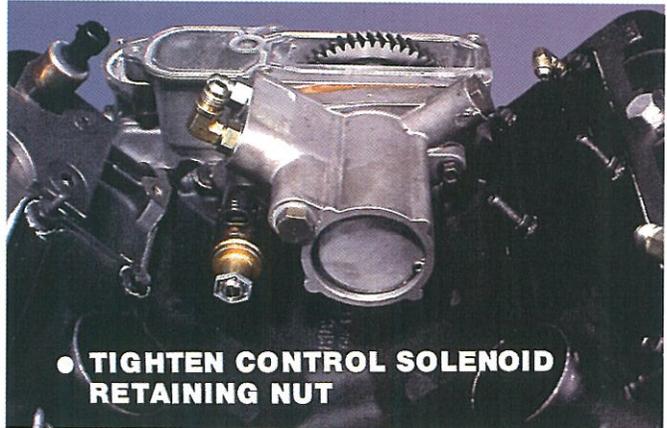


UNIQUE SERVICE PROCEDURES

INSTALLING IPR SOLENOID

- The jam nut that holds the solenoid must be tightened to the torque specified in the service manual. If the jam nut comes loose the IPR won't function properly.



● **TIGHTEN CONTROL SOLENOID
RETAINING NUT**

167



● **INSTALL HIGH PRESSURE
OIL HOSES**

168

HIGH PRESSURE HOSES

The hoses are made specially to withstand the pressure and temperature of this system. Use only FORD certified replacement hoses.

FUEL FILTER ASSEMBLY REMOVAL

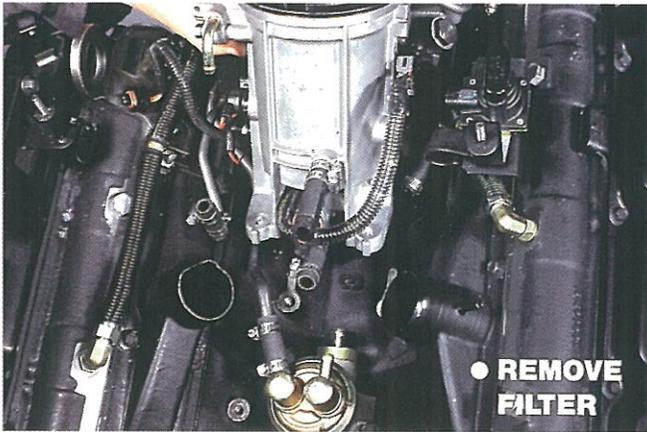
- To remove the fuel filter housing from the engine valley, the filter must be drained using the water drain lever (yellow), at the top of the housing. Then loosen the transfer pump to filter hose clamps, as well as, the filter drain clamp.



● **REMOVE
HOSE
CLAMPS**

169

UNIQUE SERVICE PROCEDURES



170

FUEL FILTER ASSEMBLY REMOVAL

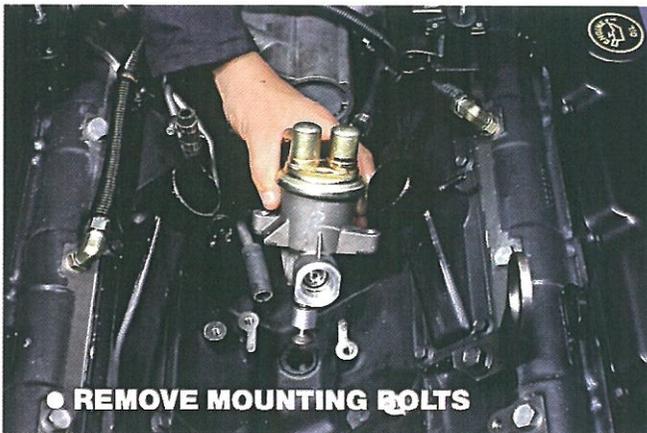
- Remove the two mounting bolts from the engine valley and remove the filter assembly from the valley.

TRANSFER PUMP

- The fuel line assembly for the cylinder heads is secured by a bolt and sealed by a coated aluminum gasket on each side of the banjo part of the assembly. The lines are sealed by square cut "O"-rings at each cylinder head.



171



172

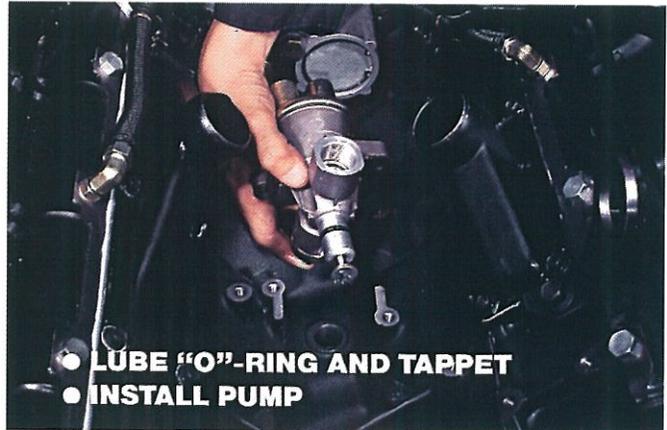
TRANSFER PUMP

- After removing the two mounting bolts that secure the pump to the crankcase the pump can be lifted from the valley. Care must be taken so that nothing falls into the open bore and onto the camshaft lobe.

UNIQUE SERVICE PROCEDURES

TRANSFER PUMP INSTALLATION

- Lube the "O"-ring and bottom side of tappet with engine oil prior to setting into crankcase. The pump bolts must be tightened evenly. If the cam lobe is at its highest point to the tappet the pump will have to be drawn down to the crankcase mounting pad. If not drawn evenly by the two bolts, the nose of the pump could get broken.



