

This personal website is a collection of information about my truck.

The information that is gathered here **I do not personally endorse or am I recommending.** This is a collection of information from various sources about the Ford PSD Pickup truck 1994 to 1997. This web page is just a collection of ideas to read about and try . I am not endorsing these ideas just listing them as I collect them. I am not responsible for anything that may happen as a result of anyone doing any or all of these ideas.

Please Enjoy!!!

SteveBAZ...

1996 Ford F350 PSD 4x4, Crew Cab, 5 Speed Manuel Transmission, 355 Differentials, 40 Gallon Transfer Flow Tank Center & 18 Gallon Rear, Rancho 9000's Shocks, Rancho Steering Wheel Dampener, Auxiliary Idle Controller by Sparky, Velvet Rides, Maddog Stage 1 Injectors, Superchips 70 horse power chip w/130 Torq, ISSPRO Gauges in A-Pillar Pyrometer & Boost, Dash Cluster - Oil Pressure, Water Temp, Trans Temp, Hypermax Down Pipe, TYMAR, Nathan P-3 Train Horns, ViAir Air Onboard Compressor, ViAir 2 Gallon Air Tank & Air Tool Valve, Viper Alarm System, LUK Clutch, Draw-Tite Front & Rear Receivers, Poly Shock Bushings, Computer Stand, Earth Mate GPS System, Swing Out Towing Mirrors, Rebel Pickup Shell, Fumoto Drain Valve, TYMAR Intake, No Kat, PIAA Lights, Diamond Plate Rail Caps, Dura-Liner Bed Liner, Bed Slide, Carr Side Steps, BF Goodrich KO's 295's, Cobra CB 29 Classic LTD, Pioneer Premier 8400 CD-CDR-CDRW-WMA, XM Satellite Radio, Infinity Front Speakers, Altec Lansing 3 Way Rear Speakers, Kicker ProComp "VR" 8" Subwoofer.

Just A Tip To Start You Off!!!

THERE IS LOTS OF INFORMATION HERE IN "**TIPS & TRICKS**" To find what you want use "ctrl F" To search for a specific item.
Here is a example "**SPEEDO**"

Acronyms - Ford-Diesel Abbreviations

2x4 =Two Wheel Drive
4L100 =Automatic Transmission 4 Super Duty Trucks
4x4 =Four Wheel Drive
ABS =Anti-Lock Braking System
AC =Air Conditioning
AIC =Auxiliary Idle Control
APCM =Auxiliary Power train Control Module
ATF =Automatic Transmission Fluid
BARO =Barometric Pressure Sensor
BB =Bulletin Board
BBS =Bulletin Board System
BCA =2nd Best Bearing Company
BTW =By the way
CC =Crew Cab (4 door)
CDR =Crankcase Depression Regulator
CPS =Cam Positioning Sensor
DORA =Dealer Order Receipt Acknowledgment
DRW =Dual Rear Wheels
DTC =Diagnostic Trouble Code
DVOM =Digital Volt-Ohm Meter
E4OD =Auto Transmission on Pre-'99 Ford Pickups
EEC =Electronic Engine Control
EGT =Exhaust Gas Temperature
EOT =Engine Oil Temperature
FAQs =Frequently Asked Questions
GM =General Motors
GP =Glow Plug
GPR =Glow Plug Relay
GVWR =Gross Vehicle Weight Rating
HEUI =Hydraulic Actuated Electronic Controlled Unit Injector
IAT =Intake Air Temperature Sensor
IDM =Injector Drive Module
IMHO =In My Humble Opinion
LB =Long Bed
LOL =Laugh Out Loud
MAF =Mass Air Flow Sensor
MAP =Manifold Absolute Pressure Sensor
OD =Over Drive
OEM =Original Equipment Manufacturer
OTC =Owatonna Tool and Equipment Company
PCM =Power train Control Module
PCV =Positive Crankcase Ventilation
PDL =Power Door Locks
PM =Power Mirrors
PS =Power Stroke
PSD =Power Stroke Diesel

PTO =Power Take Off (winch)
PTTTM =Power Telescoping Trailer Tow Mirrors
PW =Power Windows
PWM =Power Window Motor
RC =Regular Cab
SB =Short Bed
SC =Super Cab (extended cab)
SRW =Single Rear Wheel
TC =Torque Converter or Transfer Case
TPS =Throttle Position Sensor
TSB =Technical Service Bulletin
TTM =Turbo Temp Monitor
VAC =Volts Alternating Current
VDC =Volts Direct Current
VECI =Volts Direct Current
WOT =Wide Open Throttle

Glossary

AP: Accelerator Pedal position sensor Load/demand input; PCM uses this to determine mass fuel desired, adjusts fuel delivery through IPR duty cycle and fuel pulse width and injection timing; 5 volts in, 0.5-0.7 volts at idle, 4.5 volts at WOT.
PID: AP

BARO: Barometric pressure sensor Strategy input; PCM uses this to adjust fuel quantity and injection timing for optimum running and minimum smoke, also glow plug on time to aid starting at higher altitudes; 5 volts in, @4.6 volts/14.7 psi at sea level, decreasing as altitude increases. **PID:** BARO (pressure)

CMP: CaMshaft Position sensor Strategy and load input; PCM uses this to monitor engine speed to determine engine state and load, and cylinder position in order to control timing and fuel delivery; Hall Effect sensor which generates a digital voltage signal; high, 12 volts, low, 1.5 volts. **PID:** RPM

DTC: Diagnostic Trouble Code System malfunction or fault codes stored in the PCM to aid in diagnosis.

EBP: Exhaust BackPressure sensor Feedback input; PCM uses this to monitor and control EPR operation; 5.0 volts in, 0.8-1.0 volts/14.7 psi KOEO or at idle, increases with engine RPM/load, decreases as altitude increases. **PID:** EBP (pressure), EBP V (volts)

EOT: Engine Oil Temperature sensor Strategy input; PCM uses this for determining glow plug on time, EPR actuation, idle speed, fuel delivery and

injection timing and adjusts as temperature increases; 5.0 volts in, 4.37 volts@32°F, 1.37volts@176°F, .96volts@205°F. PID: EOT (degrees)

EPR: Exhaust backPressure Regulator, also EBP regulator Output; For quicker engine warm-up at cold temperatures. If the IAT is below 37°F (50°F some models) and the EOT is below 140°F (168° some models) the PCM sends a duty cycle signal to a solenoid which controls oil flow from the turbo pedestal. This causes a servo to close a valve at the turbo exhaust outlet. The PCM monitors the EBP input to determine if the EPR needs to be disabled to provide power for increased load, then reapplys the EPR as load demand decreases until EOT or IAT rises. PID: EPR (duty cycle), EBP (pressure)

GPC: Glow Plug Control Output; The PCM energizes the glow plug relay for 10 to 120 seconds depending on EOT and BARO. PID: GPC (time)

GPL: Glow Plug Light Output; The PCM controls the "Wait to start" light independently from the GPC output; 1 to 10 seconds depending on EOT and BARO. PID: GPL.

GPM: Glow Plug Monitor Feedback input; On 1997 and newer California emission vehicles, the PCM monitors glow plug relay output voltage to determine if any glow plugs are burned out or if the relay is functioning. PID: GPML (left bank current), GPMR (right bank current), GPMC (relay output)

IAT: Intake Air Temperature sensor Strategy input; The PCM uses this for EPR control. 5 volts in, 3.897volts@32°F, 3.09@68°F, 1.72@122°F. PID: IAT (degrees)

ICP: Injection Control Pressure sensor Feedback input; The PCM monitors the high pressure oil system to determine if it needs to be increased if load demand increases. It also uses this to stabilize idle speed. volts in, 1.0volt@580psi, 3.22volts@2520psi. PID: ICP (pressure), ICP V (voltage)

IDM: Injector Driver Module The PCM sends a Cylinder Identification and Fuel Demand Control signal to the IDM. The IDM sends a 110 volt signal to the injectors. It then grounds each injector as fuel is required for that cylinder. Fuel Pulse width is increased to deliver more fuel. The IDM sends a feedback signal to the PCM for fault detection. PID: FuelPW Fuel Pulse Width signal from PCM (milliseconds)

IPR: Injection Pressure Regulator Output; The PCM controls the high pressure oil system by varying the duty cycle of the IPR. The IPR controls the oil bypass circuit of the high pressure pump. 0%=full return to sump (open valve), 100%=full flow to injectors (closed valve). The PCM monitors the system with the ICP input. The PCM can control fuel delivery to the injectors by increasing the IPR duty cycle which increases fule pressure through the injector nozzels. PID: IPR (% of duty cycle), MFDES Mass Fuel Desired an internal PCM calculation based on load demand (MG)

IVS: Idle Validation Switch Strategy input; On-off switch that the PCM uses to identify required operating mode; idle or power. 0 volts at idle, 12 volts off idle.
PID: IVS (off/on)

MAP: Manifold Absolute Pressure sensor Strategy and feedback input; The PCM monitors manifold pressure to control fuel delivery in order to minimize smoke. It also optimizes injection timing for detected boost. It also monitor boost to limit fuel delivery to control maximum turbo boost. Frequency output; 111Hz=14.7psi, 130Hz=20psi, 167Hz=30psi. **PID:** MAP (pressure baseline 14.7psi), MAP HZ (frequency), MGP Manifold Gauge Pressure (pressure base line 0psi) turbo boost

MAT: Manifold Air Temperature sensor Strategy input; The PCM uses this signal to adjust fuel and timing. 99 model/year engines. **PID:** MAT

MIL: Malfuction Indicator Lamp "Check Engine" or "Service Engine" light that the PCM illuminates when certain system faults are present.

PCM: Powertrain Control Module, also ECU or ECM for Electronic Control Unit or module The computer which monitors sensor inputs and calculates the necessary output signals to the engine control systems. It also checks for readings outside of normal parameters a records trouble codes for these faults.

PID: Parameter IDentification, also Data Stream or Sensor Data Sensor readings displayed to a scan tool that represent sensor readings to- and ouput signals from the PCM. Useful PID comparisons

AP: Accelerator Pedal--and IVS--Idle Validation Switch: IVS should switch state when AP voltage is approximatly 0.2-0.3 volts higher than base idle position.

ICP: Injection Control Pressure--IPR--Injection Pressure Regulator--and MFDES--Mass Fuel Desired: ICP should rise as IPR duty cyle increases; MFDES and IPR should rise at the same rate as load and/or demand increases (actual readings may not match); ie. ICP=500psi, IPR=12%, MFDES=10MG @500 RPM; ICP=900psi, IPR=22%, MFDES=20MG @1800RPM/cruise; ICP=1800psi, IPR=50%, MFDES=40MG @3000RPM/hard accel.

ICP: Injection Control Pressure--and RPM--CaMshaft Position Sensor: After 3 minutes at 3300 RPM, ICP pressure should be below 1400psi for Federal, 1250psi for California Emmisions, and 1500psi for 99.5. At idle, ICP should be 550-700psi for Federal, 400-600 for California and stable.

V PWR: Battery Voltage--RPM--CaMshaft Position sensor--ICP--Injection Control Pressure--FuelPW--Fuel Pulse Width: When starting V PWR should be above 10volts, ICP should be at least 500psi, at least 100RPM, and FuelPW 1mS-6mS. Once the PCM recognizes CMP speed and cylinder ID, FuelPW should default to 0.42mS, 0.60mS for 99 up, until ICP reaches starting pressure.

EOT: Engine Oil--and IAT--Intake Air Temperatures: After a cold soak, before starting EOT and IAT should be within 10 degrees of each other, Key On Engine Off.

BARO: Barometric--MAP--Manifold Absolute--and EBP--Exhaust Back Pressures: All three should indicate atmospheric pressure (14.7psi at sea level) and read within 0.5 psi of each other, Key On Engine Off.

ICP: Injection Control Pressure--and ICP V--ICP Voltage: ICP should read 0psi, ICP V should read 0.20-0.25 volts, Key On Engine Off.

EBP: Exhaust BackPressure--MGP--Manifold Gauge Pressure--and RPM--CaMshaft Position Sensor: At full throttle in neutral, EBP should be below 28psi; At full throttle in fourth (manual) or third (auto) gear, MGP should be 15psi.

The PCM reads only voltage signals from the sensors. All readings which are not displayed in volts are what the PCM calculates those sensor inputs equal. In some cases, the PCM uses one voltage input to calculate a base line for other sensor readings. For example, BARO is used to calculate MAP/MGP base line. At sea level, calculates BARO at 14.7 PSI, so a MAP reading of 14.7 equals 0 PSI MGP. At an elevation of 5000 feet, BARO and MAP would be 12.1 PSI, so the MGP base line would be recalculated to reflect 0 and not -2.6 PSI.

All outputs are functions that the PCM is attempting to perform based on the inputs it is receiving. If there is an output device malfunction, the results may not be what the PCM is trying to achieve, but the output signal may still show normal. Some outputs may not match actual measurements. For example, the displayed duty cycle of the IPR may not match the actual duty cycle as viewed on a scope, or the displayed transmission control pressure output may not match the actual pressure on a test gauge.

Strategic displays like MFDES will change as the PCM detects changes in sensor inputs which may indicate changes in environment, such as altitude, or wear in the engine. This is part of the PCM's adaptive strategy, or "learning" capability.

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Sonnax Trans Performance Parts ----- <http://www.powerglide.com>
Southern Truck Parts "Power Plus" ----- <http://www.dieselhp.com/home>
SPA Gauges (DIS) ----- <http://www.dieselpage.com/spa.htm>
Summit Racing Electronics ----- <http://www.summitracing.com/>
Sun Pro Gauges ----- http://www.actron.com/cgi-bin/web_store.cgi?page=sungauge.htm&cart_id=6580810_13356
Superchips ----- <http://www.superchips.com/>
Superlift ----- <http://www.superlift.com>
1-800-The Hitch ----- <http://www.trailerhitch.com/>
The Power Shop (Drive Train) ----- <http://www.thepowershop.com/frameset.htm>
Transfer Flow Fuel Tanks & Filler Necks ----- <http://www.transferflow.com>
TS Chip ----- [http:// www.tsperformanceproducts.com/](http://www.tsperformanceproducts.com/)
Tymar Performance "Dale Isley" ----- <http://www.tymarperformance.com/> or 1-509-922-8785 or TYMARPerformance@MSN.com
Us Gear Company ----- <http://www.usgear.com/>
VDO Gauges & Mounts (E-Gauges) ----- <http://www.egauges.com/>
Western Diesel ----- <http://www.westerndiesel.com/turbochip.html>
Western Diesel Gauges ----- <http://www.westerndiesel.com/turboguage.html>
Westach Gauges ----- <http://www.westach.com/>
West Fleet Direct ----- <http://www.westfleet.com/>

AC MOD

It will stop the flow of hot water through the heater core when the AC controls are in the MAX setting and the OFF position providing cooler temps and preventing the hot pocket of air down by you feet. I went to NAPA and asked for the 'hot water shut off valve' from a 1990 Ford Ranger with a 4.0 V-6, I also got 4 - 5/8 hose clamps, a couple feet of 1/8" vaccume line a a 1/8" plastic "T" for the vaccume line. To begin the install loosen the cap on the radiator overfill to remove pressure from the system (do this while the engine is cool). On the passenger side of the engine compartment there are 2 - 5/8" hoses that come from the firewall and continue to the engine, these are the heater hoses. Cut the hose closest to the drivers side (It does'nt really matter where, I did mine about 6 inches after the fire wall). Then holding the 'shut off valve' with the vaccume controller twards the pass side install the portion of the heater hose coming from the cab to the top left nipple on the 'shut off valve'. Tighten the clamp. Install the portion of the heater hose coming from the engine to the top right nipple and tighten the clamp. Next cut the heater hose closest to the pass side in the same location as the previous. Install the portion coming from the cab on the lower left nipple, tighten the clamp. Now install the portion going to the engine on the lower right and tighten the clamp. Measure out how much of the 1/8" vaccume line you need to reach from the bottom of the vaccume canister on the shut off valve to the white vaccume line on the pass side that goes to the vaccume operated door underneath the pass side cowl. Cut that white vaccume line and splice in the 1/8" plastic "T". Then run the 1/8" vaccume line you meassured out from that plastic "T" to the nipple on the bottom of the vaccume canister on the shut off valve. It sounds more complicated than it is. Once you do it it will seem real simple. Happy trucking!
Thanks Bryan Central Texan

Axles

Axle Shaft Universal Joint Installation

By Keith Carpentractor

I recently changed my front axle universal joints on the TTB. They were very badly frozen. I was originally just going to change the Automatic Locking Front Hubs to Manuals. As soon as I started I realized there were more problems than I expected. I expected to inspect and lubricate all of the front bearings and to make sure the axle shafts turned easily. They did not.

I couldn't turn the shafts at all by hand I couldn't even turn them with a pair of Channel Lock Pliers. I then decided to remove the spindles and assess further the condition of the axle shaft U-Joints. Getting the spindles off was no small task. Each side took almost 30 minutes of heat, penetrating oil, a huge wheel puller and a moderate amount of BFH. The Right side gave me the most grief. After removing

the spindles the rest came out very easy. snip off the Oetiker Clip on the Right side shaft and all pulls out of the hole in the Steering knuckle. Before I disassemble the shafts I always mark them so that they go back together the same way. I used a center punch and made two hits for the right side shaft and one hit for the left side shaft. The left side comes free by pulling the shaft out of the Dana 50. As soon as I removed the shafts I could see why the shafts were not turning freely. The shafts came out frozen in the position they were last in. The Universal Joints had been frozen solid in one phase and had an 1/8" of play in the other phase. In layman's terms these babies were toast. Removing those U-Joints was next.

I removed the U-Joints with very little problem. The hardest part of this operation was getting the old external clips out of the yoke. Once again heat and penetrating oil did the trick. (You may want to mark your shafts before removing the U-Joints.) There are three U-Joints on this application and two them are on the shafts. The last one remains in the truck and is difficult to remove even with the proper U-Joint tool. There is not much room to work the tool in and I believe that raising the right side beam may give you some additional room to get the joint out and affixed in place without excessive interference. This original third joint was actually in good condition, but I chose to replace it with a zerk type U-Joint to avoid a repeat of this job in the future. I always like to clean up the parts that I have removed as best I can and make them look like new. I have a small sandblaster and did a quick cleanup on all the axles shafts and yokes to remove much of the rust and scale. Remember to use duct tape or similar to block any openings where you do not want the sand to go. I do not recommend sandblasting the riding surfaces of the spindle or the threaded end. I taped mine from threaded end to the middle of the seal seat, as sand and bearings do compliment each other. This is also the reason why I did not sandblast the steering knuckles, half shaft yoke left in the Dana 50 and the Brake drum and hub. I then wash the sandblasted parts in Hot soapy water and rinsed them with hot water. I allow the parts to dry in a warm spot and then paint them. This protects them from rust and allows for a very clean assembly.

Assembling the Shafts: When I assemble the Yokes and U- Joints I always will use Anti-Seize to help lubricate the assembly and to prevent the seizure of rusted parts, in case this job ever needs to be done again. I liberally paint the Anti-Seize onto the mating surface on the yoke making sure that the clip groove is liberally covered. I then proceed to install the U-Joints. You can use a vise and some impact sockets to do the job. I wouldn't use regular sockets as they are hardened and may send a chip flying when you apply the pressure. I used a U-Joint tool. It Looks like a big C- Clamp and is available for Under 50 bucks in either Northern Hydraulics or Harbor Freight.

Do Not use Anti-Seize to lubricate anything other than bolt threads and certain press fit applications. Its use is basically to keep metal parts from and corroding together. It is not designed to be a lubricant like grease. The slip joint in the Right side axle shaft requires lubrication, and I used Mobil 1 synthetic grease for this. Be careful with the female side of this slip joint as it has a small seal on the end that can

be damaged. Once you slide the slip joint together you will need to replace the clamps on the slip joint boot. I went with the original Oetiker clamps. I had a dog of a time finding them but I believe they are the best way of keeping the boot watertight. I do not recommend the use of the universal type clamps as they do not tighten as well as the Oetikers do.

Spindles: My Spindles had some surface corrosion on the riding surfaces that I removed with a fine steel wool. I cleaned out the roller bearings inside the spindle, inspected them for damage and re-packed them. It takes about 7 pumps of grease from the typical grease gun to provide enough grease to pack these bearings. So don't be stingy. Pack the bearing by pressing your finger into the grooves between the bearings to get the grease all the way down into the bearing. Rotate the bearing as you are performing this packing operation. Prior to installing the shafts I wire brushed the steering knuckle mounting bolts and mating surfaces, I sandblasted the mating surface of the drum brake shield, and then installed the spindle back onto the steering knuckle using Anti-Seize on all of the mating areas and on all of the studs and nuts. . Do not forget to replace the yoke seals (Called Rotating Diaphragm Seal, in the Service Manual) and spread a film of grease on the inner lip of the seal. These seals are little difficult to find and you may have to wait a day or so to get them. I had to cross reference mine as there was no re- using them. Both of them were pretty chopped due to the frozen U-Joints.

I proceeded to examine the bearings and races after a very thorough cleaning of the hub. I was able to see immediately that one bearing was wasted and exposed to high heat. It had very little grease in it and it was discolored to a slightly blue color. The other three I replaced because of scoring on the races and some pitting on the bearings. One of those bearings was completely brown with rust upon removal. After replacing all four races. I brought the Discs to the machine shop for resurfacing. It is very important to lock down at least one of the lug nuts onto the hub to keep the rotor from moving off the hub from the vibrations or pressure of the cutting machine. After getting the rotors and hubs turned I clean out the hub again with Brakeleen and blow out any chips that may have found their way into the hub. I then packed the bearings with Mobil-1 synthetic replaced the Grease seals and then mounted and installed the hubs and discs as the service manual instructed. I also purchased new disc pads. I prefer OEM pads due to my experience with aftermarket pads but unfortunately had to go with Raybestos due to availability problems at my local Ford Dealer and a FUBAR ordering problem.

The best part of this job is the satisfaction of knowing that I have a dependable 4 wheel drive axle now. I love my Warn Premium Manuals and I cannot say enough about what an easy job it is to swap out the autos. It can be done by anyone with very few tools needed. I did not require a retrofit kit for mine and the hubs go in like a dream. It basically comes down to placing the hub in affixing the small snap ring and the outer hub ring, then bolt on the outer cover. It is that easy. I like the classic look of the Warn Premiums and the Gold middle with black lettering gives it

a nice look. I think it is worth the extra 20 bucks. Plus no plastic. I also like the 350 degree twist as opposed to the 90 degree twist.

Finding Out Your Gear Ratio With New Tire Sizes

Axle Gear Ratio Conversion Chart

Rear Hub Axle Seal leak

Get the type of seal that spins inside itself, probably made by Chicago Rawhide (Scotseal name). These are the best type of seal made since the rubber part that slides on the spindle is stationary to the axle and the parts that actually spin on each other are enclosed inside the seal itself. When you put in this type of seal you are in effect replacing the seal and the metal surface it rubs on (no need for speedi-sleeves). Leaking seals like this are a common problem on full floaters especially when you use a simple seal and are usually caused by improperly torque on axle nuts, bad bearings or damaged seals on assembly. After you drive the seal in the hub, make sure the seal spins in itself and you are virtually assured it won't leak again. It wouldn't have any effect on your bearings unless your oil got real low and then you'd have more problems than bearings. If they weren't Timken or BCA I'd toss them and get Timkens as you're living on borrowed time anyway. I always pack them with grease as you cannot trust the oil getting to the bearing before it burns up.

Installed Aftermarket Differential Cover

Just installed an Off Road Unlimited Differential cover and I am very pleased with the product. The stock cover would be very hot to the touch after the ride to work (about 30 miles). The new cover with its large aluminum fins dissipates heat much better than stock and allows one additional quart of fluid

<http://www.offroadunlimited.com/> \$109.00

Axle Maintenance

Reason being that the metal particles that are found in the bottom of the differential are from gears, bearings and even the case and cover. The wear parts, gears and bearings, require some break in time before they reach a smooth, minimum friction point. When machined parts are new they are quite porous and rough as seen under a microscope. When the same parts are viewed after break in they appear polished

and the porosity is significantly diminished. This includes bearings, gears, races, etc. These small particles are important in the break in process. (This goes for rebuilt or new engines too.) The smaller ones accumulate in suspension and assist in the break in process helping to scour off the rough edges and polishing the gears and bearings. The small particles' job is pretty much complete by 5000 miles. The magnet you are referring to will help accumulate many of the particles especially the larger ones but cannot get all of them. The lube is too thick and the currents are too great to keep the really small ones from falling out of solution. This is why I believe the 30 K service is so important the first time around. If you were to do a 30K and then a 60 K you would still find some particles but there will be significantly less and they will be very small in comparison to the ones you would see in the 30K service.

