EXHAUST SYSTEM

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EXHAUST SYSTEM AND TURBOCHARGER

DESCRIPTION

The basic exhaust system consists of an engine exhaust manifold, turbocharger, exhaust down pipe, exhaust pipe, exhaust heat shield(s), muffler and exhaust tailpipe

The exhaust system uses a single muffler.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. If the system contacts any body panel, it will transfer objectionable noises originating from the engine to the body.

When inspecting an exhaust system, critically inspect for cracked or loose joints, stripped screw or bolt threads, corrosion damage and worn, cracked or broken hangers. Replace all components that are badly corroded or damaged. DO NOT attempt to repair.

When replacement is required, use original equipment parts (or equivalent). This will assure proper alignment and provide acceptable exhaust noise levels.

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

SPECIFICATIONS - TORQUE

2.5L DIESEL - TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Nuts, Exhaust Manifold	32.4	24	-
Bolts, Exhaust Manifold Heat shield	27.5	21	-
Bolts, Turbocharger Bracket	47.1	35	-
Nuts, Turbocharger Downpipe	32.4	24	-
Fitting, Turbocharger Oil Feed Line	24.5	18	215
Nuts, Turbocharger to Exhaust Manifold	32.4	24	-

CHARGE AIR COOLER AND PLUMBING

DESCRIPTION

The charge air cooler is located in front of the radiator and cools the super heated air produced by the compression of inlet air by the turbocharger. The cooling of this super heated air maintains engine power and efficiency (Fig. 1).

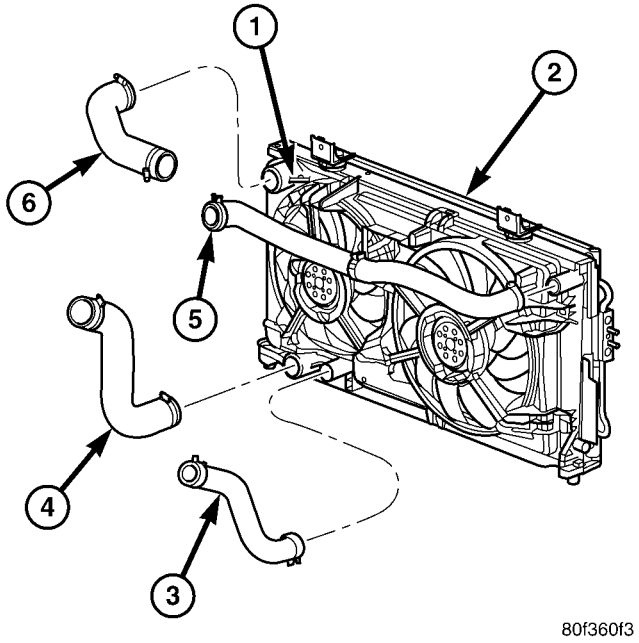

Fig. 1 CHARGE AIR COOLER AND HOSES - 2.5L DIESEL SHOWN

1 - CHARGE AIR COOLER
2 - COOLING MODULE
3 - RADIATOR OUTLET HOSE
4 - CHARGE AIR COOLER TO TURBOCHARGER OUTLET HOSE
5 - RADIATOR INLET HOSE
6 - CHARGE AIR COOLER TO INTAKE MANIFLOD

TURBOCHARGER

DESCRIPTION

CAUTION: The turbocharger is a performance part and must not be tampered with. The wastegate bracket is an integral part of the turbocharger. Tampering with the wastegate components can reduce durability by increasing cylinder pressure and thermal loading due to incorrect inlet and exhaust manifold pressure. Poor fuel economy and failure to meet regulatory emissions laws may result. Increasing the turbocharger boost WILL NOT increase engine power.

The turbocharger is an exhaust-driven supercharger which increases the pressure and density of the air entering the engine. With the increase of air entering the engine, more fuel can be injected into the cylinders, which creates more power during combustion.

