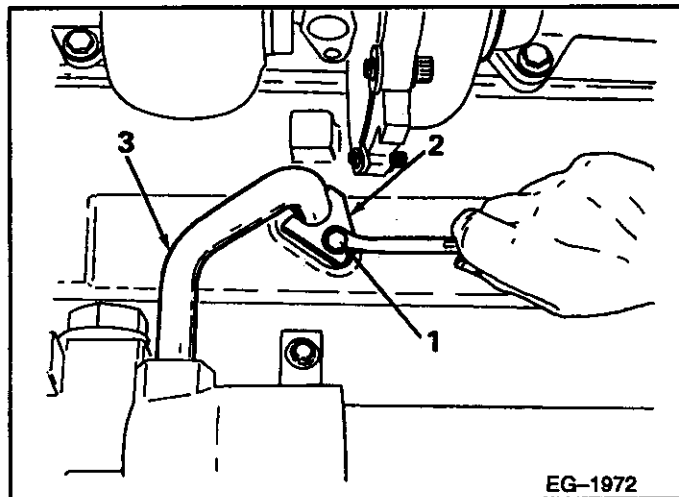


MOUNTING ENGINE ON STAND

NOTE:

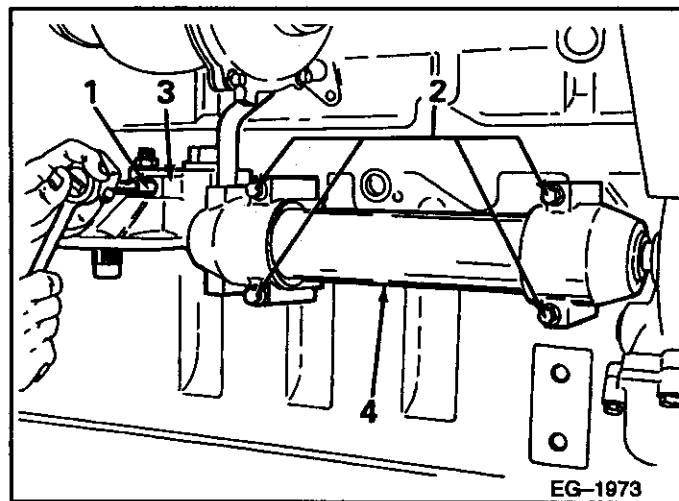
Remove oil cooler and water coolant supply tube as an assembly.

8. Remove one (1) bolt and retainer plate securing water coolant supply tube from crankcase. (Refer to **FIGURE 4-6**)
9. Remove oil cooler assembly as follows: (Refer to **FIGURE 4-7**)
 - a. Remove bolts securing oil cooler filter header and front header to crankcase.



1. Retainer Plate Mounting Bolt
2. Retaining Plate
3. Water Coolant Supply Tube

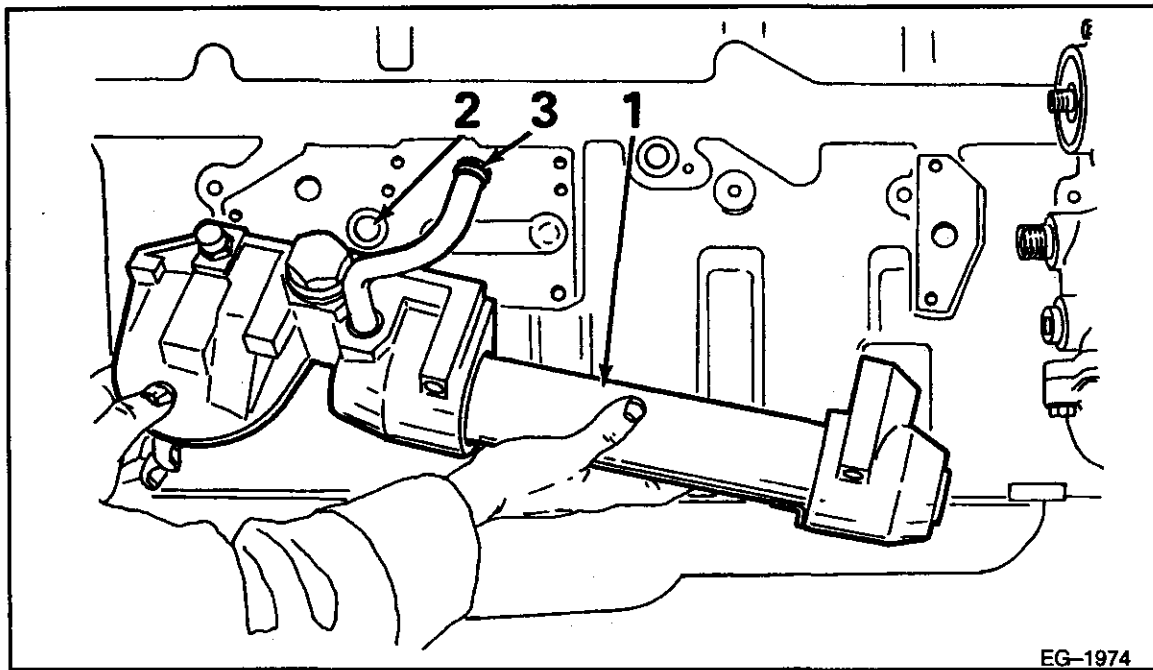
FIGURE 4-6



1. Mounting Bolt (2)
2. Mounting Bolt (5 Long)
3. Oil Cooler Filter Header
4. Oil Cooler Bundle

FIGURE 4-7

MOUNTING ENGINE ON STAND



- 1. Oil Cooler Assembly
- 2. Oil Pressure Regulating Valve

- 3. Water Coolant Supply Tube

FIGURE 4-8

10. Remove oil cooler and water coolant supply tube as an assembly from crankcase. (Refer to **FIGURE 4-8**)
11. Remove oil pressure regulating valve assembly from the crankcase. (Refer to **FIGURE 4-8**)

NOTICE: The oil pressure regulating valve should be tagged upon removal to ensure identification. **DO NOT** mix oil pressure regulator valve with oil pressure relief valve (found in front cover).

MOUNTING ENGINE ON STAND

12. Cap **ALL** openings to prevent debris from entering.

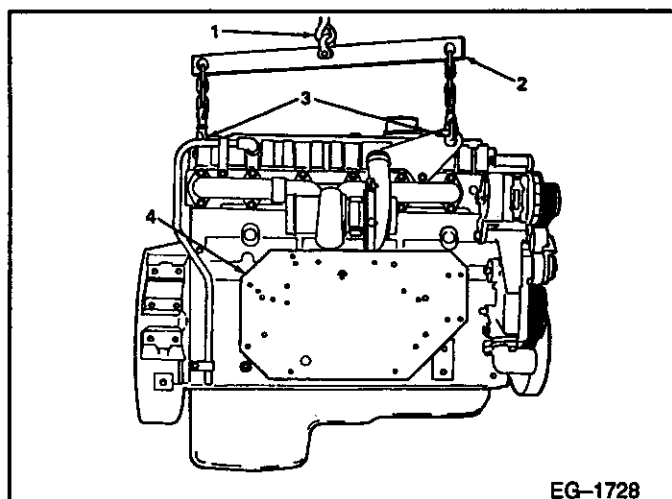
NOTICE: Whenever mounting an engine to a repair stand, refer to the instructions included with the mounting stand and its corresponding adapter plates for specific directions on their safe use. Use only metric m-10/grade 8 bolts when mounting the engine to an engine stand.

13. Install adapter plate as directed. Refer to instructions included with engine stand and secure adapter plate to side of engine. (Refer to **FIGURE 4-9**).

NOTE:

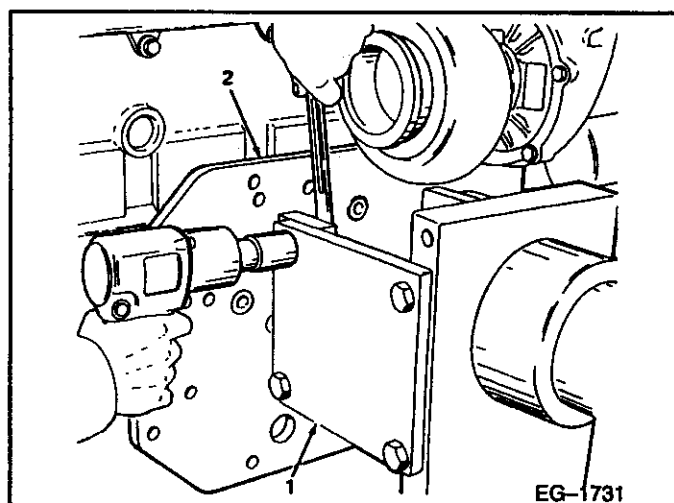
Adapter plate must be mounted to engine first before installing engine stand. Locating guide pins (made locally) are recommended to assist in aligning and holding adapter plate.

14. Attach engine stand to adapter plate. (Refer to **FIGURE 4-10**)



- 1. Hoist Hook
- 2. Lifting Bar
- 3. Adapter Plate
- 4. Lifting Eye (2)

FIGURE 4-9



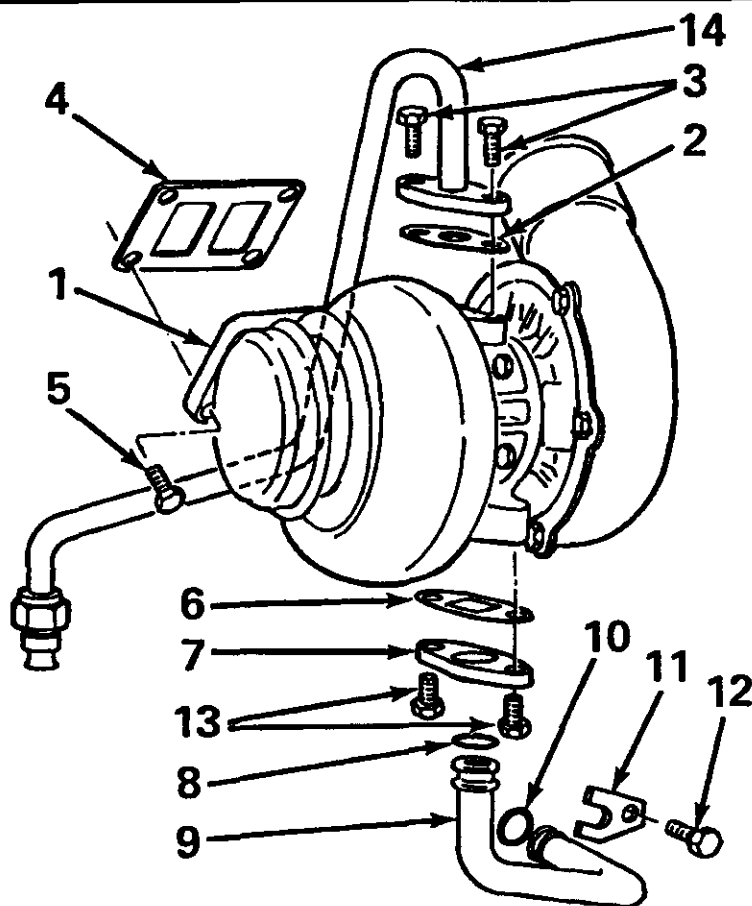
- 1. Engine Stand
- 2. Adapter Plate

FIGURE 4-10

5 TURBOCHARGERS

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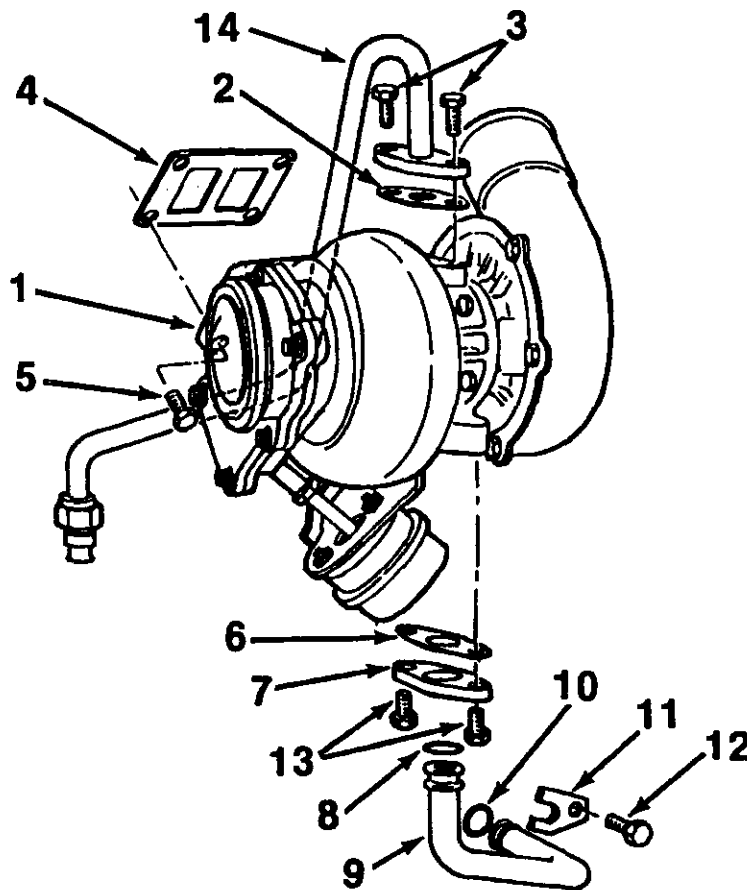
5.1 TURBOCHARGER EXPLODED VIEWS