- LUBE "O"-RING AND TAPPET
- INSTALL PUMP

173



- INSTALL BANJO FITTING

174

TRANSFER PUMP INSTALLATION

- Install new square cut "O"-rings on the cylinder head ends of the fuel line. Be sure the tang on the banjo aligns with the flat on the transfer pump body. This tang and flat limit the twisting of the banjo while the fuel banjo nut is being tightened. Loosely assemble the banjo fitting with new seal rings. Start compression nuts on fitting on each head, then tighten all three fittings to specified torque. Specifications are in the service manual.

TRANSFER PUMP

- With hose clamps loose on the hoses, set the filter in the valley and align the hoses with the proper transfer pump port. Tighten the mounting bolts for the fuel filter base and then tighten the fuel line hose clamps.



- INSTALL FUEL FILTER

175

UNIQUE SERVICE PROCEDURES



- REMOVE COMPRESSOR OUTLET "Y"-PIPE

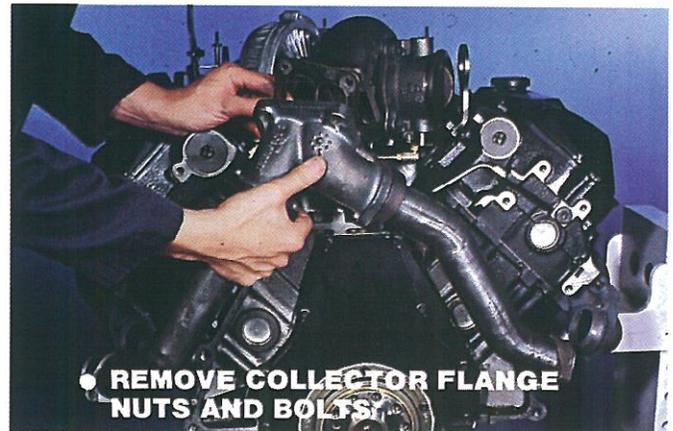
176

TURBOCHARGER

- Remove the "Y"-pipe from compressor outlet to the intake manifolds. A special "O"-ring is used to seal the "Y"-pipe to compressor housing.

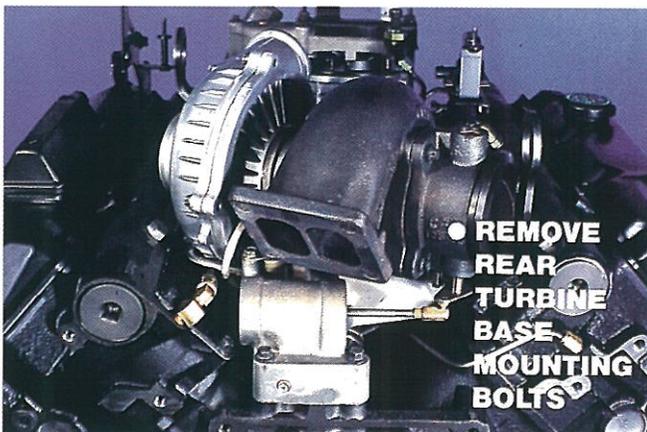
TURBOCHARGER

- Remove the two nuts and two bolts that hold the turbine collector to the turbine inlet housing of the turbocharger. A gasket is used to seal this connection.



- REMOVE COLLECTOR FLANGE NUTS AND BOLTS

177



- REMOVE REAR TURBINE BASE MOUNTING BOLTS

178

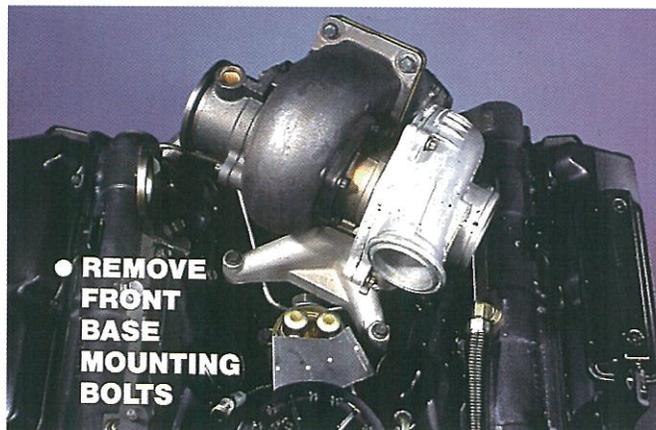
TURBOCHARGER

- The turbocharger and pedestal must be removed as an assembly.
- Remove the two rear turbocharger pedestal mounting bolts.

UNIQUE SERVICE PROCEDURES

TURBOCHARGER

- Remove the front turbocharger pedestal bolts and lift from crankcase.



179



180

TURBOCHARGER

- The oil supply for the turbocharger is from the #5 main oil gallery. Oil is directed from the gallery up through a passage to the mounting pad. Oil returns to the crankcase rear plate area back to sump through the larger of the two holes.

TURBOCHARGER INSPECTION

- To remove the EBP device housing from the turbine, first remove the actuator rod by sliding the collar and pushing the rod down from the ball stud connection.
- The rod has some preload so it will move inward towards the base when released.



181

UNIQUE SERVICE PROCEDURES

● REMOVE EBP BUTTERFLY



182

TURBOCHARGER INSPECTION

- When the four bolts are removed from the bottom of the turbocharger base the turbocharger can be separated from the mounting base. Two "O"-rings seal the turbocharger to base. Oil supply is the smaller hole, while oil drain is the larger.