The turbocharger assembly consists of four (4) major component systems (Fig. 2) (Fig. 3):

- Turbine section
- Compressor section
- Bearing housing
- Wastegate

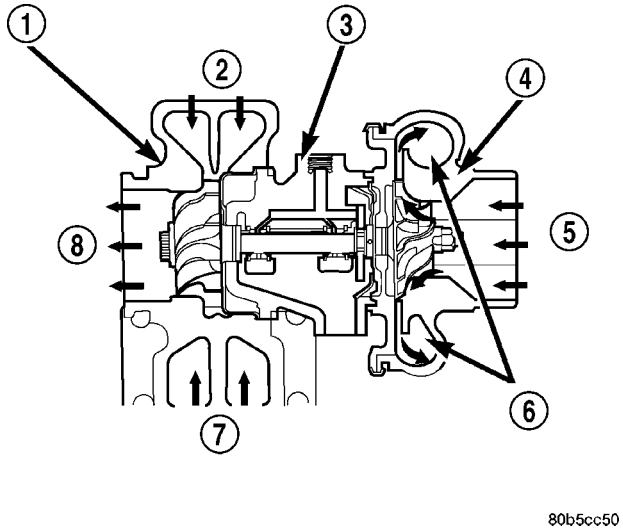

Fig. 2 Turbocharger Operation

1 - TURBINE SECTION
2 - EXHAUST GAS
3 - BEARING HOUSING
4 - COMPRESSOR SECTION
5 - INLET AIR
6 - COMPRESSED AIR TO ENGINE
7 - EXHAUST GAS
8 - EXHAUST GAS TO EXHAUST PIPE

OPERATION

Exhaust gas pressure and energy drive the turbine, which in turn drives a centrifugal compressor that compresses the inlet air, and forces the air into the engine through the charge air cooler and plumbing. Since heat is a by-product of this compression, the air must pass through a charge air cooler to cool the incoming air and maintain power and efficiency.

Increasing air flow to the engine provides:

- Improved engine performance
- Lower exhaust smoke density
- Improved operating economy
- Altitude compensation
- Noise reduction.

TURBOCHARGER (Continued)

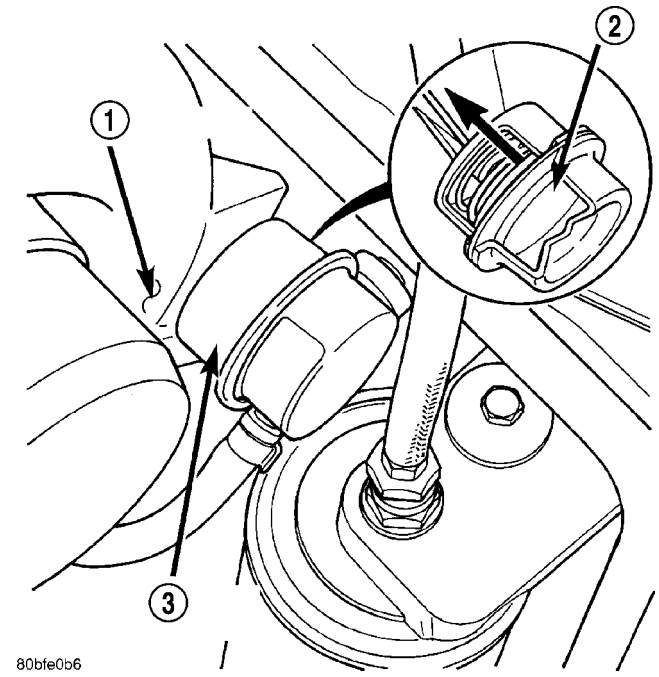

Fig. 3 Turbocharger Wastegate Actuator

1 - TURBOCHARGER
2 - DIAPHRAGM
3 - WASTE GATE ACTUATOR

The turbocharger also uses a wastegate (Fig. 4), which regulates intake manifold air pressure and prevents over boosting at high engine speeds. When the wastegate valve is closed, all of the exhaust gases flow through the turbine wheel. As the intake manifold pressure increases, the wastegate actuator opens the valve, diverting some of the exhaust gases away from the turbine wheel. This limits turbine shaft speed and air output from the impeller.

The turbocharger is lubricated by engine oil that is pressurized, cooled, and filtered. The oil is delivered to the turbocharger by a supply line that is tapped into the block. The oil travels into the bearing housing, where it lubricates the shaft and bearings (Fig. 5). A return pipe at the bottom of the bearing housing, routes the engine oil back to the crankcase.

The most common turbocharger failure is bearing failure related to repeated hot shutdowns with inadequate “cool-down” periods. A sudden engine shut down after prolonged operation will result in the transfer of heat from the turbine section of the turbocharger to the bearing housing. This causes the oil to overheat and break down, which causes bearing and shaft damage the next time the vehicle is started.

