

EXHAUST SYSTEM

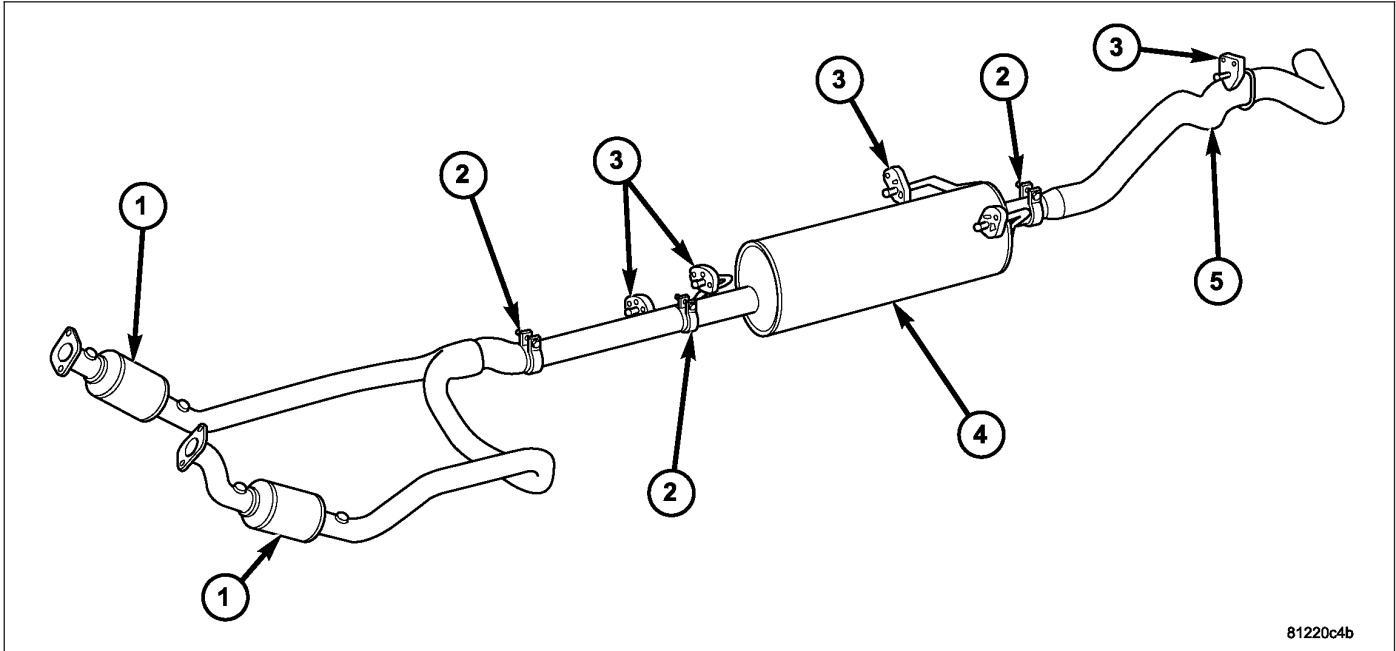
TABLE OF CONTENTS

	page		page
EXHAUST SYSTEM		5.9L DIESEL ENGINE	20
DESCRIPTION		INSTALLATION	
GAS ENGINES	2	3.7L/4.7L/5.7L ENGINE	20
5.9L DIESEL	3	8.3L ENGINE	21
DIAGNOSIS AND TESTING		5.9L DIESEL ENGINE	21
GAS ENGINE	4	TAILPIPE	
DIESEL ENGINE	5	REMOVAL	
SPECIFICATIONS		3.7L/4.7L/5.7L ENGINE	22
TORQUE	5	5.9L DIESEL	22
SPECIAL TOOLS	7	8.3L ENGINE	23
CONVERTER-CATALYTIC		INSPECTION	23
DESCRIPTION	8	INSTALLATION	
OPERATION	8	3.7L/4.7L/5.7L ENGINE	23
REMOVAL		5.9L DIESEL	24
3.7L/4.7L ENGINE	8	8.3L ENGINE	24
5.7L ENGINE	9	TURBOCHARGER SYSTEM	
5.9L DIESEL ENGINE	9	DIAGNOSIS AND TESTING	
8.3L ENGINE	10	TURBOCHARGER BOOST PRESSURE	25
INSPECTION	10	TURBOCHARGER	
INSTALLATION		DESCRIPTION	26
3.7L/4.7L ENGINE	10	OPERATION	27
5.7L ENGINE	11	REMOVAL	
5.9L ENGINE DIESEL	11	TURBOCHARGER	29
8.3L ENGINE	12	TURBOCHARGER OIL DRAIN TUBE	30
PIPE EXHAUST		CLEANING	30
REMOVAL		INSPECTION	30
3.7L/4.7L/5.7L ENGINE	13	INSTALLATION	
5.9L DIESEL	13	TURBOCHARGER	31
8.3L ENGINE	13	TURBOCHARGER OIL DRAIN TUBE	32
INSPECTION	14	WASTEGATE - ELECTRONIC ACTUATOR	
INSTALLATION		REMOVAL	33
3.7L/4.7L/5.7L ENGINE	14	INSTALLATION	33
5.9L DIESEL	14	CHARGE AIR COOLER AND PLUMBING	
8.3L ENGINE	15	DESCRIPTION	34
HEAT SHIELDS		OPERATION	34
DESCRIPTION	16	DIAGNOSIS AND TESTING	
REMOVAL	16	CHARGE AIR COOLER SYSTEM - LEAKS	35
INSTALLATION	17	REMOVAL	35
MUFFLER		CLEANING	36
REMOVAL		INSPECTION	36
3.7L/4.7L/5.7L ENGINE	19	INSTALLATION	36
8.3L ENGINE	19		

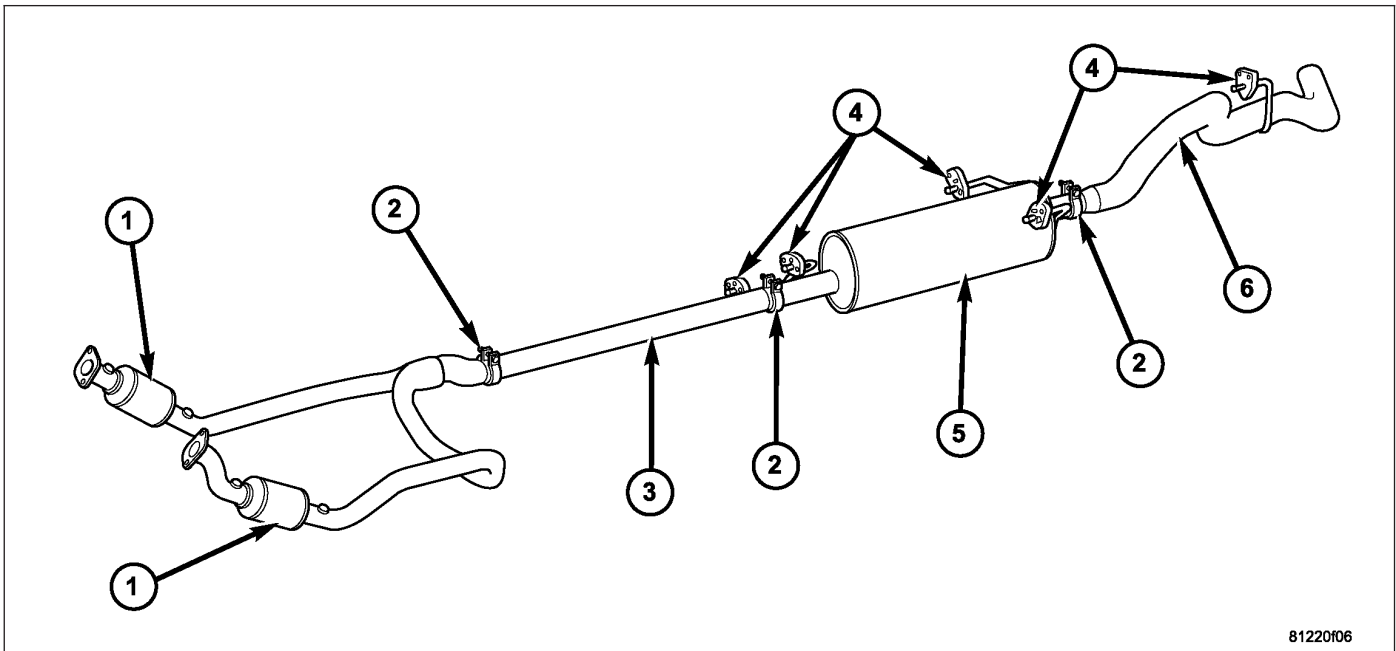
EXHAUST SYSTEM

DESCRIPTION

GAS ENGINES

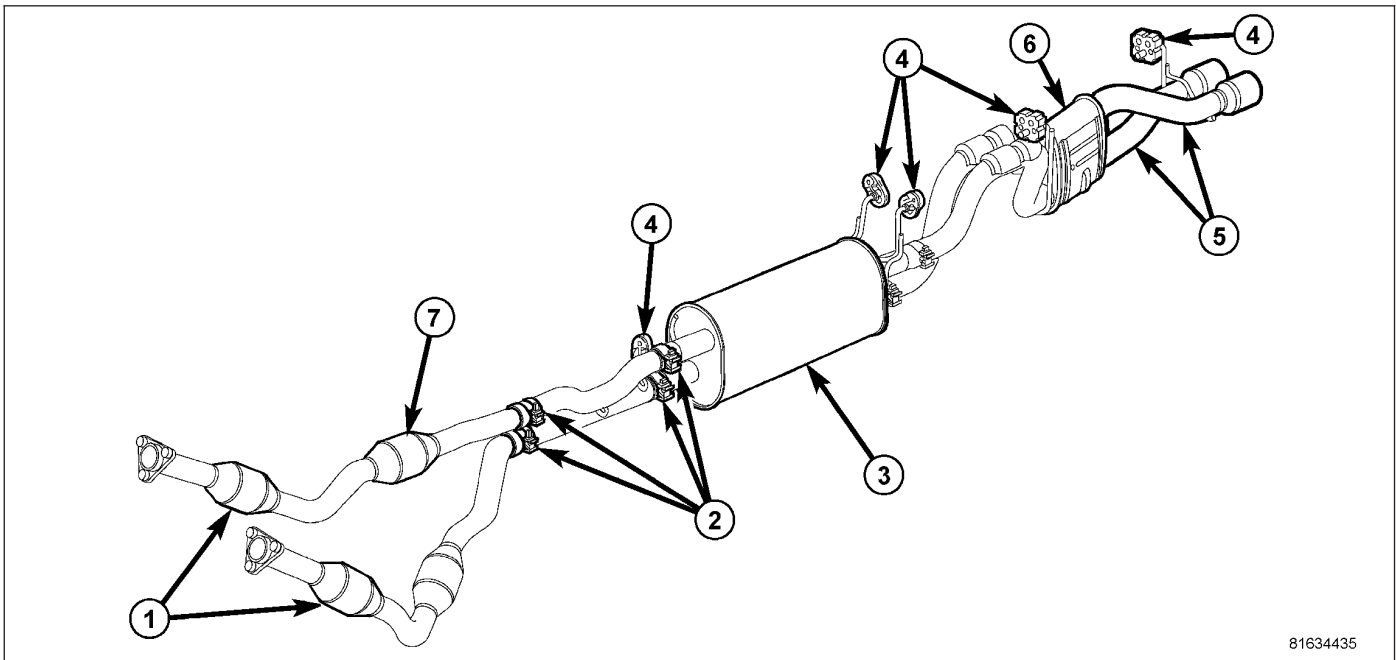
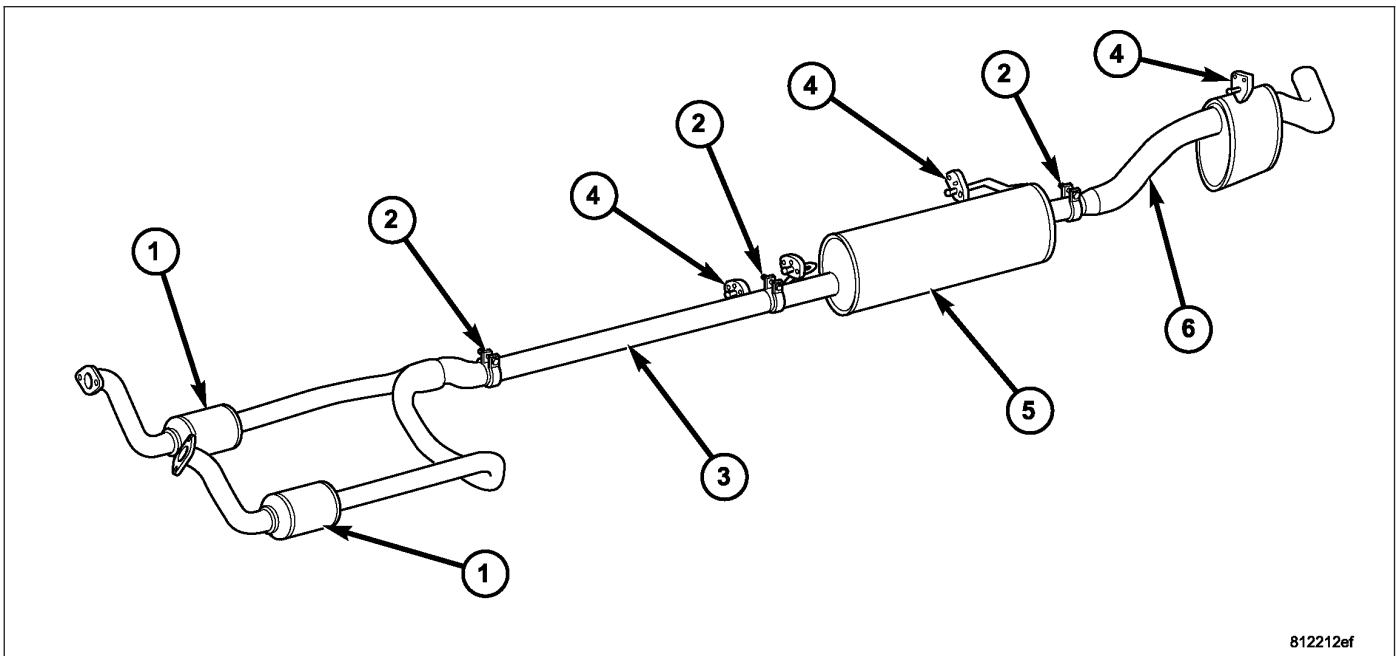


CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.