EG_1743

- | | |
|--|--|
| 1. Turbocharger Assembly | 8. Turbo Oil Drain Tube Flange O-ring |
| 2. Turbo Oil Inlet Tube Flange Gasket | 9. Turbo Oil Drain Tube |
| 3. Turbo Oil Inlet Tube Flange Bolt (2) | 10. Turbo Oil Drain Tube O-ring |
| 4. Turbocharger Assembly Gasket | 11. Turbo Oil Drain Tube Retaining Bracket |
| 5. Turbocharger Assembly Mounting Nuts (4) | 12. Turbo Oil Drain Tube Retaining Bracket Mounting Capscrew |
| 6. Turbo Oil Drain Tube Flange Gasket | 13. Turbo Oil Drain Tube Flange Bolt (2) |
| 7. Turbo Oil Drain Tube Flange | 14. Turbo Oil Inlet Tube Assembly |

FIGURE 5-1 Non Wastegate Turbocharger and Common Parts



EG-3016

- | | |
|--|--|
| 1. Turbocharger Assembly | 8. Turbo Oil Drain Tube Flange O-ring |
| 2. Turbo Oil Inlet Tube Flange Gasket | 9. Turbo Oil Drain Tube |
| 3. Turbo Oil Inlet Tube Flange Bolt (2) | 10. Turbo Oil Drain Tube O-ring |
| 4. Turbocharger Assembly Gasket | 11. Turbo Oil Drain Tube Retaining Bracket |
| 5. Turbocharger Assembly Mounting Nuts (4) | 12. Turbo Oil Drain Tube Retaining Bracket Mounting Capscrew |
| 6. Turbo Oil Drain Tube Flange Gasket | 13. Turbo Oil Drain Tube Flange Bolt (2) |
| 7. Turbo Oil Drain Tube Flange) | 14. Turbo Oil Inlet Tube Assembly |

FIGURE 5-2 Wastegate Turbocharger and Common Parts

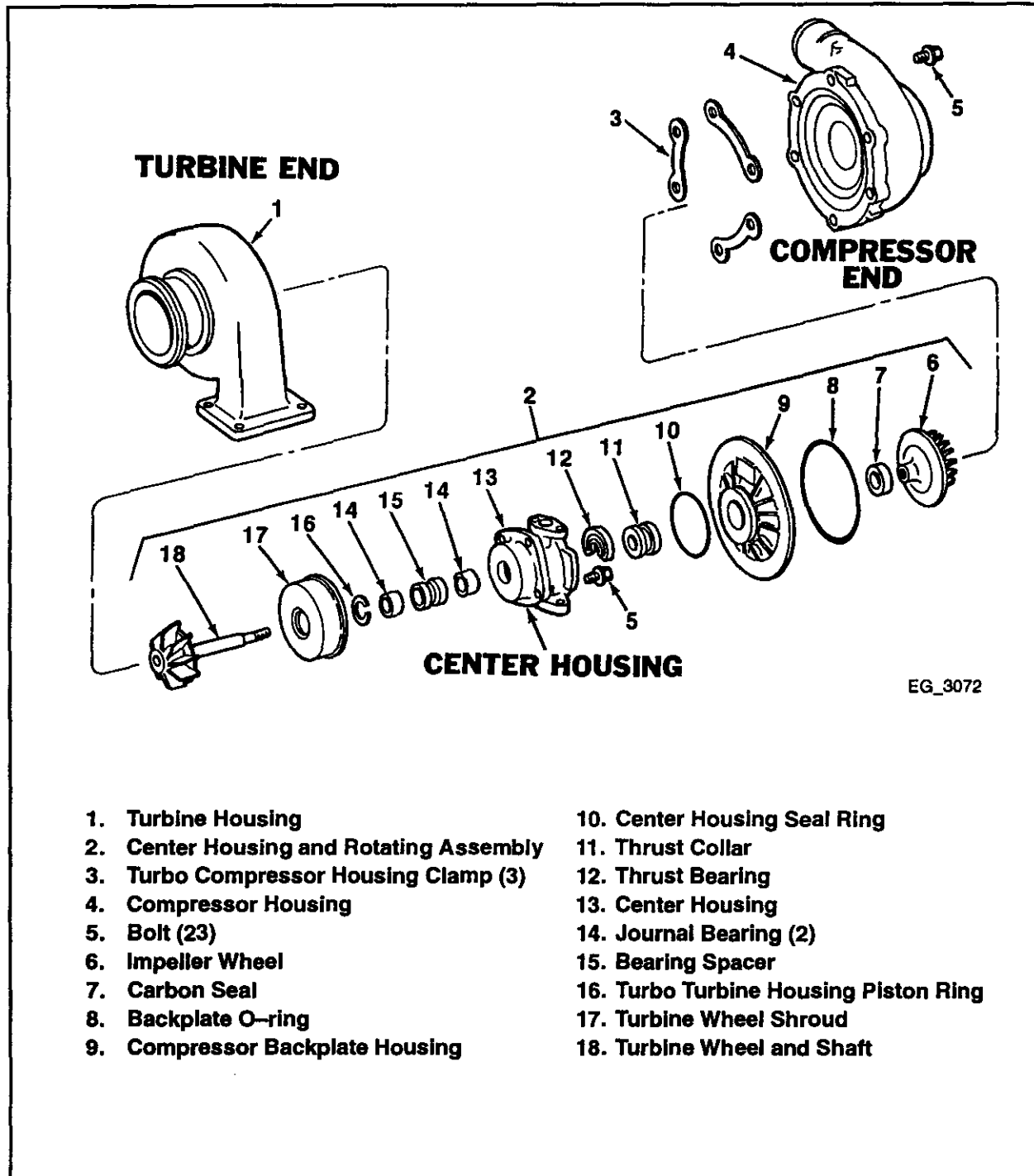


FIGURE 5-3 Non Wastegate Turbocharger Components

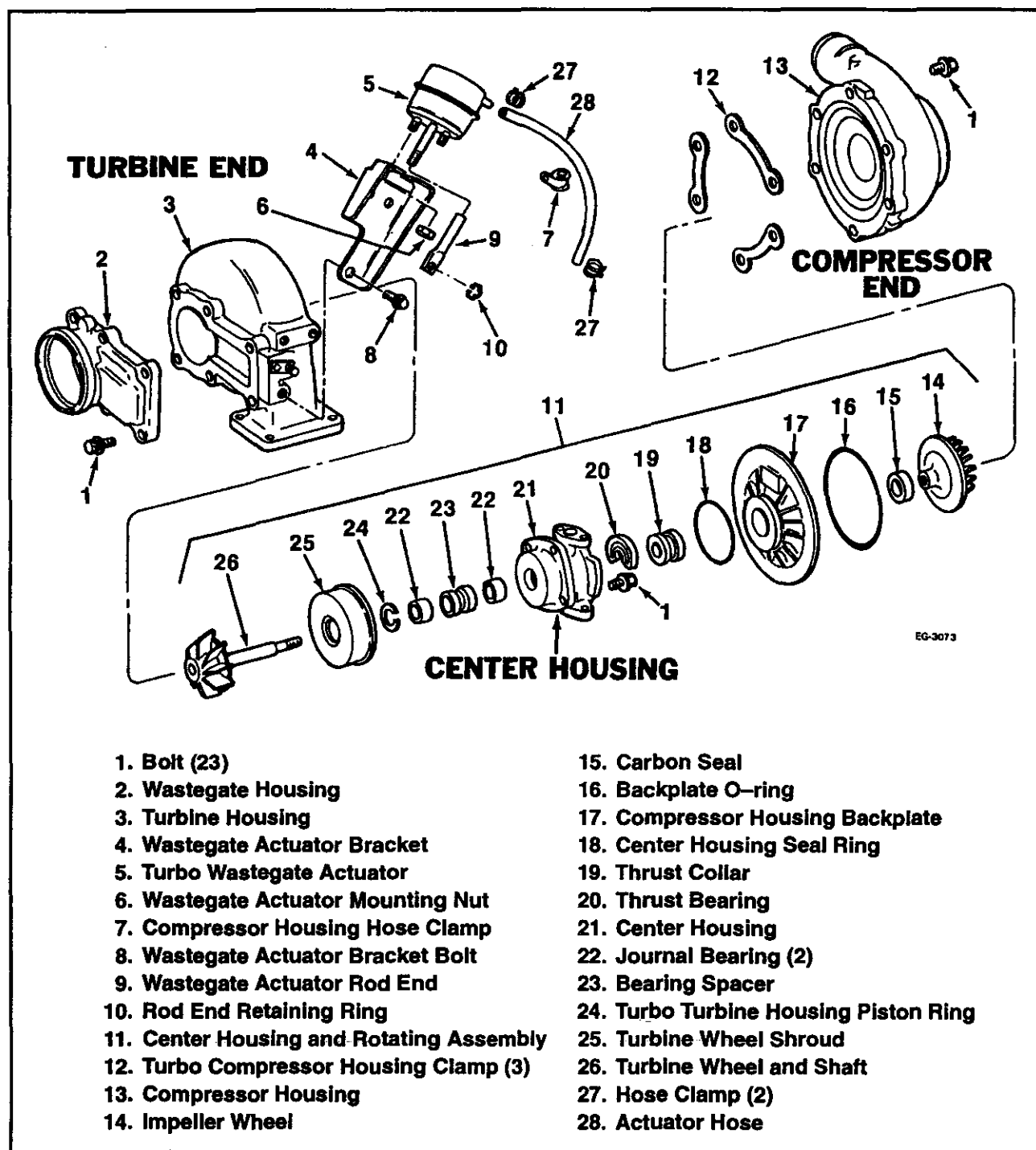


FIGURE 5-4 Wastegate Turbocharger Components

5.2 SPECIFICATIONS

Turbine Shaft Axial End Play	0.001–0.004 in. (0.02–0.10 mm)
Turbine Shaft Radial Shaft Movement (Play)	0.003–0.006 in. (0.08–0.15 mm)
Wastegate Actuator Movement	.015 in. (0.381 mm) at 28.5 lb/in. ² (196 kPa)

5.2.1 Special Torques

Back Plate-to-Center Housing Capscrews	185–215 lb-in. (21–24 N·m)
Center Housing-to-Turbine Housing Capscrews	115 lb-in. (13.0 N·m)
Center Housing-to-Compressor Housing Capscrews	185–215 lb-in. (21–24 N·m)
Compressor Wheel	100 lb-in. (11 N·m)
Impeller Shaft Locknut (Tighten finger-tight plus 90°)	
(Use tee handle wrench only)	19 lb-in. (2.15 N·m)
Turbocharger Mounting Nuts	50 lb-ft. (68 N·m)

5.2.2 Turbocharger A/R

A/R	MODEL
	Non-Wastegate Version
0.85	195 HP and 150 HP
0.95	210 HP
1.06	250 HP, 195 HP and 230 HP
	7.6 L, 195 HP and 6.7L, 230 HP
1.19	210 HP and 230 HP
	Wastegate Version
0.95	275 HP and 300 HP and
	250 HP and 275 HP

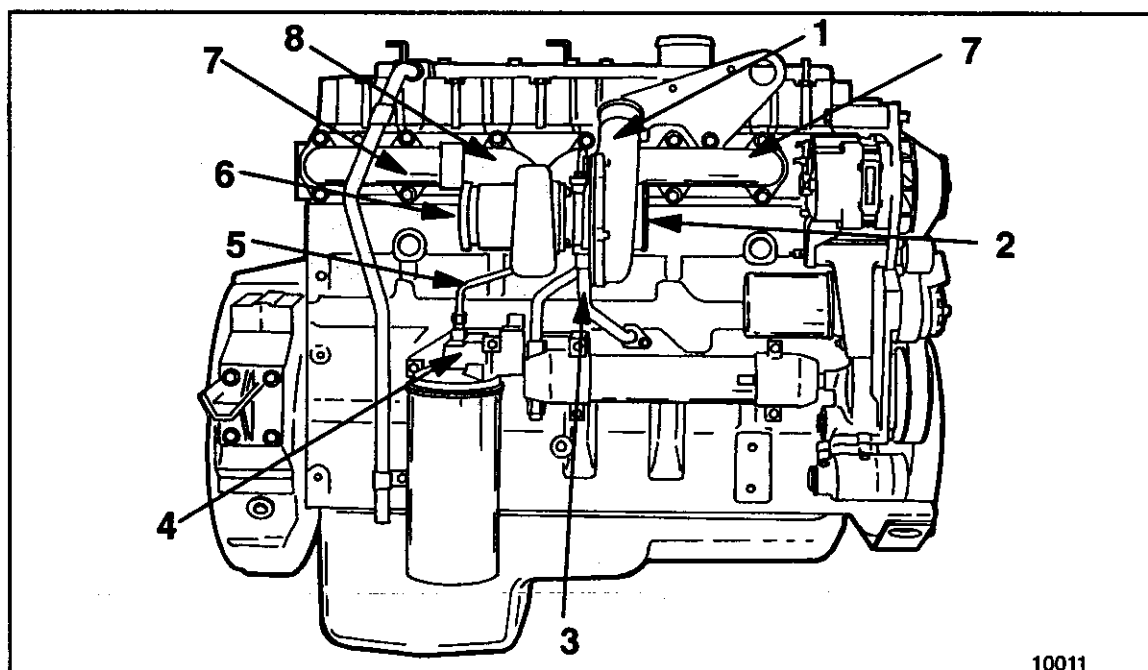
5.3 GENERAL OPERATION

The turbocharger assembly is an exhaust-driven centrifugal air compressor. Its purpose is to increase power output by supplying compressed air to the engine. The center housing is oil and air cooled. Engine oil is circulated through the center housing which acts as a heat barrier between the "hot" turbine and the "cold" compressor. Bearings are sleeve-type and are lubricated by engine oil. Oil is pumped directly from the clean-oil side of the oil filter, thru the turbocharger oil feed supply tube, then circulated in the center housing of the turbocharger and returned to the engine through an oil drain tube.

