7.3L DIT Power Stroke - Part 1

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Part 1 of 4 in a series of articles outlining the Features, Description, and Unique Service Procedures of the original 7.3L DIT Power Stroke

7.3 DIT Power Stroke

Introduction

7.3 DIT Overview

- This publication is not intended to replace the Service Manual but to introduce the 7.3 DIT.

Engine Features

- The 7.3 DIT has been designed to meet customer expectations for increased performance.
- New features used in this engine are discussed in detail.

Horsepower Comparison

- The 7.3 DIT engine will consistently produce 215 peak horsepower @ 3000 rpm at sea level and up to elevations of 10,000 feet.
- This is a 13% increase over the 7.3 IDI Turbocharged engine.
- Electronic engine management combined with turbocharging and more robust power cylinders provides an increase in horsepower over previous 7.3 engines, and accomplishes this at lower emission levels.

Torque Comparison

- The 7.3 Direct Injection Turbocharged Diesel engine produces 450 lb./ft/ of torque between 1900 and 2100 rpm compared to the 7.3 IDI's 388 lb./ft. at 1400 rpm. This is a 16% increase over the 7.3 IDI Turbocharged engine.
- The 7.3 Direct Injection Turbocharged Diesel engine provides significantly increased performance, without sacrificing reliability of the drivetrain components.

Specifications

- The 7.3 DIT Diesel engine is a totally new engine design that will provide improved fuel economy, durability, and performance.

Engine Type	Diesel, 4-Cycle
Configuration	OHV-V8
Displacement	444 cu. in. (7.3L)
Bore and Stroke	4.11 x 4.18 (10.44 x 10.62cm)
Compression Ratio	17.5:1
Aspiration	Turbocharged
Rated Power @ RPM	215 @ 3000 RPM
Peak Torque @ RPM	450 @ 1900 RPM
Engine Rotation, Facing Flywheel	Counter Clockwise
Combustion System	Direct Injection
Total Engine Weight (Dry)	920 LB. (417.6 Kg)
Coolant Flow	80 GPM (302.8L/min) @ 3300 RPM
Fan-to-Crank Ratio	1.1:1
Heat Rejection	30 BTU/Hp-Min
Air Flow @ RPM	548 CFM (15.5 m^3/min.) @ 2600 RPM
Exhaust Flow @ RPM	1600 CFM (45.3$m^{3/}$/min.) @ 3000 RPM
Cooling System Capacity (Engine Only)	12 Quarts (11.4 Liters)
Lube System Capacity (Including Filter)	12 Quarts (11.4 Liters

Physical Identification

Physical Identification

- Three ways to identify are:
- Engine Serial Number
- Calibration Label
- Engine Features

Engine Serial Number

- The engine serial number is located on rear oil cooler pad.
- 7.4 - is the engine family identifier
- JU2U is a manufacturing designator
- 000501* is a sequential build number

Calibration Label

- The calibration label is located on the front of the high pressure oil reservoir.
- The manufacturing date is identified.

Emission Label

- The emission label is located on the Right Valve Cover and identifies the engine model, horsepower, and fuel delivery rate.

HEUI Fuel System Operation

System Overview

- Demands for greater fuel economy and lower exhaust emissions, in the 90's and beyond, require improved fuel system performance. The HEUI system (Hydraulically Actuated, Electronically Controlled, Unit Injection) meets these requirements. Three critical factors that lead to enhanced performance are:
- RATE OF CONTROL
- TIMING CONTROL
- HIGHER INJECTION PRESSURES

Rate Control

- The rate of injection can be controlled to meet any engine condition.
- Because the HEUI is hydraulically actuated rather than mechanically actuated, its rate of injection does not depend on engine speed.

Timing Control

- Both start and end of injection are electronically controlled.
- Unlike conventional electronically controlled mechanically actuated unit injectors, the HEUI plunger does not move until the solenoid is energized.
- This means that plunger movement is not limited to the speed or duration of a cam lobe.

Higher Injection Pressures

- An intensifier piston in the HEUI multiplies hydraulic force on the plunger.
- By varying hydraulic input pressure, injection pressure can be controlled in a range from 3,000 to 21,000 psi.
- These high pressures are available throughout the entire engine operating range, at idle, as well as high engine speeds.

Five Major Components

The HEUI System Consists of Five Major Components:

- **Powertrain Control Module (PCM)**
  Previously referred to as EEC utilizing 104 pin connector.
- **Injector Drive Module IIDM)**
  Steps up signal from PCM to drive injectors.

- **High Pressure Oil Supply Pump**
  A separate high pressure pump with exclusive purpose to power injectors.
- **Injection Pressure Regulator (IPR)**
  Located on high pressure pump, controlled by PCM.
- **Injectors (HEUI)**
  One per cylinder under the valve covers.