The federal gasoline engine exhaust system consists of engine exhaust manifolds, exhaust pipes, catalytic converter(s), extension pipe (if needed), exhaust heat shields, muffler and exhaust tailpipe .

The California emission vehicles exhaust system also contains the above components as well as mini catalytic converters added to the exhaust pipe.



The exhaust system must be properly aligned to prevent stress, leakage and body contact. Minimum clearance between any exhaust component and the body or frame is 25.4 mm (1.0 in.). If the system contacts any body panel, it may amplify objectionable noises from the engine or body.

5.9L DIESEL

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.

The diesel engine exhaust system consists of an engine exhaust manifold, turbocharger, exhaust pipe, resonator, extension pipe, catalytic converter, muffler and exhaust tailpipe.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. The exhaust components should be kept a minimum of 25.4 mm (1.0 in.) away from the body and frame. If the system contacts any body panel, it may amplify objectionable noises from the engine or body.

DIAGNOSIS AND TESTING**GAS ENGINE****EXHAUST SYSTEM DIAGNOSIS CHART**

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	1. Leaks at pipe joints. 2. Rusted or blown out muffler. 3. Broken or rusted out exhaust pipe. 4. Exhaust pipe leaking at manifold flange. 5. Exhaust manifold cracked or broken. 6. Leak between exhaust manifold and cylinder head. 7. Catalytic converter rusted or blown out. 8. Restriction in exhaust system.	1. Tighten clamps/bolts at leaking joints. 2. Replace muffler. Inspect exhaust system. 3. Replace exhaust pipe. 4. Tighten/replace flange attaching nuts/bolts. 5. Replace exhaust manifold. 6. Tighten exhaust manifold to cylinder head bolts. 7. Replace catalytic converter assy. 8. Remove restriction, if possible. Replace restricted part if necessary.
CAUTION: When servicing and replacing exhaust system components, disconnect the oxygen sensor connector(s). Allowing the exhaust to hang by the oxygen sensor wires will damage the harness and/or sensor.		

DIESEL ENGINE**EXHAUST SYSTEM DIAGNOSIS CHART**

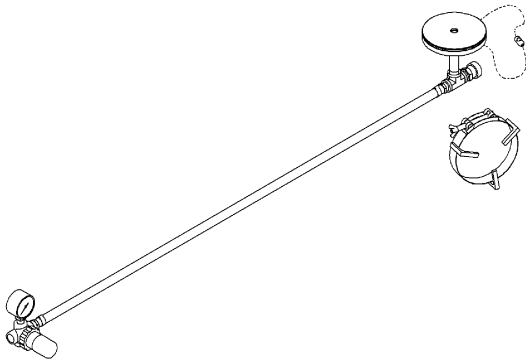
CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	1. Leaks at pipe joints. 2. Rusted or blown out muffler. 3. Broken or rusted out exhaust pipe. 4. Exhaust pipe leaking at manifold flange. 5. Exhaust manifold cracked or broken. 6. Leak between exhaust manifold and cylinder head. 7. Turbocharger mounting flange cracked. 8. Restriction in exhaust system.	1. Tighten clamps/bolts at leaking joints. 2. Replace muffler. Inspect exhaust system. 3. Replace exhaust pipe. 4. Tighten/replace flange attaching nuts/bolts. 5. Replace exhaust manifold. 6. Tighten exhaust manifold to cylinder head bolts. Replace gasket if necessary. 7. Remove turbocharger and inspect. (Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - REMOVAL). 8. Remove restriction, if possible. Replace restricted part if necessary.

SPECIFICATIONS**TORQUE**

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Bolt-Adjusting Strap	23	-	200
Nuts-Air Heater Power Supply	14	-	124
Bolts-Air Inlet Housing	24	18	-
Nuts-Cab Heater Supply/Return Line	24	18	-
Nuts-Exhaust Clamp	54	40	-
Bolts-Exhaust Manifold to Cylinder Head - (Diesel)	43	32	-
Bolts-Exhaust Manifold to Cylinder Head - (Diesel)	31	23	-
Bolts-Exhaust Manifold to Cylinder Head-(8.3L)	22	-	195
Bolts-Exhaust Pipe to Manifold	31	23	-
Bolts-Generator Mounting	41	30	-
Bolts-Charge Air Cooler Mounting	10	-	90
Nuts-Charge Air Cooler Duct	11	-	95
Bolt-Generator to Block-Diesel	24	18	-
Nuts and Bolts-Heat Shield	11	-	95
Nuts-Heat Shield-Diesel	24	18	-
Electronically Controlled Wastegate Command Valve-(Diesel)	34	25	-
Turbocharger flange studs-(Diesel)	24	18	-
Nuts-Turbocharger Mounting-(Diesel)	43	32	-

11 - 6 EXHAUST SYSTEM DR

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Bolts-Turbocharger Oil Drain Tube-(Diesel)	24	18	-
Fitting-Turbocharger Oil Supply Line-(Diesel)	36	27	-
Nut-Turbocharger V-Band Clamp Cast Elbow to Turbocharger-(Diesel)	8	-	75
Nut-T-bolt Clamp Cast Elbow to Exhaust pipe-(Diesel) NOTE: This is a One Time Use Only Nut.	11	-	100
Turbocharger Oil Supply fitting at Turbocharger-(Diesel)	36	27	-
Turbocharger Oil Supply fitting at lube filter head-(Diesel)	24	18	-

SPECIAL TOOLS***TURBOCHARGER TESTER 9022***

CONVERTER-CATALYTIC

DESCRIPTION

WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.

CAUTION: DO NOT remove spark plug wires from plugs or by any other means short out cylinders. Failure of the catalytic converter can occur due to a temperature increase caused by unburned fuel passing through the converter.

The stainless steel catalytic converter body is designed to last the life of the vehicle. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the converter. If unburned fuel enters the converter, overheating may occur. If a converter is heat-damaged, correct the cause of the damage at the same time the converter is replaced. Also, inspect all other components of the exhaust system for heat damage.

Unleaded gasoline must be used to avoid contaminating the catalyst core.

50 State emission vehicles incorporate two mini catalytic converters located after the exhaust manifolds and before the inline catalytic converter.

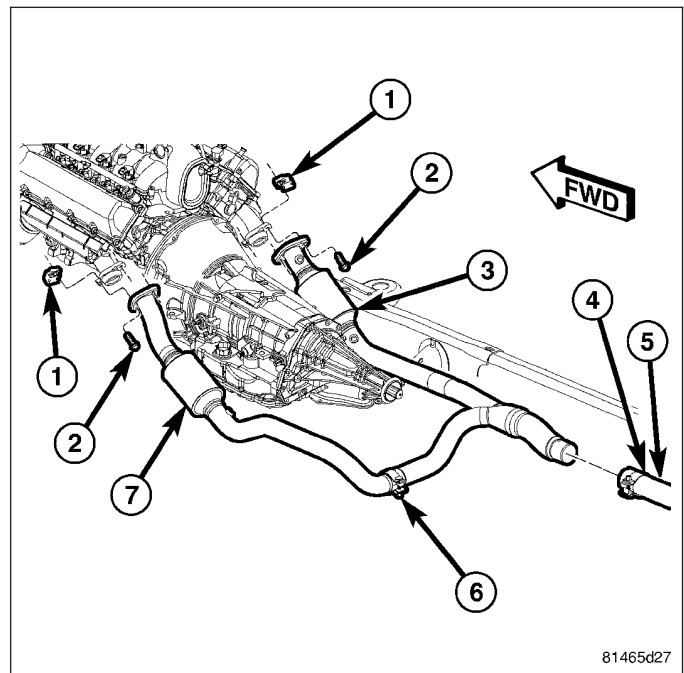
OPERATION

The catalytic converter captures and burns any unburned fuel mixture exiting the combustion chambers during the exhaust stroke of the engine. This process aids in reducing emissions output.

REMOVAL

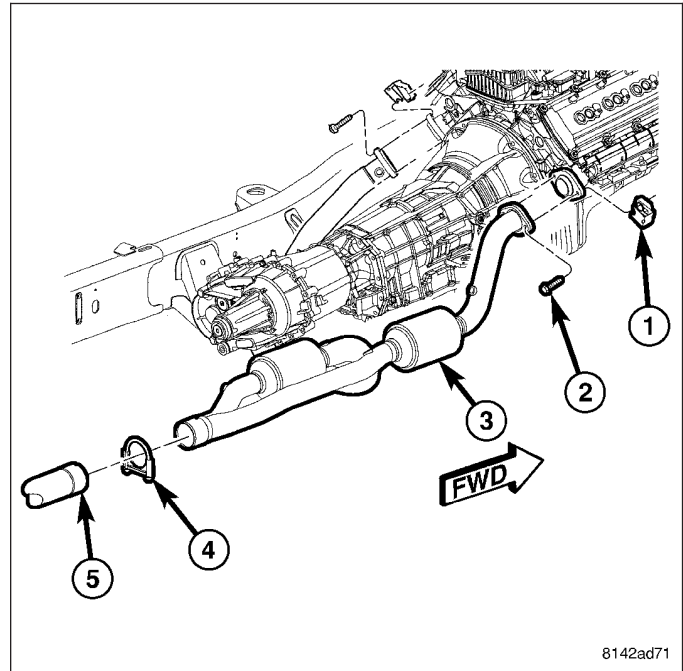
3.7L/4.7L ENGINE

1. Raise and support vehicle.
2. Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Disconnect oxygen sensor electrical connectors.
4. Remove clamp (4).
5. Remove bolts exhaust to manifold (2).
6. Remove catalytic converter (3).



5.7L ENGINE

1. Raise and support vehicle.
2. Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Disconnect oxygen sensor electrical connectors.
4. Remove clamps and nuts (4).
5. Remove catalytic converter to exhaust manifold bolts (2) and nuts (1).
6. Remove catalytic converter assembly (3).



5.9L DIESEL ENGINE

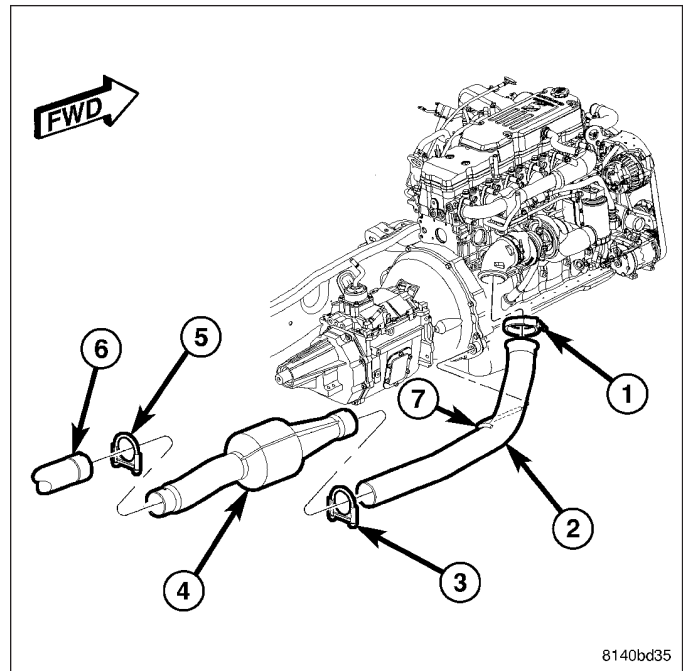
WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

1. Raise and support the vehicle.
2. Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Remove clamp bolts from exhaust pipe to catalytic converter clamp (5).