TURBOCHARGER INSPECTION

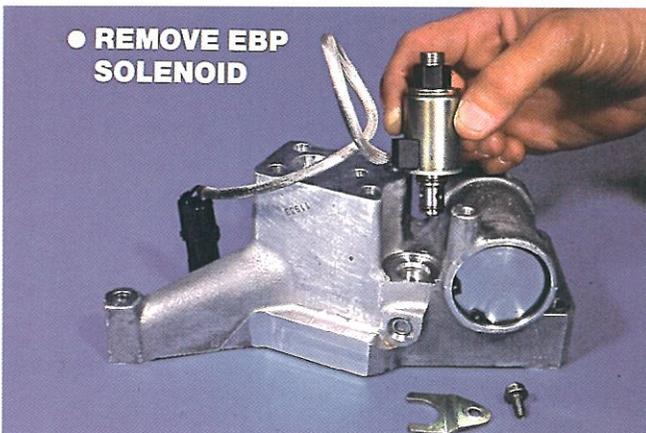
- After removing the three EBP device housing bolts, the device can be removed from the turbine housing. A metal to metal flange seal is used for this connection.

● REMOVE TURBOCHARGER BASE



183

● REMOVE EBP SOLENOID



184

TURBOCHARGER INSPECTION

- The EBP solenoid is used to restrict oil return from the actuator piston which activates the EBP device. This restricts the exhaust flow causing the engine to warm up fast creating cab heat sooner.
- The PCM uses the EBP sensor to monitor the pressure in the right manifold and make adjustments to the position of the EBP device as needed.

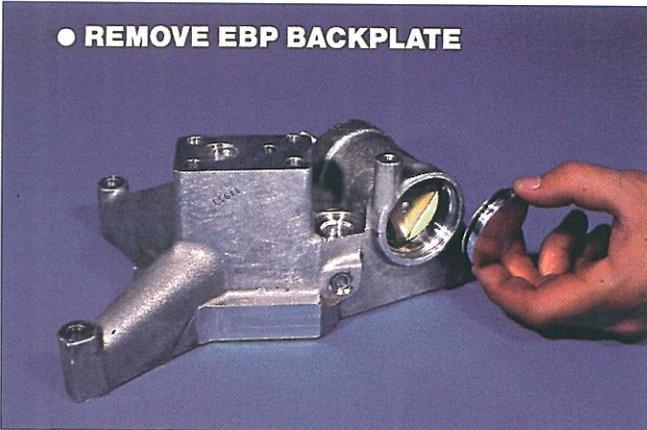
UNIQUE SERVICE PROCEDURES

TURBOCHARGER PEDESTAL INSPECTION

- To inspect and rebuild the EBP actuator piston, first remove the snap ring from the housing.



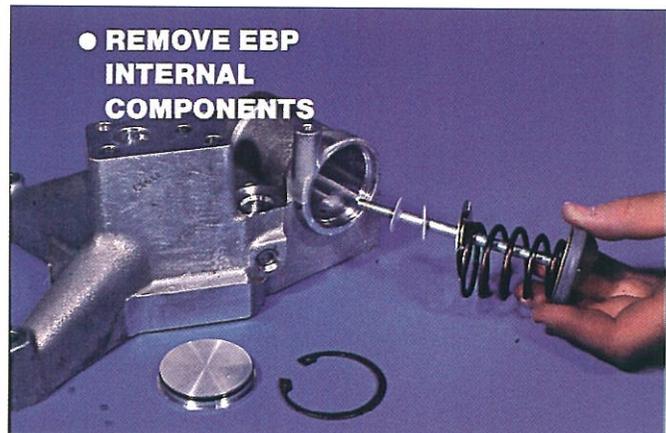
185



186

TURBOCHARGER PEDESTAL INSPECTION

- By tapping on the actuator rod, the end plate will be removed from the housing. Note the "O"-ring used to seal the end plate to the housing.



187

TURBOCHARGER INSPECTION

- The actuator piston can now be removed from the housing for inspection and repair. Inspect the housing bore for nicks or burrs that could damage the "O"-rings. Replace if necessary.

UNIQUE SERVICE PROCEDURES



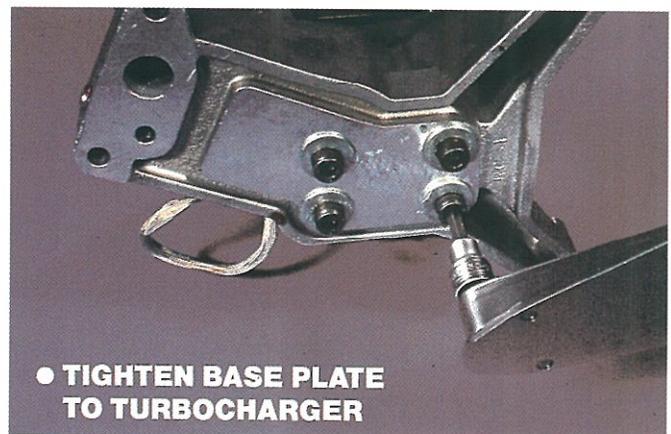
188

TURBOCHARGER PEDESTAL REASSEMBLY

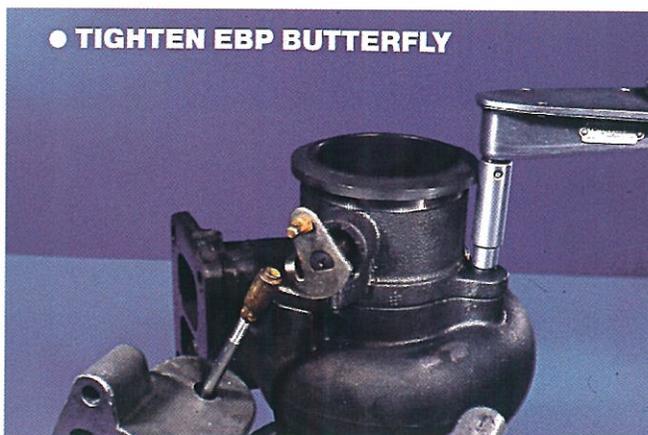
- Lubricate "O"-rings prior to reassembly into the housing. Be sure all parts are clean. Install end plate and snap ring.

TURBOCHARGER ASSEMBLY TO PEDESTAL

- Using new "O"-ring seals between the turbocharger and turbocharger base, install and tighten the base bolts.



