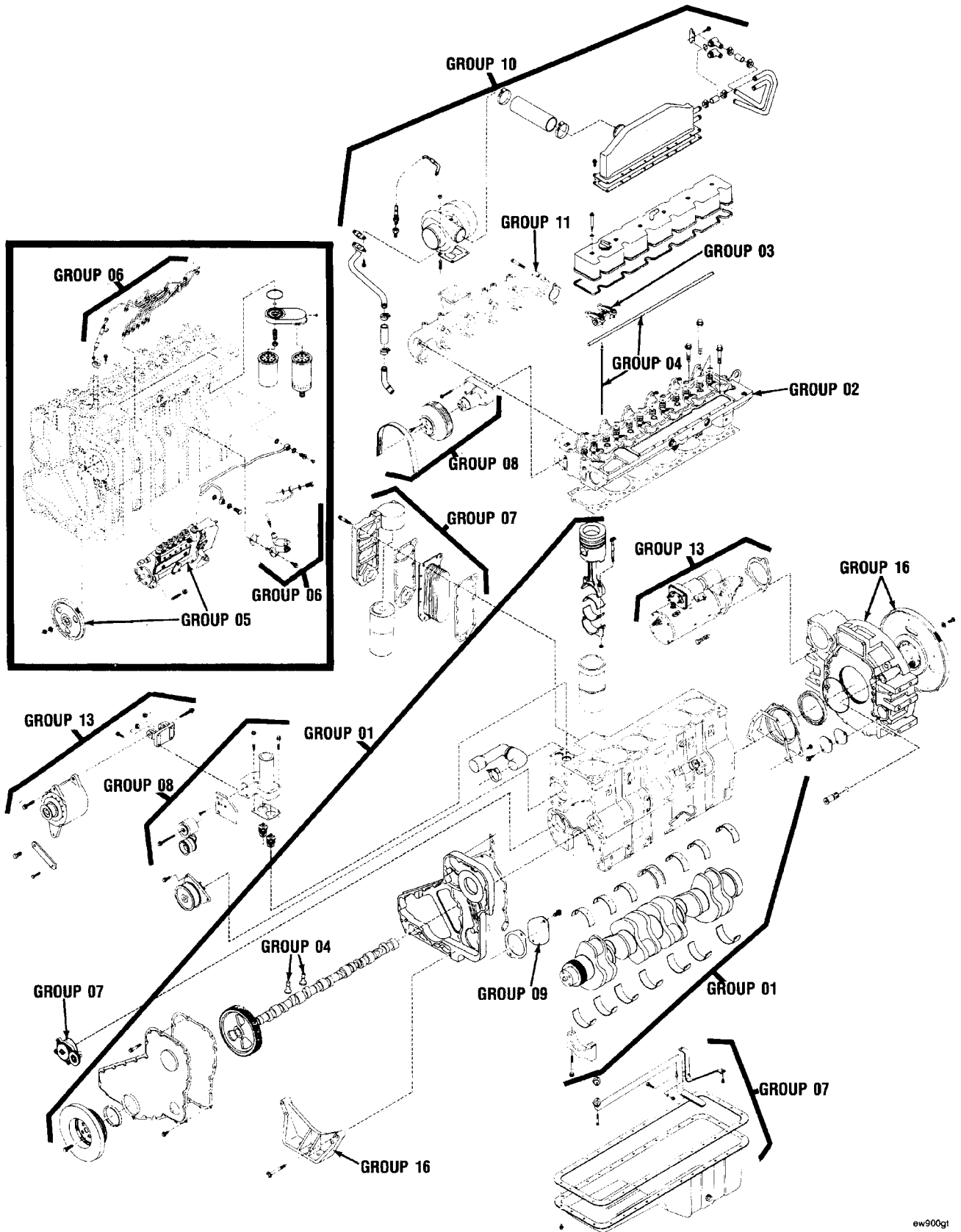
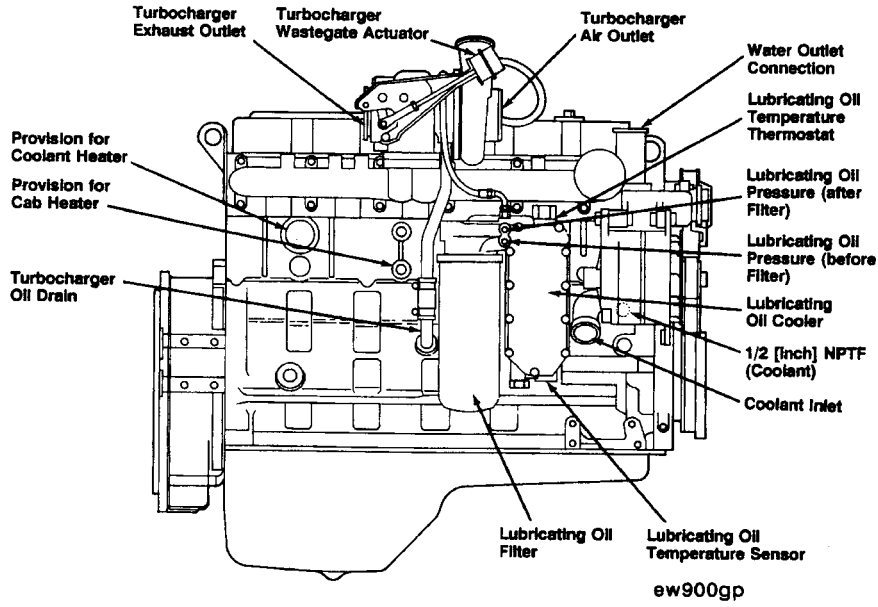


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Engine - Exploded View by Groups





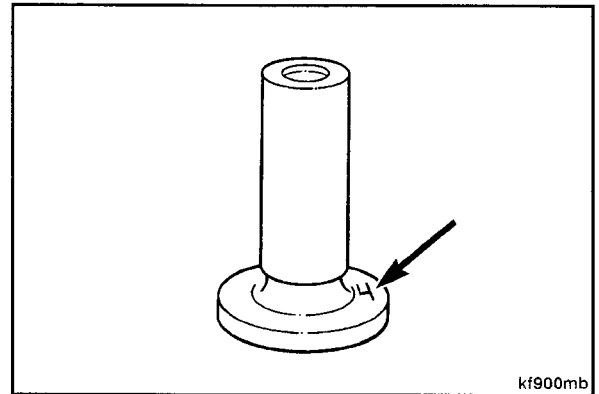
Turbocharger Side View

Valve Tappet - Removal

Electric Pencil

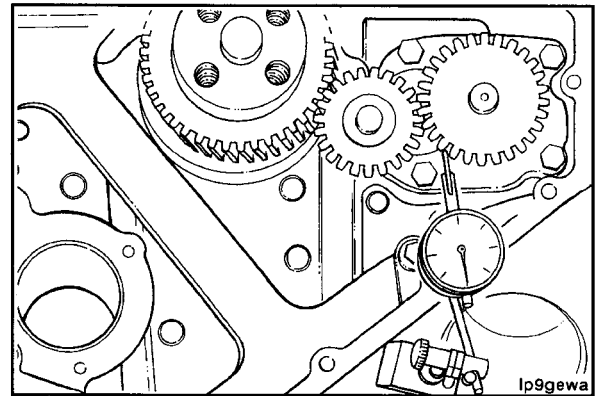
Remove the valve tappets and mark for location as illustrated.