High velocity engine exhaust gases drive the turbine shaft assembly to speeds over 100,000 revolutions per minute. Filtered air entering the compressor side of the turbocharger is compressed and delivered to the engine valve cover/intake manifold at a pressure higher than atmospheric pressure. Because more air is delivered to the intake manifold, the result is more power, fuel efficiency and the ability to maintain power at altitude.

5.3.1 Component Identification

The turbine wheel is located in the turbine housing; the compressor impeller is located at the opposite end on a common shaft that connects the turbine wheel and impeller.



- | | |
|--|---------------------------------|
| 1. Compressor Outlet | 5. Exhaust Manifold |
| 2. Compressor Inlet | 6. Turbocharger Oil Supply Tube |
| 3. Exhaust Outlet | 7. Turbocharger Oil Drain Tube |
| 4. Exhaust Manifold Center Section/Turbo Inlet | 8. Oil Cooler Filter Header |

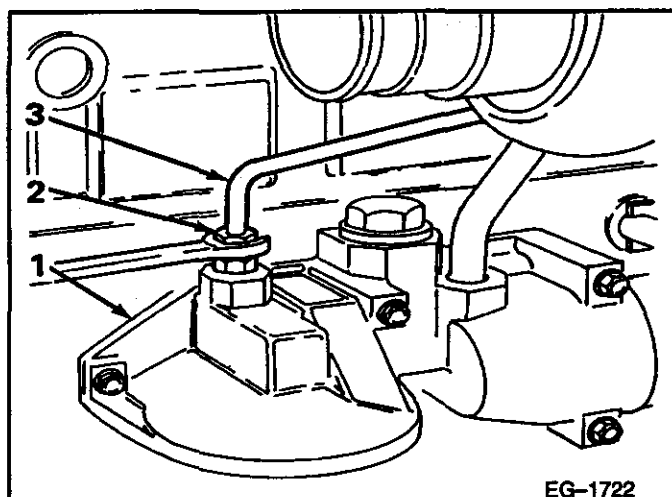
FIGURE 5-5 Turbocharger and Common Part Location

5.4 REMOVAL

CAUTION

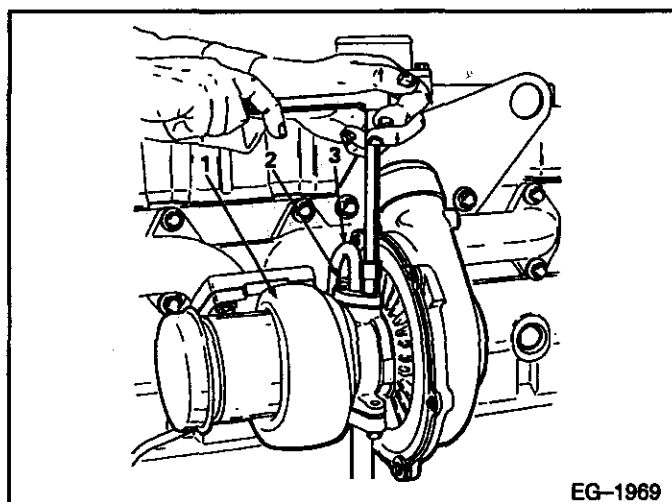
The engine must be off during the removal procedure. Never remove parts from a running engine.

1. Using an open end wrench, loosen and remove oil feed supply tube nut located on top of oil filter header. Remove and discard tube nut O-ring. Refer to **FIGURE 5-6**.
2. Remove two capscrews securing oil feed supply tube to top of turbocharger housing. Refer to **FIGURE 5-7**.



1. Oil Filter Header
2. Oil Feed Supply Tube Nut
3. Oil Feed Supply Tube

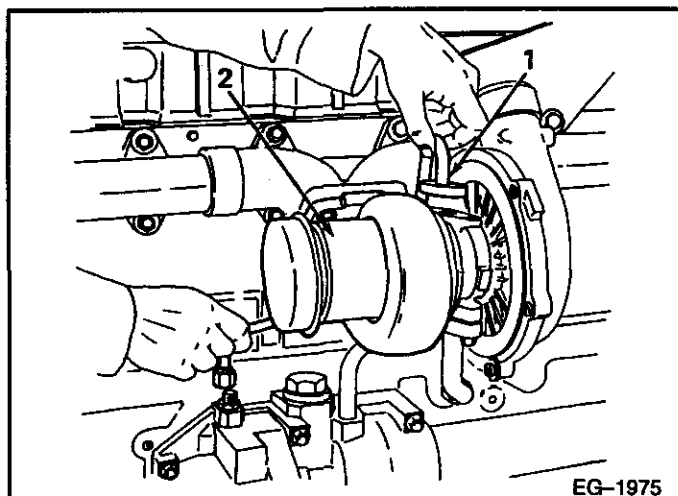
FIGURE 5-6



1. Turbocharger Assembly
2. Capscrews (2)
3. Oil Feed Supply Tube

FIGURE 5-7

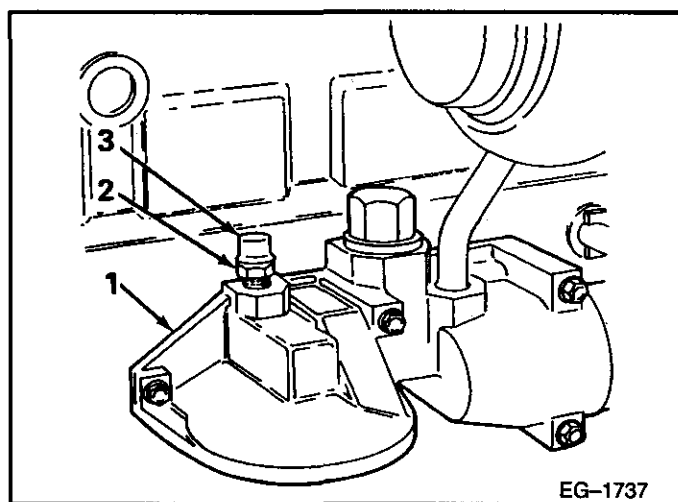
REMOVAL



- 1. Oil Feed Supply Tube
- 2. Turbocharger Assembly

FIGURE 5-8

- 3. Remove oil feed supply tube and tube flange gasket from turbocharger assembly. Discard flange gasket. Refer to **FIGURE 5-8**.
- 4. Cap oil feed supply tube fitting located on filter header. Refer to **FIGURE 5-9**.



- 1. Oil Filter Header
- 2. Oil Feed Supply Tube Fitting
- 3. Protective Cap

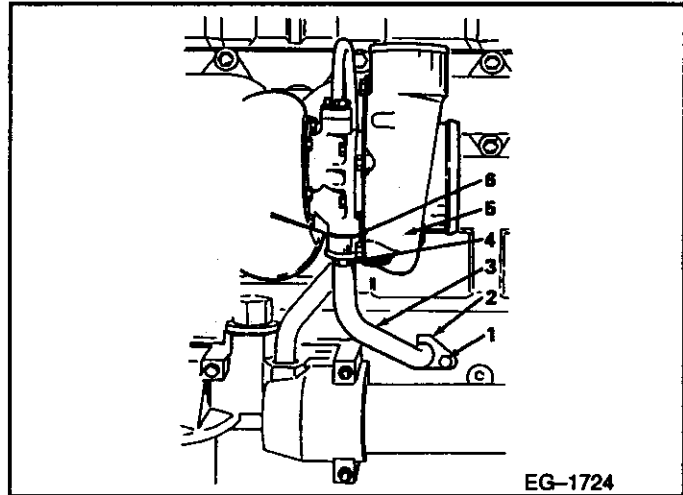
FIGURE 5-9

REMOVAL

5. Remove turbocharger oil drain tube as follows: (Refer to **FIGURE 5-10**)
 - b. Loosen capscrew securing turbocharger oil drain tube retaining plate to crankcase. Remove retaining plate and capscrew.
 - c. Remove two capscrews securing turbocharger oil drain tube to bottom of turbocharger housing.
 - d. Remove turbocharger oil drain tube retaining plate together with turbo oil drain tube, tube flange, two tube O-rings and tube flange gasket from bottom of turbocharger assembly. Discard both drain tube O-rings (one on each end of drain tube) and flange gasket.
6. Cap **ALL** openings on the turbocharger assembly.

NOTE:

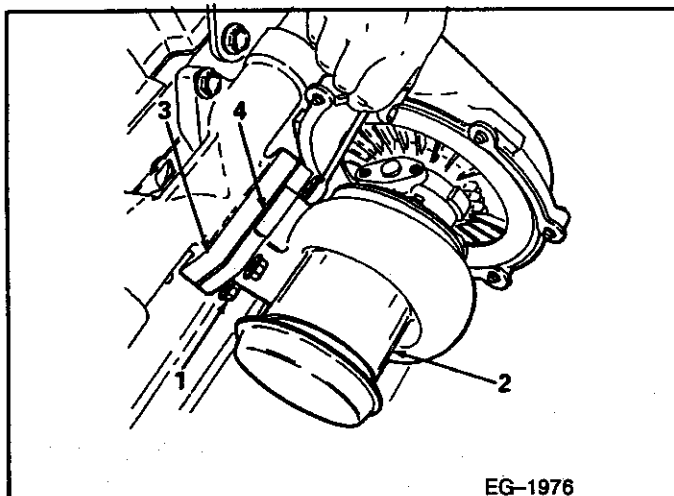
If plastic caps are not available, use duct tape to cover openings.



1. Oil Drain Tube Mounting Bolt
2. Turbocharger Oil Drain Tube Retaining Plate
3. Turbocharger Oil Drain Tube
4. Oil Drain Tube Mounting Bolts (2)
5. Turbocharger Assembly
6. Turbocharger Oil Drain Tube Flange Gasket

FIGURE 5-10

REMOVAL



1. Capscrews (4)
2. Turbocharger Assembly
3. Exhaust Manifold Flange
4. Turbocharger Gasket

FIGURE 5-11

7. Remove four capscrews securing turbocharger assembly to exhaust manifold flange. Refer to **FIGURE 5-11**.
8. Remove turbocharger assembly and gasket from engine. Discard gasket.

NOTICE:

Support turbocharger assembly during removal of mounting hardware to prevent damage.

REMOVAL

5.4.1 Cleaning

Clean these components as follows:

1. Thoroughly clean the piping connecting the air cleaner to the turbocharger with soap and water. Dry with filtered compressed air.
2. Remove the vehicle mounted air cleaner and clean inside the air cleaner element housing. (Important to prevent repeat turbocharger or engine failures.)
3. In the event of a turbocharger failure, **INSPECT** air intake piping for debris, clean as required and replace the air cleaner element.

5.4.1.1 Turbocharger

NOTE:

DO NOT use a caustic solution on turbocharger or tubes.

1. Clean air inlet piping and connecting hoses with filtered compressed air.
2. Inspect oil inlet tube and oil drain tube for restrictions. Clean with a suitable (non-caustic) solvent and a nylon brush. Dry using filtered compressed air.

5.4.1.2 Pre-disassembly Visual Inspection

Make the following checks and if the turbocharger does not meet the requirements, it

must be replaced or reconditioned. (Refer to "Reconditioning.")