189



190

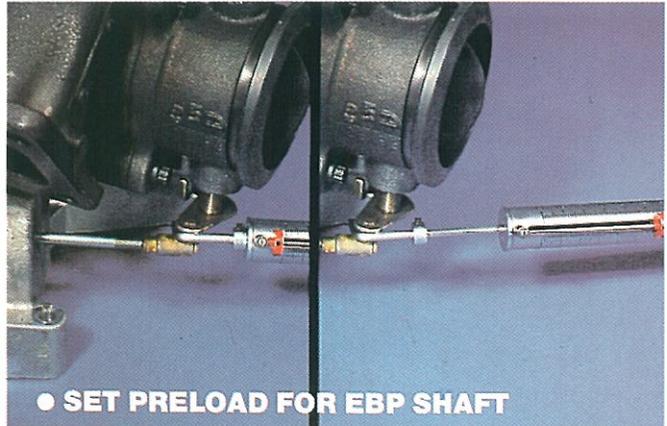
TURBOCHARGER INSPECTION

- Mount the EBP device to the turbine housing and tighten the 3 retaining bolts to the proper torque. Never Seize® is required on these bolts.

UNIQUE SERVICE PROCEDURES

EBP ASSEMBLY

- With the actuator rod connected to the EBP device, the tension to move the rod must be set. Using a spring scale, pull on the actuator rod until the rod begins to move and record this reading. To increase tension, disconnect the rod and turn the swivel in towards the base and connect to the device. Re-check. Thread the swivel away from the base to decrease the tension. Adjust to specifications shown in the service manual.



191



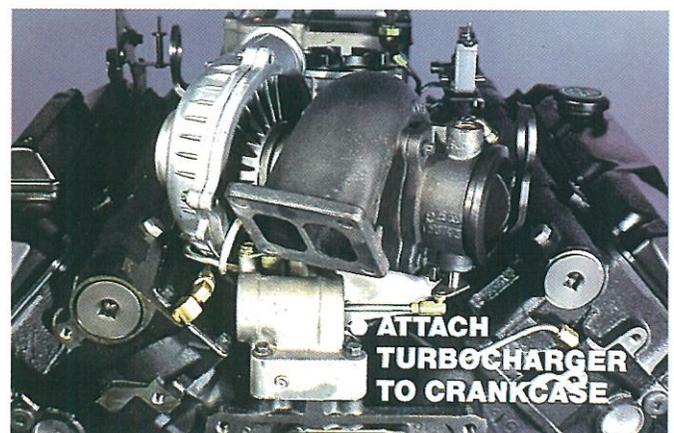
192

TURBOCHARGER INSTALLATION

- After inspecting mounting surfaces, install new seal "O"-rings into the crankcase

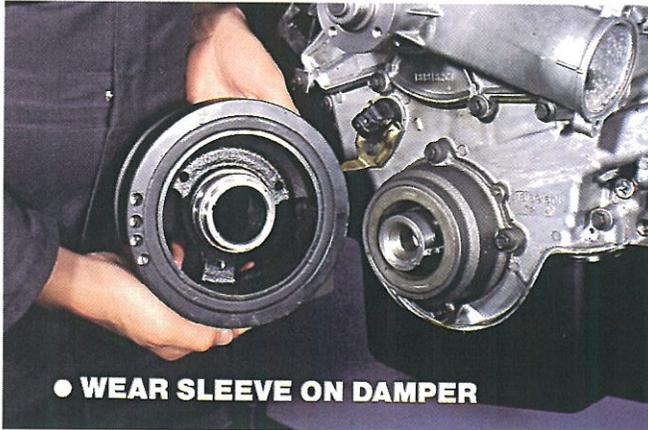
TURBOCHARGER INSTALLATION

- Set turbocharger on crankcase and tighten the four mounting bolts. Install the turbine collector piping and the compressor outlet "Y"-pipe to the intake manifolds.



193

UNIQUE SERVICE PROCEDURES



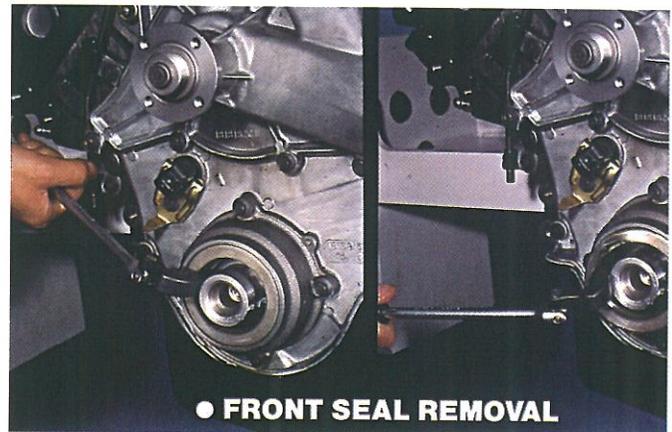
194

FRONT SEAL/OIL PUMP

- The damper incorporates a wear sleeve for the crankshaft front seal. The front seal is housed in the oil pump housing.

FRONT SEAL/OIL PUMP

- The front seal can be removed without removing the oil pump housing. Insert the tool into the lip of the seal. Roll the front seal out of the oil pump housing.