Remember thrown fluid and the particles contained therein are wearing down the case too. While it is not significant it is like erosion rounding rocks at the beach. Some would argue that these particles would not pose much of a threat. I agree that they do not but the Idea is to reduce friction and reduce erosion of the component. Replacing the solution does this. Regarding the Front differential. Here is my reasoning on this. First most people only use 4WD when they need it. Which is also the worst time to have a component failure. The 3000-mile front differential break in period is a tremendous hassle especially to those with auto hubs. Every time you back up you will need to reengage them. It also has one other problem. While this process will break in all of the bearings nicely, it will typically only break in the back edge of the ring and pinion teeth. Unless you do a lot of backing (miles) you will not really let the teeth engage the forward edge unless you engage the 4X4 lever. If it is possible Truck should be put in 4WD whenever conditions will allow for it during this 3000-mile period. Dirt roads, Rain or snowy conditions will provide a decent amount of slush factor to keep the stress from screwing up the transfer case or tires. I wouldn't run my 4 WD on dry pavement for any longer than it would take to engage the auto hubs, nor would I run my 4WD on wet concrete. I would also try to keep my turns as small as possible when on wet asphalt. Even though the tires will slip on wet pavement, they are still putting a large strain on the transfer case when they grip. Wet Concrete has almost as much traction as it does dry, so keep that in mind. I purchased mine used at 58000 miles. I have had it in 4WD only on the test drive when I purchased it and once afterwards. My hubs only will fully engage when they want to on their own. So I haven't been able to run around with the front engaged. I have a set of Warn Premium manuals, sitting on the shelf of my garage, that I am going to put in before winter. I will also swap out the gear oil for Synthetic. I will probably go with AMSOIL 2000 75W90 in the Dana 50. Then I will commence my own 3000-mile break in. I am also going to install a drain plug on the bottom of the Dana. To those who have 4X4 trucks it is a good idea to engage that differential once a month and allow it to get up to operating temps. About 20 minutes time. This is a good Idea too before using 4X4. Very bad to use the front differential when it is cold with the rest of the truck warmed up and raring to go. Going to drill and tap the bottom of the housing. The plug will be a female type square drive 1/4" NPT Standard Dorman hardware. If I can get one with a magnet then all the better. if not, oh well. Not my original Idea. I have to give credit to one of the other site members for this idea though. Regarding the Sterling 10.25 If you

are filling while on the truck I believe it is just over 3 quarts. So you will need four. Mobil 1 is a 75W90 weight oil.

Belts

How to change serpentine belt???

I use a 15 mm socket with a breaker bar myself, I thread the grooved pulleys first and leave the smooth one at the top to go on last where I can hold the bar and slide the belt on at the same time. **A FEW IMPORTANT THINGS YOU HAVE TO KNOW!!!!** there are two types of belts some have 7 (SEVEN grooves) and some have 8 (EIGHT grooves) it depends on year of truck. When you get new pulleys (and you will) make sure you have all 7's or all 8's. Check with your FORD parts guy to be sure. Also not only do I carry the socket and breaker bar but when you put the new belt on take the old one and place it underneath or behind the back seat, when one breaks it always seems to be 2:00 am in the rain and cold in the middle of nowhere. The old used belt will get you to civilization.

PS: Make sure you get the right belt with Air and Without Air are two different lengths and 7 rib and 8 rib be sure to get the right one. If you have a problem routing it. There's a sticker with a diagram showing the routing in the engine compartment.

Serpentine Belt Squeaks

I went to gates.com and they have an excellent discussion of how and why belts "chirp". In my case its probably due to a slight misalignment of one of the pulleys.

Brakes

Exhaust Brake - Make one by Doing It Yourself

Mod & Article by Jonathan Ryan

The Engine Exhaust Back Pressure Valve (EBPV) is a butterfly type valve located on the outlet of the turbocharger, between the turbine and the down pipe. It is controlled by the Power train Control Module (PCM), and activated by engine oil

pressure. Its purpose is to decrease engine warm up time in cold weather by restricting exhaust flow out of the engine. It can be very easily and very inexpensively converted into an engine exhaust brake by adding some simple wiring and a switch.

The valve is very practical for assisting braking. When used correctly its braking effect can be compared to the restriction gained by downshifting one gear while descending a hill. The valve is most valuable to braking when engine speed is between 2500 and 3000 RPM. Unfortunately, it will lose the engine braking abilities when engine speed drops below 2000 RPM.

The following method outlines the manner in which the EBPV can be converted to a braking device. The following will cover any vehicle equipped with a manual transmission. Vehicles equipped with automatic transmissions will require an additional circuit to be added in order to maintain torque converter lockup while the exhaust brake is activated. That circuit will be addressed at the end of this article, however the majority of this article is applicable for both transmission types.

EBPV Schematic at

<http://community.webshots.com/photo/31332816/33154054yrQYVH>

In order to control the function of the EBPV, I recommend using a 3-position switch. This type of switch will control the Valve in the following manner:

Switch in the OFF Position (center position): The EBPV will function normally, as it would for a stock vehicle. This means that the valve will only actuate in order to warm up the engine.

Switch in the "A" ON Position: the EBPV closes and remains closed until the switch is turned OFF.

Switch in the "B" ON Position: the EBPV will close whenever the brake pedal is pressed, and will open when the pedal is released. There will be a 2-3 second lag for the exhaust valve to close upon stepping on the brake. Thus, it is important to understand that when using it in the "B" ON position to push the pedal and hold it down with steady pressure. The reason for keeping pedal pressure is that the EBPV actuator is receiving power from the brake light circuit when the switch is in this position. Thus, pumping the brakes or releasing the pedal will cause the valve to deactivate or open. Furthermore, once the brake is applied again it will take another two seconds for the EBPV to activate again. Unfortunately, pumping the brake pedal will result in the exhaust valve remaining in a constant open position. This will provide ZERO engine braking force. To prevent this less than desirable phenomenon from happening, it is important the operator keep his foot on the brake lightly enough that the brake light switch is continually activated. I prefer touching and holding my pedal just hard enough for the brake lights to come on; then, when I hear the EBPV close (it makes a distinct hissing), I begin applying

additional pressure to the brake pedal. Reducing brake pedal pressure can be done without losing exhaust-braking force, as long as there is enough pedal pressure maintained to keep the brake lights on.

Materials:

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(1) ON-OFF-ON type Heavy Duty Double-Pole Double-Throw (DPDT) toggle switch. It will have connections for 6 wires on the back, and the switch will have 3 positions UP=ON, CENTER=OFF, DOWN=ON. RS (Radio Shack)# 275-1533A \$2.49 or 275-710 \$2.99 · 25'-30' of 18 gauge wire. 5'-7' each of 4 different colors is best. · (10-12) Ring or Spade terminals for wire connections. 18-22 gauge are red. RS# 64-3032A or 64-3033A \$1.49 (4-6) Butt connectors for wires. 18-22 gauge are red. RS# 64-3037A \$1.49 · (2) Rectifier Diodes. A diode is the equivalent on an electrical check valve, allowing current to flow in only one direction. RS# 276-1114 · (2) Optional Mini Indicator lamps. RS# 276-085A (red) 276-084A (green) \$1.99 each. (By using the switch indicator lights, the operator immediately knows how the EBPV is activated or not.) · 10' Split loom for protecting wires. RS# 278-1264 \$3.99 · (10) Wire ties. · (1) Inline fuse holder. RS# 270-1213 \$1.99 · Electrical tape. I recommend Liquid Electrical Tape as being better for almost everything. · Tape and Marker (In order to label wires.)

Tools:

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Wire cutters/strippers · Screw Drivers · Drill w/ bits up to 7/16" · Volt/Ohm Meter, or at least a test light. · Soldering Iron is recommended but not essential. · Torx bits &/or 1/4" drive metric sockets to remove dashboard trim to install switch.

Procedure:

Decide on a place in the dash to install the switch. I installed mine in the black panel just to the right of the "Wait to Start" light. There is room for 2-3 switches there.

Remove the necessary trim and molding around the steering column / instrument panel to access the reverse side of where you want the switch. Drill a 1/2" hole, and install the switch. Re-install the molding to make sure it fits into place when the switch is installed. Then, remove the switch and the molding again for ease of access while wiring.

Wire #1: Decide what you will use for a positive power source. Insure that this source is one that is "ON" only when the ignition is in the "ON" position. I recommend the 8 gauge, gray/yellow wire in the bundle under the steering column. You can also tap a fuse in the fuse panel. Run wire [#1] from the source to the

switch, connecting it to terminal A2. I numbered the terminals as viewed from the back of the switch. Install the inline fuse holder on this line. Make sure to leave 6"-12" or more of slack on all the wires. You can always bundle them up later.

Wire #2: Decide placement of a negative power point or ground, and run a wire from this to the switch, connecting it to terminal C1.

Connect one light to terminals A1 and C2; this is light A. Connect the other light to terminals B1 and C2; this is light B. Drill holes for the lights just above and below the switch. Install the lights with B in the top hole, and A in the bottom. I recommend this because when the switch is down, contact is made between A+C; when the switch is up, contact is between B+C. For simplicity, the diagram does not show the lights "crossed" like this.

Remove the black-hinged cover from over the fuel filter area in the engine compartment.

Wires#3 & #4: Run two wires from the switch through the firewall into the engine compartment. Connect one [#3] to terminal C2 and run it to the front of the engine. Connect the other [#4] to terminal B2 and run it to the brake master cylinder. If you have a horizontal diamond shaped plate about 2.5" wide just to the passenger's side of the clutch cylinder, remove the screws and run the wires through it. Otherwise, you may need to drill a hole. I always find that running the wires is the hardest part of any wiring project.

There should be a green wire by the driver's side of the master cylinder in the group of 4 marked "Center High Mount Stop Lamp Feed." This wire most likely will not be connected to anything. This wire is only energized when the brake lights come on. Connect wire [#4] to this one. If this wire is not present, use a voltmeter or test light to find a wire that is hot only when the brake lights are on and connect to that wire instead.

Locate the wires that travel from the PCM to the EBPV. There should be a 2-wire plug just under the turbo compressor. It is located towards the front of the engine between the turbocharger and the fuel pump on the intake side of the turbocharger. The plug is attached to the turbo pedestal. Disconnect this plug, and remove the loom (protective plastic shielding) on the plug side moving away from the turbo, to expose the wires inside. Slide off the loom until it reaches the intersection of the larger wire bundle. This will expose both wires; one wire is black w/gray, the other gray w/red.

The Two Rectifier Diodes that are required will each have a silver band around one end. Twist the wires from the "silver" ends together making a "Y." The "black" ends will be at the top and the silver ends at the bottom of the "Y." Cut the gray w/red wire 2"-3" before the plug, strip the insulation back 1/2" or so, and solder the black end on one diode to the end of the cut wire that does NOT go into the plug.

Solder the black end on the other diode to wire [#3]; solder the two silver ends to the gray w/red wire that goes into the plug. The diodes are necessary to prevent the brake lights from coming on when the PCM operates the EBPV, and to prevent the PCM from receiving a 12v signal from wire [#1]. If you don't have a soldering iron, you can use crimp connectors.

Coat all the wire connections with several coats of Liquid Electrical Tape, then wrap them with regular electrical tape, and replace the loom. Also, cover wires [#3 & #4] with loom, all the way to the switch. Bundle up any excess wire with wire ties, and secure them all to prevent chafing. Install the switch in its hole, and replace the dash trim.

Automatic Transmission Circuit:

If the intention is to use the EBPV as a brake with an Automatic Transmission equipped vehicle, then an additional circuit is required in order to reap the most engine braking benefit from this application. This circuit will keep the torque converter locked up while the valve is in an activated state. In effect, it maintains engine RPM in relation to ground speed and prevents transmission disconnection, which would result in loss of engine speed, ultimately reducing the effectiveness of the exhaust valve as an engine brake.

Auto Trans Circuit Procedure: Run a wire from [#3] to connect to the TC lockup circuit. Install a diode on that wire with the silver end towards the transmission.

Testing:

To test, start the engine. With the switch in the up position, the upper light should come on when you press the brake pedal, and you should hear a distinct hissing or swooshing sound when the EBPV closes, after 2-3 seconds. With the switch down, the bottom light should come on and stay on, and the EBPV will close immediately.

Conclusions:

I find no advantage to using the EBPV brake with an unloaded truck during normal driving. However, when I am hauling a heavy load, it is worth its weight in gold. During normal hauling, I leave it in the up position, so I will have extra braking power when I need it. For exit ramps and long or steep downgrades, I put it in the down position and leave it on as long as practical. When the truck is parked, you can leave the switch in the down position, as it is useful as an anti-theft device. The activated valve will not allow the truck to go much over 33 mph. This is also very useful for very fast warm-ups in winter.

Breaking In A New Diesel Motor

Breaking in a Diesel Engine

Source: Ford-Diesel.com by Jay Chlebowski This article outlines the processes and prescribes a superior method for breaking in the Current Production Diesel Engine.

"Breaking-in" a new diesel engine... You may immediately come up with some questions such as... Why did Ford-Diesel.com release an article about something that is a non-issue? I thought newer engines were manufactured with precision crafted parts? According to the manufacturer, there is supposed to be "no break-in necessary"? Many of the engine manufacturers claim that their engines do not require break-in. That is just pure baloney! Enough pestering and a few references to some of the Cummins shop manuals have painted a clearer picture. All engines require some kind of break-in period. This is even true with current technology. Although current technology provides the means of manufacturing engine parts with unimaginable precision, the manufacturer still falls far short of achieving the near perfect fit that a proper break-in will provide. "Break-in," for the most part, is the allowance of the machined cylinder and ring surfaces to conform to each other's shape during engine operation. This conforming or "mating" of ring and cylinder surfaces is the ultimate goal of a proper break-in. "Mating" these two specific parts will produce a very tight seal in each cylinder. A tight seal is very important because it prevents the escape of unburned fuel and pressurized gasses into the crankcase, while further preventing crankcase oil from entering the cylinder above the top compression ring. It is the intention of this article to help people understand more about the break-in process, and what happens or can happen during the first few thousand miles of engine operation.

During break-in, a small amount of compression blow-by, oil-fuel dilution, and oil consumption will be experienced. This is perfectly normal and quite common in new engines. Although acceptable at first it is imperative that these undesirable attributes be as close to zero as possible after break-in has been completed. Although the others are important, blow-by is the primary reason the ring and cylinder wall interface has to fit together so tightly. Diesel fuel needs to be introduced into an air environment that is under intense pressure in order for it to burn without an ignition source. When the fuel burns, the gasses produced multiply the compression pressure in the cylinder. Pressurized gasses that escape by means of the compression ring / cylinder wall interface are called blow-by gases. Pressure that escapes the cylinder in this manner results in a loss of energy. Whether it is pressure lost on compression or combustion, it is unable to be utilized to drive the piston through the power stroke. This loss ultimately results in a reduction of fuel mileage and power.

Today's Diesels can take a "few" miles to fully break in. 10,000 miles is not an uncommon break-in period, especially for an engine like the Power Stroke Diesel.

The reasons that break-in is such a lengthy process are generally attributed to engineering targets as well as the function of diesel combustion.

In terms of engineering targets, engine manufacturers produce diesel engines to sustain high torque loads over constant and extended load intervals. In other words, very durable parts are required to hold up to the rigors of diesel operating conditions. For example, The International Truck and Engine Company employs some very special parts in their 175 - 275 hp engines. The pistons used in these engines are manufactured from lightweight aluminum alloy, and are constructed with Ni-Resist ring inserts. The aforementioned piston combination is further complemented with keystone plasma faced rings. These rings help reduce oil consumption and can extend the life of the power cylinder further than ordinary chromium-plated rings. While chromium-plated rings continue to be produced for both diesel and gasoline applications, they are slowly becoming old technology. They still perform well but plasma faced rings have consistently shown superior performance.

When we consider the function of diesel combustion, we must first understand the engine dynamics that are associated with that process. In order for break-in to occur, a fair amount of heat, friction and resulting wear will have to take place before the compression rings will have “mated” with the cylinder walls. When the rings and cylinder wall are new, a modest amount of heat is created merely from the friction of the new rings passing over the freshly honed cylinder wall. While the heat from friction is significant, the real heat is created from combustion of fuel in the cylinder. When the fuel is burned, gasses are produced that expand and heat all of the cylinder parts. If enough fuel is introduced, the resulting combustion can create gasses that expand so much they will actually expand the cylinder wall and the compression rings. It is important to understand this because expanding these parts places additional pressure on them, which creates more friction and correspondingly more heat. This does not take into account the additional heat from combustion that will be added to the heat from friction. Heat is important to assist wear for break-in but too much can cause major problems. This is the reason we should not subject the engine to significant loading for the first 1000 miles of its operation. Loading heavily will introduce more fuel to the cylinder, and will add significant amounts of heat and pressure to the cylinder components. Couple that scenario with new rings on a freshly honed cylinder wall and we can only imagine the amount of friction and heat being produced and absorbed by the rings. Furthermore, the engine oil, lubricating the cylinder walls, will flash burn when it contacts the very hot rings. The burned oil will leave a hard, enamel like residue on the cylinder wall, commonly known as oil glazing. When the rings are permitted to operate under such high temperatures, oil glazing of the cylinder can happen very quickly. Once this glaze builds up, the only repair is a labor-intensive process that requires disassembling the engine and re-honing the effected cylinders. Oil glazing is a problem because it is typically not distributed evenly in the cylinder, and the spaces that exist between the ring and cylinder wall are either still there or new larger ones are created. Oil glazing is typically thicker towards the top of the

cylinder and it builds up in the areas where heating is the greatest. The glaze has very smooth and friction free properties that do not allow it to be scraped away by the rings. This inhibits further metal-to-metal wear between the cylinder wall and rings, preventing further mating of ring and cylinder. Thus, those small gaps between ring and cylinder surface will never seal. These spaces will then allow pressurized gasses and unburned fuel to escape into the crankcase, while allowing oil from the crankcase to enter the cylinder above the top compression ring.

Well why not run the engine at idle or under no load? This is bad too. It can create a similar condition to glazing. The rings need to expand a little during this initial break-in period, just not so much that they overheat and flash the engine oil. The engine needs to be moderately loaded in order to break in correctly. Running the engine under very light or no load prevents the oil film placed on the cylinder wall from being scraped away by the expanding compression rings. The rings will instead “hydroplane” or ride over the deposited oil film, allowing it to be exposed to the cylinder combustion. The oil film will then partially burn on the cylinder leaving a residue that will build up and oxidize over time. Eventually this leaves a hard deposit on the cylinder wall that is very similar to the glaze left from flash burning. My caution to those just running the engine as a normal daily driver (without some loading) and especially those who love to idle their vehicles, expect some VERY extended break-in periods (up to 30,000 miles on one I know of). Expect oil consumption forever due to oil glazing. The rings never really seat well if they cannot expand from the dynamics and heat that a load produces. Expect poor mileage due to the passing of compression and combustion gasses around the compression rings. Additionally, expect to see increased bearing wear and engine wear due to the fuel passing the rings diluting the engine oil.

Thus, we can see that heavy loading and light loading can cause some major problems. Moderate loading is the key to a proper break in for the first 1000 miles. It permits the loose fitting piston rings to expand into the cylinder walls allowing them to perform double duty: First, scraping oil off the cylinder wall, and second, to create friction that will promote wearing the two surfaces to each other's proportions. Furthermore, moderate loading will allow the rings to get hot but not to the point where it will flash the lubricating oil supplied to the cylinder walls.

Once the rings and cylinder have "mated," they will have worn away a considerable amount of their roughness. They will wear slower than they did when they were new. This reduced wear rate indicates the end of break-in, and a decrease in oil consumption should be obvious to the owner / operator. Furthermore, blow-by and fuel dilution should also be reduced but may not be so obviously evident. Be aware that engines employing Plasma faced ring technology will take a longer time to break-in. These rings tend to wear far slower than chromium-plated rings. The plasma ring's hardness allows it to wear the cylinder wall in a more aggressive manner while only polishing the ring surface. Eventually the cylinder wall wears to the shape of the ring and subsequent cylinder wear evolves to a polishing process. This extended process drastically improves the sealing potential of the cylinder,

which will correspondingly reduce blow-by and the amount of physical wear on these components. Therefore, we can safely say that the plasma faced ring / Ni Resist insert combination greatly extends engine life. Unfortunately, the price of this better seal is a longer break-in period.

So the big question is: How long does it take for an engine to break-in? Outside of the rings being hard as rocks and just taking their own sweet time to mate to the cylinder bores, the greatest factor is how the engine is broken-in. Most engines will be broken-in after running for some time, but some ways of breaking-in an engine are far superior to others as they are more likely to produce low blow-by and near zero oil consumption.

Therefore, I will lay out some recommended DOs well as definite DON'Ts:

1. DON'T run the engine hard for the first 50 to 100 miles. It is recommended that the engine be operated around the torque peak (1500 to 1800 RPM) in high gear. This loads the engine very gently, and allows the internal parts to "get acquainted" without any extreme forces.
2. DON'T let the engine idle for more than five (5) minutes at any one time during the first 100 miles. (Even in traffic.) Remember those loose fitting rings, and possible fuel-oil dilution that were noted above? (Fuel Dilution is very common when diesels idle, even with well broken-in engines.) Well, if that fuel is allowed to contact the main and rod bearings during break in (not really good at any time), you might be looking at an engine that will always consume some oil and one that may not produce power or mileage as expected. In the first few miles of break-in, the bearings are mating to the crank, rods, etc. It is imperative during this time that the lubrication qualities of the oil remain robust. Fuel in the oil will reduce its ability to absorb shock and float the rotating parts in their bearings. Contact between bearings and journals will occur more frequently which will result in additional friction wear. This will ultimately reduce the tight tolerances between the bearings and journals. What was originally a tight fit will be sloppy and will never be able to mate properly.
3. DO drive the engine at varying RPMs and speeds until about 1000 miles. The idea is to alternately heat and cool the rings under varying RPMs. Manual transmission-equipped trucks are the best for this as they typically employ engine compression to slow the vehicle during normal operation, this constantly allows for varied RPMs. This can also be done with automatic transmissions, but it requires that you manually downshift the transmission into the lower gears while driving. Typically, most people with automatic transmissions operate their vehicles in Drive or Overdrive gear positions without making these manual shifts. When their vehicle is decelerating and the speed falls below 38 mph the transmission has little influence on engine RPM. This is because the torque converter unlocks and the auto transmission does not downshift to lower gears in the same fashion that manually shifting does. My suggestion to those with auto transmissions is to find an empty

parking lot in the evening, and drive back and forth across it in the lower gears. (This can be done with standard transmission trucks as well.) Each time revving her up close to redline and letting engine compression slow it back down. This gets the rings a bit hot, but the compression braking allows the pistons to cool with high oil spray flow and no fuel load. Keep doing this for a number of runs, or until boredom sets in.

4. DO put a load on the engine at around 1000 miles, and get the thing hot! Diesels are designed to work, and in many cases, they operate best under a load. Baptize your engine with a nice "initiation load," to introduce it to hard work. Keep the revs up (but watch the EGTs), and make sure the coolant temps rise. Hooking up your trailer and finding some hills to pull works great for this. After the 1000 mile pull, just drive it normally, always making sure to let the engine get up to normal operating temps (no 1-mile trips to 7-Eleven). Towing is ok but remember to not overload and to monitor your gauges carefully erring on the side of caution. Under these conditions, I have seen most diesels completely break-in between 10-15,000 miles, and have always been able to tell that point from mileage gains. One may also notice that the "symphony" of the engine also changes slightly at this point.