NOTE: Do not remove nut from T-Bolt. Only remove nut far enough, so that the T-end can be removed from the clamp.

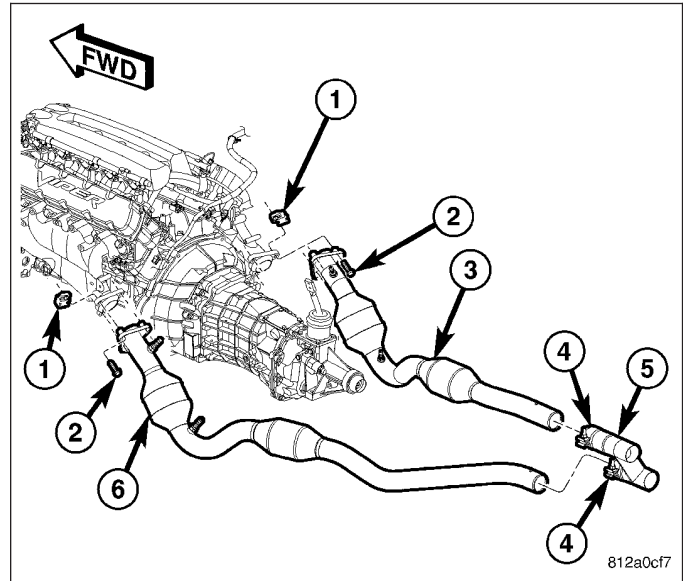
NOTE: The catalytic converter to exhaust manifold clamp is not reusable. Always use a new clamp when reinstalling the catalytic converter.

4. Loosen the nut from clamp (1) at turbocharger.
5. Remove the T-bolt end of the fastener, from the clamp (1).
6. Spread the clamp, and remove the catalytic converter (4) and front exhaust pipe (2) from the vehicle.
7. Discard the clamp.
8. Remove front exhaust pipe to catalytic converter clamp (3).
9. Separate front exhaust pipe (2) from catalytic converter (4).



8.3L ENGINE

1. Raise and support vehicle.
2. Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Disconnect oxygen sensor electrical connectors.
4. Remove LH exhaust pipe to manifold bolts (2), retainers and nuts (1).
5. Remove LH catalytic converter to muffler clamp nuts (4).
6. Rotate LH catalytic converters (6) from the muffler (5).
7. Remove RH exhaust pipe to manifold bolts (2), retainers and nuts (1).
8. Remove RH catalytic converter to muffler clamp nuts (4).
9. Rotate RH catalytic converter (3) from the muffler (5).
10. Remove clamps and nuts (4).



INSPECTION

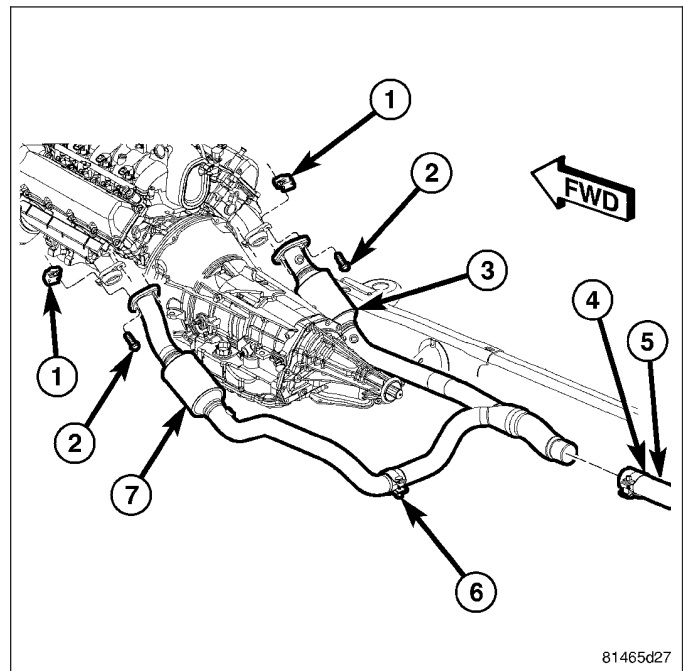
Look at the stainless steel body of the converter, inspect for bulging or other distortion that could be a result of overheating. If the converter has a heat shield attached make sure it is not bent or loose.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

INSTALLATION

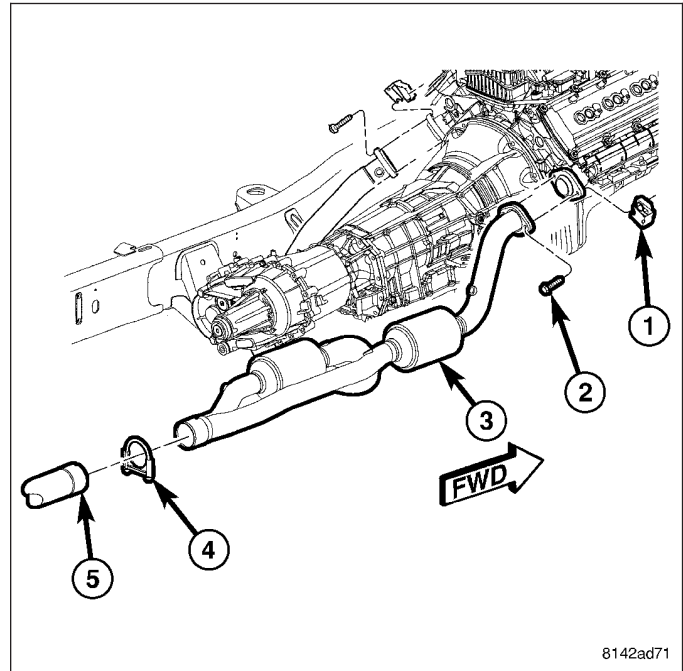
3.7L/4.7L ENGINE

1. Install RH catalytic converter to exhaust clamp (4) on RH catalytic converter (3) and position into exhaust pipe (5).
2. Install and hand tighten RH catalytic converter to exhaust manifold bolts (2).
3. Install c-clip nut (1) and bolt (2) to converter (3) to manifold.
4. Tighten catalytic converter to exhaust manifold bolts (1) to 31 N·m (23 ft. lbs.).
5. Tighten all clamp nuts (4) to 52.2 N·m (40 ft. lbs.) torque.
6. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
7. Check to ensure you have at least 25 mm clearance to oil pan.
8. Plug in O2 sensor wiring.
9. Lower the vehicle.
10. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



5.7L ENGINE

1. Install catalytic converter to exhaust clamp (4) on catalytic converter (3) and position into exhaust pipe (5).
2. Make sure the alignment tang on catalytic converter (3) is fully seated in the notch on the exhaust pipe (5).
3. Install catalytic converter to exhaust manifold bolts (2) and nuts (1).
4. Tighten catalytic converter to exhaust manifold bolts (2) to 31 N·m (23 ft. lbs.).
5. Tighten catalytic converter to exhaust pipe clamp nuts (4) to 52 N·m (40 ft. lbs.) torque.
6. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
7. Lower the vehicle.
8. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.

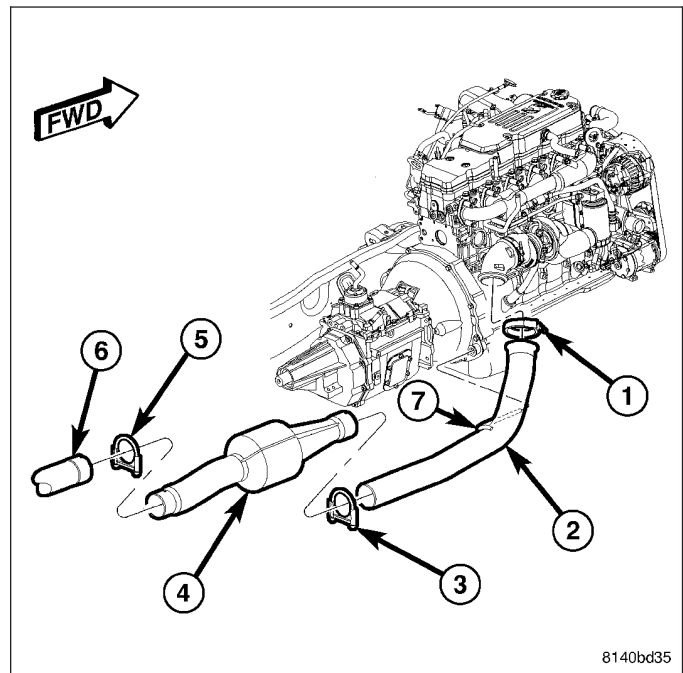


5.9L ENGINE DIESEL

NOTE: The catalytic converter to Front exhaust pipe clamp is not reusable. Always use a new clamp when reinstalling the catalytic converter.

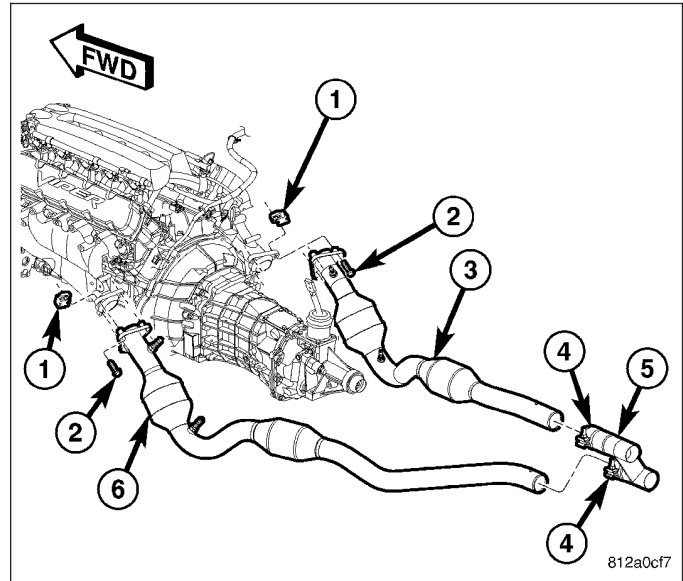
NOTE: The Front exhaust pipe to Elbow clamp is not reusable. Always use a new clamp when reinstalling the Front exhaust pipe.

1. Position the catalytic converter (4) onto the front exhaust pipe (2) until the alignment tab is seated into the alignment slot of the catalytic converter (4).
2. Install catalytic converter (4) into the exhaust pipe (6) until the alignment tab is seated into the alignment slot of exhaust pipe (6).
3. Position front exhaust pipe (2) onto turbocharger and install new clamp (1). Tighten the nuts to 11 N·m (100 in. lbs.) torque.
4. Install the exhaust clamp (5) at the exhaust pipe (6) and catalytic converter (4) connection. Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
5. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
6. Lower the vehicle.
7. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



8.3L ENGINE

1. Make sure catalytic converters (3, 6) and mufflers (5) are free of burrs.
2. Insert RH catalytic converter (3) into muffler (5).
3. Make sure the alignment tang on the catalytic converter (3) seats in the alignment slot on the muffler (5).
4. Position the catalytic converter (3) to the exhaust manifold. Install and hand tighten bolts (2), retainers and nuts (1).
5. Insert LH catalytic converter (6) into muffler (5).
6. Make sure the alignment tang on the catalytic converter (6) seats in the alignment slot on the muffler (5).
7. Position the catalytic converter (6) to the exhaust manifold. Install and hand tighten bolts (2), retainers and nuts (1).
8. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Clearance between catalytic converter and frame is 15 mm (.59 inch). Make the necessary adjustments, if needed.
9. Tighten catalytic converter to exhaust manifold bolts (2) to 20 N·m (15 ft. lbs.) torque.
10. Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
11. Lower the vehicle.
12. Start the engine and inspect for exhaust leaks. and exhaust system. Repair exhaust leaks as necessary.



PIPE EXHAUST

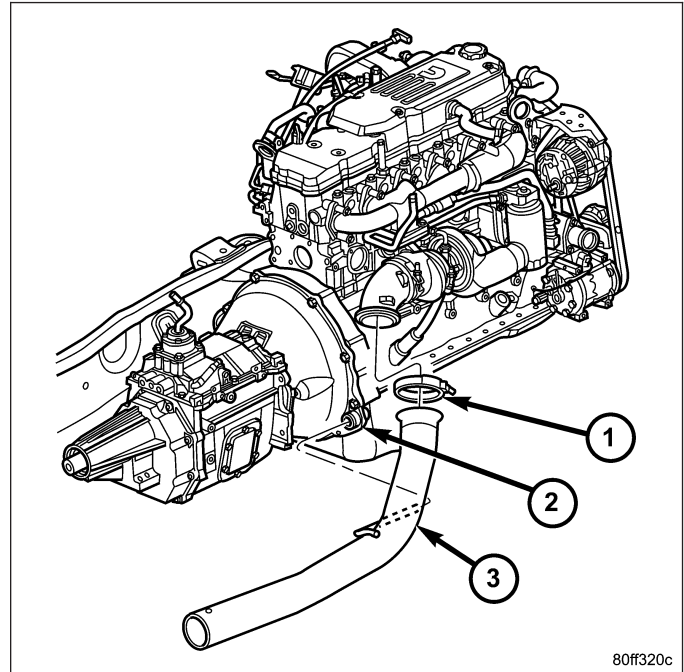
REMOVAL

3.7L/4.7L/5.7L ENGINE

1. Raise and support the vehicle.
2. Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Remove exhaust pipe to manifold bolts and nuts.
4. Remove the clamp nuts.
5. Remove the exhaust pipe.

