Swamp’s Diesel Performance

Competition Parts For Your Diesel
304-A Sand Hill Rd.
La Vergne, TN 37086
Tel 615-793-5573 or (866) 595-8724/ Fax 615-793-5572
Email: dave@swampsdiesel.com

To Purchase HPOP Test Gauge -
https://swampsdiesel.com/products/hpop-test-gauge/

How to check if my HPOP is good

Before we help you decide on a style of injector, it is very important that we (both) know how good (or bad) your HPOP is.

There are 2 ways to measure the oil pump's performance.
If you have access to a scantool, hook it up to the trucks OBD connector, and go to the "datastream"...scroll through the sensor values, until you find ICP (or injection control pressure)...this is your HPOP's "oil pressure".

***NOTE: if you are running any kind of "box" such as the "Edge EZ" or the "Banks Six Gun" you either have to remove the aftermarket jumper harness/plug at the ICP sensor, and reconnect the factory harness by itself. If you are running a home made "10k mod", etc...which plugs/taps into the ICP sensor wires (or connector pins), you will have to remove it as well, or proceed with getting the parts together to run the mechanical gauge, as the scantool will not receive accurate data from the ICP sensor if its signal is being modified from any one of theses "ICP foolsers".

To test the HPOP's output, you will be looking on the scantool for the line labeled "ICP" and it's units should be in psi not volts. Some scantools measure ICP in kPa (kilopascals) which you can convert to psi after you take your measurement in kPa.
1kpa = 0.145psi
(for example 19,310kPa = 2800 psi)
Put your chip in its' highest setting, and go out on the interstate (while having someone watch the ICP value on the datastream) and start at about 60mph...
FLOOR the pedal, and stay in it, 100% from ~60-90mph...what you're likely to see (on the scantool) is that the ICP will spike up rather quickly, to 2800-3000psi or so, and then the longer you stay in the pedal...the ICP will slowly drop and drop and drop...the ICP will eventually stabilize (stop dropping).

WHERE the ICP levels off can be some indication as to the condition of your HPOP. If your truck can maintain 2800+psi then you are one of the FEW folks that have a terrific HPOP.
I would estimate that 90% of the Power Strokes can only maintain ~2200(+/- 200)psi of HPOP pressure, or ICP...5% are above 2600, the other 5% are below 1900psi... depending on how low (or high) of ICP you are able to maintain will greatly affect which model of injector I would recommend.

If you don't have access to a scantool, then go to your local hydraulic supply house, and have them make you up a mechanical gauge.

You might spend $60 or so on high pressure hose, fittings, and a quality 0-3500psi liquid filled gauge....but having this hose available for future diagnostics might be more valuable than you think.

The hose which you will need will need to be about 40" long, rated for (minimum) 3000psi working pressure (12k psi burst rating!) with the gauge on one end, and a #6 female JIC swivel fitting crimped onto the other.

You will also need an individual fitting to screw into the head to go from the head to the hose. This single fitting will be a 90degree fitting # 5 "male boss" (sometimes called # 5 o-ring) on one end of the 90, and a # 6 male JIC on the other end of the 90. Our local hydraulic shop would label such a fitting as 5MB-6MJ90 "JIC" is nothing special...it's just 'hydraulic talk' for a 37degree flare fitting...standard hydraulic stuff here...nothing rare by any stretch.

Looking at the top of (either) cylinder head, you'll see the factory stainless braided oil lines (one to each head) then you'll see a few bronze colored plugs... (Engine off, of course) Using a 5/8" wrench, remove any one of the bronze plugs, and install the 90deg fitting into the hole. (save the plug for reinstallation , after testing).

And the O-rings are reusable, unless brittle, cracked, etc...

The single 90deg fitting will have a "jamb nut" on the O-ring side...screw the fitting into the head, "aiming" the 90 away from the turbo, intercooler pipes, etc...and then tighten the jamb nut, to "squish" the O-ring also locking the 90 from "spinning" around as you attach the swivel end of the hose to the 90. No sealants, loctite, or teflon tape are needed on "JIC" or O-ring fittings...and don't overtighten them...usually about 180degrees with a wrench past finger tight...check for leaks prior to getting too far from home... run the hose, away from moving parts, electrically conductive junk (like batteries, glow plug relay, starter relays, etc) ..and just route the hose up through the cowl toward the windshield...for short term testing purposes, we just lay the gauge up under a windsheild wiper, and go drive...testing it just like I describes previously...chip in the highest setting, floor the truck, etc....