1. Visually inspect the compressor impeller and turbine wheel for blade erosion, bending, breakage or deposits. Replace as required.

NOTE:

Compressor impeller and turbine wheel deposits can be caused by:

- **HIGH AIR INLET RESTRICTION** – which allows oil to transfer from the turbocharger center housing, resulting in oil deposits.
- **EXCESSIVE OIL CONSUMPTION** – resulting in turbine wheel carbon deposits.
- **ENGINE OVERFUELING** – can result in excessive operating temperatures which can cause aluminum components to melt. Such deposits may be found on the turbine wheel if such a failure occurs.

2. Visually inspect the turbine and compressor housings for evidence of wheel rubbing. Replace the housing(s) as required.

NOTE:

DO NOT attempt to straighten bent wheel blades.

REMOVAL

3. If the turbocharger passes all pre-disassembly inspections, reinstall on engine. (See installation, this section.) If one or more inspections are out of specification or visually unacceptable, follow the instructions in this section under "Reassembly".

5.4.1.3 Check For Free Rotation

1. Stand the turbocharger on bench with shaft in a horizontal position.
2. Wheels must spin freely when turned by hand.

5.4.1.4 Check For Turbine/Compressor Housing Rub

1. Visually inspect the turbine and compressor housing for any wear.
2. Rotate shaft and check for any rubbing within the housings.

REMOVAL

5.4.1.5 Check Axial End Play

1. Clamp turbocharger mounting flange in a vise and position a dial indicator with a magnetic base on the frame of the vise. Place the tip of the indicator on the turbine end of the shaft. Refer to **FIGURE 5-12**.
2. Move the shaft back and forth by hand and record the readings.
3. If the reading exceeds the specifications, the turbocharger must be replaced or reconditioned.

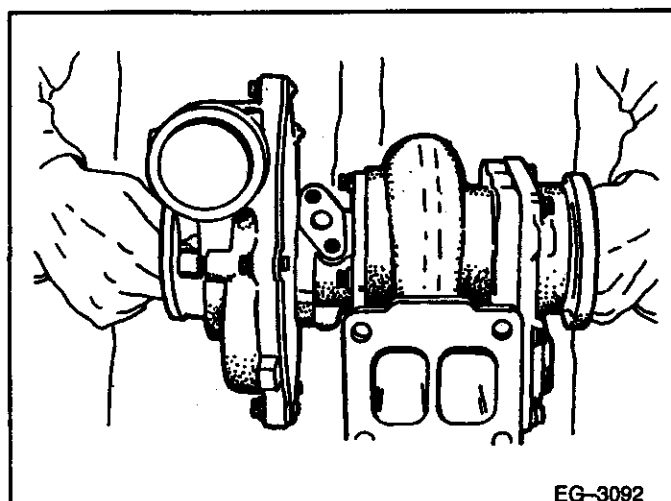
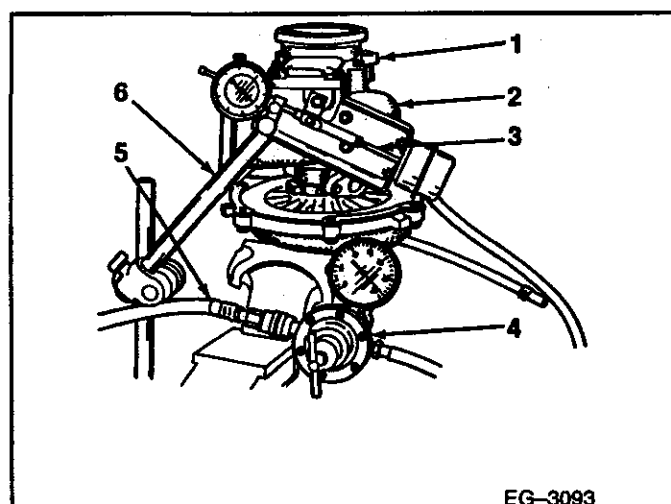


FIGURE 5-12

5.4.1.6 Check Wastegate Actuator (If Equipped)

1. Clamp turbocharger mounting flange in a vise and position a dial indicator with a magnetic base on the frame of the vise. Place the tip of the indicator onto the actuator lever. Refer to **FIGURE 5-13**.
2. Connect an air hose to a 30 lb/in.² (207 kPa) pressure regulator.
3. Using a hose, connect the pressure regulator to the wastegate actuator. Measure actuator rod travel.
4. Gradually apply air pressure to 28.5 lb/in.² (197 kPa). Refer to Specifications for actuator movement tolerance.
5. If tolerance exceeds specifications, the actuator must be replaced or reconditioned.



1. Wastegate Housing
2. Turbine Housing
3. Wastegate Actuator Arm
4. Air Pressure Regulator
5. Air Hose
6. Dial Indicator

FIGURE 5-13

5.5 DISASSEMBLY

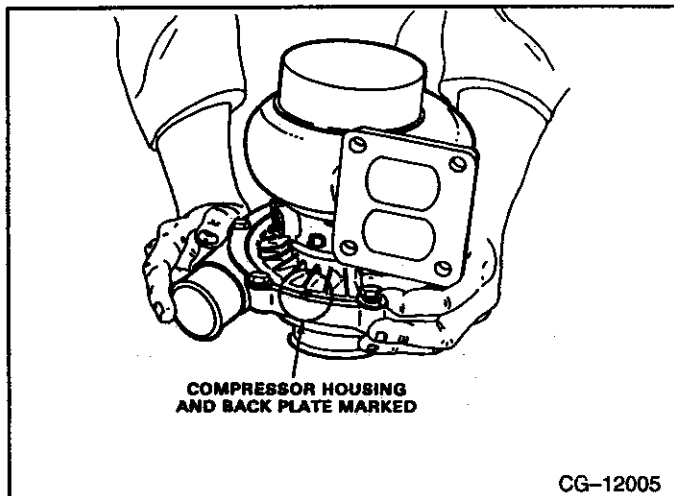
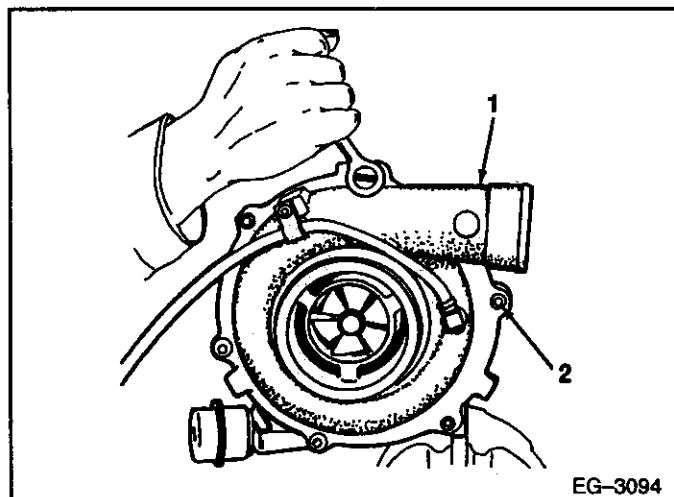


FIGURE 5-14



1. Compressor Housing
2. Clamps W/Mounting Bolts

FIGURE 5-15

Mark the compressor housing location to the back plate to aid in reassembly. Refer to **FIGURE 5-14**.

NOTE:

Reorientation of compressor housing on vehicle will damage compression housing O-ring.

NOTE:

The disassemble procedure is the same for the wastegate and non wastegate turbochargers except where noted.

Disassemble turbocharger as follows:

1. Remove two (2) hose clamps on the hose connecting the turbine side of the turbocharger to the wastegate actuator. Remove hose.
2. Remove six (6) bolts securing compressor housing to backplate. Remove clamps. Refer to **FIGURE 5-15**.

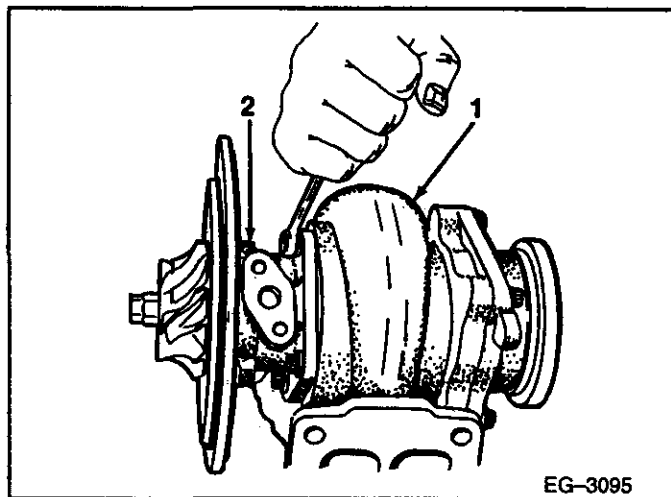
DISASSEMBLY

3. Remove compressor housing from backplate and O-ring.
4. Mark turbine and center housing.
5. Remove four (4) bolts securing center housing to turbine housing (FIGURE 5-16)

NOTE:

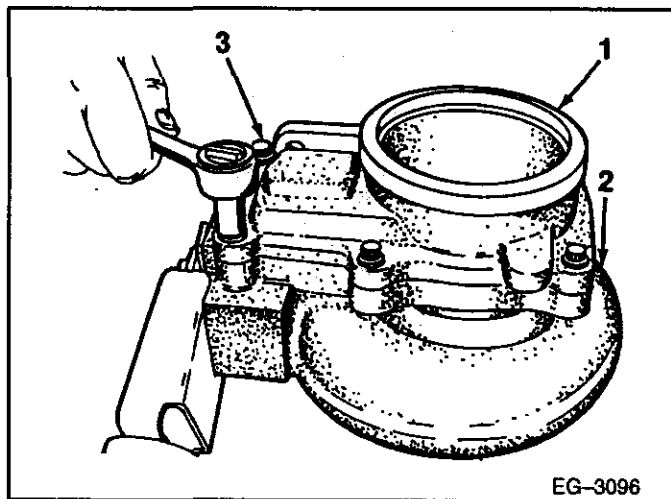
If turbocharger is equipped with a wastegate, perform steps 6, 7 and 8. If turbocharger is not equipped with a wastegate, proceed to step 9.

6. Remove six (6) bolts securing wastegate housing to turbine housing. Remove housing. Refer to FIGURE 5-17.



1. Turbine Housing
2. Center Housing

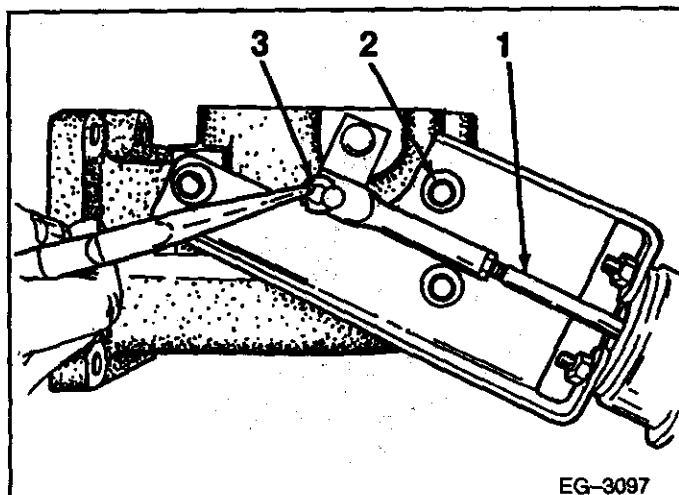
FIGURE 5-16



1. Wastegate Housing
2. Turbine Housing
3. Wastegate Housing Mounting Bolts (6)

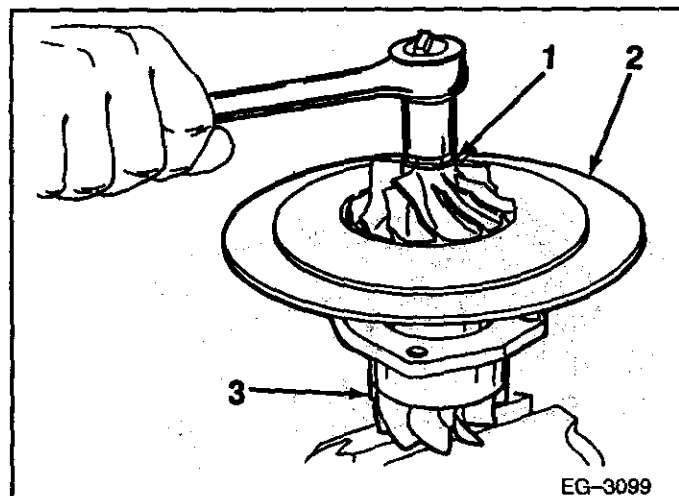
FIGURE 5-17

DISASSEMBLY



1. Wastegate Actuator Arm
2. Wastegate Bracket Mounting Bolts (3)
3. Retaining Clip

FIGURE 5-18



1. Impeller Wheel
2. Compressor Housing Backplate
3. Turbine Wheel

FIGURE 5-19

7. Remove retaining clip to disengage wastegate actuator arm (FIGURE 5-18).
8. Remove three (3) bolts securing wastegate actuator arm bracket to center housing. Remove actuator bracket arm. Refer to FIGURE 5-18.