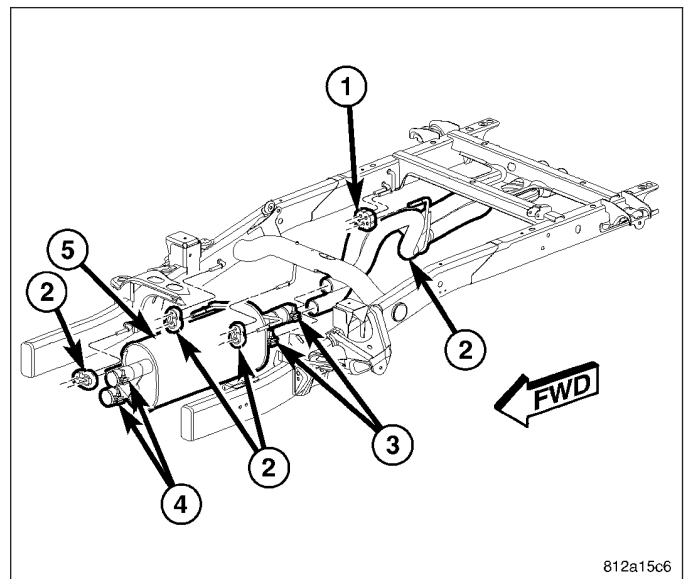
5.9L DIESEL

1. Disconnect the battery negative cables.
2. Raise and support the vehicle on a hoist.
3. Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
4. Remove the exhaust pipe-to-extension pipe clamp. Separate the exhaust pipe and extension pipe.
5. Remove the exhaust pipe-to-turbocharger elbow clamp and discard.
6. Remove the exhaust pipe from the transmission support.



8.3L ENGINE

1. Raise and support the vehicle.
2. Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Remove clamp nuts.
4. Remove exhaust pipe isolators.
5. Rotate the exhaust pipes to remove from the muffler.



INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

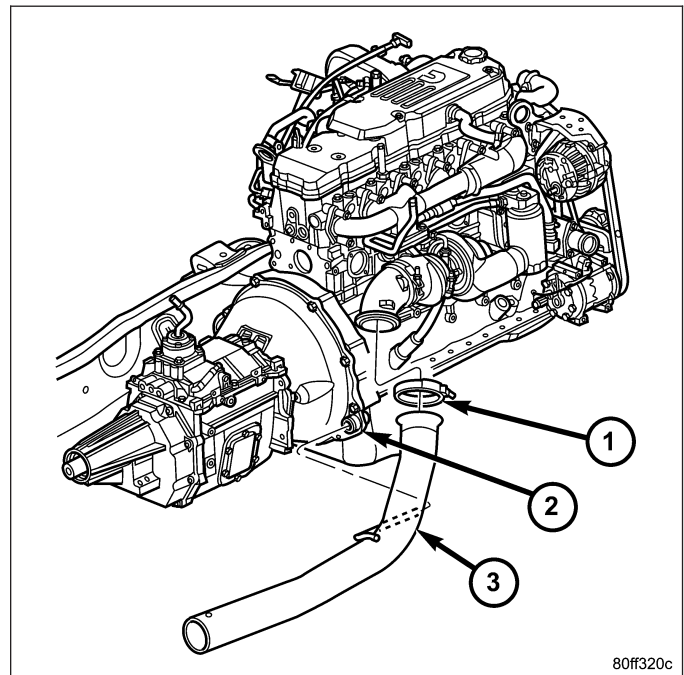
INSTALLATION

3.7L/4.7L/5.7L ENGINE

1. Position the exhaust pipe for proper clearance with the frame and underbody parts. A minimum clearance of 25 mm (1.0 in.) is required.
2. Position the exhaust pipe to manifold. Install the bolts and nuts. Tighten the nuts to 31 N·m (23 ft. lbs.) torque.
3. Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
4. Lower the vehicle.
5. Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

5.9L DIESEL

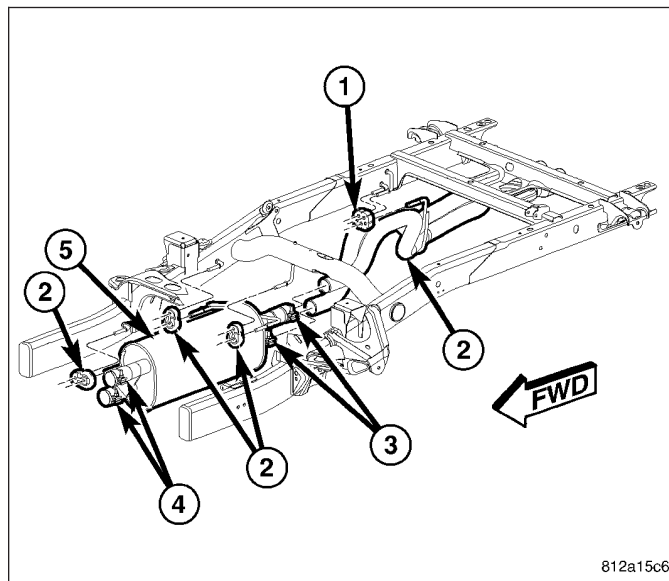
1. Install the exhaust pipe into the transmission support and onto the turbocharger flange.
2. Install a New exhaust pipe-to-turbocharger elbow clamp and tighten to 11 N·m (100 in. lbs.) torque.
3. Install the extension pipe and clamp to the exhaust pipe using a new clamp and tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
4. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
5. Lower the vehicle.
6. Connect the battery negative cables.
7. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



80ff320c

8.3L ENGINE

1. Make sure exhaust pipe is free of any burrs.
2. Insert exhaust pipes into muffler.
3. Make sure alignment tang on exhaust pipes seat into alignment slot on muffler.
4. Install exhaust pipe insulators.
5. Position the exhaust pipe for proper clearance with the frame and underbody parts. A minimum clearance of 25 mm (1.0 in.) is required.
6. Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
7. Lower the vehicle.
8. Start the engine and inspect for exhaust leaks and inspect for exhaust leaks. Repair exhaust leaks as necessary.



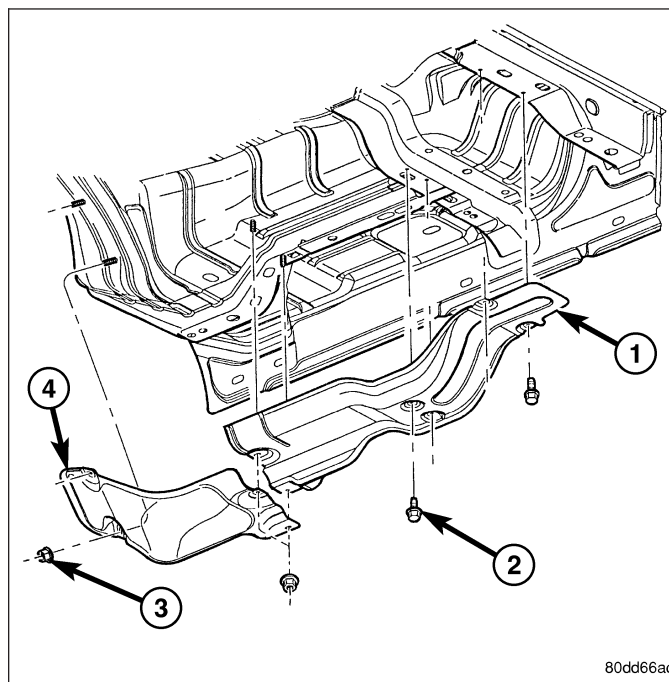
HEAT SHIELDS

DESCRIPTION

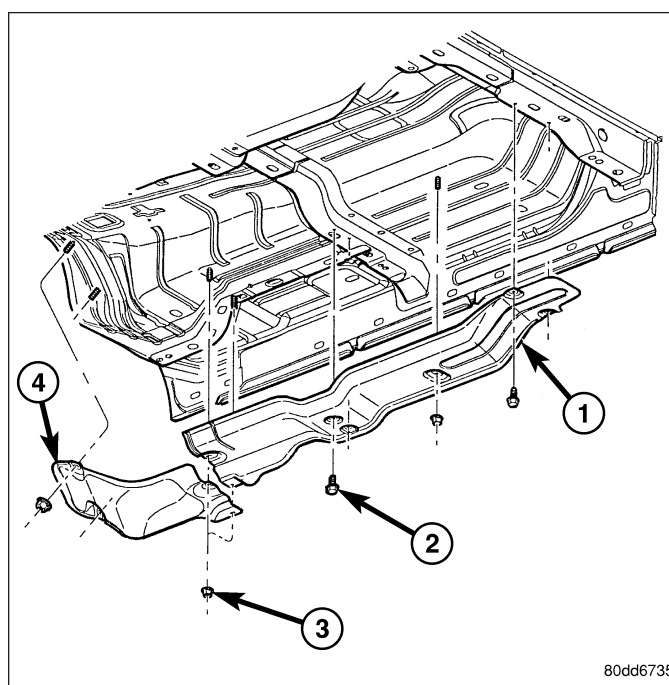
There are two types of heat shields used. One is stamped steel the other is molded foil sheets. The shields attach to the vehicle around the exhaust system to prevent heat from the exhaust system from entering the passenger area and other areas where the heat can cause damage to other components.

REMOVAL

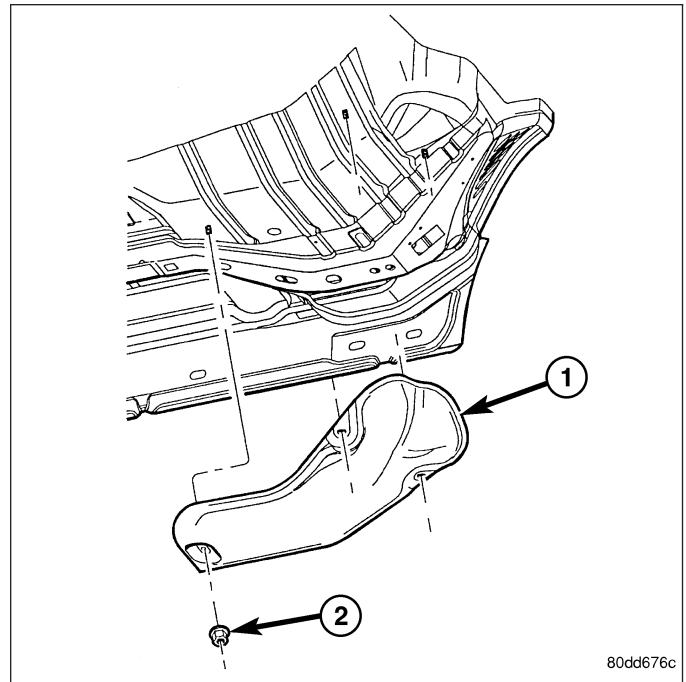
1. Raise and support the vehicle.