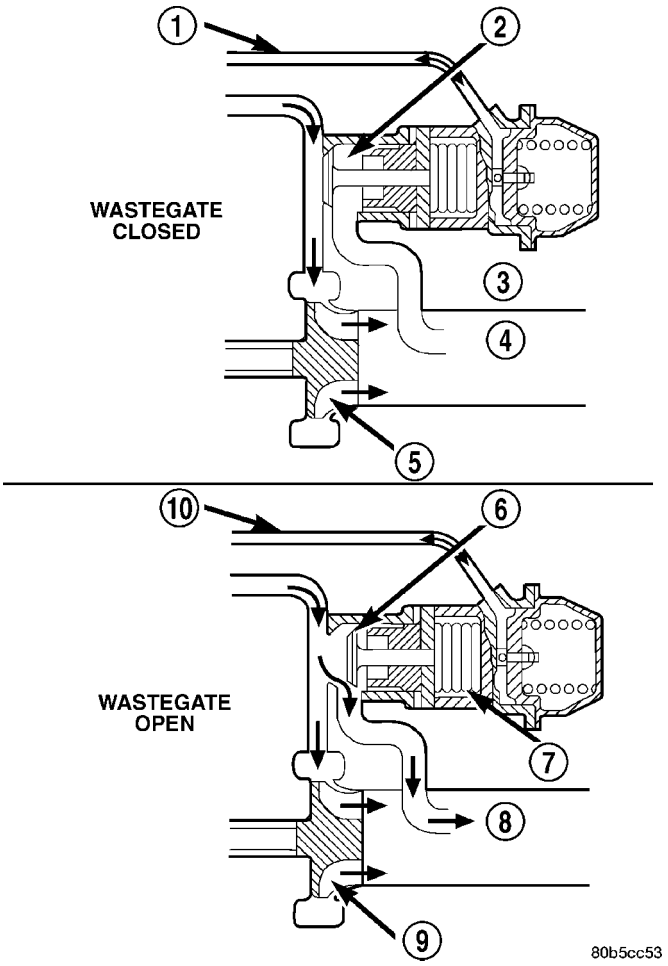

Fig. 4 Wastegate Operation

1 - SIGNAL LINE
2 - EXHAUST BYPASS VALVE
3 - WASTEGATE
4 - EXHAUST
5 - TURBINE
6 - EXHAUST BYPASS VALVE
7 - WASTEGATE
8 - EXHAUST
9 - TURBINE
10 - SIGNAL LINE

Letting the engine idle after extended operation allows the turbine housing to cool to normal operating temperature. The following chart should be used as a guide in determining the amount of engine idle time required to sufficiently cool down the turbocharger before shut down, depending upon the type of driving and the amount of cargo.

TURBOCHARGER (Continued)

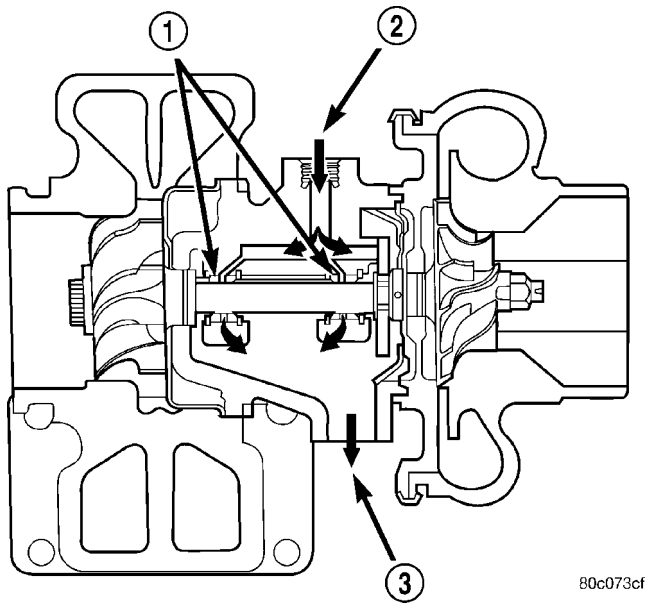

Fig. 5 Turbocharger Oil Supply and Drain

1 - BEARINGS
2 - OIL SUPPLY (FROM ENGINE BLOCK)
3 - OIL RETURN (TO OIL PAN)

TURBOCHARGER ″COOL DOWN″ CHART			
Driving Condition	Load	Turbo-charger Tempera-ture	Idle Time (in minutes) Before Shut Down
Stop & Go	Empty	Cool	Less than 1
Stop & Go	Medium	Warm	1
Highway Speeds	Medium	Warm	2
City Traffic	Max. GCWR	Warm	3
Highway Speeds	Max. GCWR	Warm	4
Uphill Grade	Max. GCWR	Hot	5

REMOVAL

(1) Remove the battery and tray assembly (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL).

