

Scan Tool on the 7.3/6.0 Powerstroke

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 reapplies 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 fuel pressure through the injector nozzles. PID: ICP DC (% 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: Malfunction 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 and 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 output signals from the PCM.

Useful PID comparisons:

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

ICP--Injection Control Pressure--**IPR**--Injection Pressure Regulator--and **MFD**--Mass Fuel Desired: ICP should rise as IPR duty cycle 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 Emissions, 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 BackPressures: 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.

Quick **KOEO** Sensor Checks:

There are a few sensors that can be easily checked with a scantool. Starting with a "Dead Cold" engine (let it sit overnight, don't start), connect to the truck with the ScanTool. Check the following:

Oil Temp should closely match the current Ambient Temp.

Readings for Exhaust Backpressure, Manifold Absolute Pressure and Barometric Pressure should all be within 1/2 psi of each other (this should be true with the engine either warm or cold).

(Note: with the engine running, MAP and EBP values are "Pressure + Baro". For example, if Baro is 14.7 and there is 2psi of boost, MAP will read 16.7. Also, there is a calculated PID called "Manifold Gauge Pressure" that doesn't have the Baro pressure added in).

7.3L Injector "**Buzz**" Test

The Injector "Buzz" Test can be used to look for a faulty fuel injector. It is best to run this test on a totally cold engine, one that has sat overnight and has not been started. Initiate the "Buzz" test and then listen carefully to the injectors as the test is completed. First, all 8 injectors will "Buzz" at the same time. Then, the IDM will "Buzz" the injectors in numerical order (1, 2, 3, 4, 5, 6, 7, 8). Remember that cylinders 1-3-5-7 are on the passenger side and 2-4-6-8 are on the drivers side, with cylinders 1 & 2 being at the front of the engine. You should hear a strong "Buzz" bouncing from side to side for all 8 injectors. If one of the injectors doesn't "Buzz", you've found a problem cylinder. It is important to note that when an injector fails to "Buzz" properly, you will still hear the other 7 injectors make a faint buzz...this is a designed function to protect the IDM. Remember, The buzz test is not an audio test only, you should get fault codes with this test.

Note: Because the IDM will "buzz" the other 7 injectors faintly during individual cylinder tests, it is possible for the "Buzz" test to report no problems detected. If the "Buzz" test reports no failures, but you don't hear a particular cylinder "Buzz"...more than likely there is a problem with that injector.

It should also be noted that an injector failing a "Buzz" test can have many causes. The injector can be in a failed state (loose armature plate screw, bad solenoid, etc.), the UCV (under valve cover) gasket or harness could be damaged or disconnected, the main engine harness could be damaged or the IDM could be damaged. Further inspection will be necessary to determine the actual problem...but at least you now have a place to start.

KOER (Key On Engine Running) On-Demand Test:

On the 7.3L, the primary purpose of this test is to check the functionality of the High Pressure Oil System and the Exhaust Back Pressure Solenoid. On the 6.0L this test may return Misfire, VGT or Glowplug codes.

Requirements to Start (7.3L and 6.0L)

7.3L Powerstroke Starting Req.:

Vehicle Power : 10.5v

RPM Signal : 100rpm

Inj. Cntrl Press. (ICP) : 0.85v (about 500psi)

Fuel Pulse Width : 1 to 6 milliseconds

6.0L Powerstroke Starting Req.:

Vehicle Power : 10.5v

RPM Signal : 100rpm

Inj. Cntrl Press. (ICP) : 0.85v (about 500psi)

Fuel Pulse Width : 0.5 to 2 milliseconds

FICM SYNC and SYNC Achieved

Note: the above starting requirements for both 7.3L and 6.0L Powerstroke Diesels assume the following:

Sufficient Base Engine Oil Level and Pressure

Acceptable Quality Fuel

Sufficient Fuel Pressure

Sufficient Air Supply

Proper Glow Plug Operation

Proper Injection Timing (PCM Controlled)

P1298 - "IDM Failure" (7.3L)

This code can be set by a low battery. Connect a battery charger, clear codes and re-run KOEO tests. If this code doesn't return, check charging system and batteries and repair as necessary. If the code returns, IDM is suspect.

P1316 - "IDM Codes Detected" (7.3L)

IDM Codes are stored in memory in the IDM itself. The P1316 DTC is an indication that there are stored IDM Codes that need to be retrieved and/or cleared. Executing a "Clear Codes" will clear both PCM and IDM codes...DO NOT CLEAR CODES until you have retrieved and reviewed the codes stored in the IDM Please keep in mind that IDM Codes are stored in memory. If you have a code indicating a fault, but there is no driveability problem, the fault may not currently exist. After taking note of the codes, execute a "Clear Codes". At this time you should be able to re-run the above tests with no IDM codes generated. If one or more IDM codes are still present after the "Clear Codes" command has been successfully executed and the above tests performed again, the fault still exists and further examination is necessary.

P1211 - "ICP Higher/Lower Than Desired" (7.3L)

We all know that this code is commonly caused by "Hot Chips" that are demanding more Injection Control Pressure (ICP) than the High Pressure Oil Pump can deliver. For what it's worth, these are the exact parameters that trigger this code:

ICP 410psi Higher Than Desired for 7 Seconds

ICP 280psi Lower Than Desired for 7 Seconds

This code can also be caused by legitimate High Pressure Oil System issues. Below is a list of some of the causes:

- Failed or Sticking IPR (Injection Pressure Regulator)
- Failed or Weak HPOP (High Pressure Oil Pump)
- Any Leak in High Pressure Oil System (o-ring, stuck injector, etc.)
- Low Fuel Pressure or air in fuel
- P1280 / P1281 / P1283 - (7.3L)

The above codes are related to ICP also. If the Service Engine Soon (SES) light is on and these codes are present, the ICP reading through any scantool will not be accurate as the PCM is using a "default" ICP value. These codes are all "electrical" in nature. Common causes are shorts between the Red and White IPR wires or between the Red IPR wire and ground. These can also sometimes indicate a PCM problem.