195



196

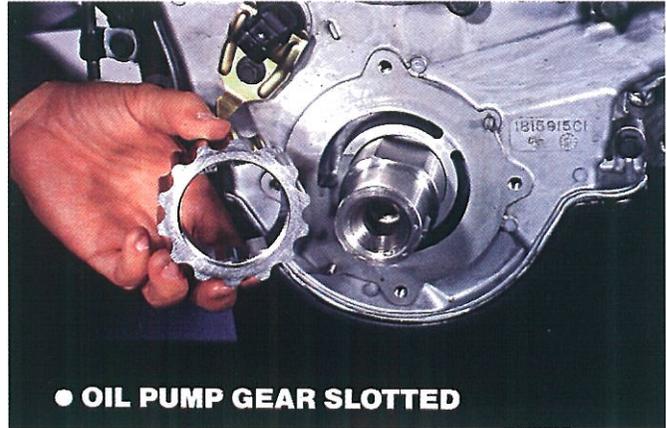
FRONT SEAL/OIL PUMP

- Four bolts attach the lube oil pump housing to the engine. The oil pump housing is centered to the crankshaft by dowel pins in the front cover.

UNIQUE SERVICE PROCEDURES

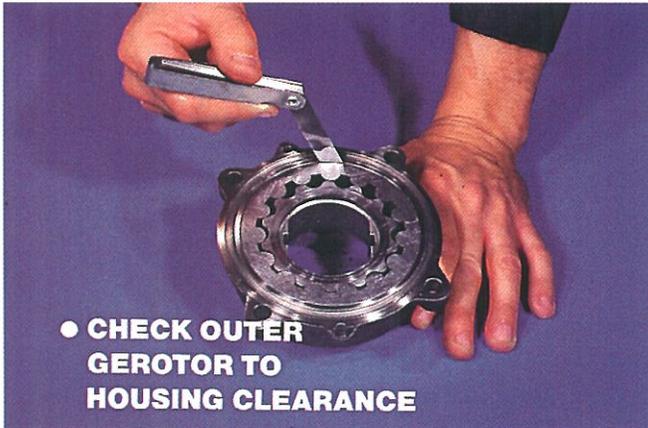
FRONT SEAL/OIL PUMP

- The outer gerotor is driven by the inner gerotor which is driven by the crankshaft. Oil is pulled into the oil pump at the lower slot and pressurized for delivery to the engine at the upper slot.



● OIL PUMP GEAR SLOTTED

197



● CHECK OUTER GEROTOR TO HOUSING CLEARANCE

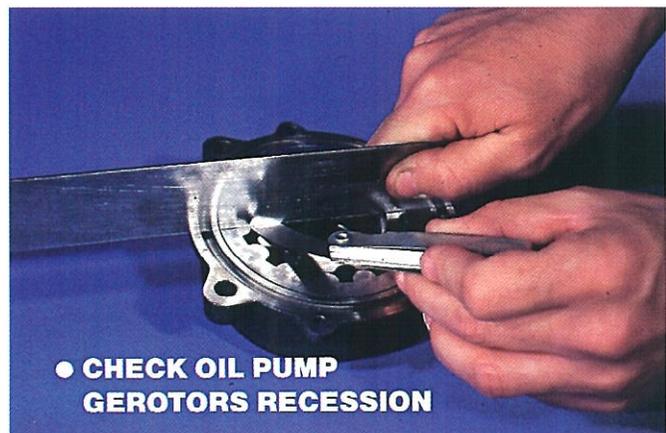
198

FRONT SEAL/OIL PUMP

- Measure the clearance of the outer gerotor to housing using a feeler gauge. See service manual for specifications.

FRONT SEAL/OIL PUMP

- Check oil pump gerotors axial clearance using a straight edge and a feeler gauge.



● CHECK OIL PUMP GEROTORS RESSION

199

UNIQUE SERVICE PROCEDURES



● CHECK GEROTORS FOR DEFECTS

200

FRONT SEAL/OIL PUMP

- Removal of the wear sleeve from damper without impacting the balance is accomplished by using the proper tool, #T94T-6379-AH1.



● REMOVE WEAR SLEEVE USING TOOL

201



● REMOVE WEAR SLEEVE

202

FRONT SEAL/OIL PUMP

- Install the collars and the screw plate to remove the sleeve.

UNIQUE SERVICE PROCEDURES

FRONT SEAL/OIL PUMP

- After surrounding the collars, turn the bolt with a wrench to remove the wear sleeve.



203



204

FRONT SEAL/OIL PUMP

- Wear sleeve removed.



205

FRONT SEAL/OIL PUMP

- Prior to installing front seal wear sleeve, LOCTITE® No. 271 should be applied to the wear sleeve inside diameter to prevent oil migration.

UNIQUE SERVICE PROCEDURES



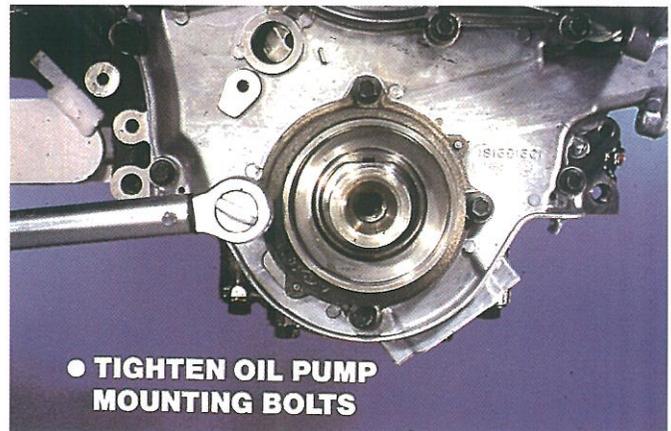
206

FRONT SEAL/OIL PUMP

- Install wear sleeve using the correct tool, #T94T-6379-AH2.

FRONT SEAL/OIL PUMP

- The front cover is aluminum so it is very critical to properly tighten the oil pump mounting bolts to the proper torque. Specifications are in the service manual.



207



208

FRONT SEAL/OIL PUMP

- Install front seal making sure hydraulic sealant, LOCTITE® No. 271 has been applied to the seal outside diameter.

UNIQUE SERVICE PROCEDURES

FRONT SEAL/OIL PUMP

- Install front seal until the tool, #T94T-6700-AH, bottoms against the housing.