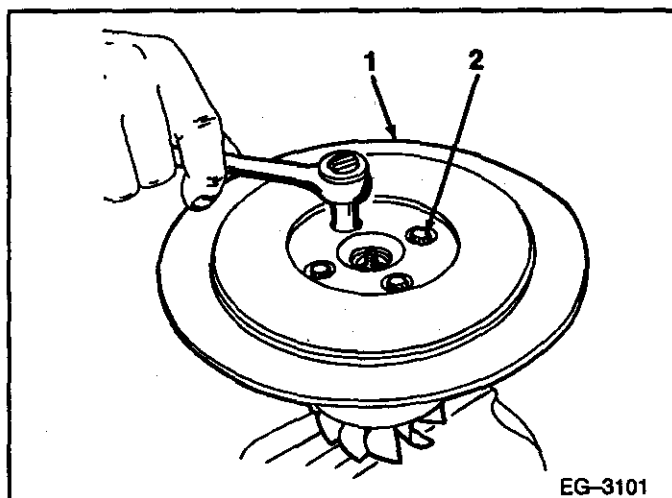
NOTE:

Compressor wheel must be turned clockwise when removing from turbine shaft. If compressor wheel is turned counter-clockwise, threads located on the shaft will be damaged and turbine can not be reused.

9. Disassemble center housing as follows:
 - a. Clamp turbocharger center housing in a vise and separate compressor impeller from turbine shaft (FIGURE 5-19).

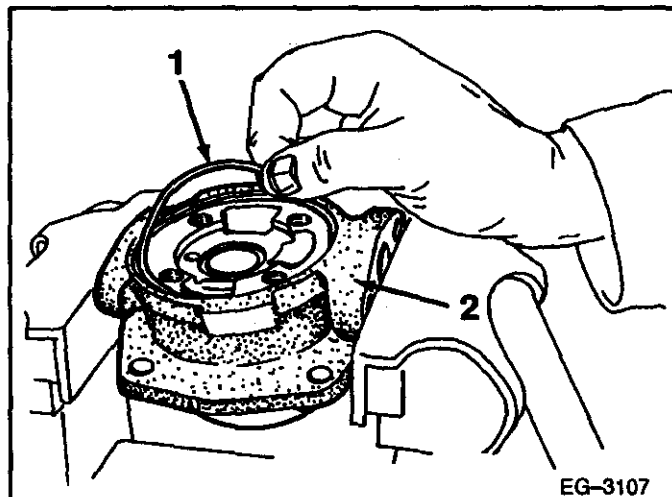
DISASSEMBLY

- b. Remove four (4) bolts securing center housing backplate (**FIGURE 5-20**).
- c. Remove O-ring from center housing (**FIGURE 5-21**).



1. Compressor Housing Backplate
2. Compressor Housing Backplate
3. Mounting Bolts (4)

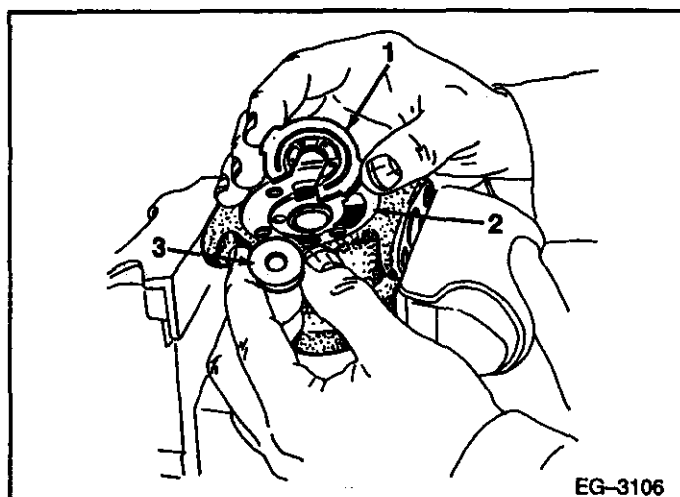
FIGURE 5-20



1. O-ring
2. Center Housing

FIGURE 5-21

DISASSEMBLY



- 1. Impeller Wheel
- 2. Compressor Housing Backplate
- 3. Turbine Wheel

FIGURE 5-22

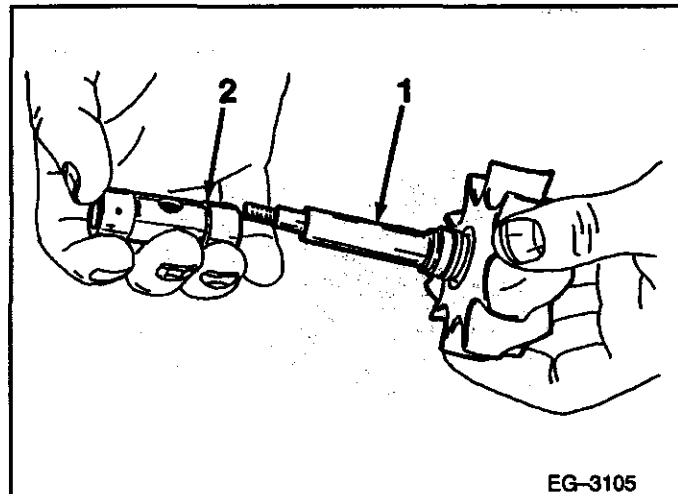
- 10. Push turbine shaft wheel from center housing.
- 11. Remove two bearings, spacer and piston ring from center housing (**FIGURE 5-22**).

5.6 REASSEMBLY

CAUTION

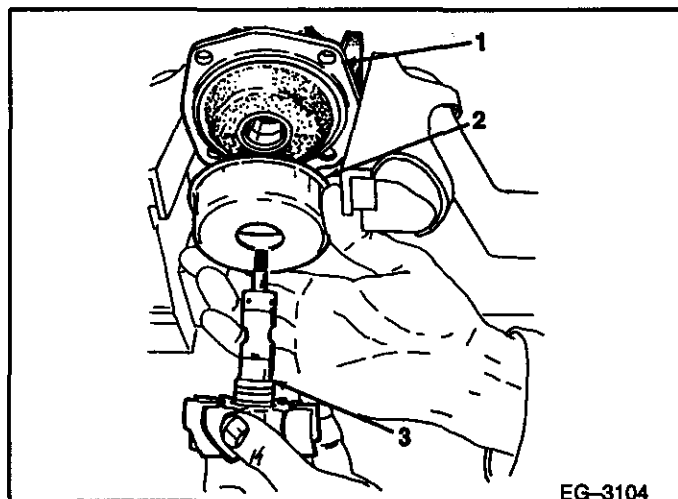
Care must be taken during handling of impeller and turbine wheel. Be very careful and avoid bending any blades. Bent blades must never be used.

1. Install two (2) bearings and spacer onto turbine shaft (**FIGURE 5-23**).
2. Slide shroud and turbine wheel shaft into center housing (**FIGURE 5-24**).



1. Turbine Wheel and Shaft
2. Bearings and Spacer

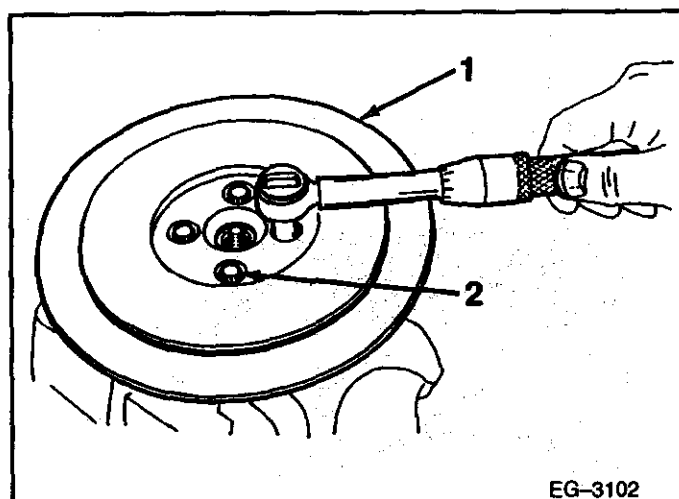
FIGURE 5-23



1. Center Housing
2. Turbine Wheel Shroud
3. Turbine Wheel and Shaft

FIGURE 5-24

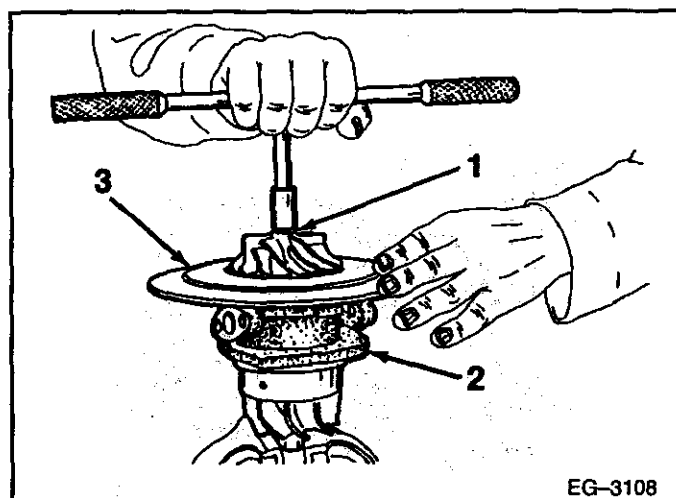
REASSEMBLY



1. Compressor Housing Backplate
2. Compressor Housing Backplate Mounting Bolts (4)

FIGURE 5-25

3. Reassemble center housing as follows:
 - a. Place an O-ring onto compressor housing.
 - b. Install four (4) bolts securing center housing backplate. Tighten to special torque. Refer to **FIGURE 5-25**.
 - c. Install compressor wheel onto turbine wheel shaft. Tighten to specified torque. Refer to **FIGURE 5-26**.



1. Impeller Wheel
2. Center Housing
3. Compressor Housing Backplate

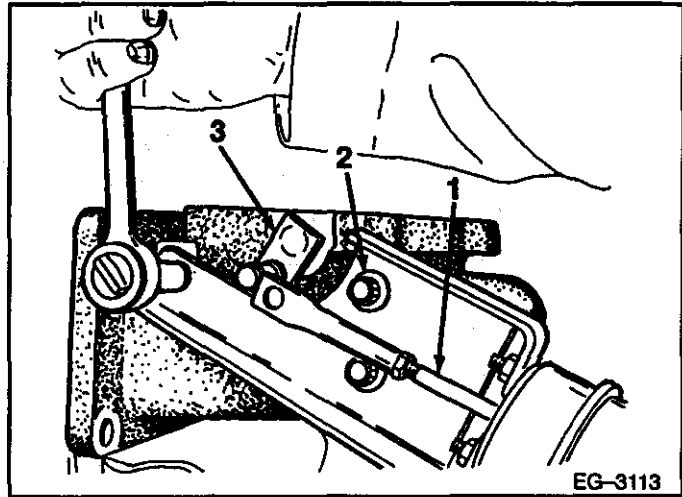
FIGURE 5-26

REASSEMBLY

NOTE:

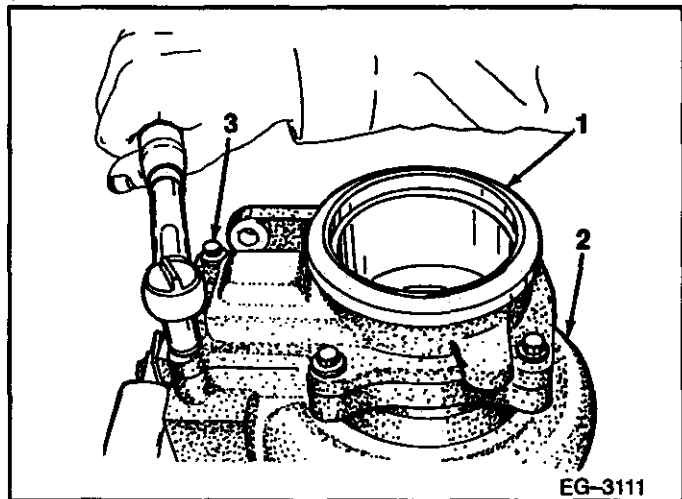
If turbocharger is equipped with a wastegate, perform steps 4, 5 and 6. If turbocharger is not equipped with a wastegate, proceed to step 7.

4. Install wastegate actuator bracket with actuator arm and diaphragm attached to center housing. Secure with three (3) bolts. Tighten to standard torque. Refer to **FIGURE 5-27**.
5. Connect wastegate actuator arm to wastegate and install retaining clip.
6. Align marks and attach wastegate housing to turbine housing and secure with six (6) bolts. Tighten to special torque. Refer to **FIGURE 5-28**.