We know that Engine Manufacturers have built today's diesel engines using state of the art technology. They have fashioned parts to match in near perfect fashion. We can understand, through this article, that breaking-in this modern marvel of technology is more important than the manufacturers have lead us to believe. Furthermore, we can appreciate that following their claims can result in an engine that is wrought with inefficiency, sloppy fitting parts, and oil consumption problems. Following the guidelines and warnings set forth in this article will provide anyone who desires maximum efficiency and power out of his engine many miles of trouble free operation.

Buying Used Power Stroke Diesels

Things To Look For When Buying A Used Power Stroke Diesel

Turbo:

You might take the air tube off the back of the air filter and look inside of it. If there is dirt build up, that is a very bad sign, so are the turbo fins looking sand blasted or bent. A little oily film is normal since the valve cover breather exits inside the tube.

Airbox:

Check the two bolts holding down the airbox lid. If they are plastic with a square recess, it is a recalled part. The recall is expired, but without the updated lid the risk

of dirt infiltration is greater, the lid was updated with more supports and the updated bolts are metal with a straight slot. If it is the old style, you spend around \$80 to update it.

Tranny:

If you buy a truck with an auto tranny, finding out if it's been maintained is essential, as the E4OD is an expensive transmission. Also, (if auto) seeing if the truck has an auxiliary transmission cooler would be worthwhile. For sticks, listen for clunking when shutting off or small vibration while operating. It could be an indication of a dual mass flywheel going out. Many have replaced them with single mass units.

Rear Gear Ratio:

4:10 will pull better, get slightly lower mpg's and run a higher RPM compared to 3:55.

Coolant:

Ask the previous owner about the coolant - have they been adding FW16 or DCA4 to keep a proper SCA level? It is very important for stopping cavitation. You can get test strips to check the SCA level from NAPA, International, or Ford. I would test the current condition while looking over the truck, the SCA level should be between 1.5 and 3.0. Also, see if it has a block heater (it was an option on 97's).

Front end:

Check the front end for wear, or have an alignment shop check out the ball joints and steering linkage (tie rod ends). If they are shot, it is spendy (all four tie rods are around \$400 just for parts, ball joint labor is also very spendy)

Oil:

The questions to ask are how often the oil was changed (at least every 5,000) and what kind of oil they used (diesel rated)? An oil analysis could tell you if there might be an engine problem or not.

Aftermarket stuff:

Seeing if the truck has got an aftermarket downpipe would be nice, a chip, or gauges (pyrometer, trans temp, etc.). Ask about any added items and who installed them.

Glow Plugs/Relay:

Find out if the glow plugs are in good working condition as well as the relay. Ask if either has been changed and when. You can check the glow plug resistance through the valve cover connector if needed (http://forums.ford-diesel.com/cgi-bin/ubbcbgi/ultimatebb.cgi?ubb=get_topic&f=21&t=005210), and the relay should have power to both large terminals on top when the key is turned on, and one of the terminals should go out before ~2 minutes.

Injector o-rings:

The injector O-rings have been known to be a problem. The new o-ring sets have a pink middle seal. If the truck has an o-ring problem, one of the signs can be a discoloration of the fuel in the filter bowl. There is a drain on the passenger side front of the filter bowl for draining water (the filter is also the water separator) and you can catch some of the drained fuel in a jar – it should be dingy yellow and not blue or dark.

Leaks and Drips:

You can check the valley between the heads of the V8 for moisture and/or fluid. It should be dry not wet. Most leaks will run through this valley and down the back of the motor dripping off by the tranny/engine coupling.

VIN number:

If you take the VIN to any dealer, they can tell you when it was built, when it went into service, and some of the work that might have been done on it. You can also run prospective VIN's through Carfax.com to see the title history.

Catalitic Converter

Gutting The Cat

Cat Delete Pipe -- Ford part number F4TZ-5A212-V

Best way to remove the cat is to loosen the clams front and rear. With a marker mark the front and align the mark at the very bottom to help you get it back on in the right direction and bottom facing straight down. **NOTICE THE LITTLE TIT AND NOTCH AT THE BACK OF THE CONVERTER, THAT MUST BE LINED UP TO RE-INSTALL.** Unhinge both muffler hangers behind (2) of them go to the drivers side of the truck and pull the cat in that direction and with a dead blow hammer or a heavy hammer OR with a piece of 2 x 4 hit the cat forward until it releases. Then wiggle the front section loose.

Now is the fun part. With a steel breaker bar or a pipe or anything that is longer than the length of the cat start beating the honey comb up and keep dumping it out

of the side your hitting. do this until it is all out. Hint beat the crap out of it is not as simple as it seems. Make sure it is all clear before removing because you do not want any rattles.

Installing the cat back by banging the cat fully into the front using the mark to align the cat right and the arrow forward. Hint: Make sure the cat is seated all the way forward before re-clamping. Then make sure you align the back to the tit and notch before you start banging the back in place. Make sure the tit is all the way seated before clamping and set the hangers back before tightening the clamp. Finish tightening and then go back and tighten again because it must be very tight. Check the exhaust hangers and make sure they are on properly. Your done..... Great job you just gutted the cat.

Clutches

Difficulty Shifting, and / or Low Clutch Engagement

by Keith Carpentra

[Go To the Original Article](#)

Many of the 1994-1997 F-Series 5 Speed owners have complained about Clutch Problems. The symptoms of many of these complaints are:

- Pedal needs to be pushed into the floor to allow starter to engage,
- Difficulty getting the transmission into gear from start,
- low clutch pedal engagement and also
- noticeably harder shifting between gears, with possible grinding on downshifts.

People with these symptoms often ask if there is an adjustment on the clutch, or in the clutch linkage to rectify this situation. There is no such adjustment. While these symptoms can indicate a number of possible problems the most common problem causing all these symptoms is probably going to cost you no more than \$10 dollars. Here is a simple fix that most people can do themselves.

On the 1994-1997 F-Series Manual Transmission Trucks, these symptoms are most likely due to a worn clutch master cylinder bushing. This bushing lies in the eye of the clutch master rod. This rod is located just above the accelerator pedal. The bushing in question is made of plastic nylon, and when it wears out, the eye of the clutch master rod will typically slip on the clutch linkage pin about 1/8th of an inch. That 1/8th inch at the linkage translates to about 1 inch to 1 1/2 inch loss of travel at

the pedal. Thus your clutch will either be partially engaged or it will engage with the pedal only traveling a ¼ inch from the floor. If the truck is a 1994 to 1995 the clutch master rod was manufactured as a plastic rod. Continued use of the clutch while the linkage is misaligned can result in the plastic clutch master rod breaking in two. While I have never heard of the metal rod in the 96-97 trucks ever breaking I would not recommend continuing use as the bushing wears out very quickly when misaligned and there is bound to be metal wear at some point in the near future. This is covered in more detail later in this article.

To fix this problem: Members of this site have come up with a couple of modifications to the original equipment to rectify this problem. First you need to do is go to the local Ford house and purchase Ford Part # E69Z7526A, crowned bushing. Usually they are made of white plastic but some are said to have come in black. They run the better part of \$3 each. The consensus from the membership at Ford-Diesel.com is that just replacing the worn bushing will solve your problem initially but the same problem is likely to recur within a month. Many of us have solved the recurrence problem by insuring the proper alignment of the clutch linkage pin and the clutch master cylinder rod.

The way to insure the proper alignment of these components involves a little modification. You first start with clipping off the crown portion of the bushing with a sharp razor blade or razor knife. The bushing is then installed in its normal manner. First the bushing is placed in the clutch master rod eye and then it is slid onto the clutch linkage pin. The trick is to find a way to keep the rod and bushing from sliding off the Clutch linkage pin. There are two basic ways to accomplish this.

1. The easiest and least expensive way: Purchase a 5/16" E-Clip that will fit in the groove at the end of the clutch linkage that holds the clutch master rod in place. Also purchase two 5/16 " washers, 1 Teflon/plastic and 1 metal to be placed between the E-Clip and the clutch master rod. A 7/16" drill stop or collar bushing will also work in place of an e-clip you will Not be able to fit any washers on the pin though. This is what I used.

2. Another way is slightly more labor intensive but just as inexpensive. This one was submitted to me by Ray Varnadore. He took the picture you see on the left. Install the Rod and bushing as stated onto the clutch linkage pin. Then place one metal washer against the clutch master rod while on the pin and mark a location to drill a very small hole. Find a small cotter pin and drill the appropriate hole through the Clutch linkage pin so that it will be flush with the washer. An old Chevrolet shift linkage clip may be easier to remove and reinstall if ever the bushing were to need replacement again. It will also keep tension on the washer keeping it firmly in place. Ray said he drilled the hole with a variable speed hand held drill.

In the event that the Plastic clutch master cylinder rod has broken, you will be compelled to do one of two things to make the repair. You will either purchase a new clutch master cylinder, or you could find a metal clutch master rod and modify

it (grinding) to fit the existing old style clutch master. Well if you figure you will just suck it up and buy the Master, well there is a problem: If you choose to purchase a new clutch master cylinder you will be forced to purchase three additional hydraulic clutch components, to the tune of \$350. The reason for this is that Ford no longer sells a direct replacement for the original clutch master cylinder. They sell an “improved” replacement clutch master that uses a steel rod. (This clutch master is the one currently used on 1996- 1997 Manual Transmission F-Series’.) It is entirely incompatible with the hydraulic clutch components that are in your truck. Unfortunately, if you choose this route, this fix is going to involve bringing a shopping bag to the dealer because this is what you will need to get you shifting again:

- New Clutch master cylinder with metal rod Ford Part # F2TZ7A543D
- New Slave cylinder Ford Part # E3TZ7A564A
- New Neutral Safety Switch Ford Part # FF57Z11A152A
- New High Pressure Line Ford Part #. F5TZ7A512A

One good thing about the 1996 – 1997 F-Series is that the metal rod is unlikely to break but if it does the only replacement part needed would be the Clutch master cylinder. Or find a rod in a junkyard.

So it may behoove you to keep an eye out for rod misalignment or just spend a couple of bucks and beat it to the punch.

I want to give thanks to Ray Varnadore, Steve Klein and any other Ford-Diesel.com member who contributed to help make this article possible.

Coolants

Extended Life Coolants

Cooling system maintenance

The cooling system on any diesel has special concerns. It's possible for the coolant to cavitate --produce tiny bubbles--that can with time cause pinholes through the cylinder walls from the water jackets. For this there is an additive; Ford P/N FW-15 or FW-16, Fleetguard P/N DCA4; that needs to be maintained in the coolant. Generally this means installing 8 to 10 oz of the additive to the cooling system every 15000 miles. Another method is to monitor the cooling system with Fleetguard's DCA4 test kit P/N CC2602 or CC2602A. This measures the level of DCA4 in the system, and then you add the amount as required. The cooling system should be drained (and flushed if you live in an area with especially alkaline water) and refilled with a fresh 50/50 mix of coolant/water and one pint of the additive for every two gallons of coolant/water at 30,000 miles. Use only a low-silicate ethylene glycol-based coolant. Ford does not recommend using propylene glycol coolants in any of

their vehicles.

- Ford or Motorcraft Premium Antifreeze • Motorcraft Premium Gold Antifreeze (does not require SCA/DCA)

- Texaco Antifreeze/Coolant

- Texaco Antifreeze/Coolant Pre-diluted 50/50

- Zerex 5/100 (white bottle) Antifreeze/Coolant

- Zerex Ready To Use Antifreeze/Coolant (premixed 50/50 with de-mineralized water)

- Zerex Heavy Duty Pre-charged Formula

- Shellzone Premium Quality Antifreeze

- Fleetguard Complete EG--pre-charged at 1.5 units/gallon DCA4

Also available premixed 50/50 with water with the same DCA4 level • Pyroil Heavy-Duty Antifreeze/Coolant--Low Silicate

- Fleet Charge Antifreeze/Coolant--pre-charged with Pencool

Tips for using Fleetguards Test strips

One of the most common asked questions regarding test strips and how much coolant additive is required to raise the additive to a safe level. This depends on the capacity of the coolant system. Another piece of useful information is that each 1 pint bottle of additive is equal to 5 units.

Fleetguard considers the safe level to be between 1.5 & 2.5 The reason we recommend adding UP TO 2.5 is to help ensure that by the next time you check your coolant it will still be between these levels. Since not everybody maintains their vehicle in the same manner we recommend the HIGH end of the SAFEST LEVEL of 2.5. This has apparently confused some which is why we have added this statement.

For an example on getting your level to the HIGH end of the SAFE LEVEL 2.5

My Friends 99 Ford Powerstroke has a capacity of 32.75 quarts or 8.2 gallons. To figure out how many units 1 pint of additive will raise the coolant level, divide the 5 units by the capacity in gallons (8.2) $5 \div 8.2 = .61$, this tells you that each pint of additive will raise the coolant level .6. If your current level is 1.8 and you wish to reach a level of 2.5 you would need to add 2 pints ($2 \times .6 = 1.2$, $1.2 + 1.8 = 2.5$)

To assist you in getting the Ph level close to the neutral level of 7.0 Ph try adding 16oz of Plain White Vinagur and run for a day or two and then check your Ph again.

Coolant Filter Installation

Use 5/8" tees. Around \$2 each at Napa. they are black plastic. They had plastic Y's but wanted \$7 each and only had 1 in stock. There is another post that you can search for that claims that brass tees are available at Lowes (search for Lowes or Quest). I did not feel like driving that far. Also, one guy did a 5/8 by 3/8 x 5/8 tee and made smaller lines to the filter. My Napa bracket came with 5/8 ells so I kept the 5/8 size overall. The Napa bracket is heavy and will need support.

All you PSD owners out there

The answer to your coolant additives is CAT EXTENDED LIFE COOLANT. This is a premixed coolant for all engines with cavitations problems. Just flush out other coolant. Takes approx 5 1/2 gals @ approx \$6.00 per gal. All the info is under CATERPILLAR'S WEB SITE www.cat.com Check with any Heavy Equipment or Road Truck dealer, most carry. This coolant is good for 300,000 miles do not add water or additives.

Bypass Coolant Filter W/Eye

Napa parts. Bracket is the 4019, filter is 4071. Used 5/8 black plastic Tee's. The bracket allows for vertical mounting, so I ran a 1"x6"x 1/8 " aluminum angle back from the alternator bolts and mounted the coolant bracket there. It sets just above the front of the valve cover.

Coolant Filter I used a NAPA #4019 filter base kit and NAPA #4071 pre-charged filter for my application. I know there are other bases out there and Baldwin is another good one, but I like Napa's kit and the position of the inlet and outlet. This made it easier to mount. I also used BRASS T's for my application and a JOHN DEERE "coolant eye" for regular inspection as you can see in the photographs. The coolant eye really makes it nice because you can attach a garden hose with a female end to the eye for regular flushing intervals. It creates a swirl effect that forces debris down to the trap and has a drain cock on it for draining trapped debris that flows through the eye. This is also a feature of the coolant eye. The application was really easy to do and took just a short time to accomplish, but the long term effects of this type of system are a tremendous benefit to a diesel motor.

Here is a list of the parts you see so you can obtain the setup from a store nearest you. 1 - Piece of 2 inch Angle Iron - 1/8 in. thickness, cut to 4 in. long and notched on the alternator side, drilled to bolt specs.. 1 - NAPA #4019 base kit - includes base, 2 - 90's, and 3 - bolts. 1 - NAPA #4071 pre-charged filter OR equivalent. 2-3 ft. of 5/8 heater hose for attachment and in case of a problem. 10 - hose clamps (as shown because of the coolant eye) 2 - Brass T's: 3/8 thread. 6 - Brass Nipples: 3/8 thread to

5/8 hose. 1 - Can of Glossy Black Krylon Spray Paint 1 - John Deere #TY16423 (Coolant Eye)-----OPTIONAL Teflon Tape for threaded fittings. **Everything but the BRASS fittings should be available at your NAPA store. **The BRASS fittings were purchased from a local hardware store. I'm sure you can find them maybe at a LOWE'S or HOME DEPOT. They should be back in the BRASS FITTINGS area of the respected stores. I'm sure someone will have them somewhere if you look hard enough. If you can't find the BRASS fittings, plastic is an option, but I personally wouldn't use it.

Cup Holder for the front like the back bench seat

Go to the junk yard and get a cup holder and the two mounting bolts from a wrecked truck or go to Ford Parts and order them. Measure the distance between the two bolts from the middle of the bolts on your truck and center them on a 1/4" strip of steel. Then mount the strip in the center of the 20 seat of the 40/20/40 and pop rivet the strip to the metal bench bracket making sure the mounting bolts are set high enough so that the new cup holder mounts down onto and fully on the two bolts and now you have cup holder front and rear.

40 20 40 Center Console Disassembly

The whole console is made up of 5 parts, the cup holder, accordion door, the storage area, the storage area door, and the "trim piece"

The first and hardest part to get off is the trim piece. There are 2 "keepers" on the front and 3 down each side, 2 in the back, but you need to only get the front and the sides off so you can get it up just enough to get the accordion door out to get the lost change out or what ever is stuck in there.

To get the "keepers" loose, use a screwdriver to pry the foam down so you can see under the trim piece. You can't see real good but you can at least find the keepers. The way the keeper's work is they are a half arrow, and they fit into a groove. The trick is to apply some back and upward force and release the half arrowhead. I found that using a 90 deg pick tool worked the best. A small 90-degree screwdriver may work.

You're going to end up breaking a couple of the keepers when doing this. Just take some clear silicone and glue it back down and wrapped some tape around the whole thing until it dries.

Electrical

Auxiliary Idle Controller

AIC MOD

by Sparky

Ok to start off with you will have to go to Radio Shack or similar store and get some parts.

Single Pole Single Throw Switch. Radio Shack pt# 275-612

5K Linear Taper Potentiometer. Radio Shack pt# 271-1714

Linear PART # for the 2K is Radio Shack pt# 900-8587

2 Single Pole Double Throw Auto Relays Radio Shack pt# 900-2391

2 Wiring Harness Plugs Radio Shack pt# 900-2396

18 Gauge Wire

SOLDER

Wire Ties

Butt Connectors

Soldering Gun

Safety Glasses

STEP 1 Switches

Find a power source that is with the key.

Run a wire from there to one side of the switch.

From the other side of the switch run a wire to the coil terminal of both relays

From the other side coil terminals on the relays run a wire to the parking break switch wire. (There is only one wire on the parking brake.)

STEP 2 Idle Validation Switch (IVS)

As you look at the throttle pedal you will see a switch on the left side with 2 wires going to it. The wires are taped together carefully un-tape them so you can work with the wires. I used a razor knife to cut the tape, but be careful not to cut the wires. (There should be a red/orange with and a brown wire, unless they changed the color code of these wires.)

Cut the red/orange wire leaving plenty on the switch side so that you can splice onto it. The red/orange wire that is going into the wire bundle needs to get hooked to the common side of one of the relays.

The other red/orange (the one attached to the IVS) goes to the **NORMALLY CLOSED CONTACT (NC)** of the relay. Now take a wire from the **NORMALLY OPEN CONTACT (NO)** and run it over to the brown wire by the IVS, you will just tap onto this wire so you don't need to cut it. Just take some of the insulation off and solder it on, then tape her back up.

STEP 3 The other Relay and the Throttle Position Sensor (TPS)

Throttle Position Sensor (TPS) is located on top of the pedal and has 3 wires going to it. Remove the tape to expose the wires. (There should be a brown/white wire and a gray/white wire.)

Cut the brown/white wire, leaving enough to work with by the switch. Hook the end up that goes back into the wire bundle to the common side of the other relay.

Take the side that goes to the switch and hook it to the **NORMALLY CLOSED CONTACT (NC)** of the relay.

Take a wire from the **NORMALLY OPEN CONTACT (NO)** of the relay and go to the left terminal on the POT.

Now take a wire from the center terminal of the POT and tap it into the gray/white wire.

Tape up all the bare wires and enjoy

10k Resistor Mod

A 10k ohm resistor will raise the injection oil pressure approximately 200 psi. Increased injection pressure will deliver more fuel and will deliver more fuel sooner. This increase in fuel deliver and advance will yield higher combustion temperature but your exhaust gas temperature will remain almost steady. Such an efficient burn has it's down side. It will cause an idle rougher than stock. It may also cause the production of nitrous oxides. Thermal efficiency is a function of the $\frac{\text{high(absolute)temperature}}{\text{low(absolute)temperature}}$. In other words, the higher the peak combustion temperature in comparison to the exhaust temperature the more efficient is your engine.

Parts Needed

digital volt ohm meter

10k ohm resistor (1/2 or 1 watt)

2 fine copper wires 4" length

black tape

Procedure

1 Solder wire on resistor

- 2 Identify injection pressure sensor (on front of driver side cylinder head)
- 3 Test for voltage with key on and engine off

IPS has 3 connections:

+4.97V

+0.003V

+Output

Turn key off!

Connect resistor between output and 0.003V (do not cut any factory wires)

Slide fine wires into plug and reassemble

Cover bare wires with tape

I used a 1 watt .05 rated 10K resister. Soldered a 3" piece of wire on each side of the resister slide heat shrink over the entire part of the resister and about 1" of wire. Leave about 1" of the wire soldered on inside the heat shrink and seal each end to be sure with electrical tape. Then I stripped the wire back 1" I pulled out of the wire 5 strands and cut the rest away. Looking at the connector it looks like 2 eyes and a mouth put 1 wire in the right eye and the other in the mouth Blue/stripe and grey/stripe wire. I put the plug back into the ICP about 20 time until the check engine light did not come back on. If the check engine light comes back on you still have a open circuit. Just push it into there harder or pull it a part and put in again until no Check Engine Light comes on. It will if your work if you keep putting it in the plug and it seats.

REMOVE BEFORE DEALER SERVICE

Computer Codes

Fault Codes

0107 BARO Barometric press sensor ckt low input Defaults to 100kPa

Open/grounded circuit, biased sensor, PCM

0108 BARO Barometric press sensor ckt high input Defaults to 100kPa Circuit

shorted to 5V, biased sensor, PCM

0112 IAT Intake air temp sensor ckt low input Defaults to 15°C Grounded circuit, biased sensor, PCM

0113 IAT Intake air temp sensor ckt high input Defaults to 15°C Open circuit, biased sensor, PCM, short to 5V

0122* AP Accelerator pedal sensor ckt low input Engine will only idle if hard fault Grounded circuit, biased sensor, PCM

0123* AP Accelerator pedal sensor ckt high input Engine will only idle if hard fault

Open circuit, biased sensor, PCM, short to 5V

0195 EOT EOT sensor ckt malfunction (95 MY) Aborts KOER CCT test Engine not up to operating temp., leaking thermostat

0196 EOT EOT sensor ckt performance (96 MY) Aborts KOER CCT test Engine not up to operating temp., leaking thermostat

0197* EOT Engine oil temp sensor ckt low input No cold adv., fast low idle

Grounded circuit, biased sensor, PCM

0198* EOT Engine oil temp sensor ckt high input No cold adv., fast low idle Open circuit, biased sensor, PCM, short to 5V

0220* IVS Throttle switch B ckt malfunction Switch test - KOER Short/open circuit, switch failure, operator, PCM

0221* IVS Throttle switch B ckt performance AP/IVS disagree - Engine will only idle if hard fault Failed pedal assembly

0235* MAP Turbo boost sensor A ckt malfnct (95 MY) Uses Inferred MAP signal Open, short to ground or 5v, faulty sensor

0236* MAP Turbo boost sensor A ckt performance Uses Inferred MAP signal Restricted inlet/exhaust/supply hose, missing hose

0237* MAP Turbo boost sensor A ckt low input Uses Inferred MAP signal Sensor, PCM (95MY) Open, short, sensor, PCM (96MY)

0238* MAP Turbo boost sensor A ckt high input (96MY) Uses Inferred MAP signal Noise, faulty sensor

0261* INJ Injector ckt low - Cylinder 1 FMEM mode, engine will run on 4 cyl. Harness short to ground

0262 INJ Injector ckt high - Cylinder 1 FMEM mode, engine will run on 4 cyl. Miswired connector or harness

0263 PCED Cylinder 1 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0264* INJ Injector ckt low - Cylinder 2 FMEM mode, engine will run on 4 cyl. Harness short to ground

0265 INJ Injector ckt high - Cylinder 2 FMEM mode, engine will run on 4 cyl. Miswired connector or harness

0266 PCED Cylinder 2 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0267* INJ Injector ckt low - Cylinder 3 FMEM mode, engine will run on 4 cyl. Harness short to ground

0268 INJ Injector ckt high - Cylinder 3 FMEM mode, engine will run on 4 cyl. Miswired connector or harness

0269 PCED Cylinder 3 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0270* INJ Injector ckt low - Cylinder 4 FMEM mode, engine will run on 4 cyl. Harness short to ground

0271 INJ Injector ckt high - Cylinder 4 FMEM mode, engine will run on 4 cyl. Miswired connector or harness

0272 PCED Cylinder 4 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0273* INJ Injector ckt low - Cylinder 5 FMEM mode, engine will run on 4 cyl.