(2) Disconnect the mass air flow (MAF) sensor and the intake air temperature (IAT) sensor wiring harness connectors.

(3) Disconnect the air inlet tube at the breather and remove the air cleaner cover.

(4) Raise and support the vehicle.

(5) Remove the exhaust system.

(6) Remove the lower engine splash shield.

(7) Loosen the turbocharger support bracket and set aside.

(8) Remove the turbocharger flange (Fig. 6)

(9) Remove the auxiliary heater pipe fasteners and position pipe aside.

(10) Disconnect the turbocharger oil supply and return lines at the turbocharger.

(11) Remove the turbocharger to exhaust manifold fasteners (Fig. 6).

(12) Disconnect the turbocharger wastegate actuator vacuum line and remove the turbocharger (Fig. 6).

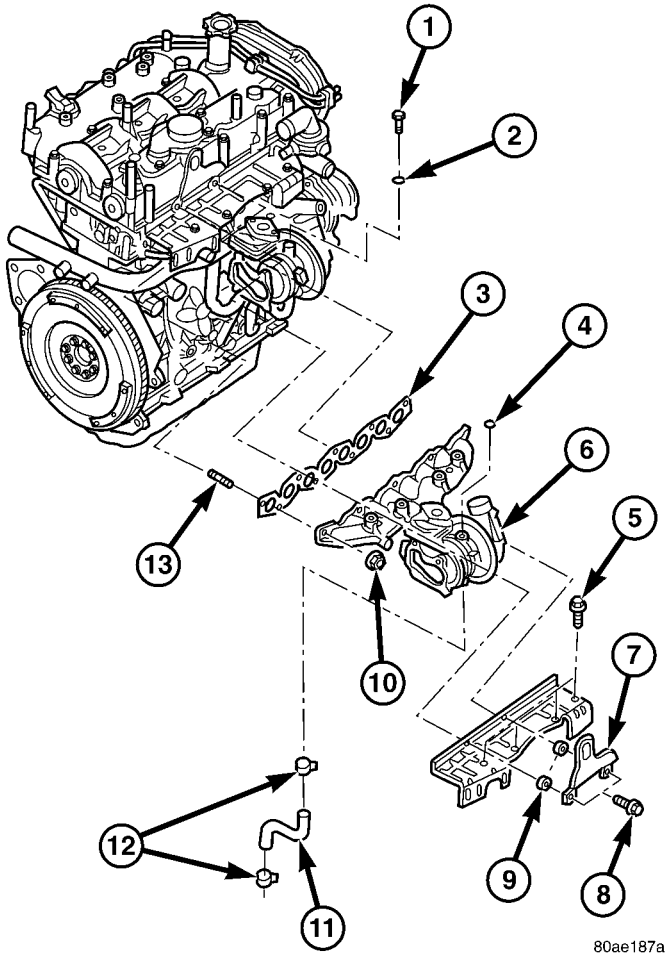

Fig. 6 EXHAUST MANIFOLD AND TURBOCHARGER

1 - TURBOCHARGER OIL SUPPLY BANJO BOLT
2 - COPPER WASHER
3 - EXHAUST MANIFOLD GASKET
4 - COPPER WASHER
5 - EXHAUST MANIFOLD HEAT SHIELD RETAINING BOLT
6 - TURBOCHARGER
7 - ENGINE LIFT HOOK
8 - ENGINE LIFT HOOK RETAINING BOLT
9 - SPACER
10 - EXHAUST MANIFOLD RETAINING NUT
11 - TURBOCHARGER OIL RETURN HOSE
12 - HOSE CLAMPS
13 - EXHAUST MANIFOLD STUDS

TURBOCHARGER (Continued)

CLEANING

All old gaskets should be inspected for any tears or signs of prior leakage. If any gaskets show such indications, they should be replaced with new gaskets. All gasket mating surfaces must be cleaned of old gasket material to produce a smooth and dirt free sealing surface for the new gasket.