209



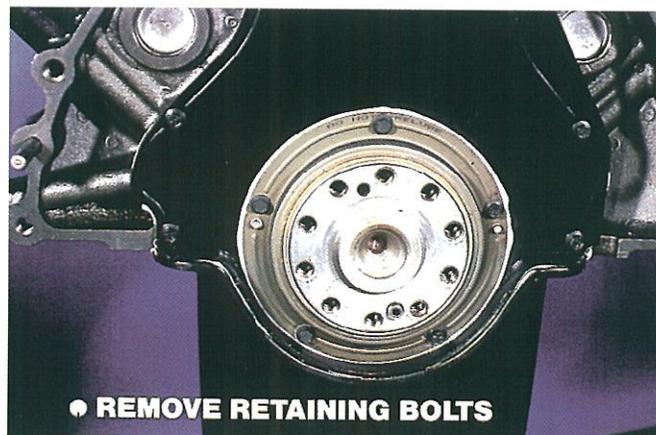
210

FRONT SEAL/OIL PUMP

- Install damper using same tool as the front seal, driving with its opposite side.

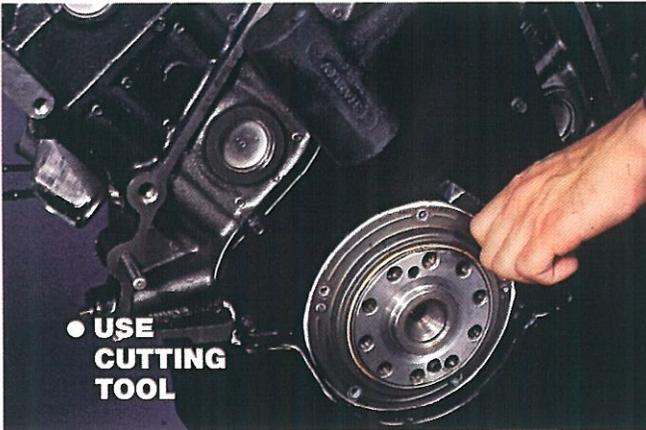
REAR SEAL

- Remove the five bolts which secure the seal carrier to the rear cover.



211

UNIQUE SERVICE PROCEDURES



● **USE CUTTING TOOL**

212

REAR SEAL

- Once the sealant has been cut, remove the rear seal.
- NOTE: A wear sleeve is used in production.



● **REMOVE REAR SEAL**
● **PRODUCTION WEAR SLEEVE**

213



● **REMOVE WEAR SLEEVE WITH TOOL**

214

REAR SEAL

- Removing wear sleeve using tool, #T94T-6701-AH1.

UNIQUE SERVICE PROCEDURES

REAR SEAL

- Removing wear sleeve using the proper tool prevents damage to the rear cover and crankshaft flange.



● REMOVE WEAR SLEEVE WITH TOOL

215



● WEAR SLEEVE REMOVED

216

REAR SEAL

- Use of the proper tool prevents damage to the crankshaft flange.



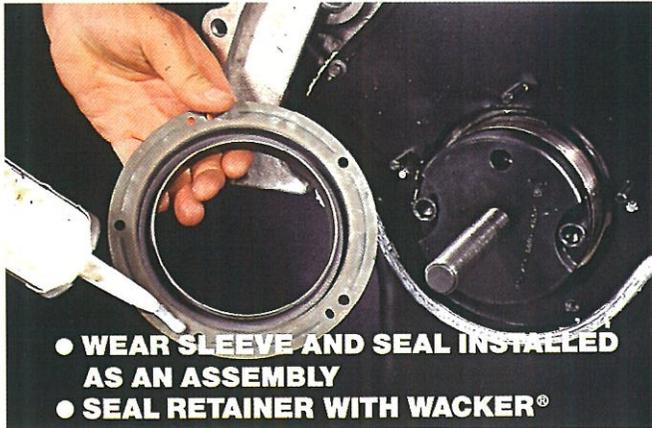
● INSTALL WEAR SLEEVE WITH TOOL

217

REAR SEAL

- To install the crankshaft rear seal wear sleeve correctly, use tool #T94T-6701-AH4.
- Seal and wear ring are to be installed as an assembly and should not be separated to avoid damaging seal.

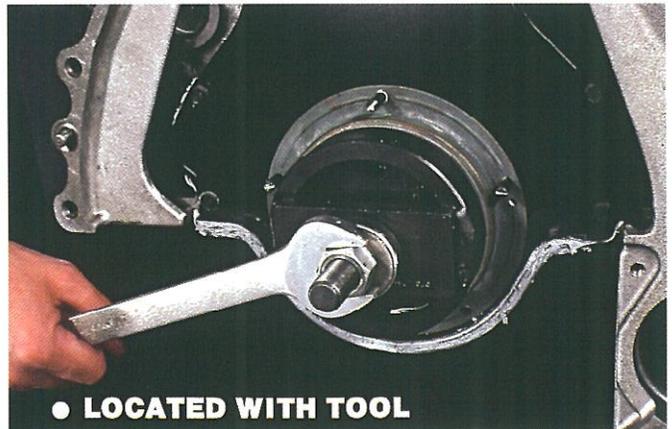
UNIQUE SERVICE PROCEDURES



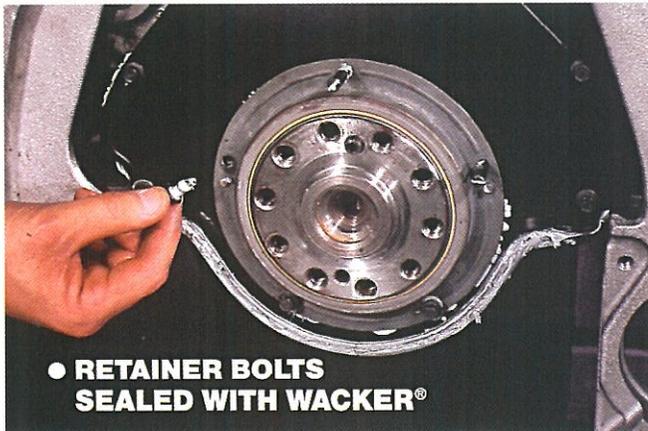
218

REAR SEAL

- Install wear sleeve and seal by aligning dowels with correct holes in seal retainer.
- Tool will bottom against crankshaft flange when wear sleeve is positioned correctly.