Harness short to ground

0274 INJ Injector ckt high - Cylinder 5 FMEM mode, engine will run on 4 cyl.

Miswired connector or harness

0275 PCED Cylinder 5 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0276* INJ Injector ckt low - Cylinder 6 FMEM mode, engine will run on 4 cyl.

Harness short to ground

0277 INJ Injector ckt high - Cylinder 6 FMEM mode, engine will run on 4 cyl.

Miswired connector or harness

0278 PCED Cylinder 6 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0279* INJ Injector ckt low - Cylinder 7 FMEM mode, engine will run on 4 cyl.

Harness short to ground

0280 INJ Injector ckt high - Cylinder 7 FMEM mode, engine will run on 4 cyl.

Miswired connector or harness

0281 PCED Cylinder 7 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0282* INJ Injector ckt low - Cylinder 8 FMEM mode, engine will run on 4 cyl.

Harness short to ground

0283 INJ Injector ckt high - Cylinder 8 FMEM mode, engine will run on 4 cyl.

Miswired connector or harness 0284 PCED Cylinder 8 contribution/balance fault Cylinder not contributing during CCT test Power cylinder, valve train or injector problem, circuit

0340 CMP Camshaft pos sensor ckt malfunction No CMP sensor signal detected during crank Open/grounded circuit, sensor fault, short to power

0341* CMP Camshaft pos sensor ckt performace Electrical noise detected Harness routing, charging ckt, sensor

0344 CMP Camshaft pos sensor ckt intermittent Incorrect number of CMP transition counts Harness routing, charging ckt, sensor, int ckt, improper gap

0380 GP Glow plug ckt malfunction Glow Plug Relay - KOEO OCC test

Open/grounded ckt, solenoid open/shorted, failed PCM

0381 GP Glow plug indicator ckt malfunction Glow Plug Lamp - KOEO OCC test

Open/grounded circuit, lamp open, failed PCM

0470 EBP Exhst press sensor ckt malfnct (96 MY) No-start or crank mode Biased sensor, open signal return

0471 EBP Exhst press sensor ckt prfrmnc (96MY) Run mode Plugged, stuck, or leaking hose

0472 EBP Exhaust press sensor ckt low input Disables back pressure device Open/grounded circuit, biased sensor, PCM

0473 EBP Exhaust press sensor ckt high input Disables back pressure device Circuit shorted to 5V, biased sensor, PCM

0475 EPR Exhst press control valve malfunction Exhaust back pressure regulator - KOEO OCC test Open/grounded ckt, solenoid open/shorted, failed PCM

0476 EPR Exhst press control valve performance Run mode and KOER on-demand test Failed/stuck EPR control, EBP fault, EPR circuit

0478 EPR Exhst press control valve high input Excessive back pressure - run mode

Plugged sensor line, stuck butterfly, restricted exhaust
0500 VSS Vehicle speed sensor malfunction Sensor, circuit, PCM, PSOM, TR failure, low trans fluid
0560 PCED System voltage malfunction B+ too low for CCT test - aborts test Charging system problem/load, glow plugs still enabled
0562 PCED System voltage low May be temporary condition at crank only Low sys. voltage, charging sys., internal PCM failure
0563 PCED System voltage high May be temporary condition - 24V jump start High sys. voltage, charging sys., internal PCM failure
0565 PCED Cruise "On" signal malfunction Switch Test - KOER (Code set if cruise not present) Open/short circuit, switch, PCM, or failed to activate switch during KOER switch test Cruise control codes will be set on every switch test on vehicles not equipped with cruise control.
0566 PCED Cruise "Off" signal malfunction Switch Test - KOER (Code set if cruise not present)
0567 PCED Cruise "Resume" signal malfunction Switch Test - KOER (Code set if cruise not present)
0568 PCED Cruise "Set" signal malfunction Switch Test - KOER (Code set if cruise not present) 0569 PCED Cruise "Coast" signal malfunction Switch Test - KOER (Code set if cruise not present)
0571 BPA Brake switch A ckt malfunction Switch Test - KOER (Code set if cruise not present)
0603 PCED Powertrain Control Module KAM error No historical faults output during a KOEO test Open PCM pin, disconnected B+, faulty PCM
0605 PCED Powertrain Control Module ROM error Internal PCM failure Internal PCM failure
0606 PCED PCM processor fault PCM inactive background fault Internal PCM failure
0703 BOO Brake switch B ckt malfunction Switch Test - KOER Open/short circuit, switch, PCM, failed to activate switch during KOER switch test
0704 CPP Clutch switch input ckt malfunction Switch Test - KOER
0707** TR Trans range sensor ckt low input Short to ground in circuit, biased sensor, PCM
0708** TR Trans range sensor ckt high input Open in circuit, biased sensor, PCM, short to power
0712 TFT Trans fluid temp sensor ckt low input Short to ground, biased sensor, PCM
0713 TFT Trans fluid temp sensor ckt high input Open circuit, biased sensor, PCM, short to power
0741 TCC Toque converter clutch ckt Circuit failure, faulty solenoid, PCM
0750 SS1 Shift solenoid A malfunction Circuit failure, faulty solenoid, PCM
0755 SS2 Shift solenoid B malfunction Circuit failure, faulty solenoid, PCM
0781** 1-2 shift malfunction Circuit failure, faulty solenoid, faulty clutch, PCM
0782** 2-3 shift malfunction Circuit failure, faulty solenoid, faulty clutch, PCM
0783** 3-4 shift malfunction Circuit failure, faulty solenoid, faulty clutch, PCM
1111 N/A System pass No PCM system faults detected N/A

1211* IPR ICP pressure above/below desired Continuous and KOER on-demand test IPR valve failed, stuck, or shorted to ground

1212* ICP ICP volt not at expected level Crank or KOEO Biased sensor or ckt, open signal rtn, low oil in reservoir

1218 PCM/IDM CID stuck high Cyl. identification line stuck high (historical fault only) CID circuit open, probably intermittent

1219 PCM/IDM CID stuck low Cyl. identification line stuck low (historical fault only) CID circuit short to ground, probably intermittent

1261-1268 INJ High to low side short cyl #1 -#8 Cylinder with fault will not operate Short circuit, shorted injector, failed IDM

1271-1278 INJ High to low side open cyl #1- #8 Cylinder with fault will not operate Open circuit, open injector, failed IDM

1280* ICP ICP circuit out of range low Uses inferred ICP strategy Open/grounded circuit, biased sensor, PCM

1281* ICP ICP circuit out of range high Uses inferred ICP strategy Circuit shorted to 5V, biased sensor, PCM

1282 IPR Excessive ICP pressure System fault Faulty IPR regulator (sticking), IPR shorted to ground

1283* IPR IPR circuit failure Run-mode or KOEO OCC test Open/grounded circuit, stuck IPR, loose connection

1284 N/A ICP failure - aborts KOER CCT test Detected sensor circuit fault - aborts KOER CCT test See codes 1280, 1281, 1282, 1283, 1211

1291 INJ High side #1 (right) short to grd or B+ Inj power supply circuit short (operates on 4 cylinders) Shorted circuit, faulty IDM

1292 INJ High side #2 (left) short to grd or B+ Inj power supply circuit short (operates on 4 cylinders) Shorted circuit, faulty IDM

1293 INJ High side open bank #1 (right) Inj power supply circuit open (operates on 4 cylinders) Open circuit, faulty IDM

1294 INJ High side open bank #2 (left) Inj power supply circuit open (operates on 4 cylinders) Open circuit, faulty IDM

1295* INJ Multiple faults on bank #1 (right) Fix low side short and rerun diagnostics Miswired connector or harness, short to ground

1296* INJ Multiple faults on bank #2 (left) Fix low side short and rerun diagnostics Miswired connector or harness, short to ground

1297 INJ High sides shorted together Fix shorts and rerun diagnostics Shorted wires, faulty IDM

1298 PCED IDM failure Internal IDM failure Internal IDM failure

1464 N/A A/C on during KOER CCT test Aborts KOER CCT test Operator error, A/C circuit shorted to power

1501 N/A Vehicle moved during testing Aborts test - KOER on-demand, CCT, or switch test Operator error

1531 N/A Invalid test - acc. pedal movement Aborts test - KOER on-demand or CCT test Accelerator pedal moved during KOER on-demand or CCT test

1536 PBA Parking brake applied fail Switch Test - KOER Circuit, switch, PCM, failed to activate switch KOER

1660 PCED OCC signal high Aborts KOEO OCC test High system voltage, internal

PCM fault

1661 PCED OCC signal low Aborts KOEO OCC test Low system voltage, internal PCM fault

1662 PCED IDM-EN circuit failure IDM enable relay - KOEO OCC test Open relay, blown fuse, open/grounded circuit

1663 PCM/IDM FDCS circuit failure Fuel demand command signal - KOEO OCC test Open/grounded circuit, faulty IDM

1667 PCM/IDM CID circuit failure Cyl. identification circuit - KOEO OCC test Open/grounded circuit, faulty IDM

1668 PCM/IDM PCM-IDM diag. communication error Communication on EF (Electronic Feedback line) Open/shorted EF or FDCS, open IDM ground

1705 TRS TR sensor out of self test range Not in PARK during KOEO or KOER Operator error, circuit failure, faulty sensor, PCM

1711 TFT TFT sensor out of self test range Transmission fluid temp too high or low Circuit failure, faulty sensor, PCM

1728 TCC Trans slip error - converter clutch failed Solenoid failure or mechanical failure**

1729 4x4L 4x4 Low switch error Circuit failure, faulty switch, PCM

1746 EPC EPC solenoid open circuit Open circuit, faulty solenoid, PCM

1747 EPC EPC solenoid short ckt Short circuit, faulty solenoid, PCM shorted to ground

1748 EPC EPC malfunction Circuit failure, PCM**

1754 CCS Coast clutch solenoid ckt. malfunction KOEO OCC test Circuit failure, faulty solenoid, PCM

1779 TCIL TCIL circuit malfunction KOEO OCC test Short to ground, PCM

1780 TCS TCS circuit out of self test range Switch test - KOER Circuit, switch, PCM, failed to activate switch in KOER

1781 4X4L 4X4L circuit out of self test range In 4X4L during KOEO or KOER Operator error, short to ground, PCM

1783 TFT Transmission overtemp condition Internal trans failure, circuit failure, sensor, PCM**

CPS PROBLEM

This applies to all PowerStroke motors from late 1994 to 2002.

Diagnosis: A bad cam position sensor is usually signified by the PowerStroke motor abruptly and unexpectedly quitting. The motor may also be suffering from slight power loss and slight increase in fuel usage which is usually not noticeable until it is seen as an improvement when the sensor is replaced. When the CPS causes the motor to shut down, the tachometer will not register. If the motor fails to restart, the tachometer will not register when the starter is turning the motor over. This may or may not cause the check engine light to come on.

Part Numbers: The International parts are usually half the price of Ford's, and I wouldn't buy one from Ford unless you absolutely had to.

International part numbers:

A change occurred mid way through 1997, so if you have a 97 it is best to look at the engine serial number. For serial number before serial number 375549 use PN# 1821720C98. For serial number 375549 (including this number) and after use PN# 1825899C93.

Ford Part Numbers:

For 1996 and older use PN# F6T012K073A For 1997 and newer use PN# F7T012K073A

Remove/Replace: CPS replacement is a very simple process. It is located at the 10 o'clock position of the crankshaft pulley and secured with one 10 mm bolt.

Removing the serpentine belt will facilitate the removal.

Step 1) Make sure key is off and disconnect battery or pull #9 fuse. This is always a good idea when working on engine electronics.

Step 2) Remove engine belt

Step 3) Unplug wiring plug from sensor by prying out on the little plastic tab and pushing it out of it's socket

Step 4) Use 10 mm socket with small extension to remove 10 mm bolt

Step 5) Clean any dirt or grease off of sensor and surrounding area to prevent contamination of crankcase oil and seal of new sensor

Step 6) Use pliers, pry bar, or whatever else to gently remove sensor by pulling it straight out. It may be slightly stuck and slight force may be needed to loosen it. It is ok to twist it in its socket to loosen it if necessary.

Step 7) Coat new sensor o-ring with clean engine oil and press sensor into hole.

Step 8) Replace 10 mm bolt, torque to 10 ft-lbs, or just make sure it is snug.

Step 9) Replace wiring plug by simply pressing it into position until you hear the holding tab click into place.

Step 10) Replace belt.

Step 11) Ensure battery has been disconnected or #9 fuse has been out for at least 30 minutes. After this amount of time, they can be replaced.

Step 12) Start engine and inspect for leaks or other problems. Make sure belt has been properly aligned on each of the pulleys.

Cab Light Installation Instructions

So you want to add cab lights to your 94-97 Ford truck. With the help of a couple guys on www.ford-diesel.com I installed a set onto my 97 crew cab F-350. I figured I'd write up a set of step-by-step instructions since none of the "kits" really come with any.

1. Muster up the courage to drill holes into your roof!
2. Gather up the lights, about 10' of white wire, about 10' of black wire, wire splices, a drill, assorted

drill bits, clear silicone or RTV, hammer, an awl or center punch, masking tape, tape measure, blanket or fender guards, and a Philips screwdriver.

3. Check the bulbs and light lenses for any broken parts.

4. Remove all the trim from around the headliner, cloths hook(s), dome light(s) and the sun visors so

as to drop the headliner. The liner of an extended cab or crew cab wont be able to be removed

from the interior of the truck without destroying it so let it rest on the headrest of the seats. A

regular cab truck should be able to remove the liner from the truck.

5. Cover your hood and cowl with a blanket or fender guards and climb on up.

6. Notice the joint in the chrome windshield trim at the top center of the trim.

Center the first light

with this joint, 3 3/4" back from the edge of the chrome trim.

7. Make sure the light is straight. I used masking tape to keep it in place as I got off the truck to look

at it from the ground.

8. Mark mounting holes.

9. With the awl or center punch indent the mounting holes and drill the appropriate size hole for the screws being used.

10. Drill a slightly larger hole between the two mounting holes for the wires to pass through.

11. Cut the loop off of the white ground wire and pass the two wires through the center hole. Apply

some clear silicone or RTV to the bottom of the light and screw holes. Place the light in it's new

home and synch the screws down.

12. Place the second light either on the left or right side of the first one (which ever way you want to

work). Measure the light 3 3/4" from the chrome trim and 1" center to center with the first light.

13. Repeat steps 6-10.

14. Continue in this fashion until all 5 lights are mounted and sealed.

15. On the inside, note the "shelf" where the sun visors were. The wires you fed through the holes will

be up on top of it. It's tight so you'll probably need to hook a cloths hanger, bailing wire, or use a

screwdriver to fish them out.

16. I "daisy chained" the wires by connecting one single wire to all the black (power) wires and one

single wire to all the white (ground) wires.

17. Run the two wires down the passenger side a-pillar and into the passenger side kick panel.

18. Behind the passenger side kick panel is a two wire connecter that is left empty.

This is where the factory lights would have plugged into. I decided not to cut the plug off, instead I just spliced the black wire from the lights to the power wire from the harness. I cant remember what color the wire was so you'll have to test it with a test light.

19. Connect the white wire to the ground from the harness.
20. Test the lights to make sure everything works. If there are any problems check the bulbs again, and all connections.
21. Replace all the panels, trim, and sun visors.

Advance Your Timing for Better Power & Efficiency

PSD Injection timing can be changed EOT Mod

The PCM uses the EOT to help determine the injection timing. Cold oil has more advanced timing. Warm oil has less advanced timing. There are several reasons Ford changes the timing as the oil warms-up.

In the past some modifications were tried on the EOT sensor. Most results were not successful. My early experiments resulted in the vehicle stalling at a red light with a woman driver.

But this modification is different. In the past the sensor was replaced with a fixed resistor. There was no feedback from the sensor. The engine could be made to run well at only one oil temperature. The changes in engine oil temperature needed to be sensed by the PCM.

The new method had to wait for the warranty to expire on the test vehicle. The new method requires cutting a wire and splicing in a resistor.

The EOT sensor is connected with two wires. Either wire can be cut and spliced with a resistor. The values that have been tried are: (0.5k 1k 1.5k and 4.1k). The 4.1k ohm has the most effect on advancing injection timing. When this resistor is wired in series with the EOT, the PCM is fooled into thinking that the engine oil temperature is lower than actual. Lower engine oil temperature causes an advance in timing.

The advance in timing seems to be good for efficiency. Power is better above 1500rpm. The turbo seems to have a bit more lag and it is now possible to run more injection oil pressure.

In general, new engines are not adjusted for peak power or efficiency. Part of the specifications requires lowering the peak combustion temperature. This is often accomplished by retarding the injection timing when the engine is at the torque peak (2000rpm). An advance (over stock timing) at this rpm is good for both power and efficiency. The test hill showed a 3mph increase in speed.

The increase in turbo lag seems to be caused by reduced heat in the exhaust manifold. Turbochargers work on waste heat in the exhaust gasses. Less waste heat is good for efficiency and this modification leaves less heat in the exhaust to run the turbo on the test vehicle.

One last comment, when the injection oil pressure is increased, the injectors are harder to open. Harder to open injectors will take longer to open. In the past, this effect has limited the injection oil pressure to about 3000psi on the test vehicle. Some people also reported that their engine towed better at higher rpm without an increase in injection oil pressure (without a 10k resistor). The advanced timing of this modification has allowed the injection oil pressure to be increased on the test vehicle. Haven't had time to gauge the increase but the injectors are working better at high rpm and load.

Electric Window Motor Replacements

To remove the window motors you have to remove the door panels. After you have the inner door exposed you are going to have to remove the three rivets that hold the window regulator assembly to the door frame. To remove the regulator from the door you have to remove one of the rivets that holds the armrest support brace, and pivot the brace down and out of the way. Then the regulator can fit through the door opening. I just thought of something, you might be able to access the motor mounting screws if you drill three holes in the door so you can stick a socket and extension through to reach the bolts. I usually remove the whole regulator and change the motor on the workbench.

Instrument Panel Removal

Dash Gauge Removal

The two trim pieces below the dash need to come out. Those would be the "Fake Wood" pieces or where they would put them. Those just pop out, they are held in with steel spring clips, and you can't break them.

Behind that are two screws an 8mm socket will work on them. Pull the head light knob out and push in the steel spring clip holding it to the shaft of the knob to remove the knob. Then as the bezel comes out, unplug the fuel switch connector and the wait to start and other lights connector. Then you can remove the bezel.

Next is white backing plate. There are 6-8 screws holding that thing in and 3 of them are across the top of the cover that you want to clean. These take a 5.5mm ignition wrench to get the 2 screws out because they are in the upper corners that you can't get a socket on them at all. With the screws removed your ready for the next step that.

The cover comes next. Be careful with the cover it is very fragile, any slight pressure and you'll crack it. It's about \$30.00 for a new one. Remove the cover and you'll be at the front face of the instrument panel. You can clean that too at this time. If you pull a couple more screws out the instrument panel comes out. Pull it out gently and remove the connector from the back. Light's can now be replaced here by taking the back light holder's and turning them 90 degrees. Lights can be purchased at NAPA for about \$3.00 for 2 of them. Just be damn careful with that cover or you'll be ordering one.

Installing Keyless Entry

Check out crutchfield <http://www.crutchfield.com/infolib/S-PDcX5uFsZjy/carindex.asp?id=carsec-lead> & they have alarm/keyless entry systems. the advantage of the alarm system is that you might be eligible for a break from your insurance company. as for installation. crutchfield gives you complete instructions on how to take your truck apart (and put it back together), what tools you'll need--the whole 9 yards. if you have any problems or ?'s--just give them a call. They have kits that start out at around \$100 (you have to purchase about \$20 worth of relays for the keyless entry) I've installed at least 10 stereos from these folks and can't believe their support.

Replacing Positive Battery Cable

My positive battery cable needs replacing. I called Ford and they told me \$103.50, my jaw dropped. None of the parts stores carry them. I called International and they said they would try to make one up for me. Does anyone know of an easier or cheaper way to fix my cables? The insulation (about 2" from the terminal) is discolored on both cables (the one to the other battery and one to the starter). Under the insulation is all corroded. I know they have replacement terminals, but do they have ones that will accept both cables into one terminal? Champion makes a replacement. Pep Boys stock them for around \$80. Still a lot of dough, but a few bucks less than Ford.

Visit you local welding supply house and have then make up some cables for you using welding cable. This is way cheaper than Ford's fix plus it flows juice much better. When our cables eventually die that what I'll be doing.

Personal Computer Scan Tools

Scan Tool Companies

Auto Tap Scan Tool www.autotap.com/
Harrison Scan Tool www.ghg.net/dharrison/
OBDII Scan Tool www.obd-2.com/

PCM Chip Codes 1994 - 1997

94 manual - BEG6 BEG 8
95 manual - SOD4 SOD5
95 auto - PRY4 TEE4 TEE5
96 manual - ALF4 AUG4 AUG6 AUG7
96 auto - MIF4 MIF6 MIF7 NAW4 NAW6 PRE4
97 manual - ALF6 JKA2 JKA3 MLE0 MLE1
97 auto - MME2 MME3 MME4 MME5 MME6 NAW6 TDE0 TDE1 YBT0

Power Chip Install For Us Who Have Not Done One

#1 you will need to remove the prom chip 1st before installing the aftermarket chip. **PLEASE BE AWARE:** The vehicle must be turned off and we strongly recommend you remove the keys from the ignition to prevent power from being applied to the computer during installation. Do not switch your ignition to the run or accessory position during installation (i.e. playing your radio) damage to your computer and YOURCHIP module could very well occur. **DAMAGE CAUSED BY THE ABOVE WILL NOT BE COVERED UNDER WARRANTY.** A 10 mm socket is required to remove the wiring harness from the computer. The 10 mm bolt is located at the center of the wiring harness. As you loosen it, the connector will slowly release. **Connector preparation** Once you have the computer removed locate the end opposite the wiring harness connector. This end usually has either a small plastic cover or a thin metal cover. Pry this out gently. A double sided electrical edge connector will now be exposed (see picture). The following can be done through this access panel or by removing the corner screws on the computer and opening the

cover(s) to better expose the connector to be cleaned. Most edge connectors have a coating of protective grease on them. Remove this using a Q-Tip, cloth or paper towel. Make sure you clean both sides of the connector thoroughly, you can use alcohol if necessary. Next, most edge connectors have a thin lacquer or coating over the electrical contacts. This is from the factory and is normal. To clean this, use a sharp knife, small flat screwdriver, or scraper. Be careful to apply gentle pressure and clean only this coating off, do not remove or damage the electrical contacts. We recommend cleaning one contact at a time, to minimize problems or damage. Clean the area in between the contacts also. (Remember to clean both sides). If you start to see the silver contacts give off fine metal shavings, you are done. STOP! If you remove the cover(s) to clean this connector, now reinstall them. Please verify that BOTH sides of the edge connector were cleaned thoroughly Improper cleaning is the largest reason Superchips modules fail or work incorrectly. **FAILURE TO CLEAN THE CONNECTOR CORRECTLY WILL VOID YOUR WARRANTY AND TRIAL PERIOD.** All Ford Modules from YOUR CHIP CO.. come with a warning label. Be sure to thoroughly read and comply with this warning label before removing it to install the chip. With the edge connector now clean, you are ready to install YOUR CHIP CO module. Notice the edge connector location on your computer. It is closer to one side than the other. Now looking at your YOUR CHIP CO module, notice the same. Slide your YOUR CHIP CO module on by applying gentle pressure evenly. See picture below. Once in place we suggest securing the chip with Duct Tape.