1. Wastegate Actuator Arm
2. Wastegate Mounting Bolts (3)
3. Wastegate Bracket

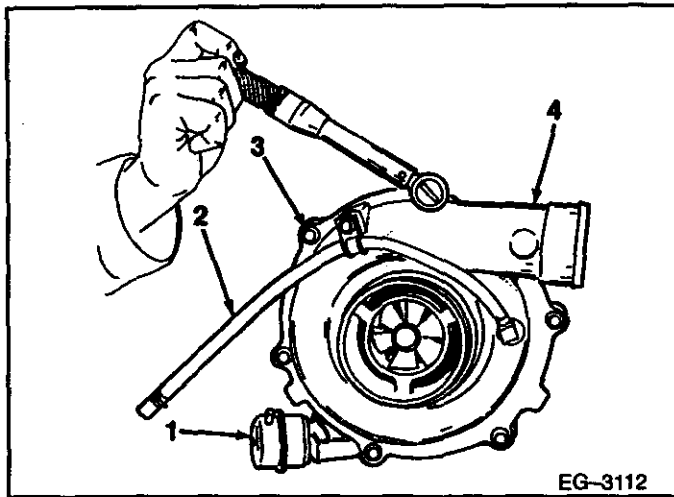
FIGURE 5-27



1. Wastegate Housing
2. Turbine Housing
3. Wastegate Housing Mounting Bolts (6)

FIGURE 5-28

REASSEMBLY



1. Wastegate Actuator
2. Actuator Hose
3. Compressor Housing Mounting Bolt (6)
4. Compressor Housing

FIGURE 5-29

7. Attach turbine housing to center housing. Secure with four (4) bolts and tighten to special torque.
8. Align marks and attach compressor housing to backplate.
9. Using six (6) bolts and two (2) clamps secure compressor housing to backplate. Tighten to special torque. Refer to FIGURE 5-29.

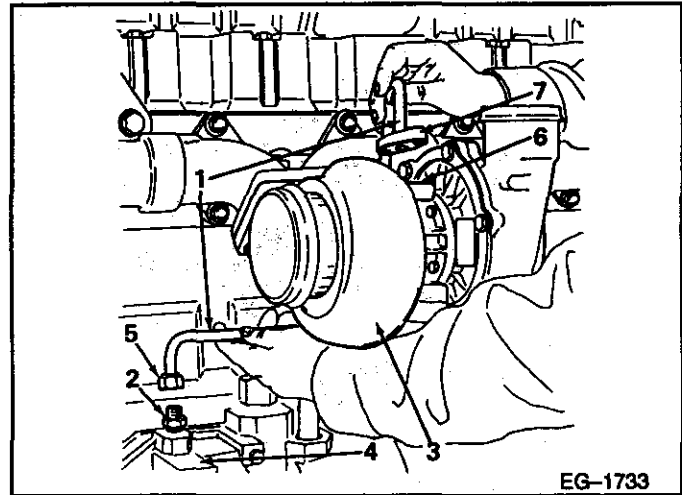
NOTE:

Use a new actuator hose when reassembling turbocharger.

10. Attach hose from the compressor side of the turbocharger to the wastegate actuator. Secure hose with two (2) hose clamps.

5.7 INSTALLATION

1. Install turbocharger assembly onto a clean exhaust manifold flange as follows:
 - a. Install a new gasket on the exhaust manifold flange.
 - b. Attach turbocharger assembly over gasket on exhaust manifold flange and tighten to specified torque.
2. Install the turbocharger oil feed supply tube as follows: (Refer to **FIGURE 5-30**)
 - a. Remove the protective caps from the oil inlet port at the turbocharger and from oil feed supply tube fitting located on oil filter header.
 - b. Pour five ounces of clean engine oil into the oil inlet opening of the turbocharger. This will provide sufficient lubrication for the turbocharger bearings until engine oil pressure is obtained.
 - c. Install a new rubber seal ring at the oil feed supply tube connector nut.
 - d. Install oil feed supply tube onto tube fitting and secure with connector nut.
 - e. Position a new gasket at the turbocharger oil inlet port.
 - f. Secure oil feed supply tube flange at the turbocharger oil inlet port using two mounting capscrews.

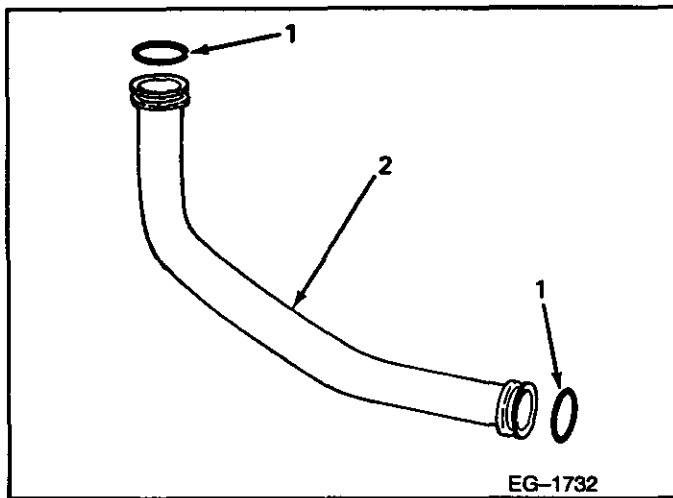


EG-1733

1. Oil Feed Supply Tube
2. Oil Feed Supply Tube Fitting
3. Turbocharger Assembly
4. Oil Filter Header
5. Oil Feed Supply Tube Connector Nut
6. Oil Feed Supply Tube Flange Gasket
7. Oil Feed Supply Tube Flange

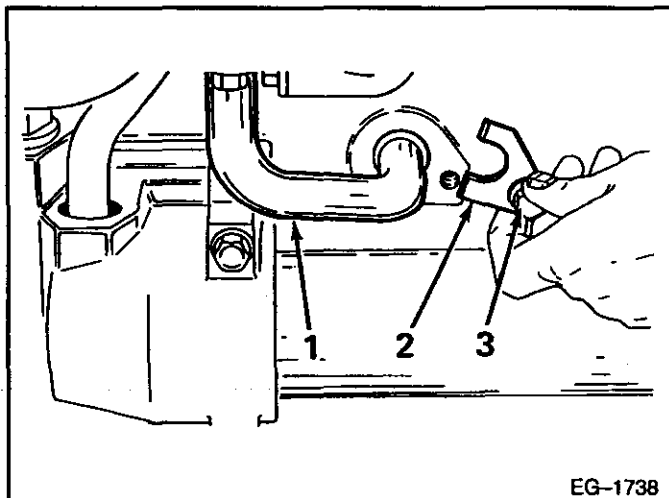
FIGURE 5-30

INSTALLATION



- 1. O-ring (2)
- 2. Turbo Oil Drain Tube

FIGURE 5-31



- 1. Turbo Oil Drain Tube
- 2. Retaining Plate
- 3. Capscrew

FIGURE 5-32

3. Install turbo oil drain tube as follows: (Refer to **FIGURE 5-31**)

- a. Remove protective cap from oil drain port on turbocharger.
- b. Lubricate two new O-rings with engine oil and install one on each end of turbo oil drain tube.
- c. Position turbo oil drain tube together with new O-rings, tube flange and flange gasket onto turbocharger oil drain port.

NOTE:

Peak of tube flange must be facing turbine side of turbocharger

- d. Secure turbo oil drain tube gasket to turbocharger assembly as follows:

4. Install loose end of turbocharger oil drain tube into crankcase and secure with retaining plate and one capscrew (**FIGURE 5-32**).

5. Run-In Checks:

Start the engine and operate at low speed for a few minutes before loading engine.

Operate the engine, observing the turbocharger for any of the following:

- 1. Unusual noise.
- 2. Lubrication leaks.
- 3. Insecure fastening to the engine.
- 4. Excessive vibration.
- 5. Excessive exhaust smoke.
- 6. Air leaks in the air cleaner-to-turbocharger or turbocharger-to-intake manifold ducting.

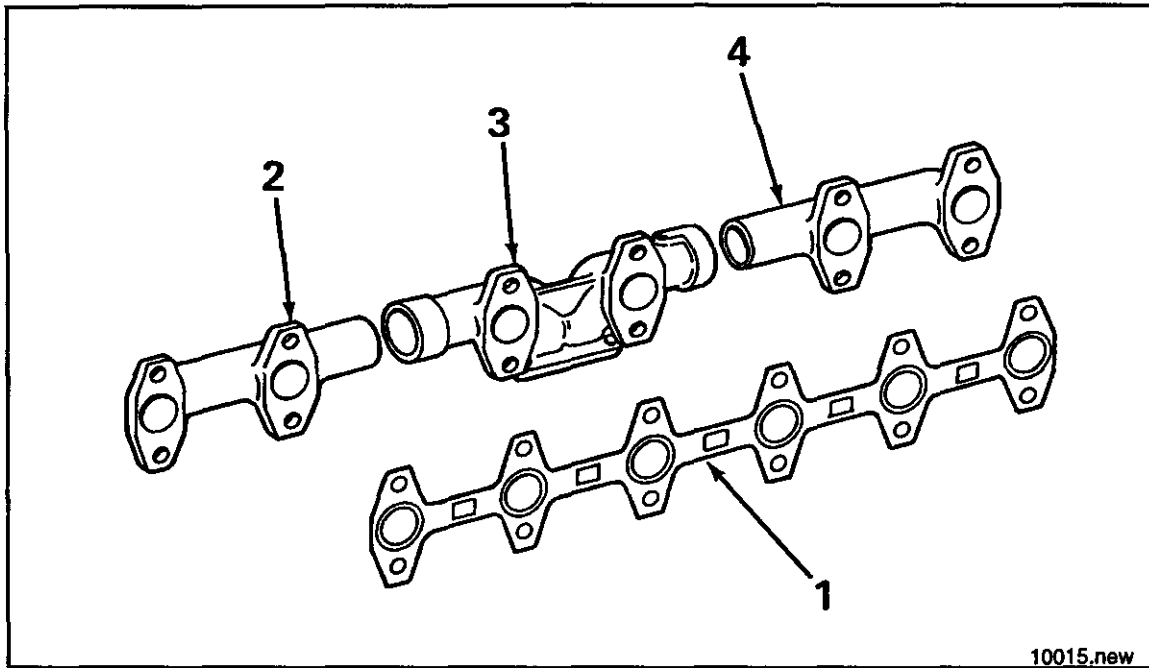
INSTALLATION

1. Investigate and correct any of these conditions immediately to avoid possible turbocharger or engine failure.
2. Retighten capscrews, hold-down nuts, air connections to and from the turbocharger after the initial warm-up.

6 MANIFOLDS

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6.1 MANIFOLD AND MANIFOLD COVER



1. Exhaust Manifold Gasket

2. Front Exhaust Manifold

3. Center Exhaust Manifold

4. Rear Exhaust Manifold

FIGURE 6-1 Exhaust Manifold.

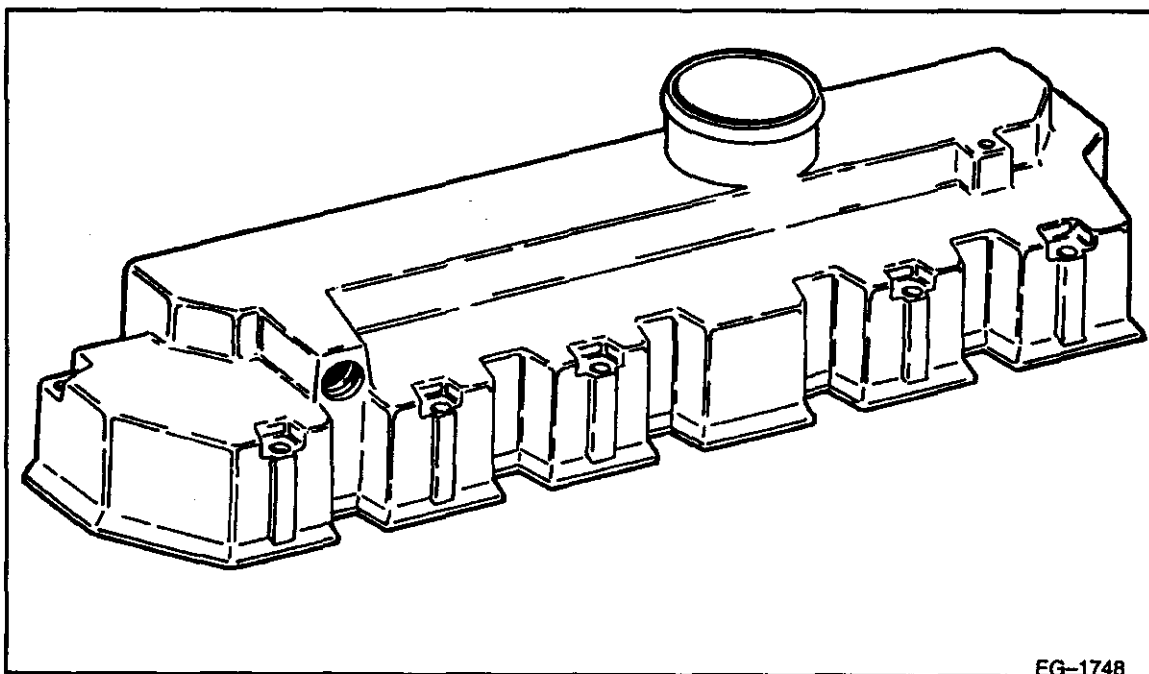


FIGURE 6-2 Valve Cover/Intake Manifold Assembly.