Powertrain Control Module (PCM)

- The PCM is a microprocessor which monitors various sensors from the vehicle and engine as it controls the operation of the entire fuel system.
- Sensors Monitored Include:
- Accelerator Position Sensor (APS)
- Camshaft Position Sensor (CMP)
- Injection Control Pressure Sensor (ICP)
- Manifold Absolute Pressure Sensor (MAP)
- Engine Oil Temperature Sensor (EOT)
- Intake Air Temperature Sensor (IAT)
- Barometric Pressure Sensor (BARO)
- Exhaust Back-Pressure Sensor (EBP)

Injector Drive Module (IDM)

- The IDM sends a precisely controlled current pulse to energize the injector solenoid.
- The timing and duration of the IDM pulse are controlled by the PCM.
- The IDM pulse consists of 100 Volts, 7 Amps, equal to 1 horsepower per injection.

- In addition to the crankshaft-driven gerotor oil pump that supplies lube oil to the engine, the fuel system features a high pressure lube pump and an injection pressure regulator.

High Pressure Oil Supply Pump

- The hydraulic supply pump is a seven piston fixed displacement axial piston pump.

Injection Pressure Regulator (IPR)

- The IPR is an electronically operated dump valve which closely controls pump output pressure, between 450 and 3,000 psi, by dumping excess flow to the return circuit.
- The IPR is mounted on the high pressure oil pump.

HEUI Injector

- The HEUI Injector is hydraulically actuated by high pressure engine oil supplied by the high pressure oil pump.
- The Injector has four major components which contribute to higher injection pressure needed to satisfy increased customer expectations for performance, while improving fuel economy and meeting emissions regulations.
- Solenoid

- Poppet Valve
- Intensifier Piston and Plunger
- Nozzle Assembly

Electronic Solenoid

- The solenoid is a very fast acting electro-magnet, which when energized, pulls the poppet valve off its seat.
- The injector is actuated 27 times per second at rated speed.
- 100 VOLTS ● 7 AMPS
  1 HORSEPOWER

Poppet Valve

- The poppet valve is held on its lower seat by a spring. In this closed position, high pressure inlet oil is blocked and the intensifier cavity is opened to drain.
- When the solenoid is energized, the poppet is quickly lifted off its lower seat to its upper seat. The path to drain is closed and the inlet for high pressure oil is opened.

Intensifier Piston and Plunger

- When the poppet valve opens the inlet port, high pressure oil enters the injector and acts on the top of the intensifier piston. Pressure builds on the intensifier, pushing it and the plunger down.
- The intensifier is 7 times larger in surface area than the plunger; providing an equal multiplication of force, i.e. injection pressure.
- The downward movement of the plunger pressurizes the fuel in the plunger cavity, causing the nozzle to open.

Nozzle Assembly

- The nozzle assembly is of conventional design with the exception of the fill check. This check ball seats and seals during the downward stroke of the plunger to prevent leakage of the high pressure fuel.
- During the return stroke, it unseats allowing the plunger cavity to fill.
- The nozzle valve is an inwardly opening type which lifts off its seat when pressure overcomes the spring force. Fuel is then atomized at high pressure through the nozzle tip.

Stages of Injection

Stages of Injection

- There are three stages of injection with the HEUI:
- Fill Cycle
- Injection
- End of Injection

Fill Cycle

- During pre-injection all internal components have returned to their spring loaded positions. The poppet valve is blocking high pressure oil from entering the injector.
- The plunger and intensifier are at the top of their bore and the plunger cavity is full of fuel. Fuel pressure in the plunger cavity is the same as fuel gallery pressure, 40 to 70 psi.

Injection

- When the PCM determines that the injector should be fired, the following sequence of events occur:
- PCM sends Fuel Delivery Control Signal (FDCS) to IDM.
- IDM sends electric current pulse to injector solenoid.
- Solenoid is fully energized almost instantly creating a strong magnetic pull on the armature.
- Magnetic pull of solenoid overcomes spring tension holding the poppet closed.
- Poppet is quickly raised off its seat.
- Upper poppet land closes off path to drain.
- Lower land opens poppet chamber to incoming high pressure oil.
- High pressure oil flows around poppet to the top of intensifier piston.
- Pressure on the top of the intensifier forces it down along with the plunger. The downward movement of the plunger pressurizes the fuel in the plunger cavity and nozzle. When the fuel pressure reaches Valve Opening Pressure (VOP) of about 2,700 psi, the nozzle valve lifts off its seat and injection begins.
- Injection pressures may be as high as 21,000 psi depending on engine requirements.

End of Injection Drain Cycle

- The end of the injection cycle begins when the PCM terminates the fuel delivery control signal to the IDM. The IDM then terminates the electric pulse to the solenoid. The following events occur:
- The magnetic field of the solenoid collapses and is no longer able to overcome poppet spring tension to hold the poppet off its seat.
- The poppet closes, shutting off high pressure oil from entering the injector.
- When the poppet is seated, the upper land of the poppet opens the poppet cavity to drain.
- Pressurized oil in the intensifier chamber and poppet chamber flows upward around the poppet seat, through the vent holes in the poppet sleeve and out the adapter drain hole.
- The pressure of the fuel in the plunger cavity exerts an upward force on the plunger and intensifier. As the pressure of the pressurized oil above the intensifier drops, so does the downward force on the intensifier.
- The upward force from the pressurized fuel almost instantly becomes greater than the downward force on the intensifier so the downward motion of the intensifier and plunger stops.
- When the plunger stops, fuel flow also stops and spring tension closes the nozzle valve.