2. Remove the nuts or bolts holding the exhaust heat shield to the floor pan, crossmember or bracket.

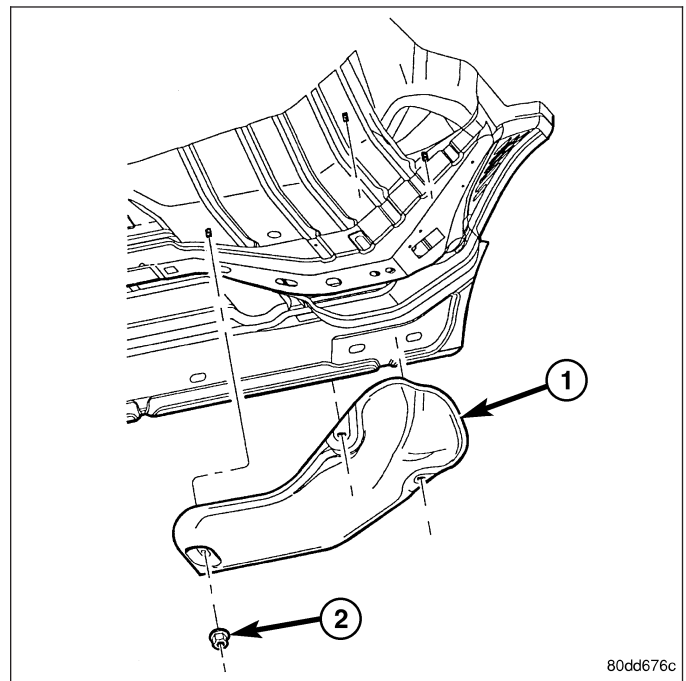


3. Slide the shield out around the exhaust system.

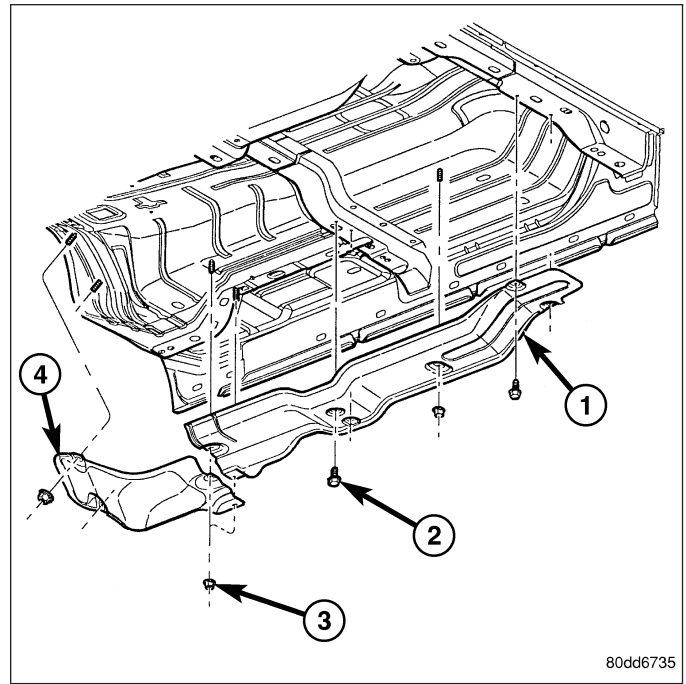


INSTALLATION

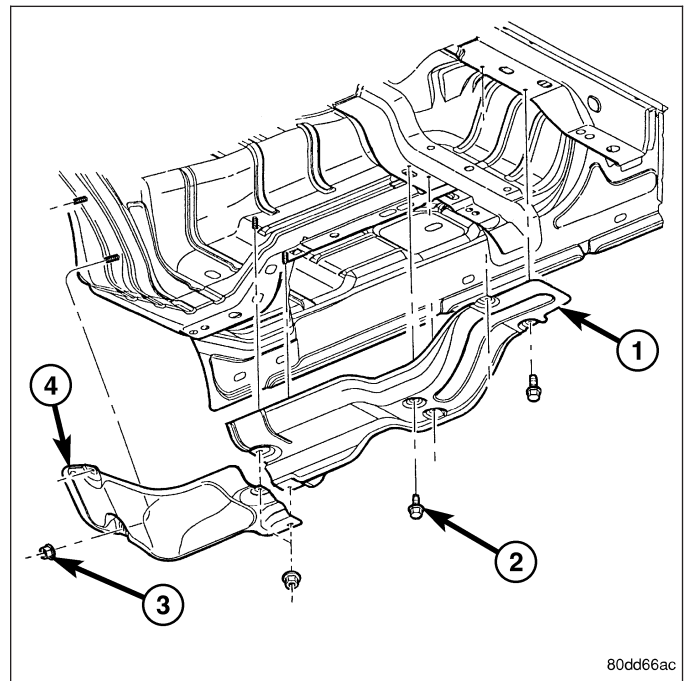
1. Position the exhaust heat shield to the floor pan, crossmember or bracket and install the nuts or bolts.



2. Tighten the nuts and bolts 11 N·m (100 in. lbs.).



3. Lower the vehicle.

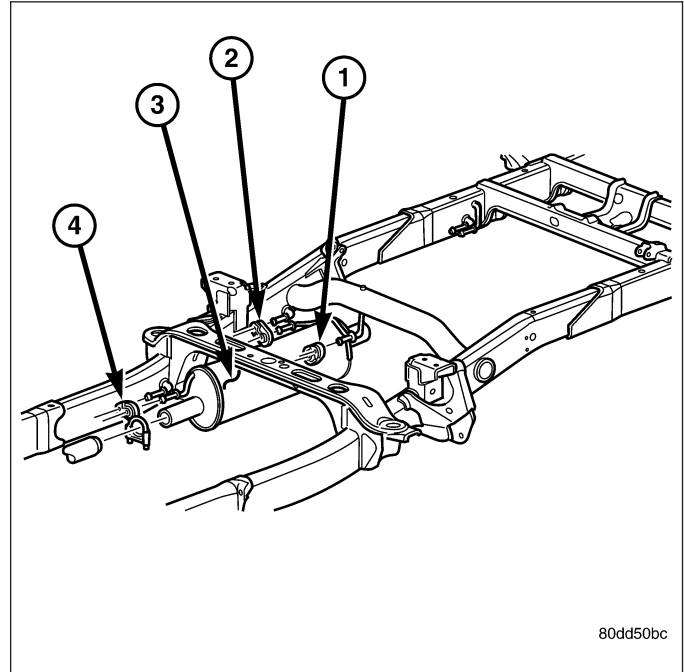


MUFFLER

REMOVAL

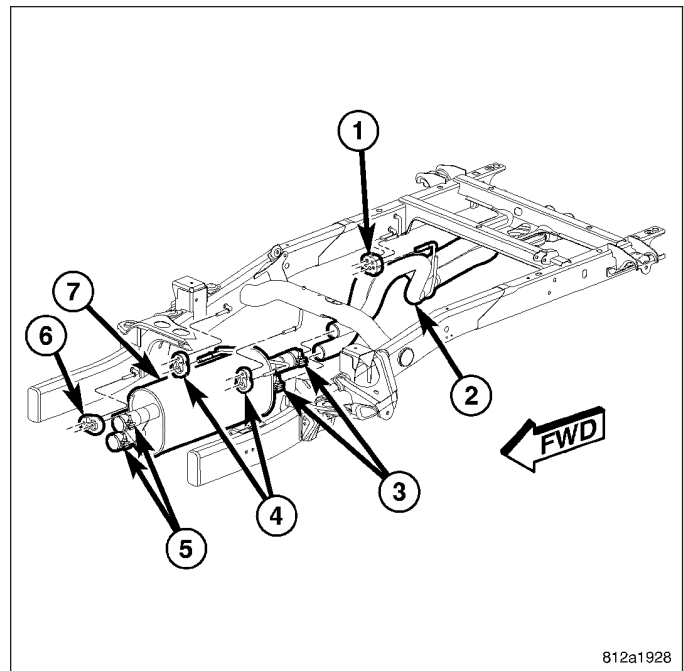
3.7L/4.7L/5.7L ENGINE

1. Raise and support the vehicle.
2. Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Disconnect the muffler hangers.
4. Remove clamps and nuts.
5. Remove the muffler.



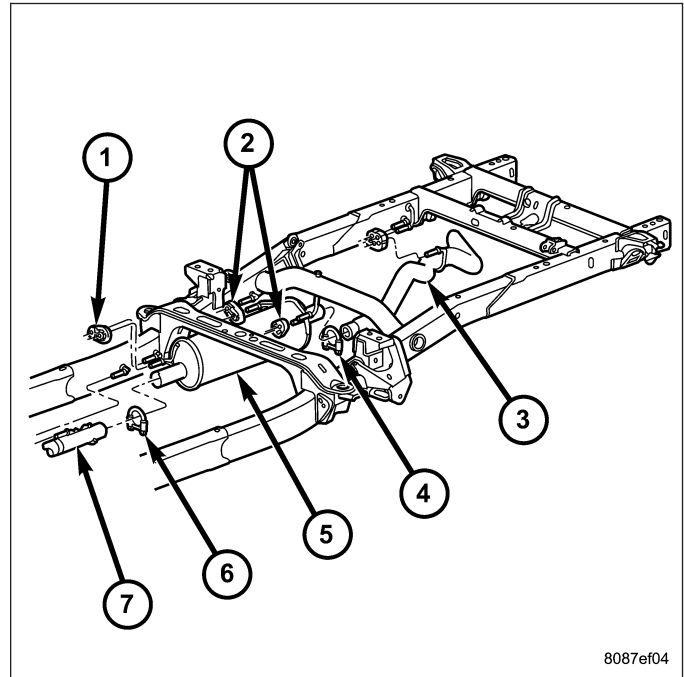
8.3L ENGINE

1. Raise and support the vehicle.
2. Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Remove exhaust pipes (Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - REMOVAL).
4. Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.
5. Disconnect the muffler hangers.
6. Remove muffler-to-catalytic converter clamp nuts.
7. Remove the muffler.



5.9L DIESEL ENGINE

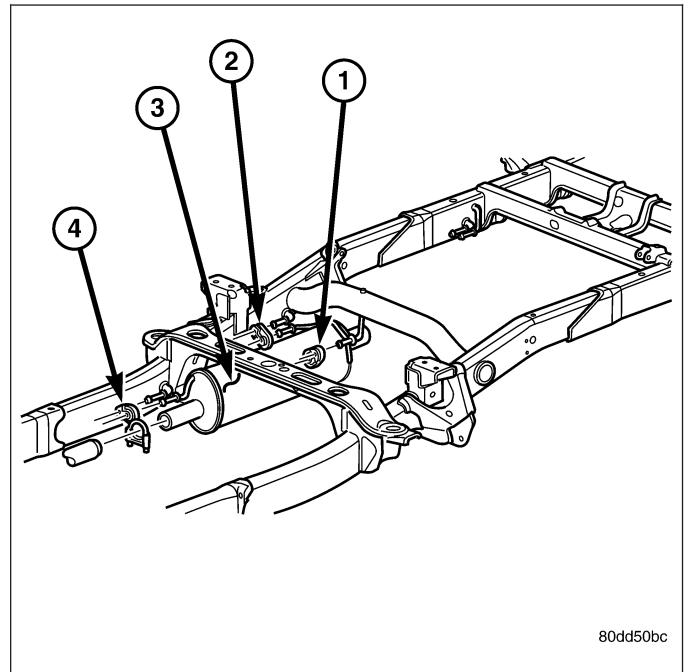
1. Disconnect the battery negative cables.
2. Raise and support the vehicle.
3. Remove the muffler to tail pipe and extension pipe clamps.
4. Disconnect the muffler from the hanger isolators.
5. Disconnect the muffler from the tailpipe.
6. Disconnect the muffler from the extension pipe and remove from the vehicle.



INSTALLATION

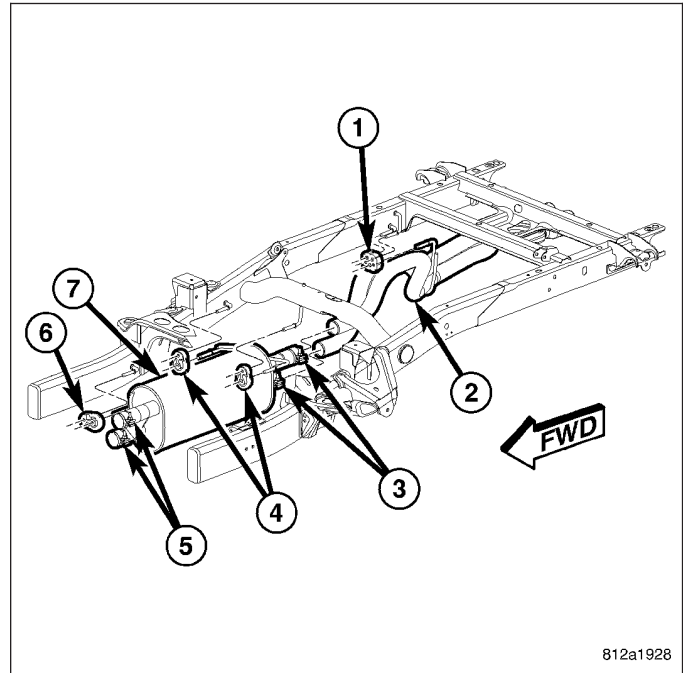
3.7L/4.7L/5.7L ENGINE

1. Assemble muffler and clamps loosely to permit proper alignment of all parts.
2. Connect the muffler hangers.
3. Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
4. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
5. Lower the vehicle.
6. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



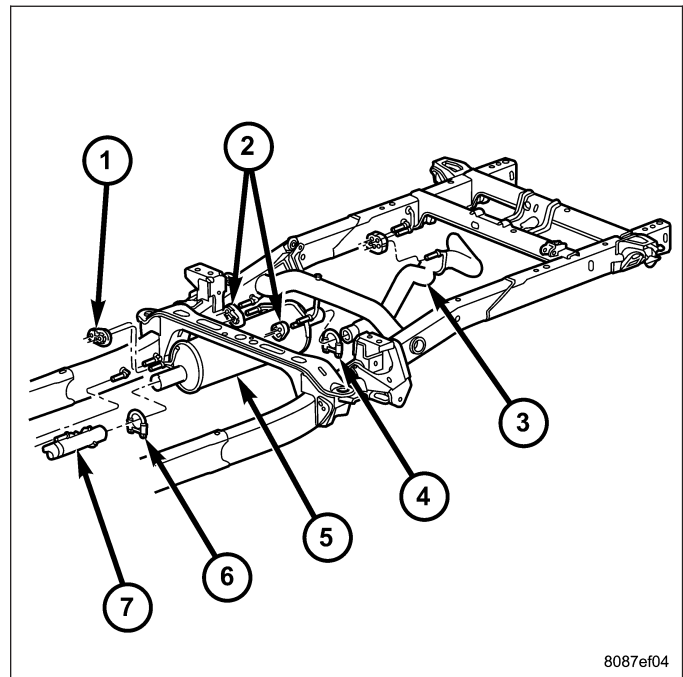
8.3L ENGINE

1. Make sure catalytic converters are free of burrs.
2. Assemble muffler and clamps loosely to permit proper alignment of all parts.
3. Make sure alignment tangs on catalytic converters seat into alignment slots on mufflers.
4. Connect the muffler hangers.
5. Install exhaust pipes (Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - INSTALLATION).
6. Check the exhaust system for contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
7. Tighten the clamp nuts to 54 N·m (40 ft. lbs.) torque.
8. Lower the vehicle.
9. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



5.9L DIESEL ENGINE

1. Install the muffler hanger rods into the isolators.
2. Install the muffler into the extension pipe.
3. Install the muffler into the tail pipe.
4. Install the exhaust clamps, align the exhaust system, and tighten the exhaust clamps to 54 N·m (40 ft. lbs.) torque.
5. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
6. Lower the vehicle.
7. Connect the battery negative cables.
8. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.

