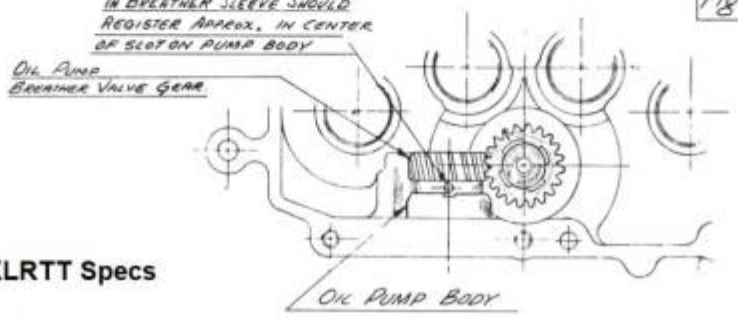


Fig. 2



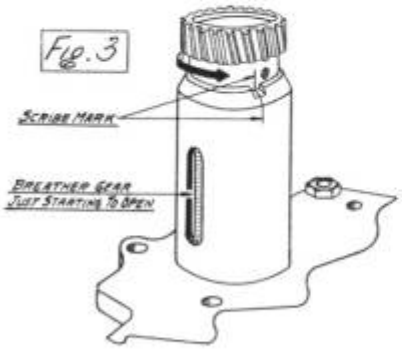
1963 KR KRTT XLR XLRTT Specs
Method "A"

BREATHER TIMING ~ METHOD B

BEFORE INSTALLING OIL PUMP TURN GEAR COUNTER CLOCKWISE UNTIL SLEEVE HOLE PASSES SLOT IN PUMP BODY. SCRIBE MARK ACROSS SLEEVE AND BODY AT SLOT WHEN NEXT OPENING IN SLEEVE **STARTS** TO OPEN (USE .002" SHIM IN OPENING). See Fig. 3

IGNORE FLYWHEEL TIMING MARK. SET FRONT CYLINDER PISTON 9/64" TO 5/16" (25°) A.T.C.
INSTALL PUMP-ENGAGING PROPER GEAR TEETH TO LINE UP SCRIBE MARKS WHEN PINION GEAR IS SET 5/16" FROM GEAR CASE FACE.
IF MARKS DO NOT LINE UP:
- SLEEVE MARK SLIGHTLY TO RIGHT OF BODY MARK - GRIND STOCK FROM ENGINE SIDE FACE OF PINION GEAR OR USE NARROWER PINION GEAR.
- SLEEVE MARK SLIGHTLY TO LEFT OF BODY MARK – USE PT. No. 18268-68 (.015" THICK) WASHER BETWEEN PINION AND PUMP DRIVE GEARS, OR USE WIDER PINION GEAR.

Fig. 3



1963 KR, KRTT, XLR, XLRTT Specs
Method "B"

Go To Technical Menu

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2) , 3) , 27) , 29) , 33)
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4)
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6) , 7) , 8) , 28)
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9) , 10)
provided by Dr Dick of the XLFORUM
11)
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16)
compilation by Hippysmack
17)
photo by thefrenchowl of the XLFORUM
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[34]
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