INSPECTION

Visually inspect the turbocharger and exhaust manifold gasket surfaces. Replace stripped or eroded mounting studs.

(1) Visually inspect the turbocharger for cracks. The following cracks are NOT acceptable:

- Cracks in the turbine and compressor housing that go completely through.
- Cracks in the mounting flange that are longer than 15 mm (0.6 in.).
- Cracks in the mounting flange that intersect bolt through-holes.
- Two (2) Cracks in the mounting flange that are closer than 6.4 mm (0.25 in.) together.

(2) Visually inspect the impeller and compressor wheel fins for nicks, cracks, or chips. Note: Some impellers may have a factory placed paint mark which, after normal operation, appears to be a crack. Remove this mark with a suitable solvent to verify that it is not a crack.

(3) Visually inspect the turbocharger compressor housing for an impeller rubbing condition (Fig. 7). Replace the turbocharger if the condition exists.

(4) Measure the turbocharger axial end play:

(a) Install a dial indicator as shown in (Fig. 8). Zero the indicator at one end of travel.

(b) Move the impeller shaft fore and aft and record the measurement. Allowable end play is 0.038 mm (0.0015 in.) MIN. and 0.089 mm (0.0035 in.) MAX. If the recorded measurement falls outside these parameters, replace the turbocharger assembly.

(5) Measure the turbocharger bearing radial clearance:

(a) Insert a narrow blade or wire style feeler gauge between the compressor wheel and the housing (Fig. 9).

(b) Gently push the compresser wheel toward the housing and record the clearance.

(c) With the feeler gauge in the same location, gently push the compressor wheel away from the housing and again record the clearance.

(d) Subtract the smaller clearance from the larger clearance. This is the radial bearing clearance.

(e) Allowable radial bearing clearance is 0.326 mm (0.0128 in.) MIN. and 0.496 mm (0.0195 in.) MAX. If the recorded measurement falls outside these specifications, replace the turbocharger assy.

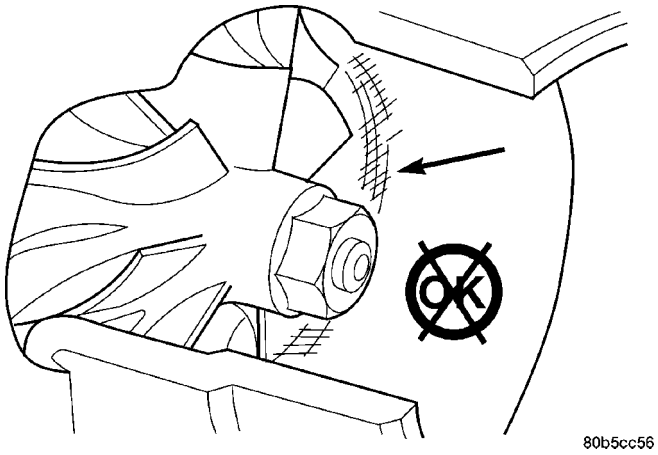

Fig. 7 Inspect Compressor Housing for Impeller Rubbing Condition - Typical

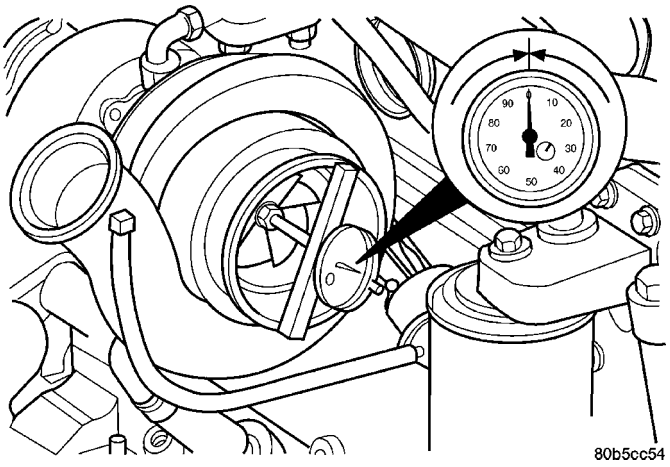

Fig. 8 Measure Turbocharger Axial End Play - Typical

TURBOCHARGER (Continued)