Caution: When reusing the camshaft and tappets, the tappets must be matched to their companion lobe on the camshaft to prevent accelerated camshaft wear. Discard tappets that were not marked during removal.



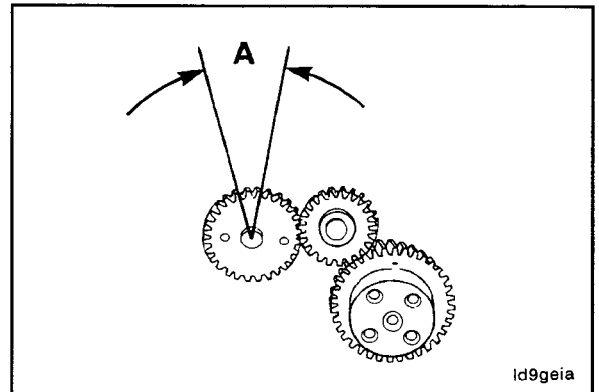
Lubricating Oil Pump Gear Backlash - Measurement

Position the indicator on a tooth of the gear.



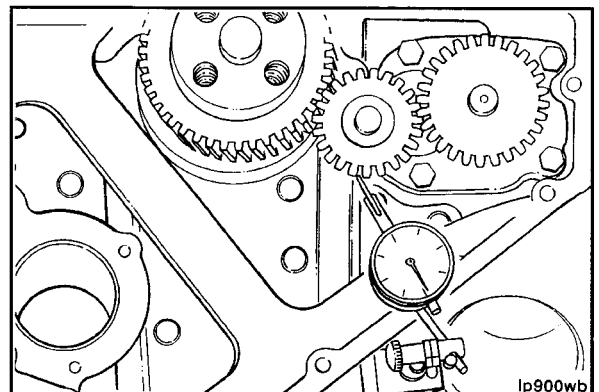
Note the drive gear backlash. Mark the drive gear and idler gear for additional analysis if the limits are exceeded.

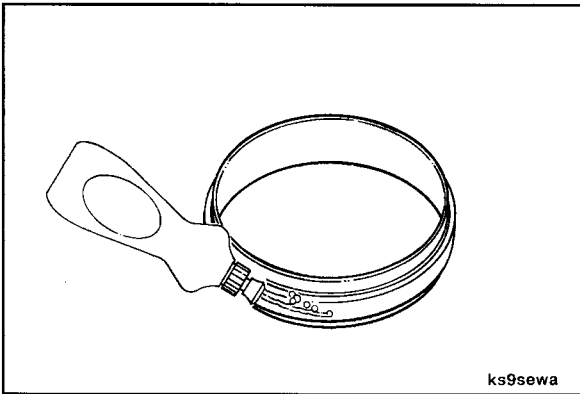
NOTE: Hold the adjoining gear from moving when checking backlash or the reading will be the total of both gears.



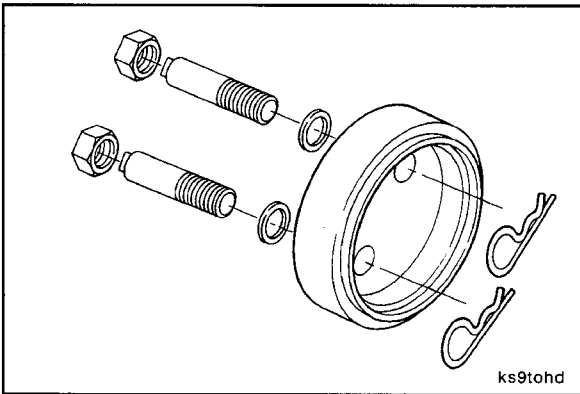
Oil Pump Drive Gear Backlash (A)		
mm		in
0.08	MIN	0.003
0.33	MAX	0.013

Position the indicator on a tooth of the pump idler gear.





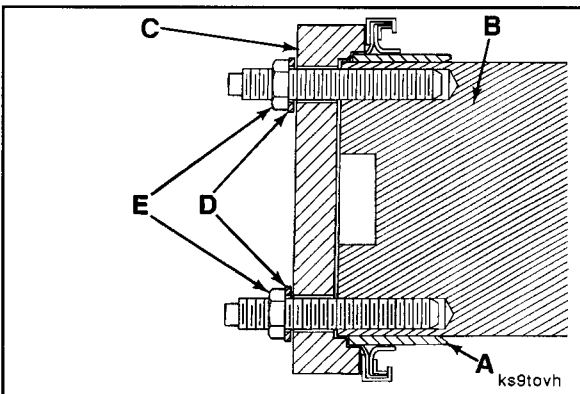
NOTE: For installation, the lubricating oil seal requires a mild soap on the outside diameter of the seal case.



Use service tool, Part No. 3824078, to install oil seal/wear sleeve assembly. Install two (2) threaded studs into the crankshaft capscrew holes.

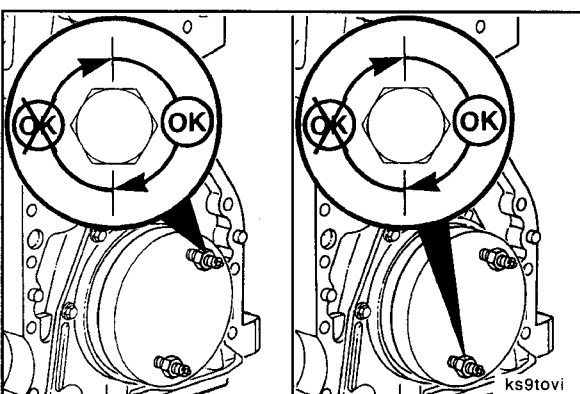


Apply a small amount of clean 15W-40 engine oil to the crankshaft, threaded studs, and inside diameter of the crankshaft rear seal/wear sleeve installation tool.



Position the chamfered end of the wear sleeve (A) onto the end of the crankshaft (B). Position the counterbore end of installation tool (C) over threaded studs and align with wear sleeve, perpendicular to the end of the crankshaft. Install the washers (D) and nuts (E) onto the threaded studs.