6.2 PIPING COMPONENT LOCATION

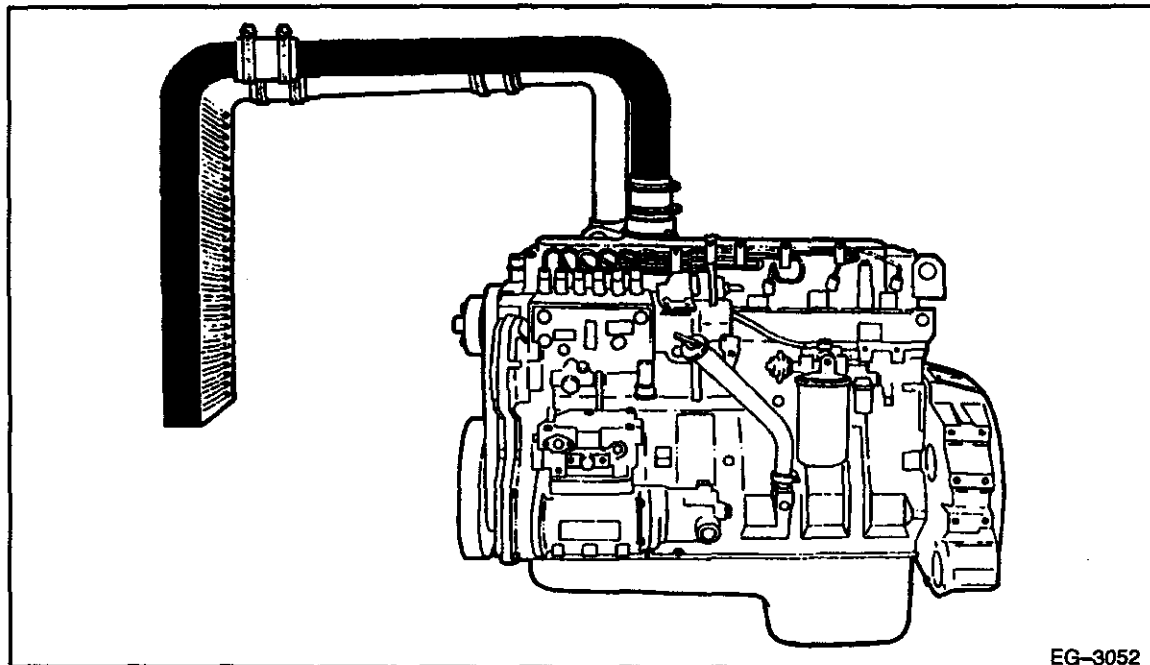


FIGURE 6-3 Major Intercooler Piping Component Location.

NOTE:

Intercooler and connecting hardware is chassis mounted. Refer to the appropriate chassis manual and parts catalog for detailed information.

6.3 SPECIFICATIONS

INTAKE MANIFOLD

Maximum Allowable Warpage 0.010 in. (0.254 mm)

EXHAUST MANIFOLD

Maximum Allowable Warpage 0.010 in. (0.254 mm)

Maximum Allowable Removal of Material 0.025 in. (0.635 mm)

Flange Thickness (Minimum) 0.725 in. (18.41 mm)

6.3.1 Special Torque Values

EXHAUST MANIFOLD

Bolts 60 lb·ft (81 N·m)

ANEROID TUBE

Hollow Screw 24 lb·ft (32 N·m)

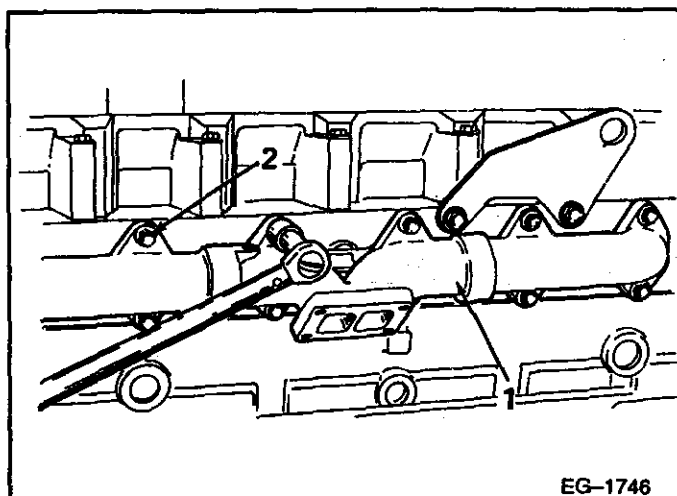
VALVE COVER/INTAKE MANIFOLD

Bolts 13 lb·ft or 156 lb·in (17.6 N·m)

6.3.2 Special Service Tools

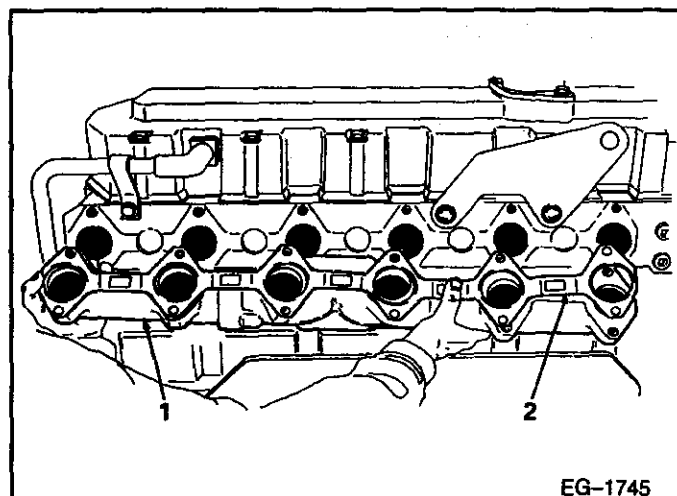
None required for this section

6.4 EXHAUST MANIFOLD REMOVAL



- 1. Exhaust Manifold
- 2. Exhaust Manifold Mounting Bolts (12)

FIGURE 6-4



- 1. Exhaust Manifold
- 2. Exhaust Manifold Gasket

FIGURE 6-5

Refer to appropriate manual section for removal of these components.

- ☐ Turbocharger Oil Feed Supply Tube
- ☐ Turbocharger Oil Drain Tube
- ☐ Turbocharger

1. Remove twelve (12) mounting bolts securing the three piece exhaust manifold sections to cylinder head (FIGURE 6-4).
2. Remove exhaust manifold and one piece gasket (FIGURE 6-5).

6.4.1 Cleaning

1. The exhaust manifold is a three piece assembly and may be cleaned with a suitable non-caustic solvent or steam cleaned.
2. After cleaning, blow dry using filtered compressed air.

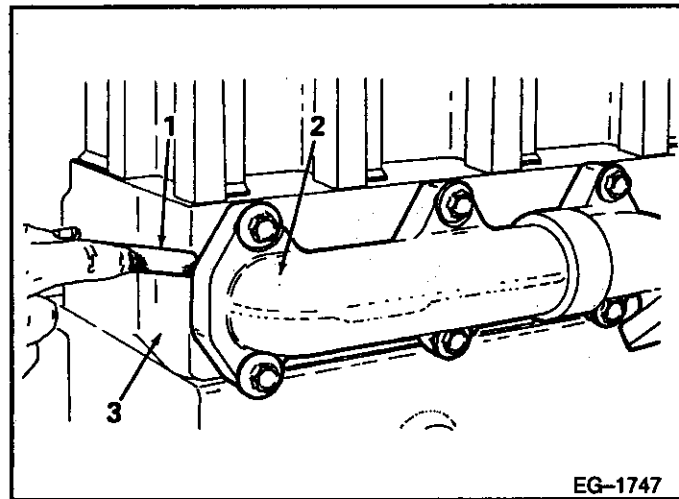
EXHAUST MANIFOLD REMOVAL

6.4.2 Exhaust Manifold Inspection

1. Visually inspect exhaust manifold for cracks. Replace as required.
2. Inspect for warpage as follows: (Refer to **FIGURE 6-6**)
 - a. Install exhaust manifold to cylinder head **WITHOUT GASKET**. Tighten bolts to specified torque.
 - b. Using a .010 in. (0.25 mm) feeler gauge, measure gap between bolts at manifold flange to cylinder head mating surface.
 - c. If feeler gauge will pass through, exhaust manifold requires resurfacing.

NOTICE: A maximum of 0.025 in. (0.64 mm) material can be ground off to correct warpage.

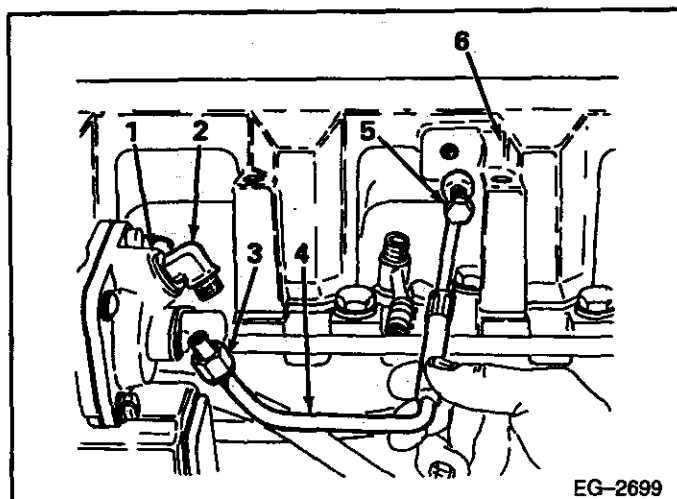
3. If warpage cannot be corrected by grinding, replace exhaust manifold.



1. Feeler Gauge
2. Exhaust Manifold
3. Cylinder Head

FIGURE 6-6

6.5 EXHAUST MANIFOLD INSTALLATION



1. Aneroid
2. Aneroid Elbow
3. Aneroid Tube Nut
4. Aneroid Tube
5. Hollow Screw And Gasket
6. Valve Cover/Intake Manifold

FIGURE 6-7

Install exhaust manifold as follows:

1. Apply "Never-Seez" to the bolts.
2. Install assembled exhaust manifold with gasket to cylinder head.
3. Assure gasket alignment with bolt holes and install twelve (12) "prevailing torque" bolts.

NOTICE: Be sure exhaust manifold gasket and exhaust manifold are aligned before tightening bolts.

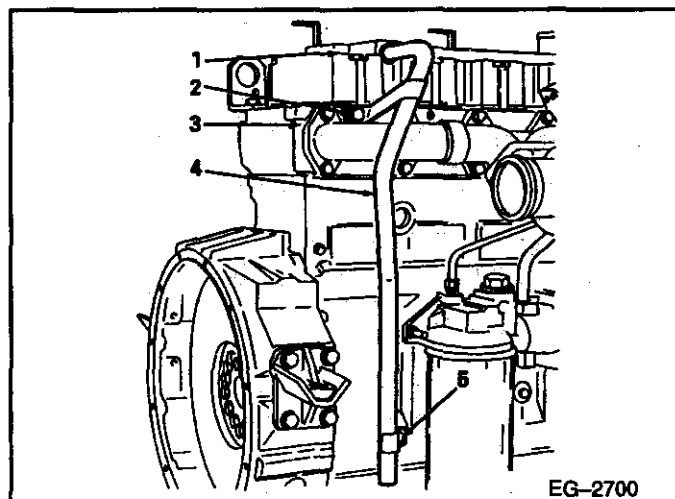
4. Tighten bolts to specified torque.

6.6 VALVE COVER/INTAKE MANIFOLD REMOVAL

1. Remove the aneroid tube as follows: (Refer to FIGURE 6-7)
 - a. Loosen aneroid tube nut at elbow fitting of aneroid. Separate tube from elbow.
 - b. Remove hollow screw together with copper gasket at valve cover/intake manifold.
 - c. Remove aneroid tube.
 - d. Discard copper gaskets.
 - e. Cap elbow on fuel injection pump aneroid and hole in valve cover/intake manifold port.