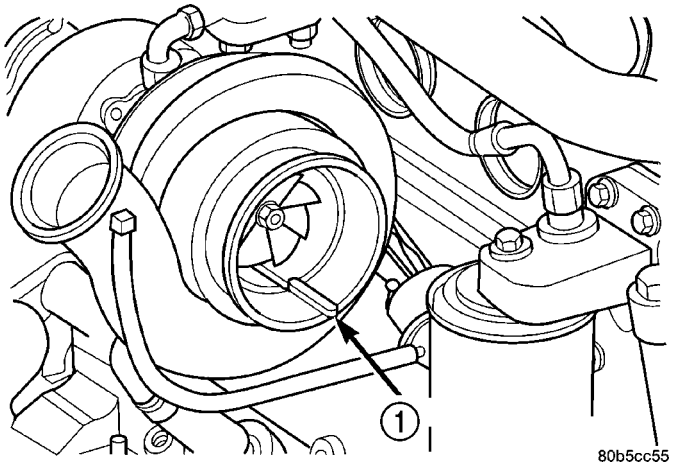

Fig. 9 Measure Turbocharger Bearing Radial Clearance - Typical

1 - FEELER GAUGE

INSTALLATION

(1) Clean all gasket mating surfaces taking care not to damage the sealing surfaces.

(2) Install the turbocharger to the exhaust manifold (Fig. 6). Tighten fasteners to 32.4 N·m (24 lbs. ft.).

(3) Connect the wastegate actuator vacuum line.

(4) Connect the turbocharger oil supply and return lines (Fig. 6). Tighten supply bolt to 24.5 N·m (217 lbs. in.) and return fasteners to 10 N·m (89 lbs. in.)..

(5) Reposition and secure the auxiliary heater pipes to floor board. Tighten bolts to 10.8 N·m (96 lbs. in.).

(6) Install the turbocharger flange (Fig. 6). Tighten fasteners to 32.4 N·m (24 lbs. ft.).

(7) Secure the turbocharger support bracket. Tighten fasteners to 47.1 N·m (35 lbs. ft.).

(8) Connect the exhaust system. Tighten the exhaust manifold to front pipe fasteners to 32 N·m (24 lbs. ft.) and the exhaust support bracket fasteners to 27.5 N·m (21 lbs. ft.).

(9) Install the lower engine splash shield.

(10) Lower the vehicle.

(11) Connect the air inlet hose to the breather and install the air cleaner cover.

(12) Connect the MAF and IAT sensor harness connectors.

(13) Install the battery and tray assembly (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION).

(14) Start engine and inspect for leaks.

HEAT SHIELDS

REMOVAL

(1) Remove front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).

(2) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).

(3) Partially drain cooling system (Refer to 7 - COOLING/ENGINE/COOLANT - STANDARD PROCEDURE).

(4) Remove thermostat housing to upper radiator hose tube (Fig. 10).