Alternately tighten the nuts until the installation tool contacts the end of the crankshaft.

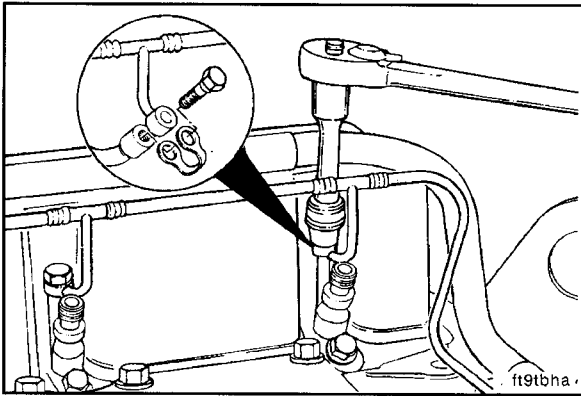


NOTE: Do not exceed 1/2 revolution of each nut to prevent wear sleeve binding and irregular stretch.

Torque Value: 20 N•m [15 ft-lb]



Remove the installation tool and threaded studs.



Fuel Drain Manifold - Installation

10 mm

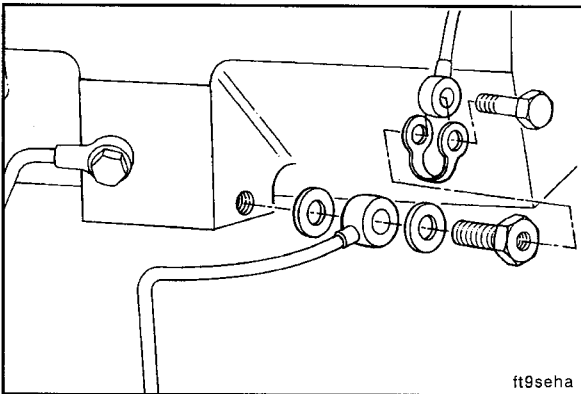
Install the fuel drain manifold and new copper sealing washer as illustrated.



Torque Value: 9 N•m [80 in-lb]



NOTE: The banjo connector seal (siamese washer) **must** be installed as illustrated.



10 mm

Install new sealing washers and connect the drain manifold to the fuel filter head.

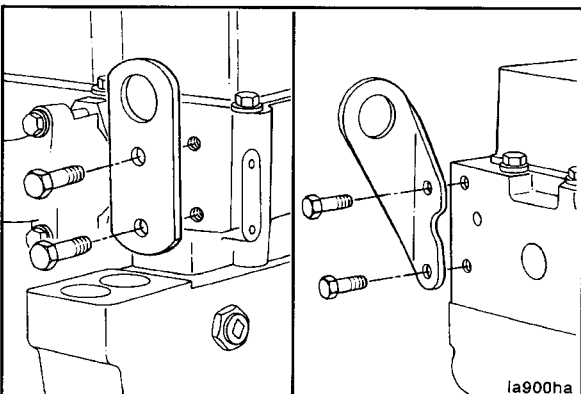


Torque Value:



Filter Head Banjo
Injector Banjo

15 N•m [11 ft-lb]
9 N•m [80 in-lb]



Engine Lifting Bracket - Installation

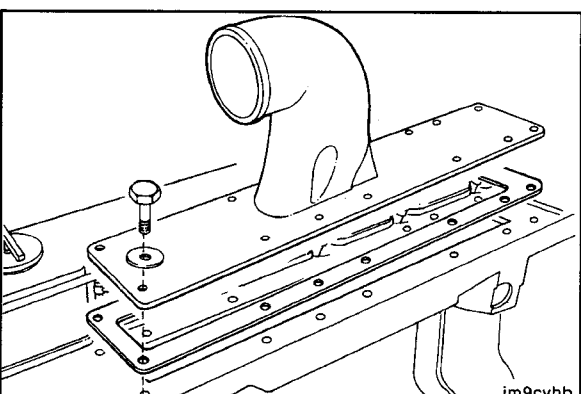
18 mm

Install the front bracket onto the front exhaust side of the cylinder head.



Install the rear bracket on the rear of the cylinder head. Tighten the capscrews.

Torque Value: 77 N•m [57 ft-lb]

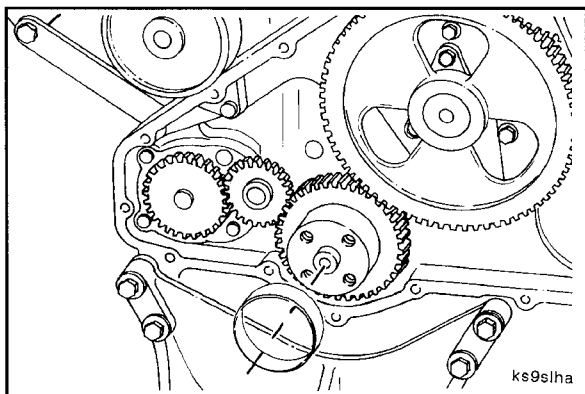


Intake Manifold Cover - Installation

Install the manifold cover, gasket and capscrews (charge air cooled engines). **Do Not install capscrews in the holes used to secure the high pressure fuel line support brackets.**



Torque Value: 24 N•m [18 ft-lb]



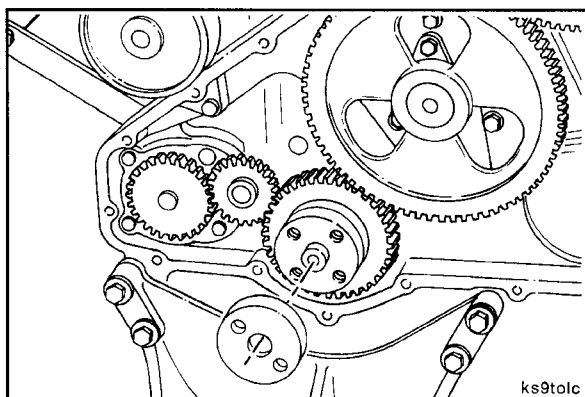
Use crocus cloth or equivalent to remove rust and corrosion deposits from the crankshaft flange.



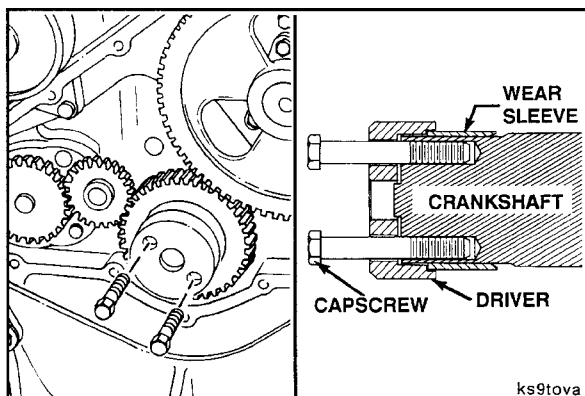
Apply a thin coat of 15W-40 engine oil to the crankshaft flange.