***** Note *****

This is for reference only on removing and replacing chips not endorsing any specific chip company.

Power Stroke Diesel Block Heater 94 -96 Was Optional on 97 Models

It is hidden under the air box and between the core support & air box. You can also start at the oil filter housing and trace it out, it comes out of the housing as an orange heavy wire and runs forward along the drivers side frame. Right on top of the frame it goes into a black wire loom. From there it changes to a gray 3 strand cord and turns upward under the air box.

Disconnecting Door Chime

There's a little black noise box under the left middle of the dash. Open the door or leave the lights on and follow the sound. Once you locate the noise box, unplug it. The noise will stop. Unplugging the box will not hurt anything or disable other circuits. Next, unbolt the box. There's only one bolt. Remove the noise box and vigorously slam it onto the pavement. The last step isn't necessary, but will insure that the noise box doesn't come back to life.

Trailer Plug "Y" For An Additional 7 Pin Connector

Go buy a T-connector from your local RV or trailer sale lot. If not, check out Reese, Draw-Tite, or Hoppy. They all make the connector that plugs right in. You will still have to tap into the brake, and hot wire. I have used these in the past, and have yet to have a problem.

Replacing Ignition Switch

Many of the 80-97 models of Ford trucks have problems with the ignition switch. Symptoms include: key getting stuck or not going in, ignition switching off randomly, and having to jiggle the ignition to get your truck to start. Here, Wesley details the procedure to replace the ignition switch. I just did this in the sweltering TEXAS HEAT, but why the hell would the dealer charge 1.5 hours that just took me, an Aggie, 15 minutes to do? Here is the procedure:

Tool's you'll need: Phillips Screw driver Flashlight, if the lighting isn't good Some kind of object to pick at the lock (I used a wire coat hanger)

This is the fun explore your truck method, if you just want to get it done, read the bottom set of steps. If you have tilt wheel, lift it all the way up Remove the bottom of the steering column, retained by 4 screws, 3 on the bottom, and 1 on the side of the ignition switch by that little cubby in the dash. Next, in the column on the bottom, you will see the ignition lock. There is a shiny chrome button on there, that's where the magic is. Insert key and turn to the Run position Unfold the coat hanger, and stick the pointed end into the little button mentioned earlier. Give the ignition lock a yank, and out it comes. Take new lock and position it like the old one is, in the run position Stick it into the void where your old one is, turn it to lock. Test all the positions, acc, lock, off, run and start Wonder why this doesn't solve your problem of the key having trouble getting out. Be happy you saved yourself 86 bucks from Ford, and 20 bucks on parts, and get online to Jason's page, so happy that you did it The quick way (no need to remove column cover) Tilt wheel up, turn key to run position. Take coat hanger and stick it into hole on the bottom of column, between

the 2 screw holes (located towards the top of the bottom, nearest to the screw hole. Pull out old lock. Install new lock.

Exhaust

Cat Delete Pipe -- Ford part number F4TZ-5A212-V

Down Pipe - Turbo Exhaust Outlet Installation

Raise the vehicle to working height with hoist or jack stands. Remove the two nuts at the catalytic converter and turbo down pipe flange. Move rearward and to the side for working clearance. Loosen (but do not remove) the v-clamp at the turbo outlet, then shake the down pipe from below to loosen at the turbo outlet. Remove the MAP sensor on the firewall to create sufficient working area for the Sawzall. Remove the transmission dipstick and tube. To Keep debris or metal shavings from getting into the exposed end of the dipstick tube under the vehicle, place a clean, large rag or wiper in the opening. (Be sure your rag or wiper is big enough that it will not fall into the tube) Angle the Sawzall high and to the left and cut the down pipe approximately 4 inches from the clamp which connects it to the turbo. The object is to remove the "corba head" from the upper end of the down pipe so that it is possible to drop the remainder of the pipe out of the bottom of the vehicle. Note: We suggest starting with a new blade (Milwaukee#5187 metal cutting blade) because the factory pipe material is tough and dulls blades rapidly. Remove both sections of the factory pipe, then determine the path for the new US Gear "round" down pipe by inserting the top section of the new pipe into the empty channel which contained the factory down pipe. Take note of where the new pipe will cross the body seam under the vehicle. Reverse the blade in the say (or turn the say upside down) and, from under the vehicle, make two cuts in the body seam approximately 3# on each side of the path where the new pipe will cross the seam. Place the "duck-bill" port-a-power at the body seam and transmission and with a block of wood, fold the seam toward the rear of the vehicle as shown. This will create the necessary clearance for the new down pipe to be placed in the path without coming into contact with the body seam. With the insulating material provided, wrap the top section of the new down pipe and clam the end. Note: Soak the wrap in water to make the material more flexible. Remember to leave 2 to 3 inches exposed at the bottom to allow for the slip joint on the lower section. Install the top section to the turbo outlet with the v-clamp provided. Note: The v-clamp included with the kit is a spare in case there is damage done to the factory clamp during removal or reinstallation. Do not tighten at this time. Position the top edge of the 3" Torca clamp provided flush with the top edge of pipe. The clamp must cover the slots. Finish tightening nut to approximately 60 ft. lbs. (Note: If torque wrench is not available, tighten nut until 13-14 bolt threads are exposed beyond nut (13/16" - 7/8"). This is equivalent to the diameter of a nickel. Reattach the catalytic converter

to the flange, but do not tighten. Staring at the flange, position all the components for proper clearance and begin to tighten, working up the pipe toward the turbo. With the down pipe in the proper position, tighten the turbo v-clamp to 50 - 70 in. lbs. Reinstall the transmission dipstick assembly and the MAP sensor. Star the engine and check for exhaust leaks. Power brake the vehicle in both forward and reverse to ensure clearance, adjust if necessary (Body clearance). Most of the direction you need to get the room from is going to be directed at the passenger side door.

Gutting the Catalytic Converter

First Choice would be to remove it and store it. Replace with a cat delete pipe or weld in a section.

BENEFITS

- 1) The smell is a lot different
 - 2) Off the line acceleration is a lot quicker.
 - 3)The turbo winds up faster. This is a noticeable difference.
- It only took 90 minutes. I did not notice a difference in the sound.

Gutting the Cat

Best way to remove the cat is to loosen the clams front and rear. With a marker mark the front and align the mark at the very bottom to help you get it back on in the right direction and bottom facing straight down. NOTICE THE LITTLE TIT AND NOTCH AT THE BACK OF THE CONVERTER, THAT MUST BE LINED UP TO RE-INSTALL. Unhinge both muffler hangers behind (2) of them go to the drivers side of the truck and pull the cat in that direction and with a dead blow hammer or a heavy hammer OR with a piece of 2 x 4 hit the cat forward until it releases. Then wiggle the front section loose.

Now is the fun part. With a steel breaker bar or a pipe or anything that is longer than the length of the cat start beating the honey comb up and keep dumping it out of the side your hitting. do this until it is all out. Hint beat the crap out of it is not as simple as it seems. Make sure it is all clear before removing because you do not want any rattles.

Installing the cat back by banging the cat fully into the front using the mark to align the cat right and the arrow forward. Hint: Make sure the cat it seated all the way forward before re-claming. Then make sure you align the back to the tit and notch before you start banging the back in place. Make sure the tit is all the way seated before clamping and set the hangers back before tightening the clamp. Finish tightening and then go back and tighten again because it must be very tight. Check the exhaust hangers and make sure they are on properly. Your done..... Great job you just gutted the cat.

Changing the Stock Exhaust to Straight Pipe

Straight exhaust helps because it releaves back pressure. It not only reduces back pressure, but also helps the engine run cooler especially while towing. I saw at least a letter drop on the temp gauge while towing after the CAT DELETE. And I tow a sizable load. Gross about 23,000 to 24,000 lbs. Diesels don't need catalytic converters. I also do not have a muffler, and it is not that loud at all. In fact, I have had several people want to know what type of exhaust I have because it makes that turbo sing and sing and sing. Sure does sound good. I have a stock truck except for that and I can really pull with the best of them. I can say that I do want a round down pipe in the near future instead of that flat factory thing. That will help performance, but the straight exhaust definitely makes a difference. The more open you can get these motors, the better off you are. . The turbo creates enough backpressure and anything else is restriction. Also because it has a turbo, the exhaust is not very loud. The turbo acts as a muffler itself when the exhaust passes over the turbine. You can definitely hear the turbo though. Good luck and happy deleting of EPA CRAP!!

Filters

Fuel and air filters

Another problem that arises, usually during wet weather, is the "water in fuel light" staying on? Diesel fuel attracts moisture, and unfortunately water does most of the damage to a diesel's fuel system. Normally the "water in fuel" light only comes on at cold starts when the water has had a chance to separate from the fuel in the filter housing. If the water is not drained regularly, it will mix with the fuel due to the agitation caused by the fuel pump, and if there is enough water in the filter the light stays on. You should drain the fuel filter at least once a month, more if the weather is wet. On early 97 and older F-series the drain is accessed through the opening on the engine trim cover. The yellow drain lever can be seen at the 7 o'clock position on the fuel filter housing. Turn the lever one quarter of a turn clockwise to open it. If the fuel does not drain, you may have to crank the engine over. On the late 97 F-series, the engine trim has been cut down, but the drain lever is in the same position as is the Econoline vans, but the vans need the air filter housing removed to access the drain.

If the fuel becomes very contaminated, you'll want to change the filter. Some aftermarket filters have a square-cut o-ring seal instead of the lip type of the original. I recommend using the Ford Motorcraft filters FD4595 for the 94-98 and

FD4596 for the 98.5-2K or their Racor equivalents: IN F4595 and IN F4596. The WIX 33518/NAPA Gold 3518 used to be identical to these, but recently they changed design (without changing part numbers) to a square cut lid seal and a weak grommet-like lower seal, which tends to split. The fuel filter also has a pin in the top, which opens a valve inside the filter-housing standpipe. Some aftermarket filters have a shorter pin than necessary which results in the valve not opening completely and this can cause lack of power concerns. The fuel filter should be changed at 15,000-mile intervals.

On the 97 and older, the filter housing cover can be removed using a large screwdriver to turn the cover by laying it across the cover and twisting against the ridges on the cover. Do not use any fuel additive containing alcohol or ones that would allow water to pass through the fuel system to be burned off in the cylinders. The tolerances of the fuel injectors are so precise that this could cause damage and failure of the injectors from the lack of lubrication. Also using fuel not meant for highway use could cause damage to the injectors or the catalytic converter. Ford does have a fuel additive for use during break-in periods such as when the injectors are serviced, and is recommended for use any time fuel quality is in question; P/N F8AZ-9C077-AA. In cold weather conditions Stanadyne's Performance/All Season Fuel Conditioner (P/N 29409[pt]).

Above all, do not mix GASOLINE in with the diesel fuel. If you have an algae problem, there are fuel conditioners to correct this, too.

Fuel

Permanent Fuel Pressure Gauge

Something else to do is to buy a fuel pressure gauge out of JEG's and just have it permanently attached all the time. You can unscrew the schrader valve and just screw in a fuel pressure gauge. You can buy them for up to 100-160 psi.

Fuel/Water Separator Drain Line Hose

When you crawl under the front of your truck you'll see a steel line following the contour of the front of the engine (pass side). I bought a three foot piece of transmission cooler line hose and a hose clamp and routed toward the front along the frame and radiator secured it with cable ties. Hangs down by the air dam about three inches after I cut it. When I change my fuel filter and drain the filter housing I place a pan under it.

Fuel filter Housing Removal 94 - 97

To gain access to the HP oil pump, replace Injection Pressure Regulator valve or lift pump, or to service the filter housing, sometimes it's easiest to get the housing off of the engine. Removal is not that difficult except for the hoses. Remove the intake Y-pipe and plug the openings into the heads. Open the water separator drain to minimize the amount of fuel dumping into the engine valley. Loosen the hose clamps on the return line at the pressure regulator block, the primary (upper) lift pump hose at the filter housing, and the secondary (lower) lift pump hose at the lift pump. Remove the two head return lines at the pressure regulator block. Disconnect the harness connector at the RH side of the filter housing. Remove the two mounting bolts at the rear of the housing base. Lift up on the LH side of the housing to disengage the return line; pivot the housing forward to disengage the primary pump hose; pivot the housing back to disengage the secondary hose; and turn the housing clockwise to disengage the drain hose. Disconnect the IPR valve wire and remove the housing from the vehicle. Any o-rings or sensors on the housing can be serviced, and removal of the pressure regulator block for service/cleaning can now be done (the regulator can be removed with the housing installed on the vehicle, but with risk of o-ring damage on reassembly). Reverse the procedure for installation, taking care not to damage the hoses when their nipples are inserted in each. Do not over tighten the hose clamps or they will strip.

Shim the fuel regulator

Shimming the fitting with a 3/16 spacer behind the spring in the fuel regulator. This is located on the right hand side of the fuel filter. You will see a 3/4 brass nut there. The spring is inside there. Shimming will raise the fuel pressure and often give you a worthwhile increase in power and no one that I can recall has reported higher fuel consumption.

Ford's Rebuild Kit For The Regulator

The kit #F6TZ-9K061-AA Cost me \$21. It contains Spring, Valve spool, o-ring and new brass plug. there seems to be a large spread on Ford part price's. I heard from \$16 to your \$30.

Baldwin Fuel Filter

Available at your local International Dealer "Baldwin Filters says its new PF7678 fuel filter gets high marks for convenience because of it is both easy-to-replace and leak proof. Designed for the 7.3 Liter Ford Power Stroke engine, this new filter

comes complete with a housing lid permanently attached to the filter element. Baldwin says that in controlled, industry-standard laboratory tests, the PF7678 doubles the dirt holding capacity of other filters while being equally efficient at removing contaminants."

3/16 BB in the regulator (low fuel pressure) Should be 60lbs to 85lbs

Regulator is the 19 mm brass bolt, on the right side of your fuel filter housing. Unscrew the bolt, pull out the spring, pull out the housing with a magnet, put the bb inside the housing where the spring goes, put the housing back, put the spring back in and put the bolt back in, just make sure the little nipple on the bolt goes in the center of the spring and tighten it up.

Explanation of how to put the BB in the fuel regulator little better and clean the regulator screen

Get a regular BB, wait till your engine cools some and take the black cover off the top of your motor. This requires a 1/2 in deep socket and ratchet. There are 3 nuts on the cover. Next look at your fuel filter bowl and just to the right at the front will be a brass 19 mm plug on the fuel regulator. You will want to place a rag below this plug in case you drop anything. Next, remove the plug and place it on the top of your fuel filter housing using a 19 mm socket or wrench. You will now see a little spring that is exposed. Take a pair of small needle nose pliers and grasp the spring and pull it out of the regulator. Place it by your plug noting the way it came out. You will want to go back in with the same end that came out of the regulator side. Next, take a pencil tip magnet and be sure everything is clean on the magnet (we don't want metal shavings in there)....place the tip of the magnet in the hole and it will pull out the little tri-angular plunger that regulates the fuel pressure. Take the plunger off your magnet and look at the end of it. The end that has the hole is where you want to place the ball bearing. Take your ball bearing and drop it in the hole. When I did it the ball just fell in the hole. Take a little punch and make sure that it seats in the counter bore of the plunger. Not with a hammer, just pushing on it by hand will suffice. Next, make sure everything is clean and place the spring back in the plunger the way it came out. Place the plunger back into the regulator. The tri-angular shape will "FIT" into it's respected groove. DO NOT FORCE IT. Turn the plunger until it slides right in. Next, take the 19 mm plug and coat the o-ring with some oil or light grease so you will not damage the o-ring. Next, note the nipple on the end of the plug where the spring is centered. Be sure to get that nipple into the

hole on the end of the spring or you will bend the spring and you have trouble. Push the plug toward the threads in the housing as it will be harder to push now, and screw your plug back into the regulator. **DO NOT CROSS THREAD THE PLUG.** Next tighten the plug back down snug. **DO NOT OVERTIGHTEN.** Now its time to do the;

Fuel Regulator Screen Cleaning

The fix is simple. Take off the cover over the fuel filter, 1/2 socket does the job. Place a towel or shop rag under the fuel regulator!!!! There are two 10 mm bolts just to the right of the fuel filter, take both out making sure you put them back the way they came out. Gently pry the fuel regulator away from the fuel filter housing, making sure you don't drop the o-ring. You will see a small screen about 1/4 inch. Using a small screwdriver or q-tip w.out the cotton ball on the end, wipe the screen and then put everything back together. The material you get off the screen I have been told is from o-rings. The fix will only take 15 to 20 minutes. If you find the regulator is blocked, clean it, install new fuel filter, and it shouldn't need to be done again for 12 months.

Replace your black cover and you are ready for a test drive to see if you made any difference. You should definitely feel a difference in throttle response. You will actually have more boost pressure.

Fuel Filling Hole Spit Back

Ford trucks are notorious for spitting fuel back at you when you're trying to fill the tanks. With diesels it's even worse since the fuel foams so bad. I had a problem with one of my trucks not accepting fuel because the hoses are kinked. I straightened the hose out while having the bed raised for hitch installation by loosening the clamps at tank and twisting the hoses to a position that opened them up the most and holding the hoses in that position while re-tightening clamps. It now works great.

Transfer Flow High Volume Filler Necks

Fords are notorious for not taking fuel at a fast pump now Transfer Flow's has a **NEW!!** fast fuel neck for the Ford truck. Give them a call at 800-442-0056

High Speed Filler Necks for \$40.00

by Jimmie

All we're trying to do is give air that's inside the tank a better way out, as incoming fuel displaces it. The actual process is easier to do. All you do is remove & gut your filler neck, by putting a fitting near the top of the filler neck for a 1/2" or 5/8" hose. Put a plastic elbow in place of the rollover valve on top of your tank, with a hose barb the same size as the fitting on the filler neck, and run the right size of hose between these fittings.

Before you even get started, you may want to go to the www.transferflow.com website, and look at the filler necks for '94-'97 Fords. This is what I tried to copy. It may be a good time to mention that these kits would be the deluxe way to go, if you want to spend around \$110 per tank. Just think ahead and try to keep the fittings fuel & air tight. These instructions will apply to F350 4x4 Crew Cabs. The other models should be similar, if not exact. 2wd trucks have their tanks mounted slightly different from 4x4s, but the mod is still the same.

Go out and pull off your fuel caps, and look at where the cap threads into the neck, and look down the inner part of the filler neck. You'll see a kind of crescent shaped slot in the bottom of where the fuel cap seats. This is where the air inside the tank comes out as fuel goes in. The outside filler neck is metal, but there is a rubber inner hose 1" in diameter that the fuel goes in. This hose runs all the way into the tank. As fuel travels down inside the rubber inner hose, air is supposed to come through the passageway between the inner hose and the outer metal tube. When the foamy #2 diesel fuel does reach a certain level in the tank, it won't allow air to escape. This design flaw is what makes the tanks so darn hard to fill. There is a little vent with a check ball in it on top of the tank. It allows a tiny amount of air to get in, but not much. It's called the "rollover valve". If your vehicle rolls over the check ball is supposed to close off so no air can get in the tank, theoretically preventing fuel from escaping. Don't make any bets on that. I removed these & replaced them with a plastic elbow to hook up a hose to.

I did my front tank first, because it was the easiest to remove the rollover valve. No need to drop the tank for that part of the mod. You can find another filler neck and modify that one so there's no down time on your rig. I found out the filler necks out of gas rigs are similar, and can be made to work. Or do like I did, and do the front one first, while driving around on the rear tank. You'll need to run the rear tank either very low or empty anyway, because it has to be dropped to get the rollover valve out. As long as you switch the tank over quick enough, you can run our PSD's out of fuel, without the problems associated with "normally injected" diesels. You'll have to run the back tank empty or at least very low on fuel, whether you modify or use Transferflow's. It's very difficult to wrestle around with fuel in it.

Stuff you need to do this mod with

2 fittings for 1/2" hose that can be attached to the filler neck. These can be 90 degree brass/metal elbows that have threads on one side, or whatever, but must have a 1/2" or 5/8" hose barb on the other end. I scrounged mine off of old Mazda air box, but this is a probably a more expensive way to go.

6' of 1/2" I.D. fuel line. I used the clear stuff from Ace Hardware.

2 nylon/plastic elbows. Again, one end will have a 1/2" hose barb, while the other will need 3/4 NPT threads. Found these in the sprinkler section of a home improvement store.

4 little hose clamps to fit over the 1/2" fuel line.

Some bolts about a half inch longer than the stock bolts holding the back tank in.

Some strips of rubber about 1" wide, 1' long, & 3/8" thick.

Note: The 1/2" stuff can be substituted with 5/8" fittings and fuel line. It would work even better, but 1/2" stuff is far more available in my neck of the woods.

A 3/8" round file.

A set of tanks with cutting and brazing tips (oxy-acetyline setup).

Some decent size drills, and a couple of screwdrivers.

The hardest part, modifying the filler neck. Remove the filler neck. There are 3 sheet metal-type screws under the fuel cap, and a hose clamp that clamps a large rubber hose from the tank to the bottom of the filler neck. There will be another hose clamp holding the filler neck to a tang on the inside of the bed also. It's not necessary to remove the large hose from the tank, but you will want a rag handy to stuff in the hose to keep dirt out. You can also stick an old lid off of a rattle can of spray paint over the hose end. When you've got the filler neck out with the rubber inner hose trailing out of it, you'll need to remove that inner hose. I stood on the trailing end, held the filler neck very firmly, & pulled the rubber hose out. Now you've got a metal filler neck, with a metal ring around it where the old rubber hose was hooked up to. The hardest part of the whole thing was removing this metal ring. I knocked mine loose with an old wooden broom handle, tapped it around the bend in the neck, and drove it down towards the bottom end. There is a taper formed on the bottom end that won't allow you to just drive it out, so you have to be creative here. I used my cutting torch turned down way low. This is very thin metal, so be careful with the heat from a torch. It may be possible to cut some slits in that ring with a Dremel tool and do some twisting with needle nose pliers, but I didn't have my Dremel tool at that time. However you can do it, remove the metal ring without hurting the filler neck. If you find an easier way to do it than how I did, please let me know about it.

After that's done, you'll need to put a fitting on the upper part of the neck for a 1/2" hose. I put mine on the side of each neck, about 1 & 1/2" below the flange the 3 little sheet metal screws go in. Drill a hole of the proper size in the location you want the hose fitting to go. Put some thought into this. This hole needs to be above where the end of a fuel pump nozzle would extend. It is possible to put your fitting where

you'll never be able to get a hose on it. Drill a hole in the place where you want the elbow/fitting at in the filler neck, and braze the fitting. Some people have simply threaded their hose barb/elbow fitting into the hole that they drilled, but I wasn't convinced it would stay liquid tight. Mine does not leak.

My fittings were taken off of old air cleaner boxes from Mazda cars. They were fittings for emissions hoses to hook up to. I cut them off of the air box & brazed them to the filler neck, at a location similar to where Transferflow's fittings are. A metal or brass elbow with a 1/2" hose barb will do.

Now let's look at the top of our gas tank. There are 2 fuel lines for each tank, and the sending unit on top. Locate your rollover valve & remove it. The rollover valve is a white plastic thing sticking out of a rubber grommet on the top of the tank, just about square in the middle of the tank. One end of the rollover valve will have a small diameter hose about 1' long clipped to the frame. Pull the hose off the frame, then grab the rollover valve & wiggle it up and out of the tank. This is easy to do on the front tank, but you'll have to drop the rear tank to do that. You need a fitting for the tank with 3/4 NPT threads to go in the grommet on top of the tank, and a 1/2" hose barb on the other side of the elbow. I modified the very top portion of the threads by filing a groove for the fitting to seat in the grommet as the rollover valve had. I just used a 3/8" round file, and made the groove about as deep as the threads and about 1/4" wide. The elbow seats nicely in the grommet this way, just like the old rollover valve did. When you put the elbow in the grommet, coat the threads with either thick oil or grease, so it goes in easier. I now recommend threading it into the grommet. I just pushed my first one in, but it also pushed the grommet inside the tank. I wound up dropping the front tank to fish out the grommet. Oh, well.