219



220

REAR SEAL

- Apply a bead of LOCTITE® No. 515 sealant to the outside diameter of the crankshaft flange.
- Wear sleeve and seal are installed as an assembly with Wacker® T-95 RTV sealant on retainer.
- Sealant must be applied around all bolt and dowel holes to seal properly.

REAR SEAL

- Apply Wacker® T-95 RTV sealant to the five seal retainer bolts.
- The 2 lower bolts penetrate the rear cover and require sealant.

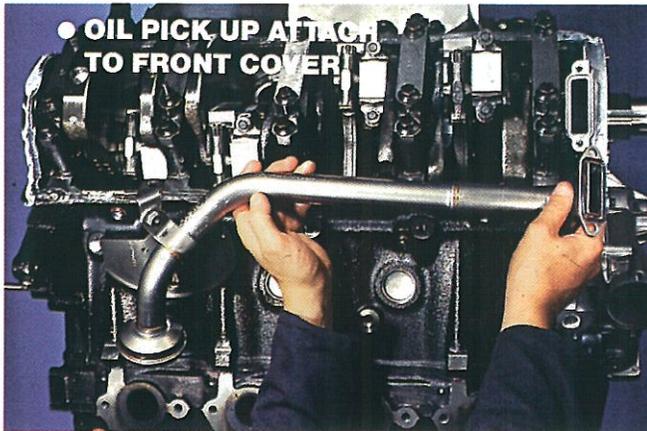
UNIQUE SERVICE PROCEDURES

OIL PAN

- Remove oil pan using a cutting tool.



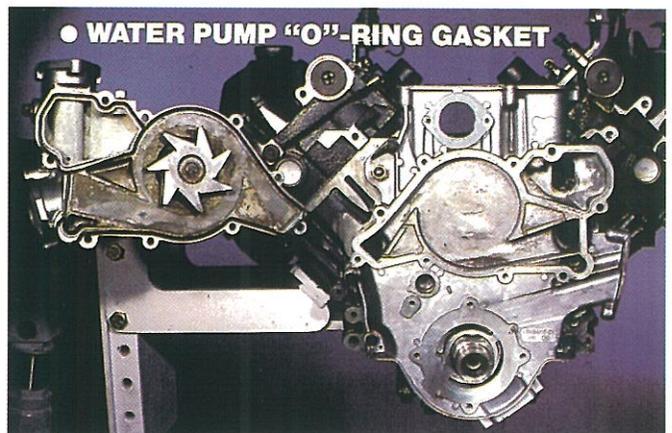
221



222

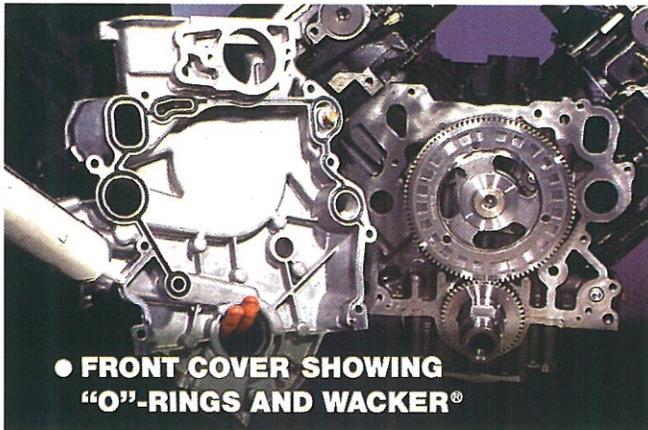
WATER PUMP AND FRONT COVER

- The water pump is sealed to the front cover by an "O"-ring.



223

UNIQUE SERVICE PROCEDURES



● FRONT COVER SHOWING
"O"-RINGS AND WACKER®

224

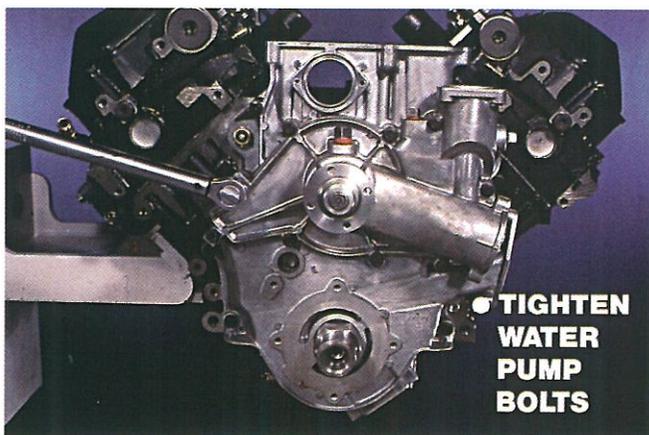
WATER PUMP AND FRONT COVER

- Four water-pump bolts go through the front cover into the crankcase.



● FOUR WATER
PUMP BOLTS
THREADED INTO
CRANKCASE

225



● TIGHTEN
WATER
PUMP
BOLTS

226

WATER PUMP AND FRONT COVER

- Tighten the water pump bolts to the specified torque, keeping in mind the front cover is aluminum.