VALVE COVER/INTAKE MANIFOLD REMOVAL

2. Remove road draft tube as follows: (Refer to **FIGURE 6-8**)
 - a. Remove capscrews securing brackets to crankcase and cylinder head.
 - b. Remove draft tube and O-ring from valve cover/intake manifold assembly.
3. Remove thirteen (13) valve cover/intake manifold capscrews (2, **FIGURE 6-9**).
4. Remove valve cover/intake manifold and gasket from cylinder head. (Refer to **FIGURE 6-9**).

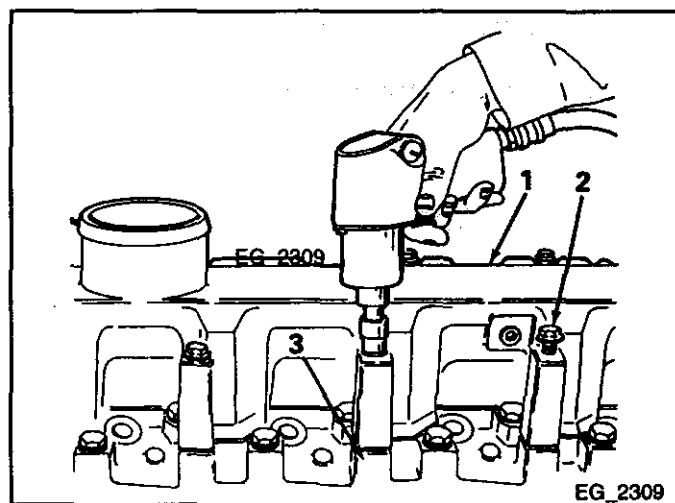


1. Valve Cover/Intake Manifold
2. Upper Draft Tube Mounting Bracket Bolt
3. Cylinder Head
4. Road Draft Tube
5. Lower Draft Tube Mounting Bracket Bolt

FIGURE 6-8

6.6.1 Cleaning

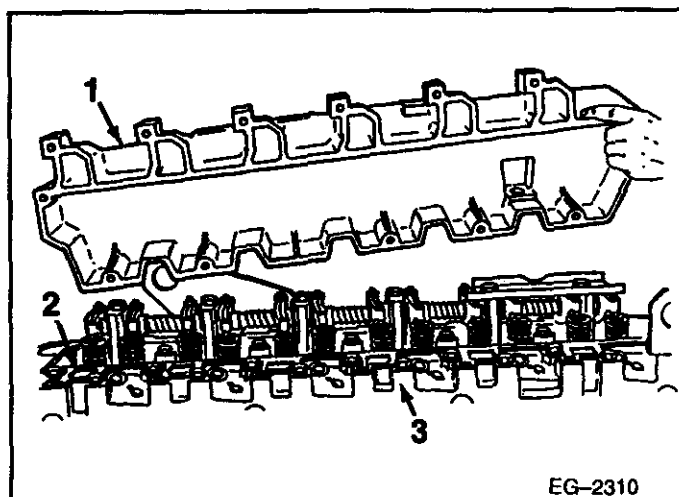
1. Clean valve cover/intake manifold using a suitable non-caustic solvent.
2. Thoroughly clean valve cover/intake manifold breather.
3. Dry using filtered compressed air, prior to inspection.
4. Visually inspect the valve cover/intake manifold for any damages.
5. Visually inspect baffle deflectors for damage.



1. Valve Cover/Intake Manifold
2. Mounting Bolts
3. Cylinder Head

FIGURE 6-9

6.7 VALVE COVER/INTAKE MANIFOLD INSTALLATION



1. Valve Cover/Intake Manifold
2. Gasket
3. Cylinder Head

FIGURE 6-10

1. Install valve cover/intake manifold as follows: (Refer to **FIGURE 6-10**)
 - a. Place gasket onto cylinder head.
 - b. Install valve cover/intake manifold onto cylinder head.
- NOTICE:** Be sure valve cover/intake manifold and gasket align properly.
- c. Secure valve cover/intake manifold to cylinder head using thirteen (13) mounting capscrews. Tighten to specified torque.
2. Install road draft tube to valve cover/intake manifold as follows:
 - a. Lubricate and install new O-rings onto draft tube and insert draft tube into bore located on the rear right-hand side of the valve cover/intake manifold.
 - b. Secure draft tube brackets to cylinder head and crankcase. Tighten to standard torque.
 3. Install aneroid tube to valve cover/intake manifold as follows:
 - a. Remove protective caps from aneroid elbow and valve cover/intake manifold port.
 - b. Attach aneroid tube nut to aneroid elbow. Tighten nut. Using new copper gaskets on the hollow screw, attach aneroid tube valve cover/intake manifold. Tighten screw to special torque.

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7.1 CYLINDER HEAD AND RELATED PARTS EXPLODED VIEW

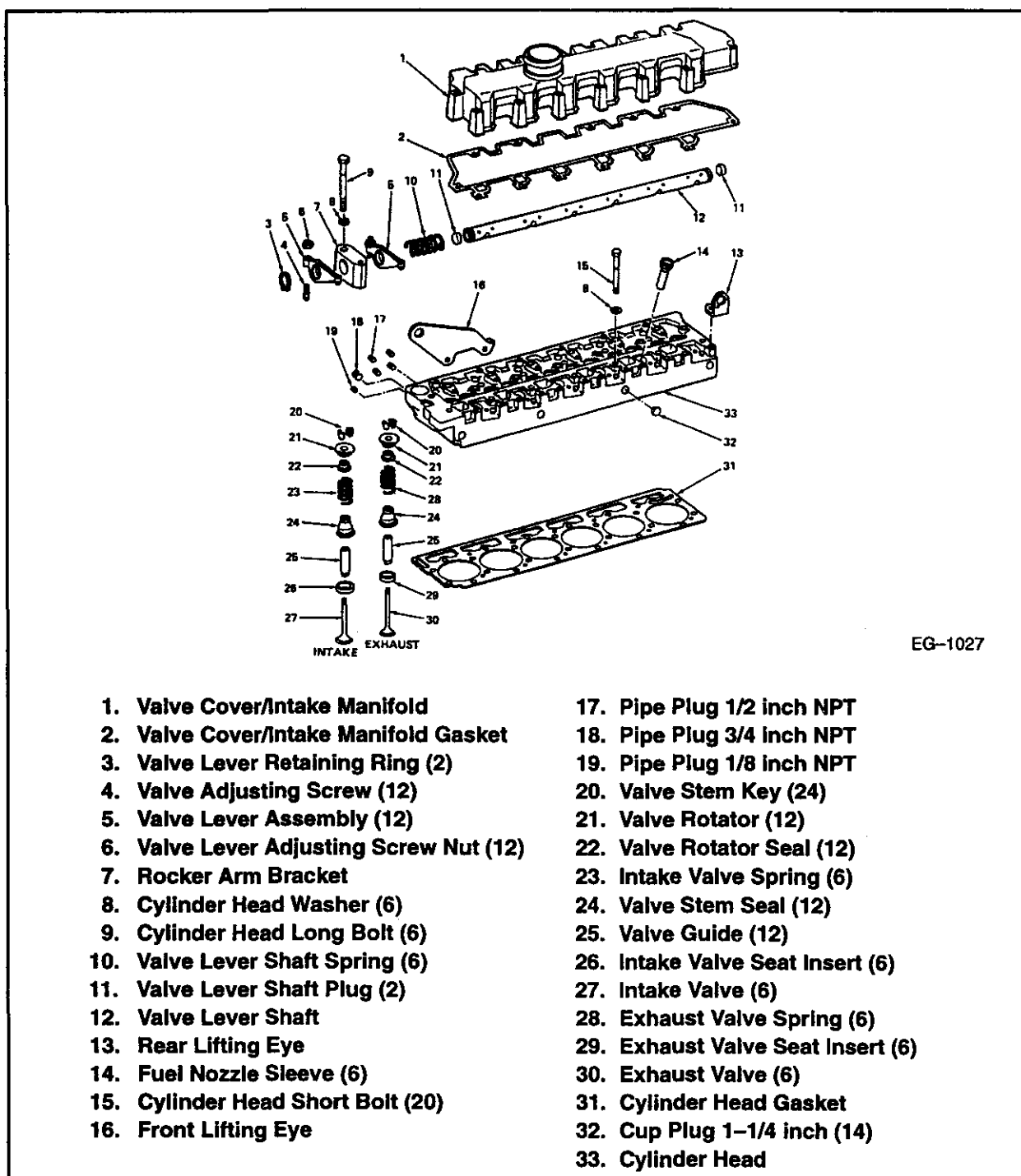


FIGURE 7-1 Cylinder Head and Related Parts.

7.2 SPECIFICATIONS

EXHAUST VALVES:

Stem Diameter	0.3118 in.(7.920 mm)/ 0.3125 in.(7.938 mm)
Stem to Guide Clearance (Max. Allowable Before Replacement)	0.006 in. (0.15 mm)
Face to Stem Run-Out (T.I.R. Max.)	0.0015 in. (0.038 mm)
Valve Face Angle	30° – 00' – 30° – 15'
Valve Face Margin (Min.)	0.088 in. (2.24 mm)
Valve Lash	0.025 in. (0.64 mm)

INTAKE VALVES:

Stem Diameter	
Stem to Guide Clearance (Max. Allowable Before Replacement)	0.006 in. (0.15 mm)
Face to Stem Run-Out (T.I.R. Max.)	0.0015 in. (0.038 mm)
Valve Face Angle	30° – 00' – 30° – 15'
Valve Face Margin (Min.)	0.088 in. (2.24 mm)
Valve Lash	0.025 in. (0.64 mm)

CYLINDER HEAD:

Valve Guide Type	Replaceable
Valve Guide Length (overall)	2.391 in. (60.73 mm)
Valve Guide Bore Diameter in Cylinder Head for Valve Guide Insert	0.5625 in. (14.288 mm)/ 0.5639 in.(14.323 mm)
Service Valve Guide O.D.	0.5646 in. (14.341 mm)/ 0.5654 in. (14.36 mm)
Service Valve Guide I.D. (After Assembly)	0.3140 in. (7.976 mm)/ 0.3157 in. (8.019 mm)
Service Valve Guide Interference Fit Dimension	0.0007 in. (0.018 mm)/ 0.0029 in. (0.074 mm)
Valve Guide Bore Out-of-Round (Max.)	0.002 in. (0.05 mm)
Valve Guide Bore Taper (Max.)	0.005 in. (0.13 mm)
Valve Guide Height from Cylinder Head Spring Pocket (Intake)	0.868 in. (22.05 mm)/ 0.888 in. (22.56 mm)
Valve Seat Insert Angle (Intake)	30° – 00' – 30° – 15'

SPECIFICATIONS

Valve Seat Insert Angle (Exhaust)	45° – 00' – 45° – 15'
Valve Seat Width (Intake & Exhaust)	0.075 in. (1.91 mm)/ 0.085 in. (2.16 mm)
Valve Seat Run-Out (T.I.R. Max.)	0.002 in. (0.05 mm)
Valve Seat Insert O. D.	
(Intake)	
0.002" Oversize	2.0015 in. (50.838 mm)
0.015" Oversize	2.0145 in. (51.168 mm)
(Exhaust)	
0.002" Oversize	1.6285 in. (41.364 mm)
0.015" Oversize	1.6415 in. (41.694 mm)
Valve Seat Insert Cylinder Head Counterbore Diameter	
(Intake)	1.996 in. (50.70 mm)/ 1.997 in. (50.72 mm)
(Exhaust)	1.624 in. (41.25 mm)/ 1.625 in. (41.28 mm)
Valve Head Recession Relative to Deck	
Surface (Intake & Exhaust)	0.000 in. (0.00 mm)/ 0.014 in. (0.36 mm)
Cylinder Head Surface Flatness	0.004 in. (0.10 mm) in 9 inches/ 0.006 in. (0.15 mm) overall
Deck-to-Deck Dimension	
(Head Thickness) (New)	4.190 in. (106.43 mm)/ 4.210 in. (106.93 mm)
Minimum Deck-to-Deck Dimension After Rework ...	4.180 in. (106.17 mm)
VALVE SPRINGS	
Number of Springs per Valve	1
Intake:	
Identification Color Strip	Blue
Valve Spring Free Length	2.292 in. (58.22 mm)
Test Length (Valve Closed)	1.980 in. (50.29 mm)
Test Load (Valve Closed)	80–88 lbs (356–391 N)
Test Length (Valve Open)	1.480 in. (37.59 mm)

SPECIFICATIONS

Test Load (Valve Open)	214–224 lbs (952–996 N)
Wire Diameter207 in. (5.26 mm)
Number of Springs per Valve	1

Exhaust:

Identification Color Strip	White
Valve Spring Free Length	2.448 in. (62.18 mm)
Test Length (Valve Closed)	1.980 in. (50.29 mm)

VALVE SPRINGS

Test Load (Valve Closed)	121–129 lbs (538–574 N)
Test Length (Valve Open)	1.530 in. (38.86 mm)
Test Load (Valve Open)	239–251 lbs (1063–1117 N)
Wire Diameter207 in. (5.26 mm)