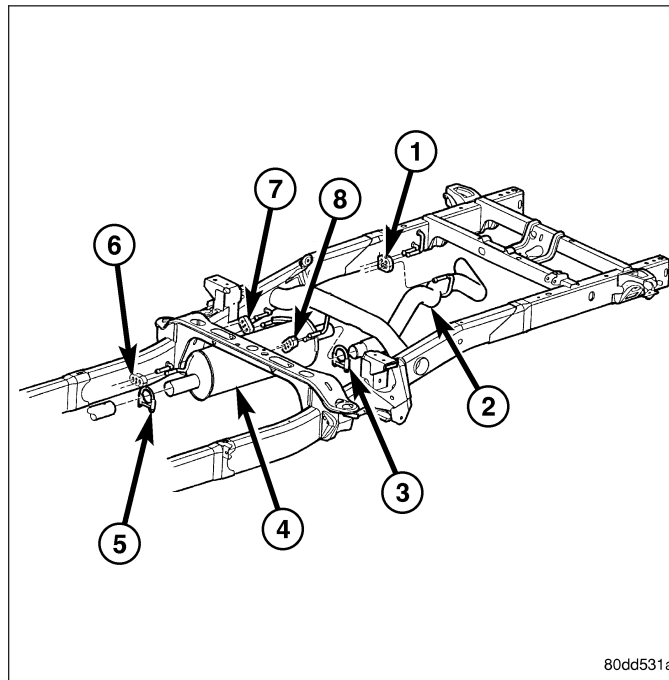


TAILPIPE

REMOVAL

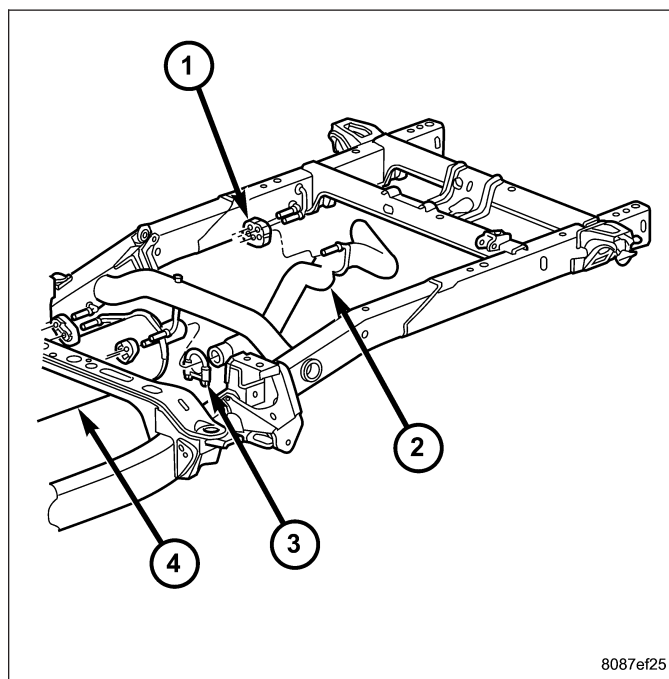
3.7L/4.7L/5.7L ENGINE

1. Raise and support the vehicle.
2. Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Disconnect the exhaust tailpipe support hanger.
4. Remove clamps and nuts.
5. Remove the exhaust tailpipe.



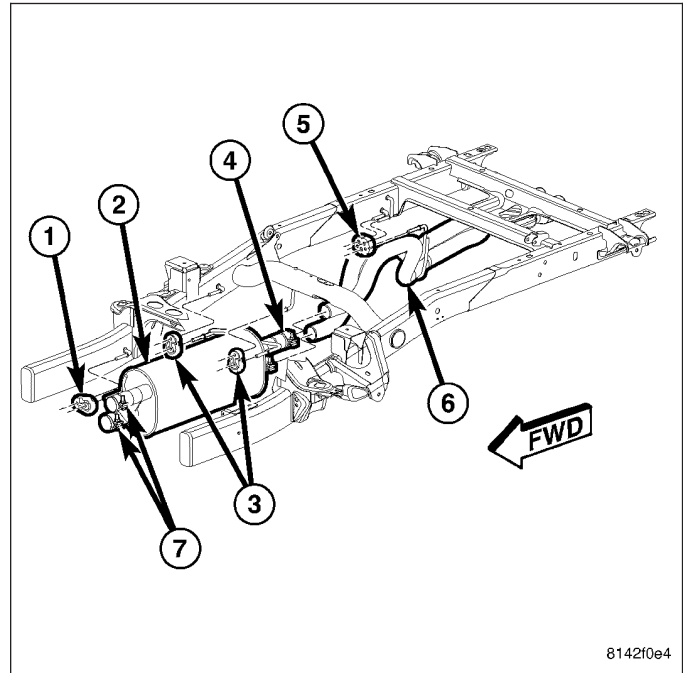
5.9L DIESEL

1. Disconnect the battery negative cables.
2. Raise and support the vehicle.
3. Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.
4. Disconnect the exhaust tailpipe support hanger isolators.
5. Remove the muffler-to-tailpipe clamps.
6. Remove the tailpipe from the vehicle.



8.3L ENGINE

1. Raise and support the vehicle.
2. Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.
3. Disconnect the exhaust tailpipe support insulators (3 and 5).
4. Remove clamps (4) and nuts.
5. Remove the exhaust tailpipes (6).



8142f0e4

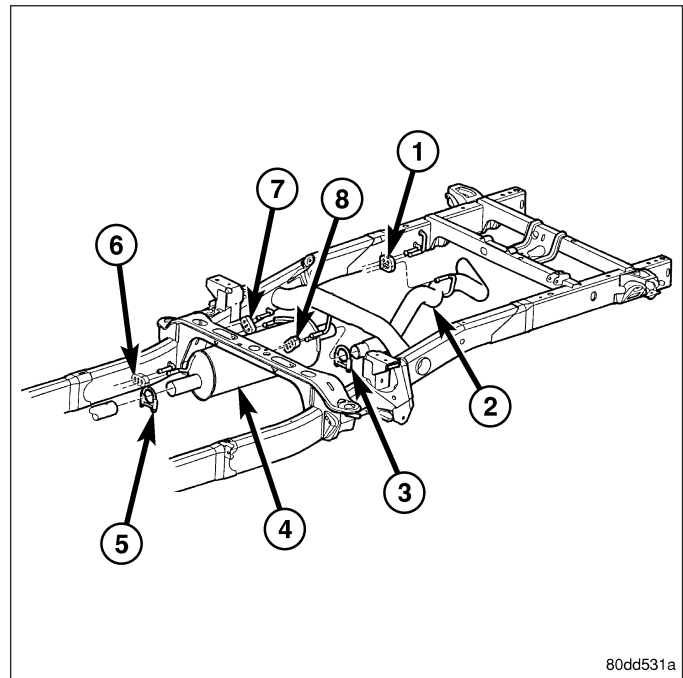
INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

INSTALLATION

3.7L/4.7L/5.7L ENGINE

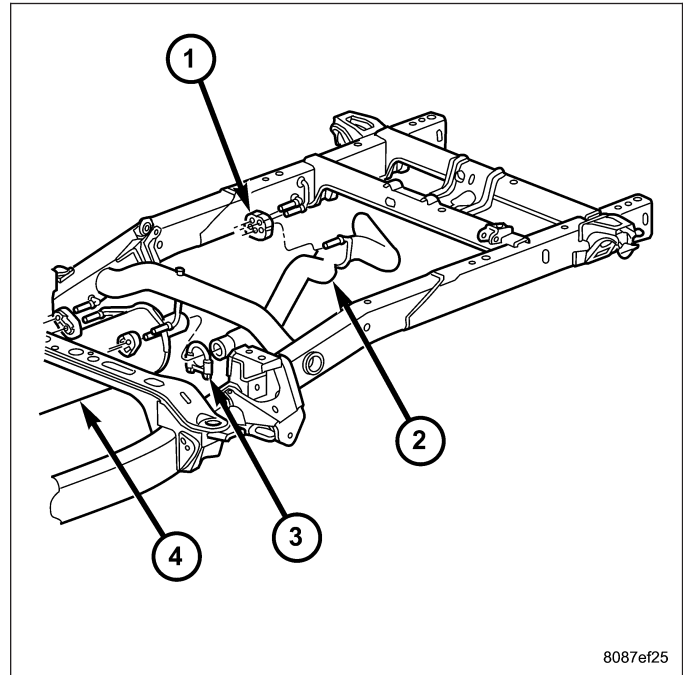
1. Loosely assemble exhaust tailpipe to permit proper alignment of all parts.
2. Connect the support hangers.
3. Position the exhaust tailpipe for proper clearance with the underbody parts.
4. Tighten all clamp nuts to 54 N·m (40 ft. lbs.) torque.
5. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
6. Lower the vehicle.
7. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



80dd531a

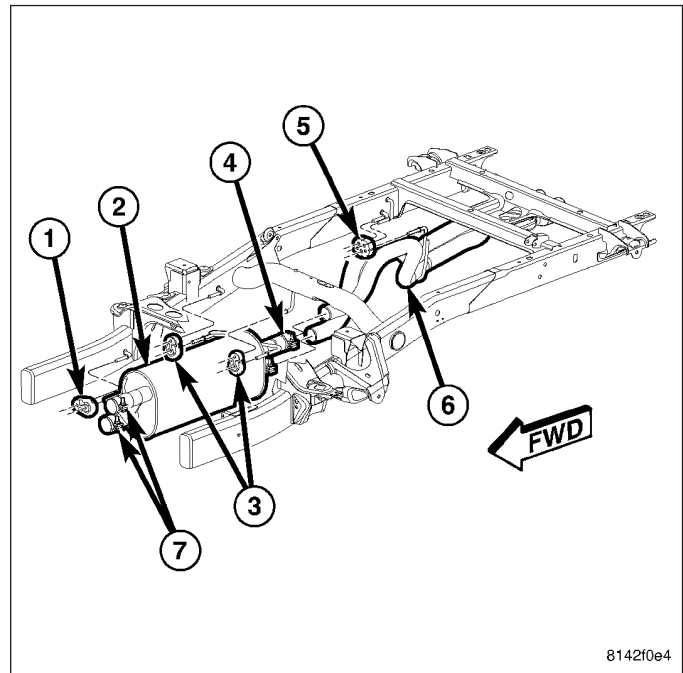
5.9L DIESEL

1. Install the tailpipe into the muffler.
2. Install the tailpipe hanger rods into the isolators
3. Install the exhaust clamp, align the exhaust system, and tighten the clamp 48 N·m (35 ft. lbs.) torque.
4. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
5. Lower the vehicle.
6. Connect the battery negative cables.
7. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



8.3L ENGINE

1. Position tailpipes (6) into muffler (2).
2. Make sure alignment tang on tailpipes (6) fully seat into alignment slots on muffler (2).
3. Install insulators (5).
4. Check the exhaust system for contact with the body panels. A minimum of 25 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Make the necessary adjustments, if needed.
5. Tighten all clamp (4) nuts to 54 N·m (40 ft. lbs.) torque.
6. Lower the vehicle.
7. Start the engine and inspect for exhaust leaks. Repair exhaust leaks as necessary.



TURBOCHARGER SYSTEM

DIAGNOSIS AND TESTING

TURBOCHARGER BOOST PRESSURE

Low turbocharger boost pressure can cause poor engine performance and driveability concerns. The following procedure will test the turbocharger boost pressure.

Causes of low boost pressure include the following:

- Restricted air inlet system
- Leak in charge air cooler system
- Restricted/high pressure drop across charge air cooler
- Damaged turbocharger compressor wheel housing
- Turbocharger wastegate stuck open
- Excessive exhaust restriction

Causes of excessively high boost pressure include:

- Turbocharger wastegate stuck closed
- Turbocharger wastegate signal line leaking or damaged
- Damaged wastegate command valve O-rings
- Wastegate command valve mechanically stuck in actuated position

Several Diagnostic Trouble Codes (DTCs) can be set that will indicate high or low system boost levels. There is a DTC for circuit faults relating to the electronically controlled wastegate command valve.