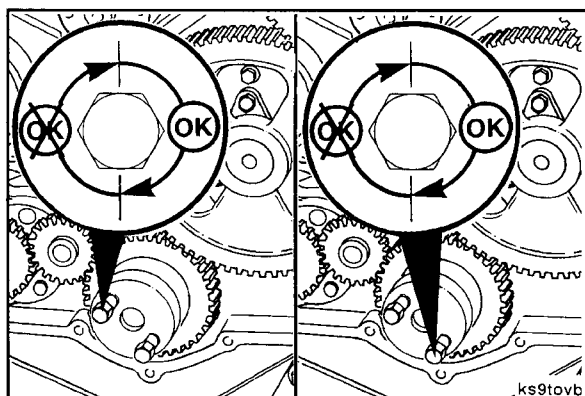
Position the chamfered end of the wear sleeve onto the end of the crankshaft.



Position the counterbore end of the driver onto the wear sleeve.



Install two cap screws (without spacers or hair pin cotters) through the driver and into the crankshaft cap screw holes. Align the wear sleeve and driver perpendicular with the crankshaft. Tighten the cap screws "finger tight".

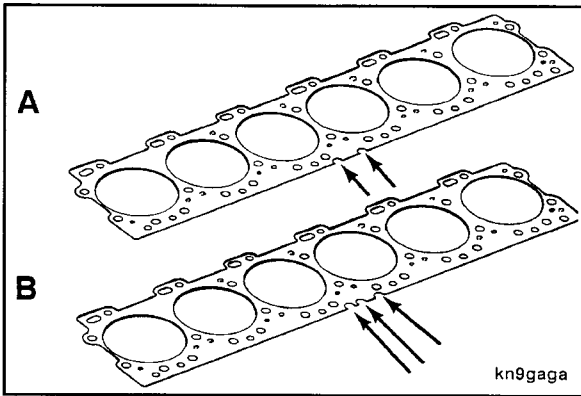


NOTE: To prevent damage to the wear sleeve, do not exceed 1/2 revolution of each cap screw.



Alternately tighten the cap screws until the sleeve is installed to a depth of approximately 16 mm [0.625 inch].

Approximate torque value: 20 N•m [15 ft-lb]



Consult the C Series parts catalog for the correct head gasket to be used with resurfaced blocks to be sure of proper piston-to-valve clearance.

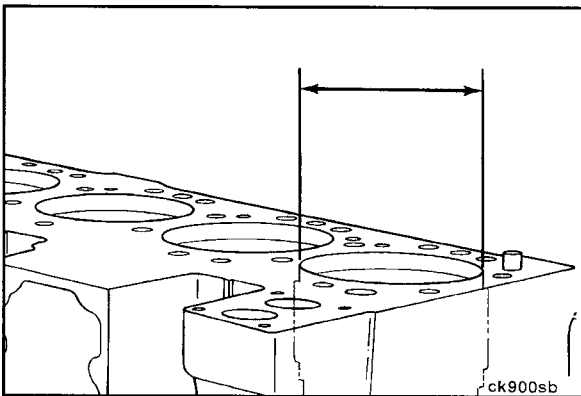
NOTE: The gaskets are notched to aid in identification. The standard gasket does **not** have a notch.

A = Use where cylinder block head deck has been resurfaced

0.25 mm [0.010 in] (two notches)

B = Use where cylinder block head deck has been resurfaced

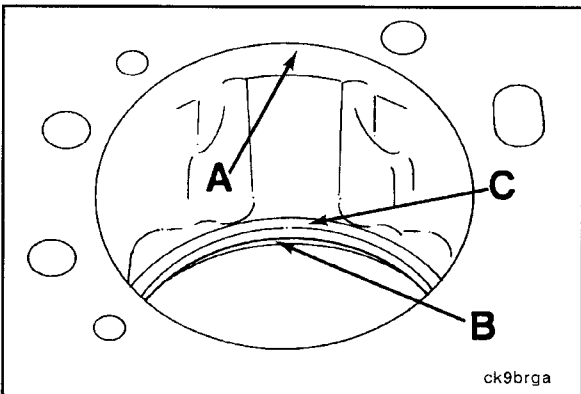
0.50 mm [0.020 in] (three notches)



Measure the upper press fit area of the cylinder liner bore.

Cylinder Liner Bore in Block (Press Fit Bore)

mm		in
If ESN is before 44706126 CDC		
21123436 DEP		
30417120 BZL		
132.900	MIN	5.2323
132.990	MAX	5.2358
If ESN is 44706126 CDC or After		
21123436 DEP		
30417120 BZL		
130.900	MIN	5.1535
130.990	MAX	5.1570



Part No. 3375432, Crack Detection Kit



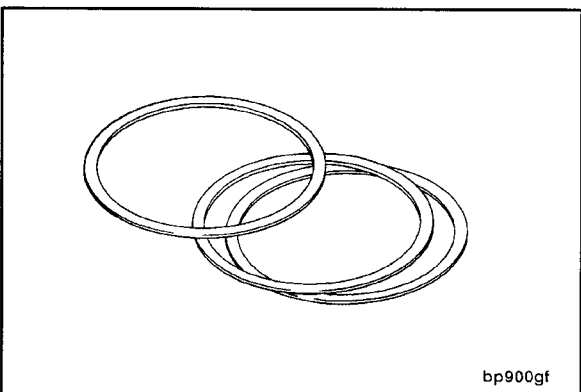
Caution: Clean all deposits and debris from sealing surfaces A, B and C. Use Scotch Brite® 7448 or equivalent and cleaning solvent to polish the surfaces. However, due to the critical machined tolerances, care should be taken not to remove any additional material.



Use a crack detection kit, Part No. 3375432, or its equivalent. Check the counterbore ledge for cracks.



If surface C has signs of extreme wear, the counterbore will require machining and the installation of shims for the correct liner protrusion.