Slide one end of your 1/2" I.D. hose over the hose barb on the tank, & put a clamp on it. Route the hose up along side the big hose going into the tank for now.

Put the modified filler neck back on the truck. Hook up that big rubber hose to the end of the filler neck, & clamp it. Attach the fuel cap end with the 3 little screws, and put the clamp on that holds the filler neck to the inner part of the box. Slide the other end of the 1/2" hose over the fitting you painstakingly put on the filler neck, and put a hose clamp on it. You now have one side done, & your tank should fill much faster, and fill up completely.

Some thoughts on this mod:

When you drop the tank(s), you don't need to unhook either of the fuel lines just to put the elbows in. Ditto for the sending unit.

On the back tank, I had to put some strips of rubber mat material (3/8" thick) on top of the tank, to space it down a tad. The new elbow with the hose barb sits higher in the grommet than the rollover valve did. The elbow would rub on the underneath

part of the bed without the extra room. This also necessitates getting slightly longer bolts for the straps or spare tire carrier to hold the tank up. I've heard Transferflow's kits come with this stuff, as it is necessary to do the same thing with their setup too. Leader used strips cut from an old truck mud flap.

All this sounds like a hassle. It took me no time at all to do the front tank, even with the fishing trip for the grommet I pushed in. Figure 3-4 hours for each tank depending on how you're set up for tools. The back required a trip to the hardware store for longer bolts. I killed more time than most would on mine, but I like spending time with my truck, just not at the pumps. Transferflow's kit is sounding pretty good by now, I bet. I just like to try doing it myself, and have probably less than \$40 into it.

Fuel Regulator

This will cause a loss in power and mileage will drop. The fix is simple. Take off the cover over the fuel filter, 1/2 socket does the job. There are two 10 mm bolts just to the right of the fuel filter, take both out making sure you put them back the way they came out. Gently pry the fuel regulator away from the fuel filter housing, making sure you don't drop the o-ring. You will see a small screen about 1/4 inch. Using a small screwdriver, wipe the screen and then put everything back together. The material you get off the screen I have been told is from o-rings. It to me looks like it is from the factory fuel filter. If you are going to have the problem, it should be in the first 5000 miles. The fix will only take 15 to 20 minutes. If you find the regulator is blocked, clean it, install new filter, and it shouldn't need to be done again.

Gauges & Installation

Helpful Hints On Installing Gauges

Hints on the gauge installation: All three gauges require a ground and a hot (+12VDC) for their lighting circuit. The pyrometer and boost gauges require no other connections to the truck electrical system. You didn't mention what the other gauges would be so I am assuming that they are a boost and trans temp. The trans temp gauge requires a separate (from the light circuit) ground and hot connection. You can connect all of the light circuit grounds and the trans temp meter ground to one side of a crimp on butt connector and to the other side an 18 gauge wire that will go to ground on the chassis. The lights on each gauge will have two wires (black) coming from them. Just designate one ground and the other hot. Connect all of the light hot wires to one side of a butt connector and add a red wire to the other side to get the fuse that controls the instrument lights on the dash. (You can identify this

one from the owner's manual and check it with a volt meter as it is the only whose voltage will drop as you dim the dash lights.) The hot wire for the trans temp gauge will require a separate connection to the fuse block and needs one that comes on with the ignition. All of the wires from the engine compartment can come into the cabin through the firewall (if you have an automatic there is a diamond shaped piece of sheet metal in the firewall that is where a clutch would connect and can be easily bored to allow all of the wires to come through in a piece of tubing to protect them.) The only waterproofing needed is where these wires enter the firewall on the engine side. Do this with silicon caulking compound.

Real Oil Pressure Gauge For My Dash? 95 & 96 Only

To make your oil pressure gauge show real pressure, follow these steps: remove gauge cluster by prying out horizontal trim strips and removing the TX20 screws underneath, pull forward on trim panel and disconnect tank switch and warning lamp module. Remove the 4 TX20 screws at the corners of gauge unit and disconnect (by pinching on both ends) the two large connectors and also the small speedometer connector. Gauge has to be turned 90 degrees to undo connectors and to remove it, watch out so as to not scratch face of gauge set. Lay gauge unit on a flat surface gauges down and locate the 20 ohm resistor (it's marked). Solder a jumper wire across the resistor using a pencil solder iron so as to not melt your circuit film. Reinstall cluster and all trim. Remove the top engine cover assembly by undoing the three 13 mm cap nuts. The oil pressure switch is on the front aluminum housing under the removed cover and has a single slide-on wire connector. Remove this switch. Fit an oil pressure sender (sender from a 1980 F150 with 400 cu. in. engine is correct) using two short 1/4 NPT nipples, one 1/4 NPT 90 elbow, and one 1/4 NPT female connector. Fit one nipple into the hole, screw on elbow, screw in the other nipple, and screw on the connector. Orient fitting so that it points at the driver's seat so as to allow clearance for sender to not interfere with fuel system sensor that is immediately behind hole where fittings are installed. Screw in sender and plug on wire. Use Teflon tape or other pipe sealant at all threads. Re-install your top cover. Oil pressure gauge seems to read 0-90 psi according to my testing. Strangely enough, when engine is hot and cruising the gauge reads where it did with the "liar" setup, but it does read higher cold and lower idling.

Best Pan Location For Temp Sensor Gauge Sending Unit

Drivers side of the transmission just above the lip of the pan. Someone replied that they had set up senders in both spots and saw about a 10 degree difference between the pan (lower) and the pressure port you speak of. The feeling was that there might be a gain as a result of heat buildup in the transmission housing. My feeling is that if it isn't too much of a hassle to mount it in the pan I will be sure as to what my readings were indicating. It does however seem that we are talking about a reference point and if one consistently shows a slightly higher temp than the other you will still have a damn good feel for what is going on in regards to fluid temp. I'm going with an additional cooler and will probably find, based on other postings, that even though I'm pulling a high profile fifth wheel things stay in acceptable ranges.

Pyrometer Installation Universal

A. THERMOCOUPLE INSTALLATION - The R650 Thermocouple mounts into a 1/4" pipe thread. If the exhaust manifold is already drilled and tapped, install the thermocouple at that location. If none is provided, make a 3/4" hole in the exhaust pipe, not more than 6" below the exhaust-manifold-to-exhaust-pipe connection and weld the R680 bushing into the the exhaust pipe - NOTE the bushing should not be installed backwards - the R650 thermocouple will only install into one side of the bushing. On a Dual Manifold: Install one R650 thermocouple into each exhaust manifold or exhaust pipe as above. NOTE: Banks predrills a tap on their Turbo Down Pipes - The location of the tap is farther down than the 6" listed below which Banks feels is the optimum area when coming off the turbo.

B. LEADWIRE INSTALLATION - Single Manifold: The R660 lead wire assembly and the R650 thermocouple are supplied with screw and ring terminals for assembly convenience. Connect the longer red leadwire to the to the red thermocouple wire and the shorter yellow wire to the yellow thermocouple wire with screws and nuts provided. Cover these connections with protective sleeves provided. Route the other end of the R660 leadwire assembly to the pyrometer, making sure that the leadwire is clear of obstructions that might cut or otherwise damage it. (If it should become necessary to replace any of the terminal ends - use crimp or clamp types only - NEVER solder terminals to the wires.) Dual Manifold with Single Gauge: Run an R660 from each thermocouple to a DPDT switch. The switch will then toggle from one engine bank to the other on the same gauge.

C. PYROMETER INSTALLATION: Remove dampening wire(s) across the meter terminals. Mount the pyrometer through the instrument panel or use or use mounting bracket at the desired position. Connect the light wires to the existing instrument light switch (12 VDC.) Single Scale Pyrometers: R602, R604, R606 and R607. Connect the R660 leadwire to the pyrometer making sure that the yellow leadwire is connected to the positive (+) terminal and the red wire is connected to the other terminal. (if the leadwires are connected backwards, the pyrometer will read backwards.) Use double nuts and lockwasher provided to attach the leadwire to each stud and tighten the gauge in the panel. Do not loosen the nuts that are already on the pyrometer gauge terminal studs. The pyrometer has been set to ambient (room) temperature at the factory and

should not require further adjustment. Dual Scale Pyrometer R624. Connect the R660 leadwires from the left exhaust pipe to the left meter and from the right exhaust pipe to the right meter, making sure that the yellow leadwires connect to the positive terminals. NOTES: 1. If the pyrometer light is too bright, substitute a 28V lamp (GE# 656.) 2. If the pyrometer is slow or erratic, check the leadwires and thermocouple with an ohmmeter for continuity and check the leadwires for resistance (wire resistance is .23 ohms per foot per wire). Also check for oil, grease or looseness at the terminals. The connection must be clean and tight. 3. The pyrometer is calibrated for use with 6 to 15 foot leadwires. 4. When properly installed, the accuracy of the system will be within 2% at 1200 degrees F under average operating conditions.

Boost Gauge Installation (Universal)

The boost gauge plumbing is installed somewhere between the compressor outlet of the turbo and the intake manifold. A hole is drilled through the firewall and deburred so that the pressure tube can then be routed to the gauge. Several layers of electrical tape or a grommet may be installed to prevent damage to the tube by the firewall. The tube is then routed to the back of the gauge and mounted to the fitting on the gauge. Extreme care should be made in routing and connecting the tube so that no kinks are experienced. The gauge light is then wired into the existing instrument light switch (12VDC) using 18 AWG or larger wire (not supplied with gauge/tubing kit)

Glow Plug Replacement

Time: About 4 hours with 2 people working together at it.

1st we tested the electrical connections to see if the bank of glow plugs we were going to replace really needed to be replaced. We decided to do the drivers side by grounding a test meter negative 200 ohms selection on the test meter and pulled the glow plug connectors wire loom apart. Touching each connector inside we either got a "NO" read (bad plug) or a value on the meter of .5 or so showing a "GOOD" glow plug. Having 2 good and 2 bad on the drivers side we decided that side needed attention, then we tested the passenger side and found 3 bad out of 4 so we knew both covers need to be removed.

We both dived in, Dale removed the AC Dryer from the firewall so we can get to all the bolts holding the cover on the passenger side, and I started removing on the

drivers side, the air intake system from the front of the hood to the turbo. I plugged the turbo so nothing could get in or fall in the turbo or damage any blades. It was time to remove the valve cover so we started the drivers side. Note! The valve cover bolts are different size heads and the length than the air intake mount on the solid aluminum bracket piece the rubber tubes mount to. Keep that in mind when you put it back together. Then while I cleaned the intake parts in solvent (brake clean worked the best) Dale started pulling the wires off the first glow plug, after he blew out the oil in the recess the plug fits into, he used a 10mm long 1/4 drive socket to loosen the old glow plug and a 1/4" vacuum tube to slide on the top of the glow plug to spin the rest out and to remove the glow plug. I then took the old plug and put a new one on the tube for Dale to screw in the new glow plug and then he tighten to 14 foot pounds. I decided to buy and replace all 8 and we worked like that until it was done. Before putting the valve covers back on we tested the plugs at the connectors like before but all had a good reading now. NOTE! The passenger side has a higher reading than the drivers side being closer to the battery. The valve cover bolts needed to be torqued to 8 foot pounds.

Glow Plug Removal

This is a straight-forward service. After removing the valve covers and unplugging the glow plug(s), loosen the glow plug a couple of turns (10mm deep socket, 1/4" drive). Then push a 4-6" piece of vacuum line over the end of the glow plug and use the hose to unscrew and remove it. Use the hose to install and screw in the glow plug, then tighten with the socket. The socket will contact the rocker arms if used to remove the glow plug. If the glow plug is difficult to turn you may be able to loosen it by working it back and forth--turn counter clockwise one turn then clockwise half a turn--until it turns freely enough that it can be loosened with the hose. If the glow plug probe is severely carboned up or swollen, the barrel may screw out of the head leaving the probe stuck in the hole. In this instance you may be able to remove the probe by removing the adjacent rocker arm and push rod to gain enough room to get ahold of the probe with a pair of needle-nose pliers. Have someone hold the pliers to prevent the probe from falling into the cylinder and use a long punch to loosen the probe by tapping it down. Once the probe is broken loose, work it up and down in the hole until it can be pulled out--some WD 40 or other solvent may help to loosen any carbon on the probe once it can move, just remember not to use too much and to remove any residual by cranking over the engine with the glow plug out. You may be able to dislodge the seized probe by cranking over the engine, just remember to reinstall the rocker and pushrod if removed, and place a blanket or fender cover over the glow plug to keep it from shooting out. If the probe falls into the cylinder or cannot be loosened, the head will have to be removed to extract the probe. To prevent damage, remove all the glow plugs on the head to be removed and install them after the head has been reinstalled.

Inquiring Minds Want To Know

40 20 40 Center Console Disassembly

The whole console is made up of 5 parts, the cup holder, accordion door, the storage area, the storage area door, and the "trim piece"

The first and hardest part to get off is the trim piece. There are 2 "keepers" on the front and 3 down each side 2 in the back, but you need to only get the front and the sides of so you can get just enough to get the accordion door out to get the lost change out.

To get the "keepers" loose, use a screwdriver to pry the foam down so you can see under the trim piece. You can't see real good but you can at least find the keepers. The way the keeper's work is they are a half arrow, and they fit into a groove. The trick is to apply some back and upward force and release the half arrowhead. I found that using a 90 deg pick tool worked the best. A small 90-degree screwdriver may work.

You're going to end up breaking a couple of the keepers when doing this. Just take some clear silicone and glue it back down and wrapped some tape around the whole thing until it dries.

Putting The Jack & The Tire Iron Under The Hood

Place the tire iron into the holder with the end that goes over the nut pointing up. this should place the tire iron next to the fender well. Next screw the jack all the way down. Place the top of the jack pointing toward the cab and the yellow screw end pointing down toward the tire and the bottom of the jack will fit into the slot that is in the fender well.

Low Volts Show On Idiot Gauge At Start-Up

Stop all the guessing. I have had this checked out and got the same answer each time. The glow plugs are in operation for a set period of time. When you first start the cycle of starting the engine a large drain on the batteries for the first few minutes. After the glow plugs shut off the gage will show low and than jump up to a normal reading.

Comment - Talked to lots of people and we all seem to agree this happens!!!!

Airbox

Is it ok to run without that air ducting that slips over the front of the air box? I removed ours when the truck was brand new. Have never put it back on and do not miss it any. The filter does get dirty rather quick but we've got a K & N and I clean that twice a year anyway and then more when we've been off roading or traveling.

How Can I Get More Boost Out Of My Turbo Without A Chip?

Stock boost was 18 to 20 psi and the only way to increase it is with a chip or different turbo housing. Some of the other methods would be; after market injectors, propane, air filter, down pipe, changing exhaust, no catalytic converter, intercooler, IDM Mod, but you need to a combination of things to get the real power the chips do.

Injector & How They Work

Run Diesel Fuel Tank Dry, Is it OK? The answer is NO!!

One thing which will happen is that the fuel injectors will continue to 'fire' under high oil pressure without the resistance and cushioning effect of the fuel on the injector pistons. ker-whack!!! Not good for the injectors. When the fuel runs out, there is no longer fuel pressure to cause injector pistons to return to top of stroke. They just sit at bottom of stroke and quit injecting. No kerwhack or whatever. Also, since the pistons are not moving, the fact that they are not getting lubricating fuel doesn't cause trouble either. I've run tanks dry a few times to get accurate reading on range. At highway speed of 75 you will be down to 35MPH or so before you start feeding fuel again. You get about one hiccough before she quits. I wouldn't try it around town, as you'd crank a while before it got fuel.

Before my 96 PSD, I had a 92 F-150 with the I-6 300. Running 140 miles a day round trip to work, I would always run one tank dry, of course watching very intently, and as soon as the first chug, I would quickly switch tanks. I was always told this kept crud from building up on the bottom? Anyway, when I bought my 'Beast' last October, (this is my first diesel), I decided to run one tank dry, (of course

being a creature of habit),one the highway, one morning after a 12 hour mid-shift, doing 75 MPH. As soon as I felt the first little hesitation, I switched tanks. Well, the next 30-60 seconds, I was sucking up some serious seat cushion. The truck had no throttle response, white smoke spewing out the back, and I was going slower and slower. I thought I was going to be stranded 50 miles from home in the middle of White Sands Missile Range. I was thinking to myself, 'Good Job Knuckle Head'. Then after my speed declined down to about 30 MPH, everything came back, and I was back up to speed. Anyway, I found out later that, that's what happens when you allow PSD to run empty. And it really is no harm, but it sure was scary. I don't do that no more!

Lift Pump Removal

This service is not difficult when working on a Federal-emissions F-series. The intake Y-pipe and fuel filter housing need to be removed first. Then, using a 1 1/4" box wrench (having two different wrenches works best because of differing angles on the box ends give you a wider working range) or socket on a flex-head ratchet, loosen the banjo bolt fitting at the rear of the pump. Take care not to drop or damage the steel sealing washers. After removing the banjo bolt, remove the pump mounting bolts and lift the pump straight out of its hole. If the pump seems stuck, use a rolling-head type pry bar (lady-slipper, duck bill, crowsfoot) to pry it up straight. Pulling straight up will prevent the pump push rod from catching and falling back down into the engine requiring engine removal to retrieve the rod. On California-emission vehicles the banjo fitting is too far under the turbo and fuel line damper to reach with a wrench and access is restricted for using a socket (you may get the bolt out, but good luck getting the it back in). In this case and with the Econoline due to its body design, it is necessary to remove the turbocharger to remove the lift pump instead of the fuel filter housing. In all cases, when installing the new lift pump, lube the o-ring on the pump shank with dielectric grease and start the banjo bolt a couple of threads before installing a tightening the mounting bolts. Again, take care not to damage the sealing washers. Once the pump is secured to the block, tighten the banjo bolt to 40 ft/lbs.

Injection Pressure Regulator Valve Removal

To remove the IPR you can remove the fuel filter housing or at least loosen it to allow room for the wrench and to maneuver the valve in and out. The 98.5/99 IPR is accessed easily from behind the fuel filter. Remove the air intake Y pipe and plug openings. Remove the fuel return hoses from the pressure regulator block, remove the filter housing bolts and lean the housing back. Unplug the EOT sensor and IPR valve. Use a 3/4" wrench to remove the solenoid nut, spacer and solenoid coil. Using an 1 1/8" wrench (or a very deep socket--the filter housing will have to be removed for this) remove the IPR valve. Make sure that the replacement IPR is the same

level part as the old one. Engines built up to serial number 187099 in early 95 use P/N F4TZ-9C968-C; engine number 187100 and up use F5TZ-9C968-A. Do not use sealer on the IPR threads, it could plug the orifice in the threaded area. Torque the IPR to 35 ft/lbs and the solenoid retaining nut to 53 in/lbs. You'll have to drive the truck to purge any air from the HP oil system and clear any codes set during the replacement.

Injection Pressure Regulator Removal and Replacement

by Coach Davis

I've been having a slight problem with my truck not wanting to idle very smooth especially when hot and the more miles the oil gets on it, the worse it would idle. With the engine cold it would idle pretty smooth, but hot, it had somewhat of a shake to it. When I purchased this truck, the oil had been in a little too long on this ONE and only ONE oil change and because the HEUI system is so sensitive to clean oil that I probably was going to have to change some of the components to remedy the idle/flutter problem.

I purchased a new IPR a few months ago and was trying to get enough miles on the oil before I changed it so I could ensure some of the characteristics that changed were not because of "NEW" oil. New oil will always make a Powerstroke run a little better than oil that has 3000 miles on it. I wanted to make sure I installed the IPR with the 3000 mile oil.

The Procedure:

I removed the plug on the top of the high pressure oil reservoir and took my tried and true turkey baister (equipped with a rubber fuel line and then steel brake line attached to the rubber fuel line so I could get through the small hole and go to the bottom of the reservoir to extract ALL the oil), and proceeded to extract all the oil out of the reservoir which took some time, but ended up getting a full quart out of it. Draining this HP reservoir really saved a big time mess!!

Next I drained my fuel filter bowl and loosened the lid to ensure all the diesel would be able to drain, then removed my intake "Y", stuffed shop rags in the ports and proceeded to loosen all the hoses and wiring harness associated with the fuel filter housing/IPR. I then removed the two bolts holding the fuel filter housing on the engine and lifted the housing up and out of the valley of the engine.

I then removed the cheap nut holding the IPR solenoid on and slid the solenoid off. I then took a deep socket and slowly removed the IPR.

I then cleaned around where the IPR was with a lint free cloth to ensure the new o-ring wouldn't be damaged by dirt/trash upon seating. I then coated the NEW IPR o-rings etc. with new engine oil and replaced it back into its respected provision. I then reinstalled the IPR solenoid and tightened the cheap nut ensuring I had the wiring harness connector turned in the correct direction.

I then took carburetor cleaner and sprayed the valley where a little diesel and a small amount of oil had spilled. I cleaned the entire valley and then reinstalled everything previously removed.

I then took a small funnel and poured exactly 1 quart of new oil back into the HP oil reservoir and re-installed the plug.

After the engine turned over a few more times than usual it cranked. After warming the engine up, I then proceeded to the highway where I ran locked out of OD for about 5 miles at 3200 rpm's to eliminate all the air from the HP oil system.

After returning home I immediately noticed the idle was more stable and after putting 100 or so miles on since the change, I can definitely tell a difference in the performance and idle characteristics of the engine. I used to have what I call a missing cylinder flutter sound and that has for the most part been eliminated so far. The truck also runs somewhat easier going down the highway and the cranking time which was actually normal before, is very quick now, even on initial startup in the morning. I was surprised by this because the truck actually cranked normally with no long cranking time hot or cold. I'm also interested to see if fuel mileage will fluctuate some and I'll post when and if it does indeed increase.

I wanted to post this information for some of you that are experiencing some of the characteristics my truck has been having. I'm also going to replace the ICP when I find a good price on one, but I do my truck as I do my race car and change ONE thing at a time so I'll know what the part actually did and IF it actually changed anything. Then I can go to the next step and change something else.

Injectors and Differant Outputs

The difference between the injectors is as follows quoted by Richard Maddon "Maddog" who did the rebuilds for me. I am sure if you are interested in talking they would be pleased to discuss them with you.

We have bench tested the High Output International injector and they do flow more fuel than the stock ford injectors and the modified or stage two injectors. But they are very expensive like \$500 per injector.

That is from International and a Diesel Injection Service

The stock Ford injectors (94-97) flow 95 to 100 cc's on our flow bench.

The stock Ford injectors (99-01) flow 120 cc's on our flow bench.

The stage one injector's flow 160 cc's (Stage 1 160 cc's after 2600 rpm's) Wide open throttle (WOT)

The stage two injector's flow 160 cc's (Stage 2 160 cc's after 2000 rpm's. Mid range and up.

The H.O. International injectors 240cc's

The modified H.O. International injectors are flowing over 300 cc's

These test's are done at a 3000 rpm's, on a 1000 count test.

I was told split shot injectors will not work in my 96 but somewhere I heard that it would in a 97 but I am not sure. I was also told that the fit of 99+ injector would not fit 94 to 97. I am not a professor on injectors but that's what I was told. The Stage Ones were a very substantial increase in horsepower at WOT (Wide Open Throttle). They are saying that the power increase is at least 75 horsepower and as much if not more than propane injection. The injectors are balanced and calibrated. Balanced meaning the spray pattern and calibrated is so that each injector produces within 2 to 3% the same amount of fuel to each cylinder. As compared to HYPERMAX injection re-build Richard told me all the springs inside are checked for the same spring load and all the internal parts are replaced and no used part goes back in like the Hypermax re-builds. It was said to me that the re-build Hypermax does for \$880.00 compared to the \$995.00 from Richard and I have heard it from an other source that they re-build with used parts that are tested and pass there inspection and the ones I have are all new internal parts including the updated new o-rings.