If you can maintain 2800+ psi of ICP, then any injector 250cc's and under will perform exceptionally well.

If you can maintain 2400psi then that's not bad, not great either. 2200psi is mediocre, and full performance from any injector will not be achieved with that HPOP, though power WILL go up with nearly any injector, driveability (excessive smoke) might be an issue.
If you cannot maintain 1900psi, you might seriously consider an aftermarket dual HPOP system, or our Gen3 HPOP. Nearly any larger injector is going to make the truck feel sluggish, and smoke excessively.
Technician High Pressure Pump Guide for the 7.3 Power Stroke Engine

- HIGH PRESSURE PUMP
- PUMP LEAKS
- ICP SYSTEM DIAGNOSTICS
- REPAIR PARTS
- TOOLS

TEST TOOLS AND ICP
PUMP LEAK REPAIR

High pressure pumps with oil leaks at the fittings for the high pressure lines and the plug at the rear (see photo #1) can be repaired in the field using the following Ford part number 2C3Z-9G804-AA kit per TSB 03-17-01. This kit contains 3 o-rings, sealant, and instructions on how to clean and seal the fittings. Torque specs. for the fittings are also included.

Note: Threads must be cleaned, sealant applied to the first 3 threads and the fittings and plug tightened to proper specs.

PUMP OPERATION

The IPR acts to increase ICP by restricting the path to drain.
The PCM attempts to increase ICP by raising the IPR%.

<table>
<thead>
<tr>
<th>KOEO</th>
<th>IPR%</th>
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<tbody>
<tr>
<td>Crank to Start</td>
<td>Less than 30% typically with no leaks and engine starts</td>
</tr>
<tr>
<td>Idle</td>
<td>8 - 16% @ operating temperature</td>
</tr>
<tr>
<td>Full Load</td>
<td>Less than 50% with no ICP system leaks</td>
</tr>
</tbody>
</table>
| No Start (Max Command) | 54\% for 94 to 97 MY  
|                  | 65\% for 98 MY or newer |

**Note:** As a general rule 7.3 Power stroke engines require 500 psi ICP (1.0 volts ICPv) minimum to start.

1.) **ICP SYSTEM DIAGNOSTICS**

P1211 sets if ICP is 410 psi above or 280 psi below the desired pressure for 7.5 seconds.
P1212 sets if 725 psi of ICP is not detected in 6 to 15 seconds of cranking.
P1280 code is for ICP circuit low (often open circuits). Typical issues include, corrosion, spread pins, or improperly crimped terminals at the ICP sensor harness connector.

If a P1280 is set, the PCM will display a default value of 725psi at idle. To verify open circuit concern use ICPv.

**ICP KOEO signal voltage should be between .16 to .28 volts.**

2.) **NO START DIAGNOSTICS**

IPR% goes high with no or low ICP. - A leak exists in the ICP system - P1211 or 1212 may be present.

Use test plugs tool # D94T 6600 A for 94 thru 98 MY
Use test plugs tool # 303-627 & 303 - 628 (Kit #T99T-1000-E) for 99 MY and newer with quick connect connections.
**CONDENSED FROM PC/ED**

- Block off right bank (passenger side).
- Attempt to start
- Start indicates leak in right bank
- Reconnect hose to right bank
- Remove right side valve cover.
- Unplug injector connectors at both valve covers
- Crank the engine
- Observe spill spout of the injector and top of injector bore for oil leakage. (No oil should be coming from the spill spouts or around the injector)
- Replace injector if oil leaks from spill spout or o-rings if leak is from injector bore.

If no start - leak/loss may not be in right head, but ICP still low
- Block off left bank and move ICP into adapter
- Attempt to start
- Start indicates leak in left bank
- Reconnect hose to left bank and install ICP into left head
- Remove left side valve cover.
- Unplug injector connectors at both valve covers
- Crank the engine
- Observe spill spout of the injector and top of injector bore for oil leakage. (No oil should be coming from the spill spouts or around the injector)
- Replace injector if oil leaks from spill spout or o-rings if leak is from injector bore.