Cylinder liner shims are available as follows:

Cylinder Liner Shim Thickness

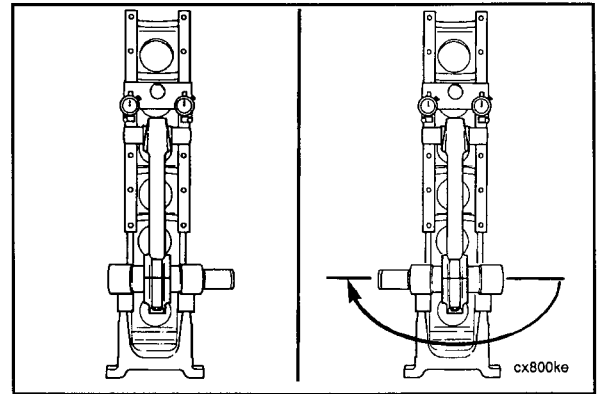
mm	Part No.	in
0.25	3924445	0.010
0.38	3924446	0.015
0.51	3924447	0.020
0.76	3924448	0.030
1.00	3924449	0.040

**Cylinder Block - Group 01
C Series**

Remove the connecting rod from the fixture.

Turn the rod 180 degrees horizontally, and install the rod into the fixture again.

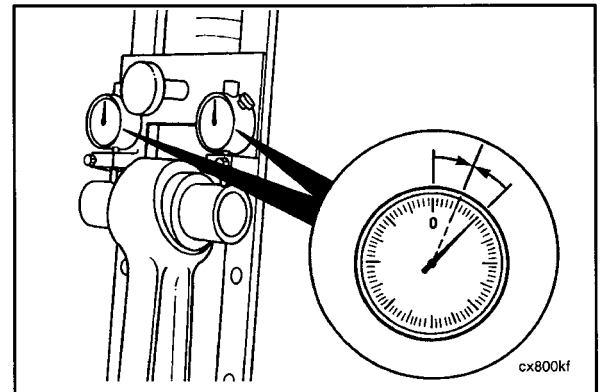
**Connecting Rods - Bend and Twist Inspection (1-20)
Page 1-43**



Check the dial indicators for the zero position again.

If the dial indicators show any change from zero, adjust the dials to half the indicated reading.

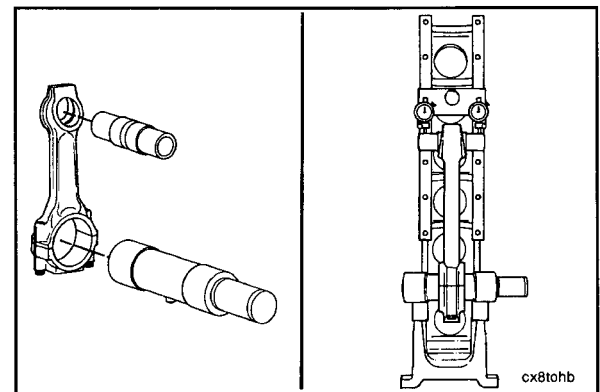
The fixture is now calibrated to allow the connecting rod to be installed into the fixture in either direction, and the dials will indicate an equal deflection on either side of zero.



Connecting Rod Alignment - Inspection

Install the mandrel and arbor into the connecting rod to be inspected.

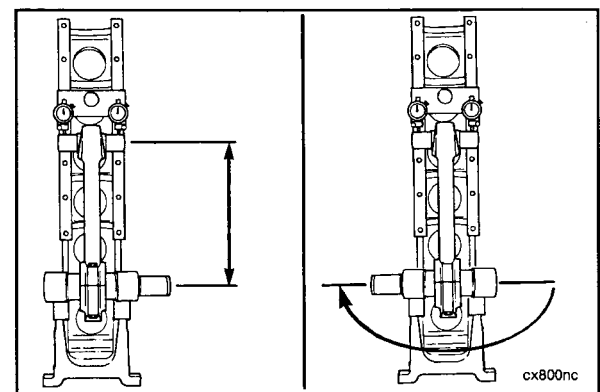
Install the connecting rod into the fixture.



Measure the connecting rod length and bend (alignment).

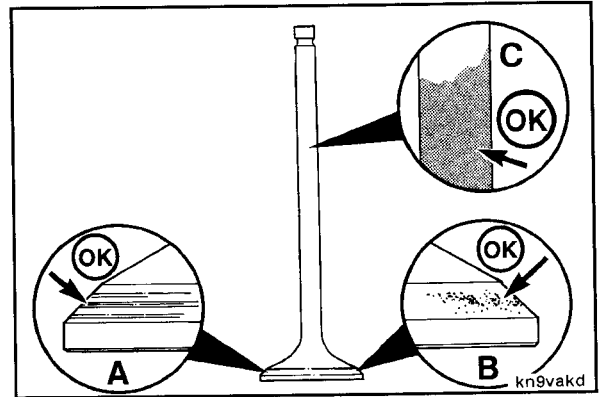
Connecting Rod Length			
mm			in
215.975	MIN		8.5029
216.025	MAX		8.5049

Connecting Rod Bend (Alignment)			
	mm		in
Bushing Removed	0.20	MAX	0.008
Bushing Installed	0.15	MAX	0.006



NOTE: It may be possible to grind and reuse valves with the following conditions:

- Minor grooves on the valve sealing surface (A)
- Fine pitting on the valve sealing surface (B)
- Carbon or varnish buildup on the valve stem (C)



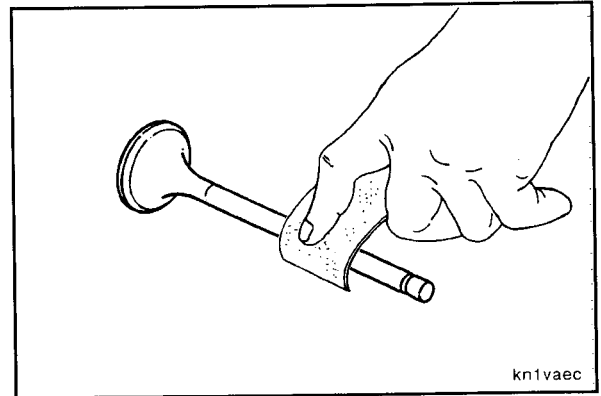
Valve - Grinding

Cleaning

NOTE: Any valves that are to be used again must have the sealing surface machined.

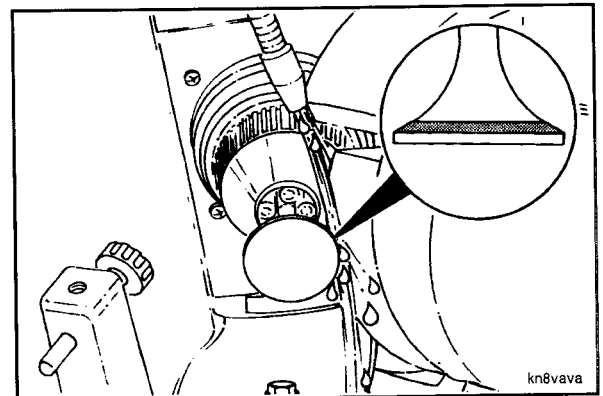
Use Scotch-Brite® 7448, Part No. 3823258, to clean the valve stems. Clean the carbon deposits from the valve sealing surface and head.