Understanding How The PowerStroke Injection System Works

Understanding how the injectors work on the PowerStroke engine can help in diagnosing a concern with this engine. Older diesels used a hydraulic injection system in which fuel pressurized by the injection pump would actuate the injector. The drawback to this system is that any air which enters the fuel lines will affect the operation of the injectors, or even prevent them from operating. Also, the amount of fuel injected is dependent on the mechanical operation of the injection pump governor, which adjusts volume based on engine load/RPM. Gasoline engines with electronic injection use a pressurized fuel system and the computer varies the actuation of the injector based on input from various sensors in order to control the amount of fuel to the cylinders. Since gasoline engines have an ignition system to ignite the air/fuel mixture in the cylinders, fuel pressure only needs to be sufficient to supply the injectors and provide an adequate spray pattern to ensure efficient combustion. But a diesel engine uses heat from compression to ignite the air fuel mixture, and this high compression requires high injection pressures. What has been done on the PowerStroke is both of these systems are used in conjunction with each other. Fuel is supplied to the injectors through fuel rails inside the cylinder

heads. Also supplied to the injectors is high pressure engine oil. As the computer determines that a cylinder should fire it signals the Injector Driver Module.

The IDM sends a 110 volt pulse-width modulated signal to the injector solenoid. When the injector solenoid is actuated, it opens a poppet valve which allows high pressure oil to flow into the intensifier piston. The intensifier piston is forced down, pressurizing the fuel inside the injector. When fuel pressure inside the injector reaches approximately 2700 psi, it causes the injector pintle to rise off its seat and fuel is injected into the cylinder from the nozzle. As long as the poppet valve is open and oil is flowing into the injector, fuel will be injected. The computer controls how long the injector solenoid is energized (pulse-width, or time on in milliseconds), but it also determines the pressure of the fuel being injected by controlling the pressure of the oil (IPR duty-cycle, or the percentage of time on vs. off--AKA dwell) in the cylinder heads. The computer determines this based on engine load and driver demand by monitoring various sensors. Since the cavity at the top of the intensifier piston is seven times the size of the fuel cavity at the bottom, fuel is injected at a pressure seven times that of the computer-controlled oil pressure--oil pressure 3000 psi = injected fuel pressure 21000 psi. Due to the high oil system pressures, the spring which closes the poppet valve once the injector solenoid is deactivated has to be very strong--and because of this, the solenoid needs to be 110 volts. Once the poppet valve is closed, spring pressure returns the injector to its normal state and the oil is exhausted into the valve cover area to return to the sump. Because of the nature of how this system operates, air in the fuel is not as great of a concern as air in the oil. The PowerStroke requires a special anti-foaming agent in its oil to prevent this aeration. Oils with an API service rating of CF-4 or CG-4 already have this agent, but it becomes depleted as the oil breaks down, so regular oil changes (3000-5000 miles depending on vehicle use) are necessary. The anti-foaming agent can also be depleted by interaction with some silicone sealers. Split-Shot Operation Split-shot injectors were originally installed on 1996 and 97 model/year trucks with California emissions, and are used in engines from 98.5 on. These injectors prolong the injection time to decrease emissions without reducing power. Fuel is delivered to the injector (green) past a check valve in the same manner as in the standard injectors. As the intensifier piston is forced down the fuel is pressurized (orange) and the check ball (blue) is lifted off its seat and fuel injection begins. Cut into the piston is a land (yellow) which receives fuel through bleed holes (red) as it is pressurized. As the piston travels down the land aligns with a port in the injector. When this happens, pressure drops below the piston and the check ball reseats and injection is suspended. As the piston travels further, the port in the injector is covered and fuel injection recommences.

Injector Removal and Replacement

With re-development of the injector o-rings, early assembly mistakes, as well as problems with fuel contamination, this job is probably one of the most common repairs. When replacing injector o-rings, it's recommended that all the injectors be resealed using the most recent kits--F8TZ-9229-AA. When replacing injectors, use

the correct parts for the given emissions--Federal F7TZ-9E527-ARM; California F8TZ-9E527-ARM. Any time a valve cover is removed, the injectors hold-down bolts on that bank should be checked for torque. Early engines from 94-95 were assembled with the injectors torqued to 106 in/lbs. This caused the potential for the injectors to work loose damaging the o-rings. If any injector hold-down torque is found to be less than 100 in/lbs, then all the injectors should be resealed. The correct torque on the hold-down bolts is 120 in/lbs. On 94 and early 95 F-series with air conditioning, half the evaporator plenum must be removed to access the #7 injector and to make removing and installing the RH valve cover easier. On 95-97, the A/C vacuum reservoir can be removed instead. To remove the valve covers on the Econoline, the A/C compressor and alternator have to be removed. The biggest concern on this job is the prevention of internal engine damage caused by oil or fuel entering the cylinders and resulting in a hydraulic lock of the engine. I purge the oil from the rails in the head by removing the oil supply hoses and the two rear 5/8" hex plugs from the tops of the heads and gently blowing the rails out with compressed air. There are actually two aluminum plugs inside the valve covers for this purpose, but they are usually frozen and "round off". On the back of each head there is a fuel rail drain that has a 1/4" square drive for a ratchet. If you can access them, unscrew each one full turn. If you can't, don't worry, you can deal with fuel in the cylinder(s) easy enough later. If you haven't removed the valve covers already, do it; also remove the gaskets and Under Valve Cover harnesses, taking care not to drop the injector connector seals on harnesses with plastic locks (the harnesses with wire flip-locks don't use seals). Remove the spill-spouts from all the injectors you are replacing/servicing. If you don't they will get damaged.

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Remove the first injector by removing its lower/outer hold-down bolt, then sliding the hold-down up towards the center of the engine. Carefully pry under the hold-down with a bar to lift the injector from its well and remove it from the engine. If you are servicing any injectors on the opposite bank, remove the rear most one to be serviced/replaced in the same way.

Remove any fuel or oil that may have entered the cylinders by bumping the engine over by hand or with a remote starter. Use cardboard over the valve train to minimize the amount of spray from the cylinders. Opening the fuel filter drain will prevent any more fuel from entering the heads, and having the supply hoses removed will do the same for the oil.

With the rear most cylinders purged, all the remaining injectors can be removed as required, keeping them in order for installation in the same cylinder. Inspect each injector well for foreign debris, and clean as required. If any injectors are missing the copper compression ring, retrieve it from the well. Inspect each well for debris and clean as necessary.

When replacing the o-rings, use the latest-level kits--F8TZ-9229-AA -and when installing the blue/black lower oil seal, lube it with clean oil and push it directly onto the injector--don't work it on like a bicycle tire, this will cause it to stretch too much. Dip each injector into clean oil before installing. Push down on the injector until it seats while holding the hold-down up to clear the upper bolt--do not hammer on the solenoid body. If necessary use a drift and tap on the hold-down to seat the injector. Install the hold-down screws and spill-spouts, torquing to 120 in/lbs. Install the valve cover gaskets and UVC harnesses, ensure that each glow plug is connected, and connect the engine harness to the gasket. Before installing the valve covers, check the connections by running the Injector Buzz test.

Connect the oil supply hoses, close the fuel filter and rail drains. Add a pint of fuel lubricity conditioner--F8AZ-9C077-AA to whichever tank you will be test driving on. With the rear oil rail plugs still removed, crank the engine over until oil runs from either rail, install that plug and continue to crank until oil runs from the other, then install that plug. Take care not to damage the o-rings (P/N F4TZ-9N693-A) on the rail plugs and torque the plugs to 21 ft/lbs. Restore the remaining items (A/C plenum, vacuum reservoir, ect.) leaving the engine show cover off, and crank the engine until it starts.

Test drive the vehicle for 20 minutes in fourth gear or with the overdrive cancelled to purge the remaining air from the oil and fuel rails. After the test drive, flush whatever oil is standing in the engine valley with a solvent while the engine is warm (to allow the residue to evaporate) in a well ventilated area, catching the run-off in a drain pan at the rear of the engine. Reinstall the engine show cover.

Manuals 1994 - 1997 Ford PSD

Contact Ford Technical Publications Department or Helms

1-800-782-4356 Mon.-Fri. 8:30am - 6:00pm EST Helms Manuals

1-800-782-4356 Ford Publications Dept.

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Oil System Related

High Pressure Oil Pump Removal

When removing the High Pressure Oil Pump, remove the fuel filter housing to allow more room to maneuver the pump in and out. Remove the EOT sensor from the reservoir to allow oil to drain, remove the HP oil pump gear access plate from the front of the timing cover. If necessary, remove the heater hose and nipple from the water pump and remove the gear-retaining nut. Carefully remove the oil reservoir--it has a partial RTV gasket, so it may adhere to the timing cover. Remove the two oil supply hoses for the HP oil pump and the two retaining bolts and remove the pump from the engine. Inspect the HP oil pump gasket for damage, and both the pump and timing cover surfaces. Clean the timing cover and reservoir mating surfaces. Carefully install the new pump, taking care not to damage the gasket. Seal the top shoulder of the pump bolts with Loctite 515 Gasket Eliminator and torque the pump bolts to 24 ft/lbs. install the gear retaining bolt and torque to 95 ft/lbs. Check the pump gear for excessive back-lash. Check the outlet fittings on the pump to make sure they are tight and install the oil lines. Install a new gasket on the oil reservoir and run a bead of Wacker T-95 or Ford F5TZ-19G204-AB gray RTV silicone along the timing cover where the gasket does not seal, install the reservoir and torque the bolts to 24 ft/lbs. Use the same silicone sealer on the gear bolt access plate and install. Finish installing the remaining components. Flush the engine valley with a suitable solvent to remove the oil spilled. The engine will have to crank awhile to re supply the reservoir in order to start. Drive to purge any air from the system and clear any codes.

Bypass Filtration System For Extended Oil Changes

Some of the Filtration Companies

Amsoil <http://www.amsoil.com/>

Oil Guard <http://www.oilguard.com/>

Champion <http://www.champlabs.com/automotive.html>

Fleet Guard <http://www.fleetguard.com/en/index.jhtml>

Motor Filters Company <http://www.motorfilters.gr/products.htm>

Primo Lube <http://www.premolube.com/>

Racer Parker Systems http://www.parker.com/racor/lfs_bypss.html

West Fleet <http://www.westfleet.com/>

You can run a bypass filter mounted inside the frame under the driver's seat for 65,000 miles or even more. The filter plus plumbing adds 2 quarts to the capacity. I ran 45,000 without an oil change using an analysis program and my numbers are as good as ever. I did change oil at 50,000 on the odometer because due to a transoceanic move (me and the truck), the oil sample chain was lost. I started a new base sample 15,000 ago. I do not plan to change. My motor currently does not leak or burn (significant) quantities of oil. I add a 1/2 quart every 2500 or 3000 miles. I originally added the bypass system @ 5000 miles (I received the truck new in Sep 94.) I also changed to synthetic oil then and I used the same oil until 48,000 miles. I

completely changed and used new synthetic oil @ 48,000 since there was a break in the oil sample trail. I have used the same oil since 48,000 (now @ 61,000) and that has been approx 13 months. Over my ownership, I have averaged (I guess) 12,000 per year. I change the full flow filter @ 12,500 miles or six months and the bypass filter @ 25,000 or 1 year. As I stated, my consumption is approx 1/2 quart every 2500 - 3000 miles. When I change filters, I (of course) replenish from new stock the oil lost from inside the discarded filter, so theoretically, I am adding 2 quarts per oil filter change (3 in a year total: 2 x full flow and 1 x bypass). Besides that 6 quart replenishment, I add (as stated above) roughly 2 quarts a year due to consumption. Adding the bypass filter to my system took my total oil capacity to just under 17 quarts. I have used oil analysis the whole time, and I think my numbers are good. I did look with interest at the string posted elsewhere by Dan V on 9/7/99 in order to compare his analysis numbers with mine. My numbers were higher than his in some categories but I have established a trend and my numbers are staying constant...i.e. not getting worse. (I think that's what oil analysis is all about.) Also I am interested in the slightest indication that I might see coolant in the oil. (I have all the parts on hand except a mounting bracket for a coolant filter...that's next for me)

Some rough \$\$\$ figuring for me @ 12,000 miles per year (based on the info I submitted above):

I spend: \$19.80 on oil
\$23.95 on one bypass filter per year
\$26.50 on two full flow filters in a year
\$30.00 (approx) on two oil analysis reports
=\$100.25

annual costs for oil maintenance in my PSD. Not included were the initial costs for tubing, fittings, bypass filter mounting bracket (I also have a renewable air filter) and for mail order shipping of what I get each year. Plus, I'm not disposing of 14 quarts of oil every 3000-5000 miles.

Engine Oil Requirements

The most common problem with Ford's 7.3 Direct Injection Turbo diesel is related to engine oil change interval and type of oil being used. It is critical for proper engine operation that the customer or technician servicing the vehicle check that the correct oil is being used. This engine uses a high-pressure oil pump to operate the fuel injectors.

Typical system pressures are 500 psi at idle, 1200 at 3300 rpm in neutral, and 3600 psi at full load acceleration. Oil for the PowerStroke requires an anti-foaming agent to prevent the oil from aerating, which would result in poor fuel injector spray

patterns and reduced power. Depending on vehicle usage, the anti-foaming agents are depleted in 3000-5000 miles.

The only oil recommended for the PowerStroke by Ford is Motorcraft Super Duty 15W40, 10W30. Each of these has the proper additives in them for use in a diesel engine including the anti-foaming agents. The 15W40 is recommended for normal climates, the 10W30 for temperatures below 20 degrees Fahrenheit. For temperatures below -10 degrees, 5W-30 is recommended. There are other oils, however, that do meet all the requirements for use in the PowerStroke. The specifications the owner needs to look for on the label are the API rating of CF-4/SH or CG-4/SH or higher. Some other oils with the correct ratings are:

Penzoil Long-Life 15W40
Shell Rotella-T 15W40
Chevron Delo 400 15W40, 10W30
Mobil Delvac 1300 Super 15W40
Castrol Heavy-Duty 15W40
Valvoline All-Fleet Plus or Cummins Premium Blue:
Union 76 Guardol QLT 15W40
Wal-Mart's Tech 2000 Universal 15W40
Texaco Ursa Super Plus 15W40, 10W30
Quaker State FCI Universal 15W40, 10W30
Quaker State FCI HDX Plus 15W40
Kendall Super-D 3 15W40, 10W30
Kendall SHP Diesel 15W40

For those of you wishing to use synthetic oil, the only ones I have seen with the correct specs for the PowerStroke engine are:

Motorcraft Super All Season 0W-30 Semi Synthetic
Amsoil Series 3000 Synthetic 5W30 Heavy Duty Diesel Oil
Amsoil 15W40 Synthetic Heavy Duty Diesel and Marine Oil
Amsoil 10W-40 and 20W-50 Synthetic High Performance Motor Oil
Amsoil 15W40 Semi-Synthetic Gasoline and Diesel Oil
Mobil Delvac 1 High-Performance Synthetic, Heavy Duty Diesel Engine Oil 5W40
Quaker State 4X4 15W40 Synthetic Blend
Shell Rotella SB (synthetic blend)
Royal Purple Synthetic 10W-30 and 15W-40 EO-L 5W-30, 10W-30, 20W50
Schaeffer's Supreme 7000 Synthetic Blend 15W-40

If these are unavailable you can use a multi-grade synthetic designated CF for use in diesel engines along with an anti-foaming additive. Some synthetic oils with this rating are:

**Mobil 1
Castrol Syntec
Valvoline SynPower
Quaker State Synchron Ultra Performance**

Recommended anti-foaming additives are Fleetrite with the Navistar P/N CH1824392 or Lubrizol 888. These are primarily used to counter the effects of silicone sealers on the anti-foaming agents in the oil or if the agents become depleted from use providing the oil is still serviceable and uncontaminated. An anti-foaming additive could also be used between oil changes if an oil-related poor running condition is suspected, especially on a long trip.

Under normal driving conditions the additive could extend the oil change interval to 6000 miles. For vehicles that are used for infrequent towing, using the additive at 3000 miles could extend the oil change interval to no longer than 5000 miles. Vehicles operated in dirty conditions, extreme weather conditions or constantly under heavy loads should stick to the 3000 mile service interval due to the other agents in the oil being depleted, and should only use the anti-foaming additive if performance problems occur between services.

The refill for the crankcase is 14 quarts for 94-97's and 15 quarts for 98.5/99's with filter change. Some early 95 and older engines were equipped with a 12-quart dipstick (Navistar P/N 1820068C1) and need to be filled to just over the word "FULL", or replaced with the correct part (Navistar P/N 1824405C1; Ford P/N F4TZ-6750-E for F-series; F5UZ-6750-A for Econoline). Some later dipstick tubes were not seated properly causing the crankcase to be over-filled in an attempt to bring the level up to the mark. The oil filter for the PowerStroke (Motorcraft P/N FL1995) is longer than that of the previous Ford/Navistar diesel, and the old-style filter should not be used. Due to its seal design, the oil filter should be hand tightened, then turned an additional quarter-turn--or torqued to 20ft/lbs--with the oil filter wrench to prevent leaking.

Drain Pug Drip Fix

You have a seal between the oil pan and the drain plug head and whoever changed your oil last crushed the brass seal when tightening down the drain plug. Easy fix the next time you change or let them change your oil give the a new drain plug seal. Wella no LEAKS!!

Oil Cap Problem

To my surprise the other day I was adding oil and I forgot to put the cap back in the valve cover (pretty stupid, huh). Well, I went for a test drive and then parked the

truck. This morning I got up and was going to take it to work but as it was warming up I saw fluid leaking heavily from under my pride and joy. It was diesel fuel. Greatly upset, I drove my car to the dealer and bought another oil cap to replace the one I lost. I got home and installed it then drove the truck to the dealer (they are about 10 minutes from my house). When I got there, the leaking had stopped. To my surprise, they told me something everyone might want to remember. The motor works on a vacuum and due to the oil fill cap being off all the internal vacuum that would develop was escaping. Therefore, the fuel was puking out the overflow. I drove the rest of the day and no more leaks.

Ram Air Modified

Click [Here](#) and go to my trick truck pictures and find the "Modified Ram Air" Here to see the pics or in my signature see all my pictures. Sorry have not gotten to labling them all yet!!

I am talking about the driver's side front right corner of the hood. There are 3 triangles cut on the corner to trap air but there is no air output. That creates a swirl of air not an injection of air. Free flowing if you follow me. Under the right 2 triangles that line up with the air intake I drilled a 2" hole to free the air trapped in the hood behind those triangles. The hole lets the air free and the ram airflow and the air is directed straight at the opening of the air intake snorkel!!! I did not drill the triangle near the middle of the hood because it's not over the air intake snorkel at all, not that it would hurt to do it.

Speedometer

Recalibrate Your Speedometer After Changing Tire Size

There is no tire size/code chart because tire size vs. actual tire dimensions are different between manufacturers. Even between the same tire size and same maker there will be a difference in actual size between the different tread designs.

The Ford calibration equation is:

$20186 / \text{tire height in inches} = \text{some number}$, then: $\text{some number} / .6666 = \text{program code}$

Example:

Start with 20186, divide by actual tire size in inches. Divide again by .6666

You want to use a rolling measurement to get your actual tire height (If you try to measure the tire in the driveway, use conversion charts, or anything else you will end up with an inaccurate reading again). Use your rear tire since the sensor is located there. Mark the ground and your tire and roll forward 3 times marking the ground each time. (I ran over a spot of oil at a local gas station and measured between my tread mark prints), then divide that number by three to get the average length of one revolution (this will protect yourself against a bad reading using just one revolution). You can then divide the length of one revolution by 3.14 to get actual tire height. Be careful in your measurements, a small amount will change the code. EX: 31.69" tire height is code 956, and 31.21" tire height is code 970.

Now, to program it into your truck:

Warning: You can only change the calibration 6 times without replacing the module.

To set the calibration, ground the single wire connector under the glove box it says PSOM (Programable Speedometer Opdometer Module). "Yes there is only one and it has a spade type plug on the end". I used a wire with clips on both ends to ground the plug to a screw under the dash or try a test light and use the clip end to the PSOM and the other jam in a dooe hinge. Now look at your speedometer on the face of your dash while sitting in the drivers seat and there should be a "reset" button and a "select" button. While holding the reset button in on the trip meter, turn the ignition to 'on' while the wire is still grounded. Let go of the reset button. The speedometer display will sweep once and will show a code of some kind then push in again the "reset" button and the existing code will be displayed with RECAL?, mine said 976 RECAL? Now you enter your new code you came up with by dividing the rolling measurement by PI or 3.14 by pushing the "select" button until it gets to the new calibration code number. You may have to push "select" a whole bunch of times until you get to your code. If you turn off the key at this point the original code will not be changed or any of the 6 lives will not be used. To store your new code press "Reset". Turn off the key. Unplug the ground wire. To check the new calibration, use the mile markers on the interstate. Run an indicated 60 mph and it should take exactly 60 seconds to go 1 mile.

Service and Maintenance

General Service Intervals & Guidelines

One of the most important, and often overlooked, subjects for car owners is preventive maintenance. Drivers know that they are supposed to change their oil or get a tune-up in order to keep their car running, but usually they will not take a car to a shop unless they notice a problem. That is the whole point to preventive

maintenance--to keep the car or truck serviced so major problems do not occur. The purpose of this page is to advise drives as to what they can do and when in order to avoid more expensive repairs.

Keep in mind; much of the information here is subject to driving conditions, habits and manufacturer's recommendations. There is information contained in every owner's manual about their vehicle's requirements. What kind of oil to use in the engine for example.

Some engines can be damaged if the wrong SAE rating or "weight" oil is used. There is also an API rating that tells if the oil is suitable for use in a gasoline or a diesel engine:

**SH or SJ for gasoline engines
CF for off-highway IDI diesels
CG for on-highway IDI diesels
CF-2 for two-stroke diesels
CF-4 or CG-4 for high-speed four-stroke diesels**

Generally, a higher second letter in the API rating supersedes previous ones, so a car requiring SC-rated oil can use SJ.

Most vehicles today use automatic transmission fluid for automatic or manual transmissions, but some manuals require special lubricants. Today's computer-controlled transmissions are more sensitive to fluid break-down and contamination, so it's important to keep up with the recommended service intervals. Not all power steering systems use ATF. Using the wrong lubricant can be as bad as not servicing the system at all.

Tire pressure should be checked when the tires are cold as the pressure do increase as the tires get hot. Maximum air pressures listed on the side wall of a tire are just that, the maximum for that tire, not necessarily the correct pressure for the tire when installed on your vehicle.

As the vehicles suspension settles and components wear, the alignment is going to change, so it does need to be checked periodically. Of course, driving off road, on rough roads or "curb-hopping" is going to affect the alignment as well, requiring more frequent checks.

Extreme driving conditions shorten service intervals as the vehicle is subject to increased stress. Examples of extreme conditions can be constant stop and go traffic driving, driving in hills, towing, dusty or off-road driving, and constant hot ambient temperatures. The fluids in your vehicle are affected by these conditions, and break down faster necessitating more frequent servicing in order to prevent a mechanical failure.

Enough about service guidelines, on to a basic service interval schedule. Mine contains some things that are overlooked by many drivers, which I see almost on a regular basis, as well as personal recommendations.

Once per month

Check all fluid levels under the hood. Automatic transmissions and most power steering fluids need to be checked hot with the engine running check the coolant in the overflow bottle, do not remove the radiator cap. Note any signs of leaks or abnormal conditions--flapping drive belts, bulging hoses. Check tire pressure and look for abnormal wear. If you own a diesel, drain the water separator, if equipped.

Every 3000-6000 miles

Lubricate, Oil and Filter. Harsh conditions require more frequent service than highway miles. Even if you put very little mileage on a vehicle, it still should be done twice a year. A running engine produces gases in the crankcase that break down the oil, even while the vehicle sits. I do mine on 5000 mile intervals to coincide with:

Every 5000 miles

Tire rotation. Front tires usually wear faster than rears because they get some side slip from cornering and have more up and down movement than the rears. It's best to rotate the tires before abnormal wear becomes apparent. When rotating, cross the tires from one axle left to right while rotating the other two front to back. This ensures that the each tire ends up on a different corner of the vehicle than previously, matching the wear patterns on all four. It is acceptable to have a radial tire rotate in a different direction than before providing its tread is not designed to rotate in one direction only. Some high performance tires are directional, as well as some dress wheels. It's easier to remember to rotate your tires if you have it done with another service. If you feel your vehicle needs the oil changed every 5000 miles, then rotate your tires every other time.