If no start / low ICP on both previous tests
- Block off both high pressure lines
- Crank engine
- If pressure is below 1000 psi remove IPR valve and inspect o-rings.
- If the IPR valve o-rings are damaged replace them with kit # F6TZ-9C977-AA and retest.
- If o-rings are ok, then replace the IPR valve and retest.

**Note: Do not replace the pump and IPR at the same time. If during any repair, the oil reservoir is allowed to drain it should be refilled before attempting to restart the vehicle.**

### 3.) ENGINE STARTS BUT HAS A P1211 CODE

IPR% higher than expected (see chart on page #2). Stall shortly after cold start may also be a symptom. Prior to diagnosing a vehicle with a P1211, fuel pressure should be verified.

This indicates a smaller leak in the high pressure system. Using the same block off plugs described earlier to block off one bank and observing IPR% when engine is running on each bank at similar rpms. Higher IPR% on one bank compared to the other would indicate a leak on the higher IPR% bank. Example:

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>LEFT BANK</th>
<th>RIGHT BANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPR% @ idle 16%</td>
<td>IPR% @ idle 26% (higher than other bank and out of spec)</td>
<td></td>
</tr>
</tbody>
</table>

| CONDITION | STARTS QUICKLY | LONG CRANK TO START COMPARED TO LEFT BANK |
| FINDING | NO LEAK | ICP SYSTEM HAS LEAK ON THIS BANK |

Repair as needed after locating leak as described in visual inspection in previous diagnostic routine.
4.) DIAGNOSING P1211 WITH IPR% LESS THAT 8 AT IDLE

ICP more than 410 psi above command for at least 7.5 seconds can set a P1211 code. IPR with low duty cycle (less than 8% @ idle) and engine running, indicates a restriction in the drain circuit. This restriction is taking the place of the IPR valve, driving the IPR duty cycle lower, with higher than expected ICP. The excess restriction will be in the reservoir, front cover, stuck IPR valve, or debris above the edge filter. The drain path through the reservoir and front cover can be visually verified. Typically the pump or IPR must be replaced to repair this concern. Do not replace both components at the same time.

This often occurs after the oil pan is resealed where excess sealant is forced through the lube system (short circuit check valve) and trapped at the edge filter of the high pressure pump.

5.) ABNORMAL LONG CRANK/STALL AFTER COLD START

A worn lube oil pump can negatively affect ICP system's performance in the following ways.
- Cold engine, abnormal long crank to start.
- Cold engine, start then stall - then long crank to restart.

These symptoms are often mis-diagnosed as high pressure oil (ICP) concerns. Both symptoms may be caused by wear in lube oil pump or thick oil (poor maintenance). Pump wear causes a decrease in pump efficiency. Cold, thick oil becomes difficult to move. Any lube oil system failure can negatively affect the performance of the ICP system.
To measure pump wear, place a straight edge across the pump housing and use a feeler gauge to measure clearance between the inner gear and the straight edge. A pump with excess gear recession will contribute to hard start issues.

Recession greater than .003” causes long crank to start and/or stall.

When replacing the pump, the directional markings (“OUT” or “Damper”) must face the vibration damper. If installed correctly there is a recess that the vibration damper fits into on the inner gear. If installed incorrectly, the inner gear will cause major damage to the front cover.
6.) FOR HARD START LONG CRANK OR NO START WHERE THE INJECTORS WILL NOT BUZZ LOUDLY (HAS BACKGROUND BUZZ ONLY) WHEN COLD

Some engines have a no start/or long crank to start and the injector have a low background buzz, not a strong normal buzz. After performing the buzz test multiple times the injector may start to buzz and the engine may start and run fine the rest of the day until the next cold start. Typically, we find that this is a high mileage vehicle with poor maintenance as far as oil changes are concerned. What is occurring is that the poppet inside the injector is not able to move freely because of the thick old oil. If an oil change is performed after driving the vehicle and then driven again with new oil the next cold start the engine may improve.

Note: This concern is related to poor maintenance and extended oil change intervals. If poor maintenance is the cause, then all 8 injectors will be affected. For additional information, refer to Section 3 of the Warranty & Policy Manual under "Damage Caused by Improper Maintenance."

If this is not effective refer to PC/ED injector circuitry diagnostics.

The audible sound heard while performing an injector buzz test is the poppet stopping at the upper and lower seat during actuation.