NOTE: The valves **must** be clean and free of carbon deposits before they are refaced. Valves can be cleaned by the bead blasting method in the head area only.



Use a valve facing machine, Part No. 3376256, to grind the sealing surface of the valve.

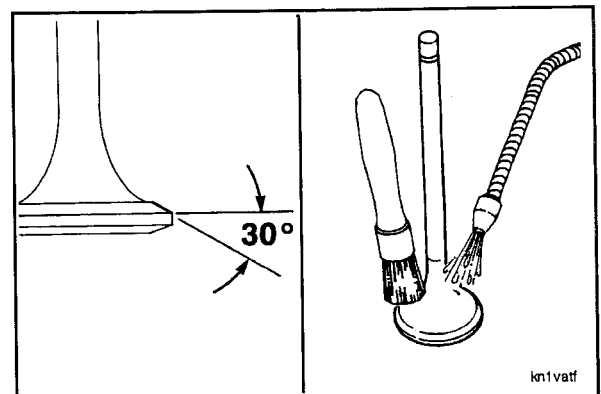
NOTE: Follow the instructions supplied with the valve grinding machine for the correct setup before grinding the valves.



Grind the intake and exhaust valves to the angle shown below:

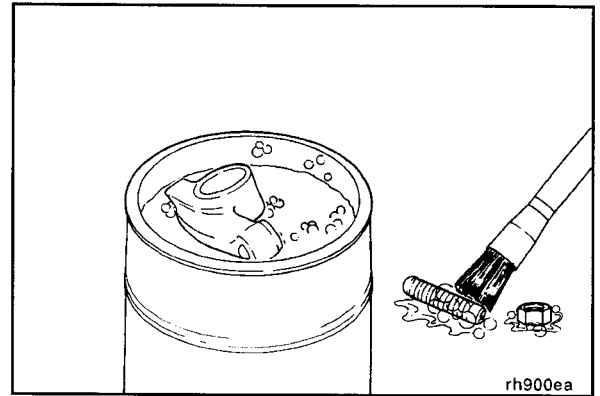
Valve Seat Angle	
Valve	Angle
Intake	30 Degrees
Exhaust	45 Degrees

Use solvent to clean the metal particles from the valve. Dry with compressed air.

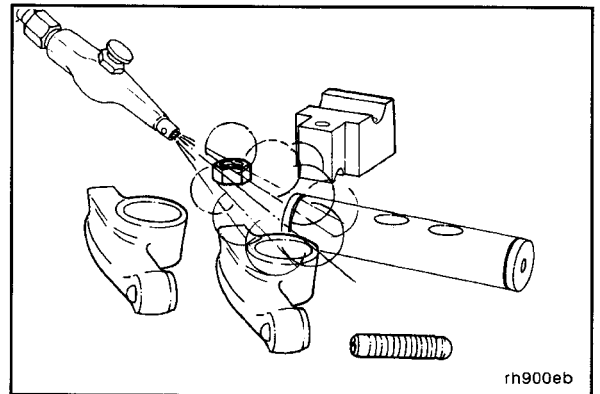


Cleaning

Clean all parts in strong solution of laundry detergent in hot water.



Use compressed air to dry the parts after rinsing in clean hot water.

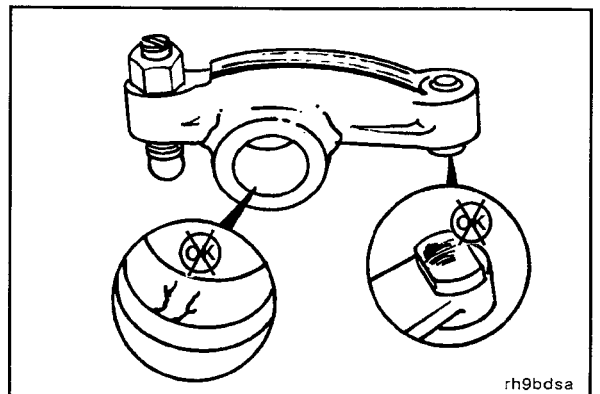


Inspection

Inspect for cracks and excessive wear in the bore and the contact surface for the valve stem.



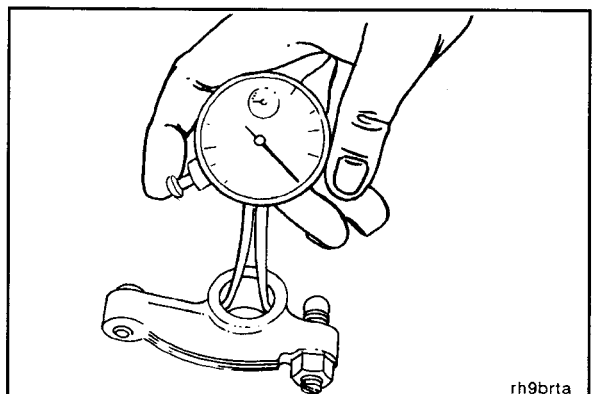
NOTE: The levers do not use a bushing in the bore for the rocker lever shaft. The lever must be replaced if the bore is damaged or worn beyond the specification.



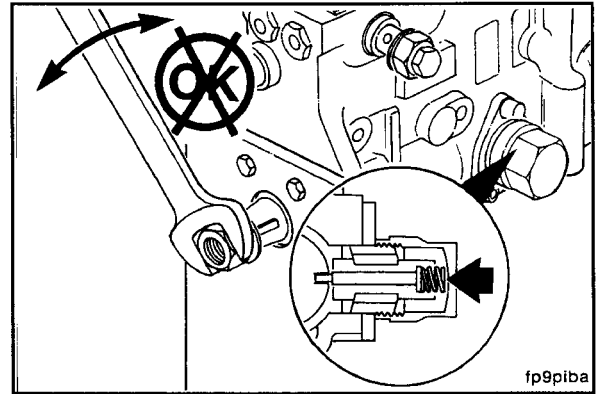
Measure the rocker lever bore.



Rocker Lever Bore Diameter		
mm		in
22.256	MIN	0.8762
22.301	MAX	0.878

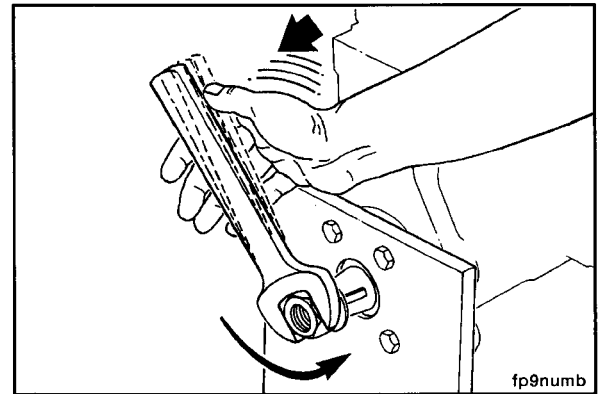


Caution: Although unlikely, it is possible that the timing pin will match the pump notch when the timing pin is first inserted, if so, the pump will be locked. Do not exert more than 7 N•m [62 in-lb] torque to turn the pump shaft. If the pump shaft does not turn with 7 N•m [62 in-lb] torque, remove the spring and timing pin, then rotate the pump slightly. Repeat the previous step again.