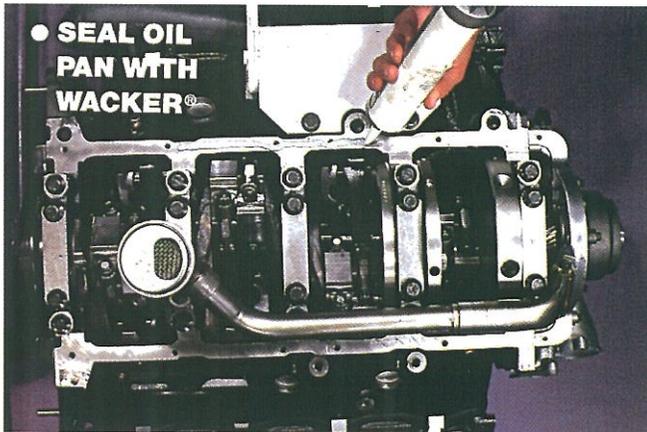
UNIQUE SERVICE PROCEDURES

WATER PUMP AND FRONT COVER

- Whenever re-installing the oil pick up tube, always install a new "O"-ring.
- Tighten oil pick up tube to front cover before tightening main bearing support.



227



228

OIL PAN

- Apply Wacker® T-95 RTV sealant to seal the oil pan to the crankcase.
- Inside of bolt holes.
- Heavier at front and rear.

GLOSSARY

APS Accelerator Position Sensor

A potentiometer style sensor that indicates the operator's pedal position.

Actuator

A device which delivers motion in response to an electrical signal.

Analog

A continuously variable voltage.

BARO Barometric Pressure Sensor

An analog device which indicates atmospheric pressure which allows the PCM to compensate for altitude. A BARO sensor has three connections, signal return (gnd), BARO signal, and Vref.

CMP Camshaft Position Sensor

A Hall effect sensor used to indicate engine speed and camshaft position. Speed is indicated by the number of vanes counted per revolution. Camshaft position is indicated by a single narrow vane which indicates #1 cylinder position or a wide vane in dual sync application that indicates #6 cylinder.

DVOM Digital Volt Ohm Meter

A meter that uses a digital display to indicate a measured value. Preferred for use on microprocessor systems because a DVOM has a very high internal impedance and will not load down the circuit being measured.

EBP Exhaust Back Pressure Regulator

A pulse width modulated controlled butterfly valve mounted on the exhaust side of the turbocharger used to create exhaust back pressure to insure faster engine and cab warmup.

EBP Exhaust Back Pressure Sensor

A transducer style sensor used to indicate exhaust back pressure.

EOT Engine Oil Temperature

A thermistor type sensor which indicates engine temperature.

GPR Glow Plug Relay

Relay which supplies power to the glow plugs.

Hall Effect Sensor

A Hall Effect sensor generates a digital on/off signal

that indicates speed and also engine timing. The signal is created by a switching action caused by the passing of a vane thru a positive and negative voltage potential. When the vane is between this potential, a signal is created. When the gap in between this potential is open, no signal is generated. The wider the vane the longer the duty cycle of the signal, the narrower the vane the shorter the duty cycle of the signal. A narrow vane is used to indicate the position of #1 cylinder and a wide vane to indicate the position of #6 cylinder. A Hall Effect sensor has three connections: ground, Vref, signal.

IAT Intake Air Temperature Sensor

A thermistor style sensor used to indicate air temperature.

ICP Injector Control Pressure

A transducer style sensor used to indicate gallery pressure.

IPR Injection Control Regulator

controls injection oil pressure. An electrical signal to a solenoid creates a magnetic field which applies a variable force on a poppet to control pressure. The quantity of fuel delivered to the combustion chamber is proportional to injection control pressure.

IDM Injector Drive Module

is an electronic unit which has the primary function of an electronic distributor for the injectors. It also is the power supply for the injectors. It supplies 90v@ 7 amps to the injectors.

IVS Idle Validation Switch

A on/off switch sensor that indicates when the accelerator pedal is in the idle position.

Impedence

A form of opposition to AC current flow measured in Ohms.

KOEO Key On Engine Off Test

A self-test operation that is performed with the ignition switch in the ON position with the engine off.

KOER Key On Engine Running Test

Self-test operation that is performed with the ignition switch in the ON position and the engine running.

GLOSSARY

MAP Manifold Absolute Pressure

A MAP sensor is a sensor that generates a digital frequency that indicates manifold boost pressure or vacuum. The signal is created by switching action caused by manifold pressure on a diaphragm connected to a capacitor circuit in the sensor. The digital frequency increases as pressure increases. A MAP sensor has three connections, signal return (gnd), MAP signal and Vref.

Normally Closed

refers to a switch or a solenoid that is closed when **no** control or force is acting on it.

Normally Open

Refers to a switch or a solenoid that is open when no control or force is acting on it.**PCM Powertrain Control Module**--The housing which contains the micro computer, Vref regulator, input conditioners and output drivers.

Potentiometer (Pot)

Converts a mechanical motion to a voltage value. Most often used to sense the position of a component. This sensor works as a variable voltage divider. The wiper arm is mechanically connected to the component desired to be sensed. Potentiometers have three connections, Vref, Signal out and ground.

Pulse Width

The length of time an actuator, such as an injector remains energized.

Thermistor

Sensor used to determine temperature. A thermistor changes its resistance value in relation to temperature change. Increasing temperature results in decreasing resistance, decreasing temperature results in increasing resistance. The thermistor in conjunction with a current limiting resistor in the ECA forms a voltage divider that provides a voltage signal that indicates temperature. Since the top half of the voltage divider is the current limiting resistor and is internal to the ECA, a thermistor sensor only has two connections, signal return and ground.

VBAT--Battery voltage. (See VPWR)

VPWR--Battery voltage. (See VBAT)

VSS Vehicle Speed Sensor--Normally a magnetic pickup style sensor that is mounted on the tailshaft of the transmission to indicate ground speed.

**7.3 DIT
DIRECT
INJECTION
TURBOCHARGED
DIESEL ENGINE**