Once a year

Have all the lights, the windshield wipers, battery and cables, charging and starting systems, belts and hoses checked and serviced as needed. Have the radiator and air conditioning condenser fins cleaned out. If you can find a shop with a policy of giving credit for any refrigerant recovered from you vehicle's air conditioning system, have the system recovered, evacuated to remove moisture and recharged. Have the entire vehicle inspected for leaks, and the cooling system and radiator cap pressure tested.

Every 15000 miles

Complete vehicle inspection including brakes, chassis fluid levels and steering and suspension components for wear. The wheel bearings, if serviceable, should be cleaned and repacked and the brake caliper slides cleaned and lubed. Have the wheel alignment checked. Have the cooling system ph checked to prevent leaks due to gasket or hose deterioration from electrolysis. In areas with highly alkaline water have the cooling system chemically treated and flushed. The air and fuel filters should be replaced and if you own a very old car (conventional ignition or carbureted), it's time for a tune-up. Diesel vehicles should have a special conditioner added to their cooling system at this time. The additive prevents deterioration of the cylinder walls. The amount depends on cooling system capacity, but the minimum recommended is 4 oz per gallon.

Every 30,000 miles

This should be the first really major service for your vehicle. The services listed above should be done as well as the following. The coolant should be drained and replaced, possibly the system flushed. The trans fluid should be drained and the filter cleaned or replaced. Even if the engine is running fine, at least have the computer system checked for trouble codes and the engine scope analyzed for potential problems. If your vehicle is five years or older, it's probably time for a tune-up including an injector service. If you own a diesel, consider having the injection pump timing and glow plug system checked. Diesels also need to have the conditioner added to their cooling system during the service--4 oz per gallon total cooling system capacity is the minimum, 9.6 oz per gallon maximum.

At 60,000 miles

It's pretty much the same as a 30,000 mile service, except that cars newer than five years old should have the spark plugs changed and the fuel injectors serviced. Most of these vehicles don't have the ignition components of the past, and the spark plugs are the only parts that wear. If the throttle body is not deposit resistant, it and the idle by-pass ports should be cleaned as well. If the hoses and belts were original, it would be a good idea to replace them at this point. If your car has a timing belt, it may be time to have it replaced.

At around 100,000 miles

You should have the axle lube changed if your vehicle is a rear or four wheel drive, as well as manual transmission fluid drained and replaced. If the timing belt has not already been replaced, this is about the maximum mileage recommended by most manufacturers, so have it done to prevent being stranded or causing major internal engine damage. If the car has a timing chain, have it inspected for wear or looseness.

The above services can be done by yourself (excluding those requiring special equipment) or by any shop, not necessarily the dealer. Some shops offer free multi-

point inspections and services that cover many of the above items. However, it is a good idea to check with the dealer service department as they have access to bulletins and recalls that others may not know about.

Vehicle Service Check List

Service intervals listed are subject to manufacturer recommendations and driving conditions.

60,000 miles

Clean throttle body and idle bypass ports if serviceable
Replace cooling system hoses as needed
Replace timing belt if required
Items listed under 30,000 mile service

30,000 miles

Automatic transmission service
Cooling system service/flush
Diesel engines--Injection timing checked, glow plugs tested and cooling system conditioner added
Items listed under 15,000 mile service

15,000 miles

Complete under-car condition and fluid level inspection
Brake inspection: Front thickness=____/32" or ____% Rear thickness=____/32" or ____%
Clean and lube caliper slides
Steering inspection
Suspension inspection
Wheel alignment
Tire balance, inspect tread wear/depth: LHF=____/32" RHF=____/32"
LHR=____/32" RHR=____/32"
Repack wheel bearings
Replace air and fuel filters
Cooling system checked and serviced as necessary; diesel conditioner replenished
Any of the following items as required

5,000 miles

Tire rotation; adjust tire pressures
Replace oil and oil filter; lubricate chassis

Yearly

Check all lights; horn operation
Check belts for wear and tension; condition of coolant hoses
Inspect and service battery and cables
Check windshield wipers
Clean out radiator and condenser fins
Pressure test cooling system and radiator cap
Test charging system, battery and starter
Service air conditioning system
Inspect for fluid leaks

Once a month

Check under hood fluid levels
Check belts and hoses
Tire pressure and condition
Drain water separator

At 100,000 miles

Have axle and manual transmission fluids replaced, the timing chain checked for wear or the timing belt replaced (if original).

Smoke Analysis

Smoke Analysis

White smoke:

Caused by unburned fuel passing through the engine. Some white smoke is normal on cold start-ups. Excessive white smoke could be an indication of inoperative glow plugs, loose injectors, low compression from worn rings or bent connecting rods, or coolant leak into the cylinders--head gasket or injector well sleeves.

Black smoke:

Caused by excessive fuel for the amount of air drawn into the cylinders. Some black smoke on hard accelerate or at higher altitudes is normal. Excessive black smoke could result from restricted intake or exhaust, inoperative leaking or weak turbo, intake hose(s) leaks, leaking or worn injectors, fuel return or supply restriction, stuck Exhaust Back Pressure Regulator valve or solenoid. Also PCM inputs such as BARO MAP ICP or EBP sensors.

Blue or blue/white smoke:

Caused by insufficient fuel or oil consumption. Normal when engine is cold or idling for extended periods. Excessive smoke could be caused by air in the fuel, contaminated fuel, loose or plugged injectors, worn or leaking injector o-rings, thermostat stuck open, oil consumption, or plugged crankcase depression regulator valve. Also PCM inputs such as MAP or ICP sensors.

Steering Wheel

What Can You Do About A Loose Steering Box

Yes the adjustment does take up slack. Done right it won't cause binding. Jack up the truck Turn the wheel full cut and count the turns back to the other stop. Then center the wheel by backing it off half that amount. This might not be straight. Then tighten the screw, back it off a little like a 1/4 turn, lock it down and test it for binding. Do this by turning it back forth, it will bind only at the high point or center. Do this with the engine off. If you don't feel any you should be good to go. If your box is too far gone this might not completely fix it, but it will help.

Stereo and Stereo Speakers

Replace Your Stock Audio Speakers With The Best Name Brands

Recently I bought speaker replacements for my truck and I found out that all the big electronic houses have stock speaker replacements for the hole cut out the factory speakers came from. You can go to Best Buy, Circuit City, or one of the local stereo shops. They have most of the top of the line names that fit in the factory hole mounts exactly.

Just got done upgrading to Polk 6.5's in the front and Polk 5x7's in the back I have JBL's. I used the factory wire adapters and took about an hour to complete. Every hole lined up - easiest install I have ever done.

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Suspension

Front End Sagging

Air Bags

They are 5 1/4 inch in high, 5 3/4 in with, they will hold 1,600 lbs of pressure, filled to 100 lbs of air, but 20lbs will raise the front of a truck and give a smooth ride. You can get added a leafs for about 75.00 each, without u bolts> New leaf springs were \$188.00 tempered much harder than fords factory or the add-a-leaf, you can call (909)862-4811 that's the tech line at MACS SPRINGS they will ship world wide for free! They have a lot more stuff. To check it out go to www.macspring.com

Superlift Add-A-Leaf Install

Install the new leaf in the spring pack so that it is under the leaf just longer than it is and over the leaf that is just shorter than the new leaf. In other words, measure the length of the new leaf (say 52"), and take your tape measure to the spring pack and measure each of the leafs. If you find one that is say 50" long and the leaf above it is say 55", then install the Superlift add-a-leaf, in between them. This all works for the rear spring pack. As a general rule for our trucks, the front add-a-leafs install as the very bottom leaf.

Tips

Lazy Man's Way to Fill a Transmission

Just buy a two or three gallon of ATF and pump the stuff in. Use one of those hand pumps that is used to prime outboard boat motors with gas. They look like a black rubber bulge in the middle of some clear poly hose. Still only about ten bucks. Works like a charm!. Again, using a three gallon jug of ATF, you can hold it in place easily and you don't make a mess. Takes a bit of pumping... your hand is tired afterwards. Anyway, it's the best, cleanest, solution so far. You can get the ATF out of the pump with a strong detergent solution after.

Accelerator Adjustment

In some cases, the accelerator sensor doesn't respond as it should. You may notice it clicking or hesitating when you push on it. The accelerator on the Power Stroke is completely electronic, there is no throttle cable. This sensor can be adjusted for better throttle response. Go easy though, if you adjust it too far, you may have a problem with the engine resetting to idle. There is no adjustment on the switch. I had to bend the tab on the accelerator that depresses the switch until I was satisfied. WHAT A DIFFERENCE!!! It's nice to have throttle control.

Transmission

E4OD Automatic Transmission

I have some products I want to share with the other Ford fanatics out there. I work for the local utility co. out here, and in our engineering depts. infinite wisdom, they ordered all of our 700 or so '97 F-superduty with E4OD transmissions. Most of these trucks have been converted to 4WD and most of them are running close to or over 15,000 LBS. We have been doing 2 of 3 things to keep them alive. As you know, running around town in OD will kill an E4OD, but every time you turn on the ignition switch OD is automatically on. Intermotive Products makes an overdrive inverter. It turns the OD off every time you turn on the ignition. It is a simple unit to install. It is a small box with 3 wires to hook up under the dash. It retails for \$189.00. The part # is OD301. Contact them at: Intermotive Products (707)438-7828 2791 North Texas St, Suite 155 Fairfield, CA 94533

We install the largest oil cooler available, the one I install is made by Tru-Cool. Part # LPD4590. It is 12 x 11 x 1.5. It is a stacked plate cooler with a self regulating feature that allows the fluid to bypass the cooler when the oil is cold. It is rated for 28,000 GVW but you can't have too much cooling when you're really working that transmission, especially in the mountains. My transmission shop highly recommends synthetic ATF. Considering that's what comes in them from the factory. We don't do this due to the cost because we service them regularly. Also I just had a transmission replaced under warranty. They put in a unit that was rebuilt by Tecumseh. Apparently this is a heavy duty rebuilt that Ford will not build themselves. A main difference that I am aware of is the overdrive planet carrier is made of steel vs. the original aluminum carrier. Normally Ford will only replace a trans with theirs, but I was told that they put the Tecumseh in for fleets.

Ford ZF Transmissions Noises

In late 1987, Ford introduced the 5speed ZF transmission in the F250, F350, & F450 trucks. They were available for gas as well as diesel models. The easiest way to identify the unit is to see that it has power take off (PTO) opening plates on the lower sides of the unit. ZF transmissions are reliable units that should provide good service when taken care of properly. Keep in mind that the ZF has 6 constant mesh main shaft gears, so there is a considerable amount of potential for heat buildup. It is never a good idea to leave the truck idling with a PTO engaged, such as in tow truck applications. The unit was redesigned in '96 and had small, but significant changes. The syncro teeth were enlarged to provide longer life and more positive shifts, and the bearing retainer was designed to be replaced without having to disassemble the case. The case was beefed up also with this design.

These units are prone to be a little noisy, and noise issues comprise most of the complaints we hear. Please do not remove your transmission if noise is a problem. Check all the components of your drive train carefully first. Things like injectors, dual mass flywheels, or even differential problems can cause a noise to come through the unit. Before we tear a unit down with a noise complaint, we make sure that we have done our best to eliminate the possibility of something else as a the source of the noise.

Clutch Lube

The clutch slave cylinder is located on the driver's side of the bell housing. The end of the actuators rod that protrudes out of the clutch slave cylinder sticks into a dimple on the stamped steel arm that sticking out of the bell housing. This arm moves the throw out bearing. There is no zerk fitting that I can find. Every 8,000 miles I take my finger and clean off as much old dirty grease from where the rod sticks into the dimple. I then place a small amount of grease on my finger and force as much grease as possible between the end of the rod and the dimple. It seems to make a difference in the operation of the clutch pedal, or maybe it's just my imagination.

E4OD Extra Capacity Transmission Pan

You can get a deep pan from B & M. Summit Racing Equipment has a kit available for the E4OD for \$339.00. It includes a deep pan, filter, trans temp gauge, and gasket. Their number is 1-800-230-3030. The extra capacity pan usually have little feet built up from the bottom of the pan to support the filter.

Turbo Chargers

Turbocharger Removal & Rebuild

This article was written to assist those interested in removing and rebuilding the turbocharger on the Early Model Power Stroke Diesels. The article should give those people willing to undertake this task some insight into what can be expected and what pitfalls to avoid.

Tools:

In addition to Standard, Metric, Wrenches and Sockets (Deep and Standard Length), and the usual things like a Big **Hammer** and a pry bar, you will also need the following **TOP QUALITY** special tools:

1. 10mm & 13mm 3/8" drive **SWIVEL** sockets.
2. 10" 3/8" drive flexible extension.
3. Misc. short and long 3/8" drive extensions.
4. 8mm 12 point 3/8" drive socket and 8mm 12 point wrench
5. 15mm 12 point **STUBBY** wrench, (a 15mm crows foot would be really handy, too.)
6. 6 point 10mm 1/4" drive socket.
7. 1/4" universal joint, and misc. short and long 1/4" extensions.
8. 8" 1/4" drive flexible extension.
9. 8mm, 10mm, 12mm 13mm ratcheting box wrenches, and if you get the stubby wrenches, that's even better, and the kind that look like a regular combination wrench with a black insert in the box end (not the kind made from two stamped pieces) would be really useful.
10. Flashlight
11. Telescoping mirror
12. WD-40 and Anti-Seize Compound.
13. Liquid Wrench, Choke and Carburetor Cleaner
14. Hi-Temp RTV silicone if you are going to disassemble the turbo.
15. Patience and Band-Aids for skinned knuckles.

Terminology:

Turbo:the entire turbocharger assembly.

Impeller: the intake/air compressor wheel or fan.

Turbine: the wheel or fan driven by the exhaust.

Volute: the snail-shell shaped part of the turbine and impeller housings. (Also referred to as the Diffuser.)

Vanes: the blades on the turbine and impeller wheels.

For more about turbochargers, see "Turbochargers" by Hugh Macinnes, published by HP Books.

Procedure:

1. Spray everything down with Liquid Wrench or Shiner Bock several times the day before you begin.

2. The factory service manual recommends loosening the two lower bolts, and removing the two upper bolts on the two pipes that run from the exhaust manifolds to the collector behind the turbocharger. This is NOT necessary! However, if you are installing a new or different turbocharger, and things do not line up properly, you will need to loosen the upper bolts to allow some wiggle room. To get to these, you need the 10mm swivel socket on 18"-24" extensions. Jacking up the cab under the door hinge area will give you a bit of clearance. On the passenger's side, unbolting the fender-well liner slightly helps, and I had to bend back the lip on the firewall with the pry-bar in order to move the down pipe out of the way.

3. I did not remove the hood, but you may want to consider it. The job would be a lot more comfortable, and possibly easier without it.

4. Remove the black cover on top of the engine, the one that says "Turbo Diesel."

5. Remove all ducting--black, aluminum and orange between air filter box and turbo compressor inlet.

6. Remove the breather element from the driver's side valve cover. If the Philips head screws have stripped, replace them with hex or Allen head bolts that have O-rings under the heads.

7. Remove "Y" pipe and orange tubing at turbo compressor outlet and intake manifold.

8. Stuff clean towels into all holes to keep dirt out of the engine and turbo.

9. Remove the "V" band clamp that connects the top of the down pipe to the EBPV. (Exhaust Back Pressure Valve, which is between the turbo and down pipe.) The nut is 7/16"; this is the only non-metric fastener.

10. Unbolt the bottom of the Down Pipe where it goes into the catalytic converter. This allows the DP to slide down slightly, giving more room to remove the EBPV

11. Unbolt the EBPV from the turbine outlet. It is held on with three 8mm, 12point bolts. Depending on how far the Down Pipe moved in step 10, you may be able to get a ratchet and socket on these 3 bolts. If not: To get the back bolt, put the 8mm 12pt wrench on it and then hit the wrench with the Big &^% Hammer using a long drift or bar. Removing the EBPV allows access to the pedestal bolt, and the collector flange bolt.

12. Disconnect the EBPV valve mechanism from the actuator rod by sliding the sleeve on the end of the rod inward. It is a ball and socket setup.

13. Remove the two forward bolts on the turbo pedestal (10mm hex bolts). Use the 10mm, 6 point, 1/4" drive socket, with the universal joint, and a short extension to get the 2 rear pedestal bolts. The driver side bolt on the rear is behind the indentation on the back of the cylinder for the EBPV actuator piston. Do not confuse it with another easy-to-see nut on a stud located on the pedestal in front of the cylinder. The bolt referenced can barely be seen with the mirror. From the passenger's side, put your left index finger around the rear, and if you have skinny hands/long fingers, you can just barely touch the bolt head to guide the socket on.

14. Using the 13mm swivel socket and a long extension, remove the two 13mm bolts that connect the turbine inlet to the exhaust collector. Use the 15mm stubby or crow's foot to remove the nuts on the studs for the lower part. Use the pry bar to leverage the stubby to break the nuts loose. I had to cut my Craftsman 15mm combination wrench in half, because I tried to get out of buying the stubby.

15. Disconnect the plug that goes to the EBPV solenoid, and pull the turbo up and out.

16. Disassembly of the turbo is straightforward. Start by removing the 8mm, 12pt bolts on the compressor, and work your way in from there. Unscrew the compressor impeller wheel from the shaft using an 18mm socket on the turbine, and a 16mm socket on the impeller. Remove the four 8mm, 12pt bolts that are under the compressor impeller. They bolt the diffuser to the bearing housing, once removed the diffuser will come off. During this step, make sure that the turbo is positioned as shown in the photo. When you remove the diffuser, do so slowly, and note the exact position and arrangement of the seal holder and the thrust plate. It is possible to re-assemble them in several positions, but only one is right, and the wrong positions will ruin the turbo. After removing the seal holder and thrust plate, the bearings and spacer should slide right out. Next, remove the four 8mm, 12pt bolts that hold the turbine housing to the bearing housing. Remove the turbine housing then, slide the turbine shaft out of the bearing housing. If the shaft seems "stuck," gently tap the compressor end of the shaft to free it. (It is stuck because the turbine seal is holding it back) Now remove the four 10mm hex bolts on the bottom of the pedestal that connects it to the bearing housing. There is a cup-shaped sheet metal "cover" on the turbine side of the bearing housing (not visible in the photo). Carefully pry this off, clean the carbon and coked oil out of it, and out of the bearing housing. While cleaning, pay special attention to the groove where the turbine-end oil seal goes.

17. Clean everything with Choke and Carburetor cleaner. If the turbine has carbon on it, you can GENTLY clean it with a small BRASS wire brush. Do not use a steel brush or a scraper. Tiny scratches cause stress riser points, which can possibly lead to turbine failure. (Remember that the turbo spins up to 125,000 rpm.) Clean any

carbon off the shaft with #600 emery cloth. Remove carbon deposits and rust from cast iron mating surfaces with #220-330 emery. If either the turbine or impeller has cracks or bent vanes, it must be replaced. If the turbine self-destructs, it only hurts your pride, because the fragments go out the exhaust, but if the impeller flies apart, all the little fragments go right into the engine.

18. My original impeller had the tips broken off the taller vanes. This was probably caused by the impeller reversing direction from a massive intake manifold backfire. (Likely due to feeding too much propane at too low an rpm.) This backfire even cracked the air filter box. I did not have money to replace the impeller, so I evenly filed the tips to a smooth finish, and then re-installed it. (A few weeks later, I determined that my engine was blown, and I replaced the impeller during the rebuild.)

19. If you want to replace the turbocharger's bearings and seals, the kit costs about \$225.00. The kit I purchased was made by World Products, part # 7-A-2058, for a Garret TP-38 turbocharger. I was able to get it right off the shelf from Fuel Injection Service, Pharr, TX. 956-787-6421. I'm sure DIS has them in stock too. After 234,000 miles, the original turbine seal showed signs of leakage, but the bearings were still tight. A symptom of turbine seal wear is thick white smoke at (cold) engine start up, which diminishes as soon as the turbo gets hot. Thick white smoke on sudden deceleration is another symptom of turbine seal failure.

20. The turbocharger rebuild kit contains:

- o 2 bearings (actually bronze bushings),
- o A bearing spacer,
- o Turbine and impeller seals, which are similar to piston rings but the diameter of a dime
- o The housing or holder for the impeller seal
- o Gasket that is installed between the bearing housing and impeller housing
- o Gasket that is installed between the turbine inlet and exhaust collector flange
- o 4 bolts, I used them to replace the ones that go under the impeller. This allowed me to replace some old bolts that were rusted.
- o The kit also came with 2 O-rings that did not correspond to my turbo.

21. While installing the impeller seal/thrust plate, pay careful attention to the thrust plate. (The thrust plate is the "U" shaped plate.) On one side is a wide groove with tiny holes drilled through it; the other side is smooth. This groove must face to the inside, or towards the bearing housing where it mates to an oil supply hole. If this is installed backwards, oil flow to the seal will be cut off, and your turbo will die a very sudden and expensive death.

22. The kit does not include O-rings to go between the turbo and pedestal or between the pedestal and block, but any hardware store will have them. Do not

reuse the old ones, unless you like the idea of going through all this again because of four 29-cent O-rings.

23. Use anti-seize on everything except the 4 bolts under the impeller; use 242 (med) thread locker on those. Coat the O-rings with engine oil, and insure the bearings and seals are lubed during assembly.

24. Seal the two halves of the compressor with RTV. Apply RTV to the backing plate half only, not the impeller housing (volute), this way the excess is squeezed to the outside.

25. Replace bolts that show any sign of damage to the threads or heads. If you cannot find 8mm 12point bolts, use Allen/socket head cap screws. 6 point, Hex head bolts cannot be used as there is not enough space to allow a socket or wrench to fit on them!

26. When you go to re-install the turbo, place the 2 rear pedestal bolts in their holes first. Stuff a bit of towel inside the pedestal bolt holes to keep them from sliding down. If the bolts stick out, they will hang up in the oil holes on the engine block or knock the O-rings out of place. Before installing the turbo, place a 4x8" piece of plastic, cut from a gallon jug, over the O-rings. This will stop them from becoming knocked out of place. After the turbo is on the 4 bolts of the collector, slide the plastic out before tightening the bolts down.

I removed my turbocharger because of a serious oil leak from the EBPV actuator. I believe that the rumors of fixing this type of leak with "50-cent seals" are totally false. I was unable to locate a seal that was even remotely like the one on the piston plunger. Ford does not sell these seals either; they only sell complete pedestals for around \$500.00. Rebuilt pedestals from International are less expensive. The actuator cylinder is aluminum, and the seal is a very hard gray material. It is almost like plastic, and it will wear the bore out before it wears out. This might be why Ford decided not to make rebuild parts available. The bore of my cylinder was severely scored, so I polished the gouges out with #600 emery cloth. However, after reinstalling the actuator, it leaked worse than it did before. If yours is leaking, my suggestion is to remove and discard the piston and rod, tap the hole to 1/4" pipe thread, and plug it up. I tried using a manual choke cable to actuate the EBPV, but it was not stiff enough. However, a transmission shift cable, such as those made by B&M, should work really well.

I've been using my EBPV as an engine exhaust brake for the last year/36 k miles. I have it wired in so that it either functions normally (only during warm-up), only when I apply the brakes, or on full time. While this has greatly increased the number of cycles for the EBPV piston, I do not believe that this was responsible for the leak. Rather, I suspect that dirt from washing the engine with a high-pressure car wash entered into the cylinder around the rod and scored the cylinder.

Windshield Wiper

Intermittent Wiper not working

There is a cap on the end of the stalk that will pop out - about 1/4" thick, domed and the size of a quarter. Once it is off, you can remove a screw in the end of the switch you rotate to turn the wipers on and operate the delay then slide the knob off the stalk - watch for falling parts, there are a couple but they probably will not fall out, just be aware. Take a lint-free cloth or paper shop towel and clean the contacts on the switch end you removed (a white nylon piece that fits into the knob) and down in the "well" of the stalk that it fits into. Do not bend any of the contacts, including the one that looks like it was bent taking it out.