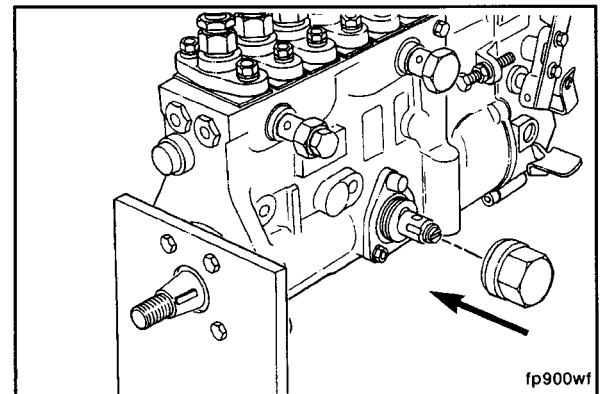
27 mm

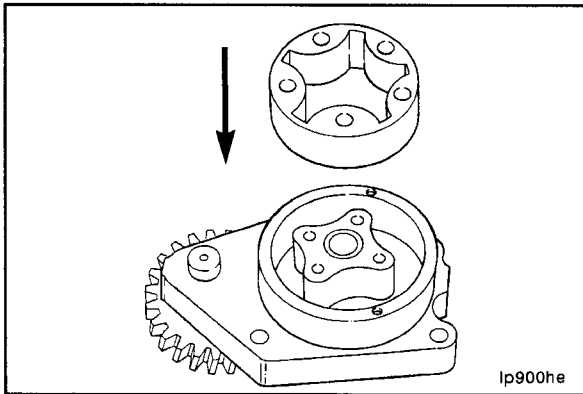
Remove the nut from the pump drive shaft by striking the wrench with a sharp blow in a **counterclockwise** direction.



Install the timing pin cover.

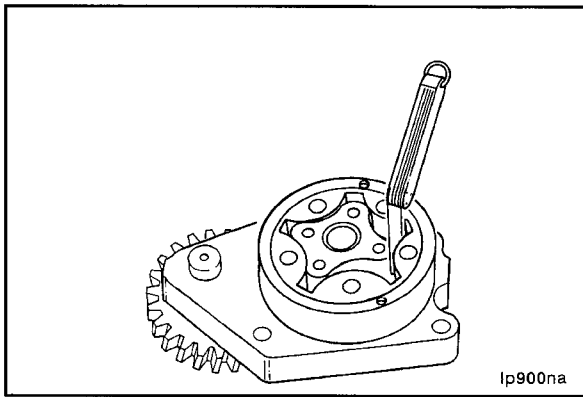
Torque Value: 70 N•m [50 ft-lb]





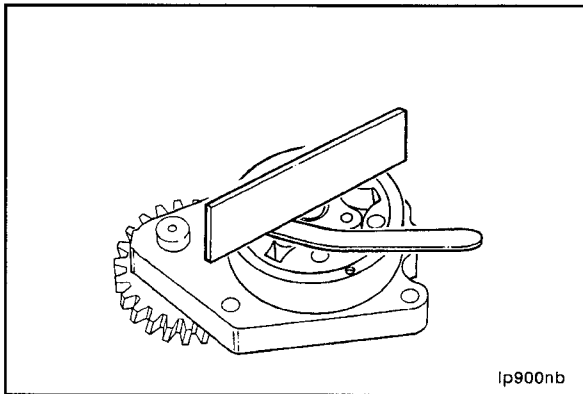
Install the gerotor planetary.

Be sure the gerotor planetary is installed in the original position.



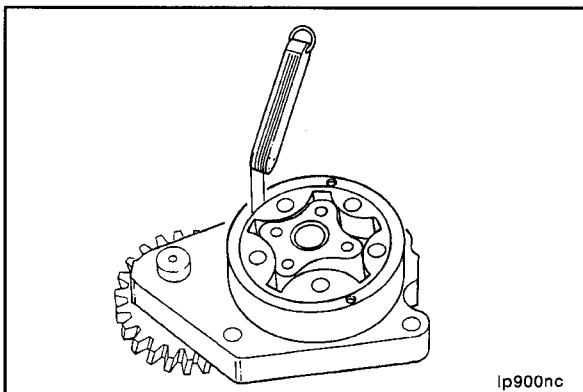
Measure the tip clearance.

Lubricating Oil Pump Gerotor Tip Clearance		
mm		in
0.025	MIN	0.001
0.1778	MAX	0.007



Measure the clearance of the gerotor drive/gerotor planetary to port plate.

Oil Pump Gerotor Drive/Gerotor Planetary to Port Plate Clearance		
mm		in
0.025	MIN	0.001
0.127	MAX	0.005



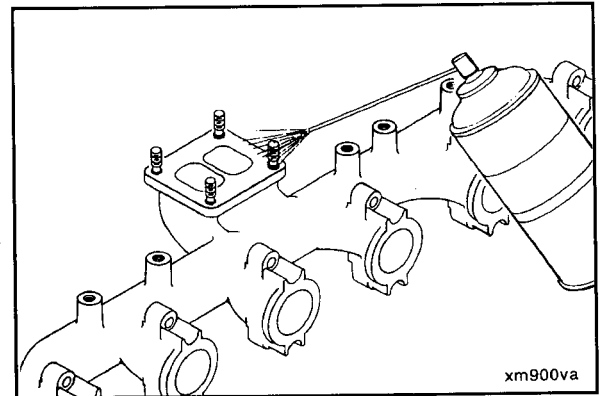
Measure the clearance of the gerotor planetary to the body bore.