(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/CHARGE AIR COOLER AND PLUMBING - DIAGNOSIS AND TESTING) for diagnosing of low or high boost pressure due to leaks.

NOTE: If oil is present on either the inlet or exhaust side of the turbo charger, check the charge air cooler for evidence of oil. Clean charge air cooler of any oil before starting the engine. Failure to do this can result in severe engine damage.

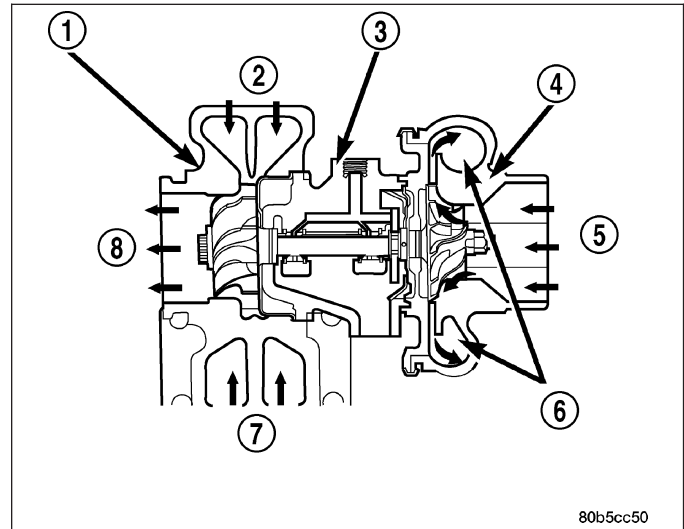
TURBOCHARGER

DESCRIPTION

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.

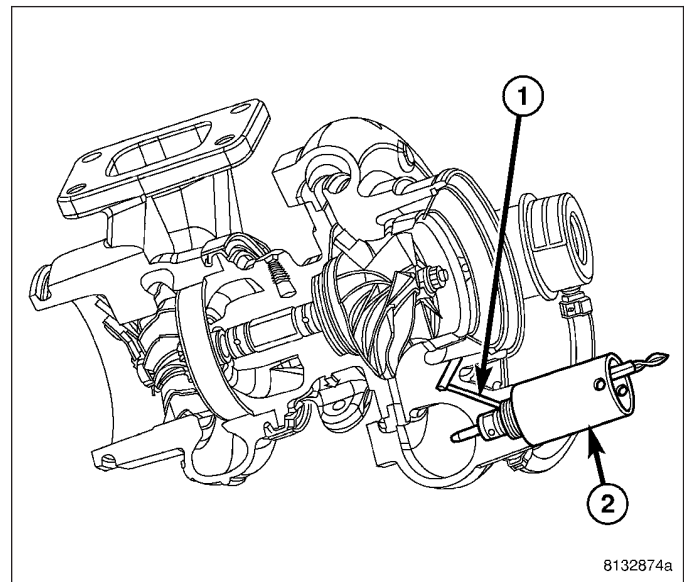
The turbocharger assembly consists of eight (8) component systems :

- 1 - Turbine section (1)
- 2 - Exhaust stream into turbine (2)
- 3 - Bearing housing (3)
- 4 - Compressor housing (4)
- 5 - Clean air inlet (5)
- 6 - Compressor section (6)
- 7 - Exhaust stream into turbine (7)
- 8 - Exhaust gas to Exhaust Pipe (8)



The turbocharger wastegate assembly consists of two (2) major component systems :

- 1 - Command Passage (1)
- 2 - Electronically controlled wastegate command valve (2)



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.

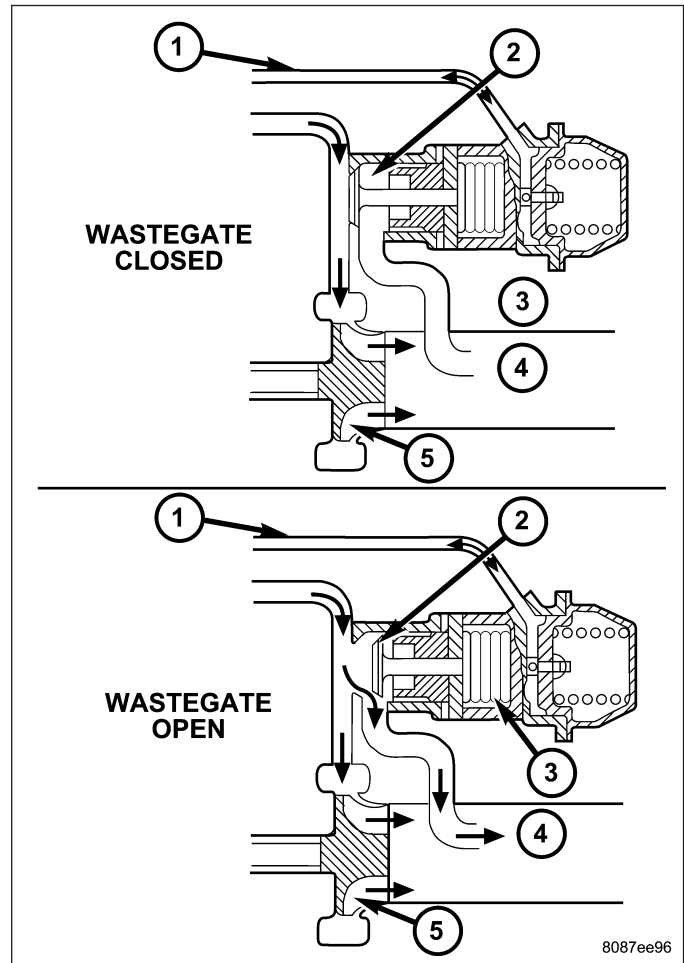
The turbocharger features a wastegate, which regulates intake manifold air pressure and prevents overboosting at high engine speeds and loads. When the wastegate valve is closed, all of the exhaust gases flow through the turbine wheel. As the boost pressure (compressor outlet) increases, the boost pressure is fed to the wastegate actuator via a wastegate signal line. When sufficient boost pressure is achieved, the boost pressure applied to the wastegate diaphragm overcomes spring pressure and moves an actuator rod to open an exhaust bypass valve. When exhaust gas is diverted from the turbine wheel, turbine shaft speed is limited which reduces compressor wheel speed, thereby limiting boost pressure.

The turbocharger wastegate system incorporates, an Electronically Controlled Wastegate Command Valve, to control boost pressure. The command valve is located on the turbocharger compressor housing.

When the command valve is not actuated (no current supplied to the valve), a passage in the valve allows the wastegate signal line to be supplied with boost pressure. This allows boost pressure to be mechanically regulated by the wastegate as in a conventional wastegated system.

When the engine control module (ECM) provides a pulse width modulated (PWM) signal to the command valve, boost pressure is bypassed away from the wastegate signal line through a drilling in the turbocharger compressor housing. The internal drilling bleeds boost pressure back to the turbocharger compressor inlet (low pressure). Actuating the command valve, (bypassing the boost pressure signal to the wastegate) allows the engine to operate at a higher boost than would be achieved if the wastegate were allowed to operate normally.

Actuating the command valve does not increase boost pressure if the boost pressure is below the wastegate actuator setting. With the command valve actuated, maximum boost pressure at a given operating condition will vary based on ambient atmospheric pressure and temperature.

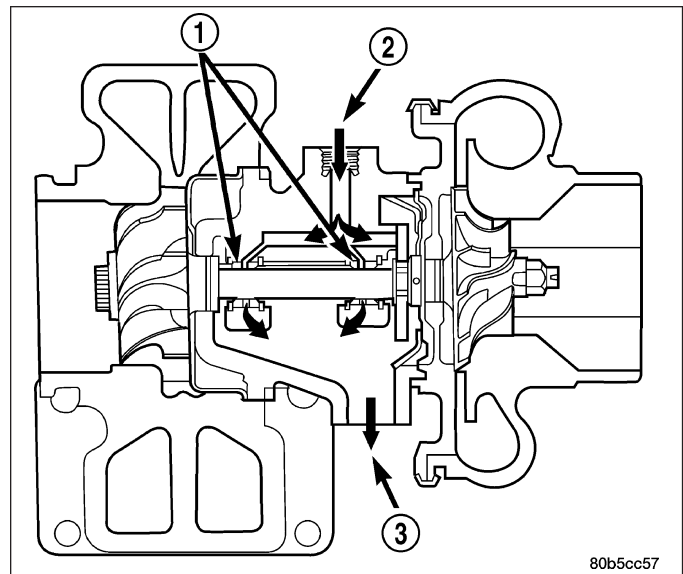


8087ee96

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 oil filter head. The oil travels into the bearing housing, where it lubricates the shaft and bearings. 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.

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 "COOL DOWN" CHART

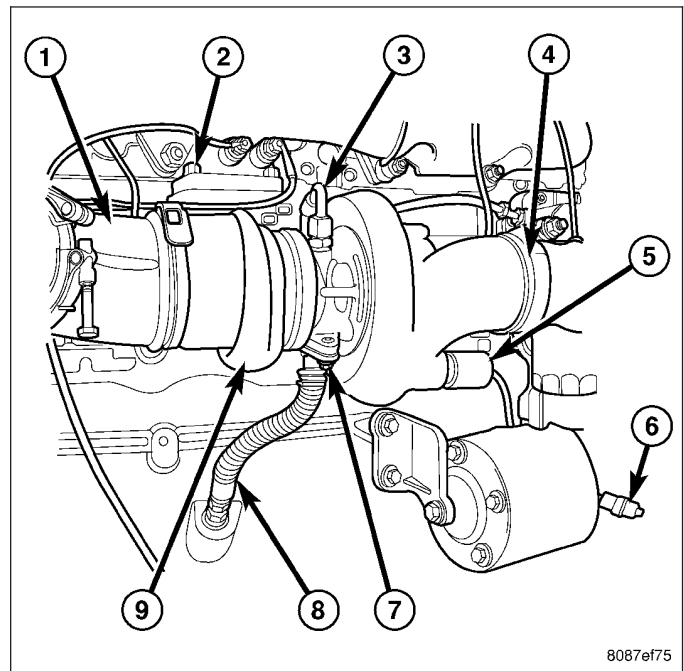
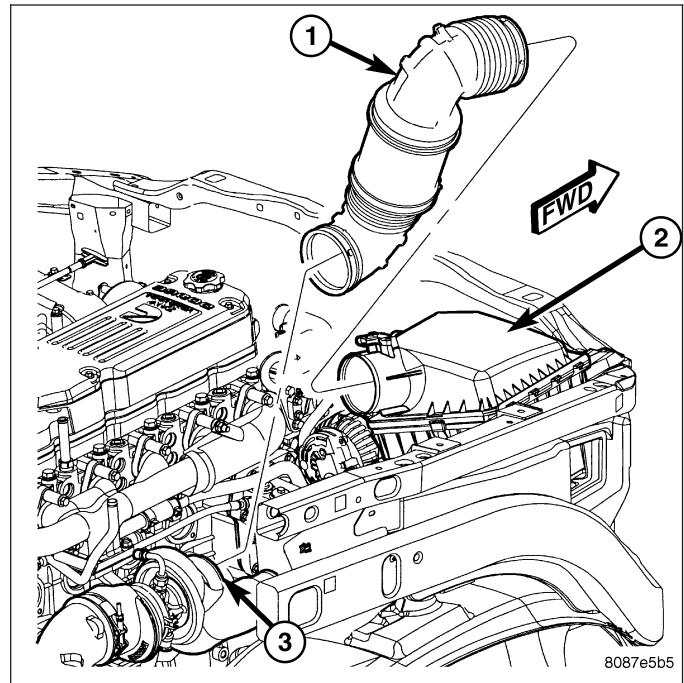
Driving Condition	Load	Turbocharger Temperature	Idle Time (in minutes) Before Shut Down
Stop & Go	Empty	Cool	Less than 1
Stop & Go	Medium	Warm	1
Highway Speeds	Medium	Warm	2
City Traffic	Max. GCWR	Warm	3
Highway Speeds	Max. GCWR	Warm	4
Uphill Grade	Max. GCWR	Hot	5

REMOVAL

TURBOCHARGER

1. Disconnect the battery negative cables.
2. Raise vehicle on hoist.
3. Disconnect the exhaust pipe from the turbocharger elbow (1) (Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - REMOVAL).
4. Disconnect the exhaust system from the exhaust hangers and move the system rearward.
5. Remove the exhaust elbow from the turbo (1).
6. Remove the bolts from the turbocharger oil drain tube (8).
7. Disconnect wastegate command valve connector (6).
8. Remove two lower turbocharger mounting nuts.
9. Lower vehicle.
10. Disconnect the turbocharger air inlet hose (1).
11. Disconnect the turbocharger oil supply line from the turbocharger (3).
12. Disconnect the charge air cooler inlet pipe from the turbocharger compressor outlet.
13. Remove two upper turbocharger mounting nuts.
14. Remove the turbocharger and gasket from the exhaust manifold from the top of the vehicle.
15. If the turbocharger is not to be installed immediately, cover the opening to prevent material from entering into the manifold.
16. If replacing the turbocharger, transfer the turbocharger oil supply fitting to the new assembly. Tighten fitting to 36 N·m (27 ft. lbs.).
17. Clean and inspect the sealing surface.