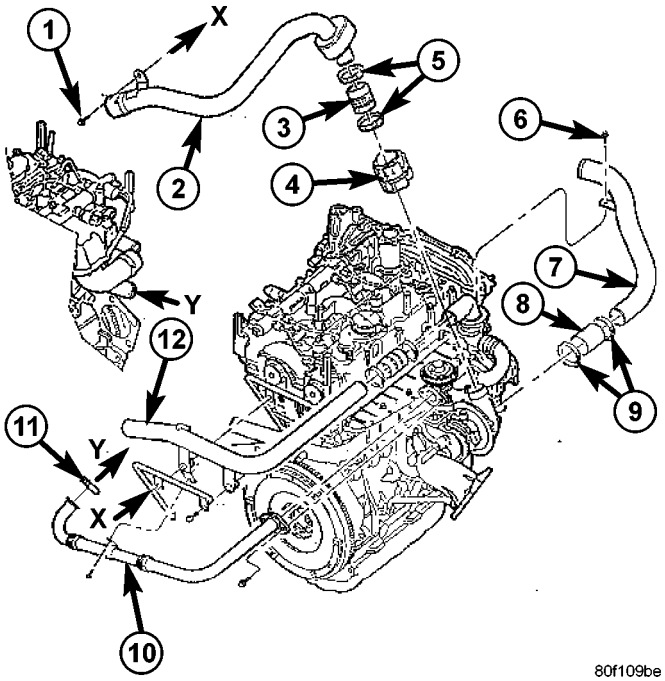

Fig. 10 TURBOCHARGER AND COOLANT PIPES

1 - TURBOCHARGER OUTLET PIPE RETAINING BOLT
2 - TURBOCHARGER OUTLET PIPE
3 - ADAPTER HOSE
4 - HEAT SHIELD
5 - HOSE CLAMPS
6 - TURBOCHARGER INLET PIPE RETAINING BOLT
7 - TURBOCHARGER INLET PIPE
8 - ADAPTER HOSE
9 - HOSE CLAMPS
10 - EGR VALVE TO INTAKE AIR INLET PIPE
11 - CLAMP
12 - THERMOSTAT HOUSING TO UPPER RADIATOR HOSE PIPE

(5) Remove exhaust manifold heat shield retaining bolts and remove shield (Fig. 11).

HEAT SHIELDS (Continued)

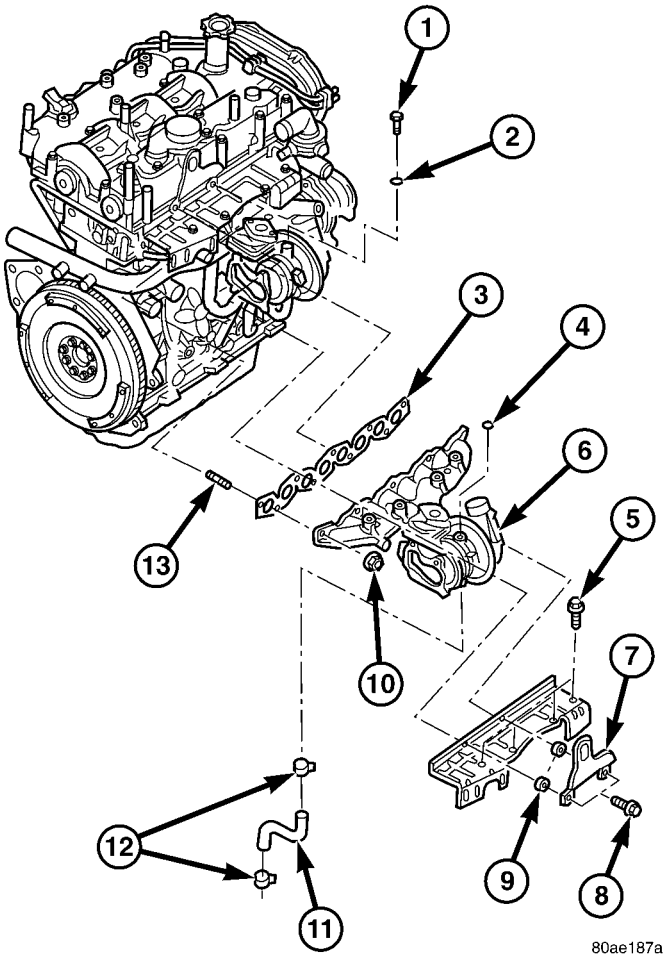

Fig. 11 EXHAUST MANIFOLD AND TURBOCHARGER

1 - TURBOCHARGER OIL SUPPLY BANJO BOLT
2 - COPPER WASHER
3 - EXHAUST MANIFOLD GASKET
4 - COPPER WASHER
5 - EXHAUST MANIFOLD HEAT SHIELD RETAINING BOLT
6 - TURBOCHARGER
7 - ENGINE LIFT HOOK
8 - ENGINE LIFT HOOK RETAINING BOLT
9 - SPACER
10 - EXHAUST MANIFOLD RETAINING NUT
11 - TURBOCHARGER OIL RETURN HOSE
12 - HOSE CLAMPS
13 - EXHAUST MANIFOLD STUDS

INSTALLATION

(1) Reposition exhaust heat shield (Fig. 11).

(2) Install exhaust heat shield retaining bolts (Fig. 11). Torque bolts to 27.5N·m.

(3) Install thermostat housing to upper radiator hose tube (Fig. 10).

(4) Refill cooling system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).

(5) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).

(6) Install front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).

(7) Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.

(8) Check the exhaust system for contact with the body panels. Make the necessary adjustments, if needed.