Oil Pump Gerotor Planetary to Body Bore		
mm		in
0.127	MIN	0.005
0.381	MAX	0.015

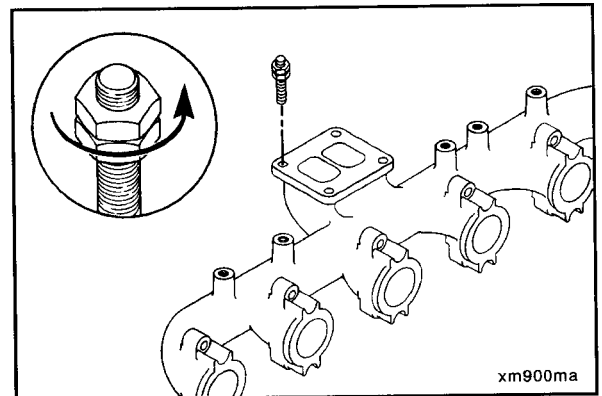
Exhaust Manifold Turbocharger Mounting Stud - Replacement (11-02)

Removal

Apply penetrating oil to the base of the turbocharger mounting stud to be removed. Follow the manufacturer's instructions.



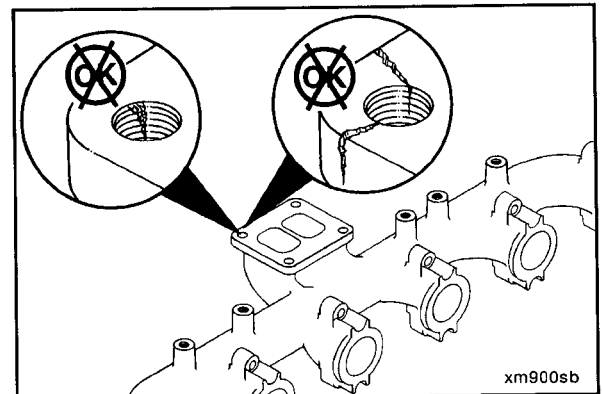
Use a standard stud extractor or two nuts locked together to remove the turbocharger mounting stud(s) from the manifold.



Inspection

Visually inspect for damaged threads in the turbocharger mounting stud holes.

Visually inspect the manifold for cracks or damage.



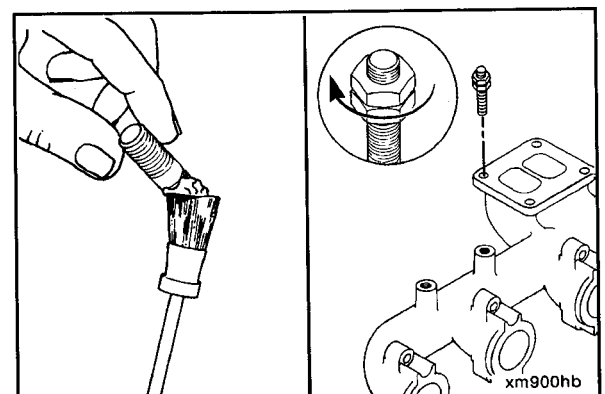
Installation

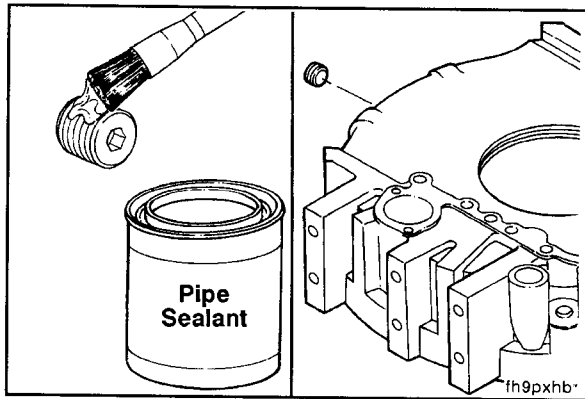
Use precoated turbocharger mounting studs or apply a thin coating of nickel based, high temperature, anti-seize compound to both ends of the stud.

Install the studs in the mounting flange.

Use two mounting nuts locked together to tighten the studs.

Torque Value: 10 N•m [89 in-lb]





Flywheel Housing - Assembly (Wet Clutch Application) (16-05)

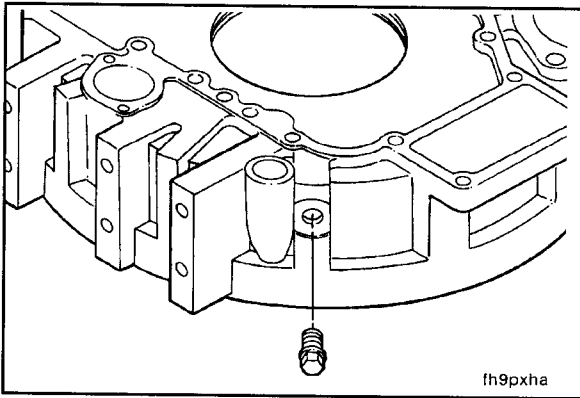
Coat the flywheel housing drain plug with pipe sealant and install into the hole in the bottom of the flywheel housing.



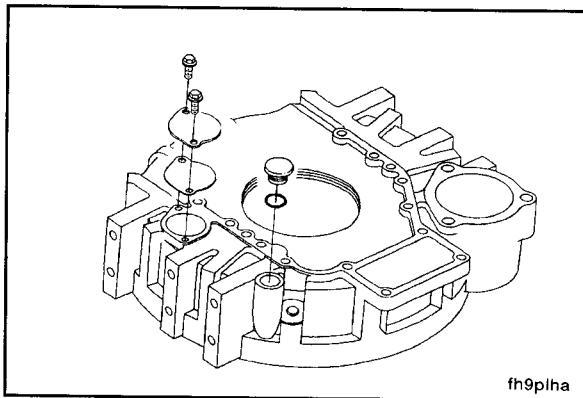
Tighten the plug.



Refer to the pipe plug torque values in Group 18 for different plug sizes.



Install the plastic plug into the tachometer drive access hole.



13 mm

Install the access plate and new gasket.

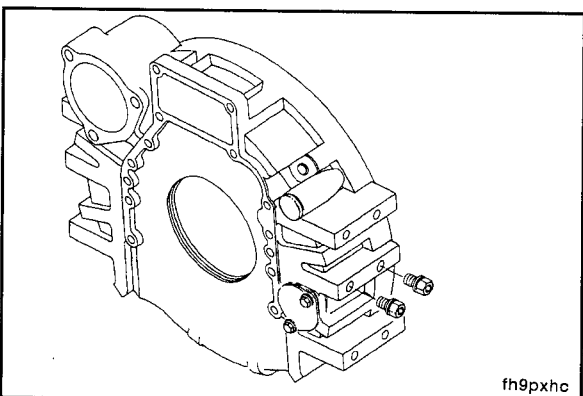


Install the capscrews and tighten.

Torque Value: 24 N•m [18 ft-lb]



Install the plug into the barring gear hole.



NOTE: The capscrew holes on the center mounting pads are drilled through. Coat the set screws with Loctite™ 277 and install into holes.

Set Screw Installation Depth		
mm		in
0.00	MIN	0.000
3.00	MAX	0.118