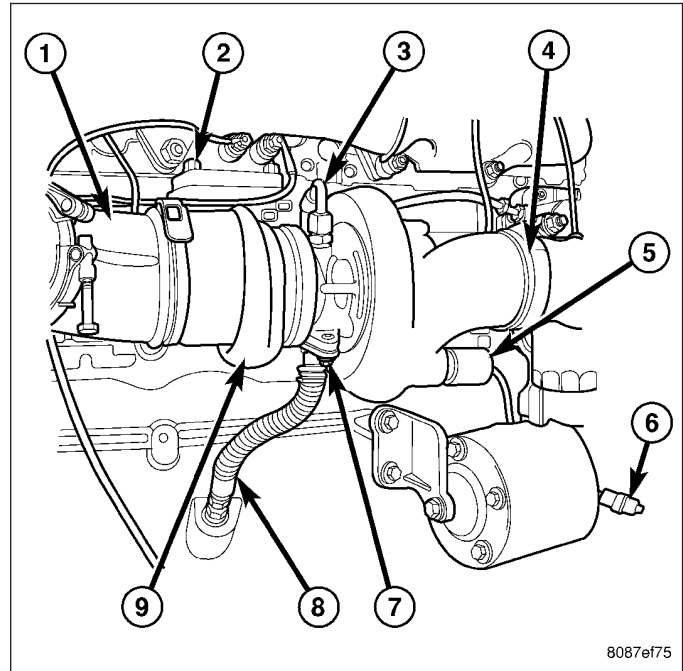
CAUTION: The Wastegate Command Valve, and Command Valve O-ring are the only serviceable components on the turbocharger. The turbocharger itself is serviced as a component. Do not attempt to repair the turbocharger as turbocharger and/or engine damage can result.



TURBOCHARGER OIL DRAIN TUBE

NOTE: If oil is present on either the inlet or exhaust side of the turbo charger, check the charge air cooler for evidence of oil. Clean charge air cooler of any oil before starting the engine. Failure to do this can result in severe engine damage.

1. Disconnect negative battery cables.
2. Raise vehicle on hoist.
3. Remove two turbocharger oil tube mounting bolts
4. Pulling upward, remove the turbocharger drain tube from the engine block.



CLEANING

WARNING: To prevent damage or personal injury, do not use a combustible cleaner to clean the turbocharger.

Clean the turbocharger, turbocharger oil drain tube flange, and exhaust manifold mounting surfaces with a suitable scraper.

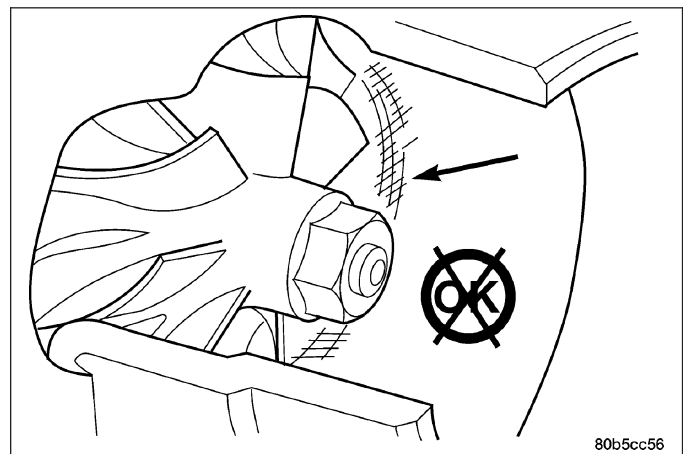
INSPECTION

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.

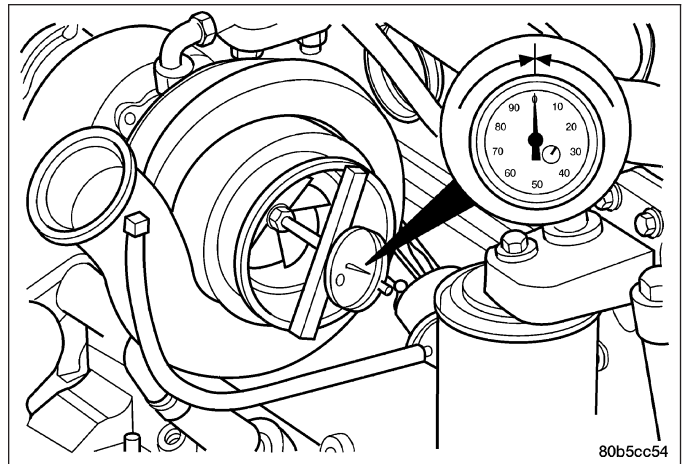
2. Visually inspect the impeller and compressor wheel fins for nicks, cracks, or chips. Note: Some impellers may have a factory placed paint mark which, after normal operation, appears to be a crack. Remove this mark with a suitable solvent to verify that it is not a crack.

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



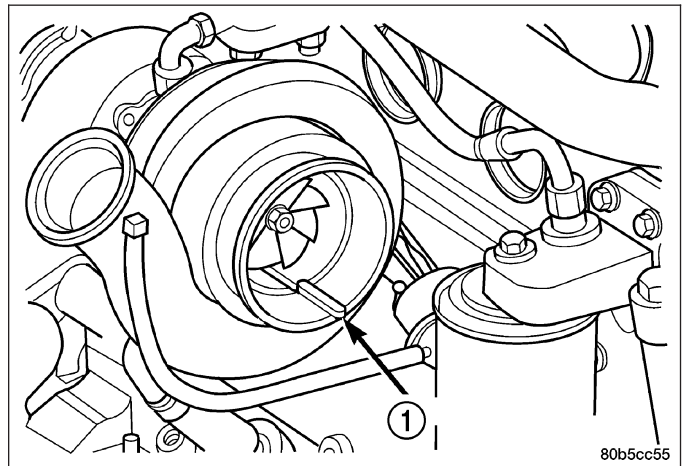
4. Measure the turbocharger axial end play:

- Install a dial indicator as shown . Zero the indicator at one end of travel.
- Move the impeller shaft fore and aft and record the measurement. Allowable end play is 0.026 mm (0.0001 in.) MIN. and 0.127 mm (0.005 in.) MAX. If the recorded measurement falls outside these parameters, replace the turbocharger assembly.



5. Measure the turbocharger bearing radial clearance:

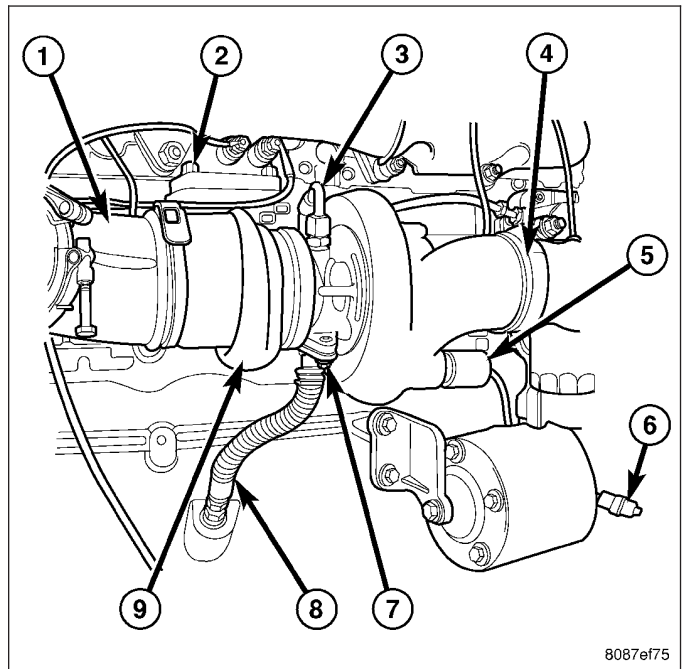
- Insert a narrow blade or wire style feeler gauge between the compressor wheel and the housing.
- Gently push the compressor wheel toward the housing and record the clearance.
- With the feeler gauge in the same location, gently push the compressor wheel away from the housing and again record the clearance.
- Subtract the smaller clearance from the larger clearance. This is the radial bearing clearance.
- Allowable radial bearing clearance is 0.33 mm (0.013 in.) MIN. and 0.50 mm (0.020 in.) MAX. If the recorded measurement falls outside these specifications, replace the turbocharger assembly.



INSTALLATION

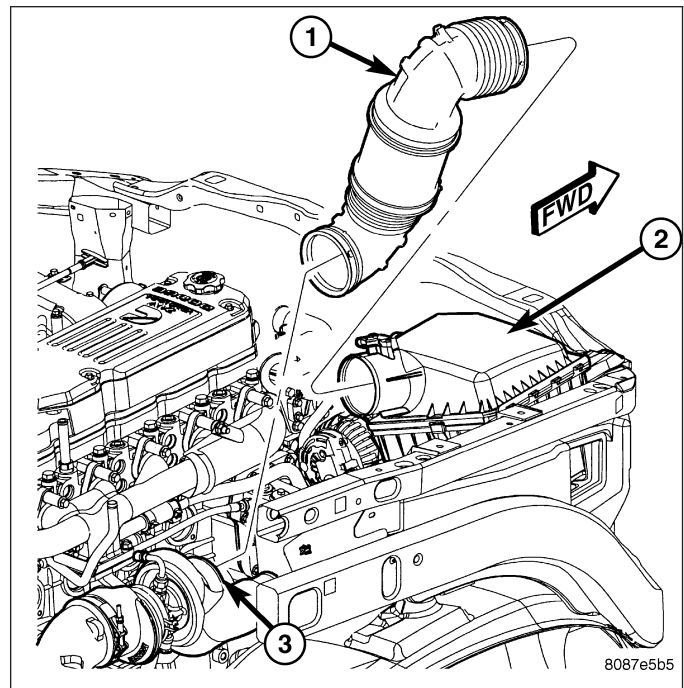
TURBOCHARGER

- Using a new gasket, install the turbocharger. Tighten the turbocharger mounting nuts to 43 N·m (32 ft. lbs.) torque.
- Raise vehicle on hoist.
- Using a new gasket, install the oil drain tube to the turbocharger. Tighten the drain tube bolts to 24 N·m (18 ft. lbs.) torque.



NOTE: Always use a new clamp when installing the exhaust elbow.

4. Install the exhaust elbow (1)
5. Reinstall the exhaust system on the exhaust hangers.
6. Connect the exhaust pipe to the turbocharger and tighten the bolts to 11 N·m (100 in. lbs.) torque.
7. Connect wastegate command valve connector.
8. Lower the vehicle.
9. **Pre-lube the turbocharger.** Pour 50 to 60 cc (2 to 3 oz.) clean engine oil in the oil supply line fitting. Carefully rotate the turbocharger impeller by hand to distribute the oil thoroughly.
10. Install and tighten the oil supply line to 24 N·m (18 ft. lbs.) torque.
11. Position the charge air cooler inlet pipe to the turbocharger. With the clamp in position, tighten the clamp nut to 11 N·m (95 in. lbs.) torque.
12. Position the air inlet hose to the turbocharger. Tighten the clamp to 4 N·m (35 in. lbs.) torque.
13. Connect the battery negative cables.
14. Start the engine to check for leaks.

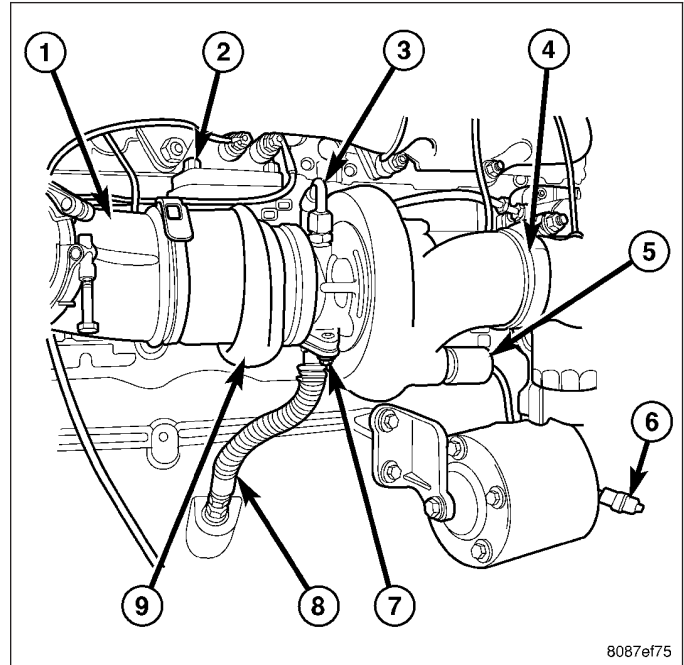


TURBOCHARGER OIL DRAIN TUBE

1. Raise vehicle on hoist.

NOTE: Lubricate o-rings and block bore prior to inserting the tube into the block.

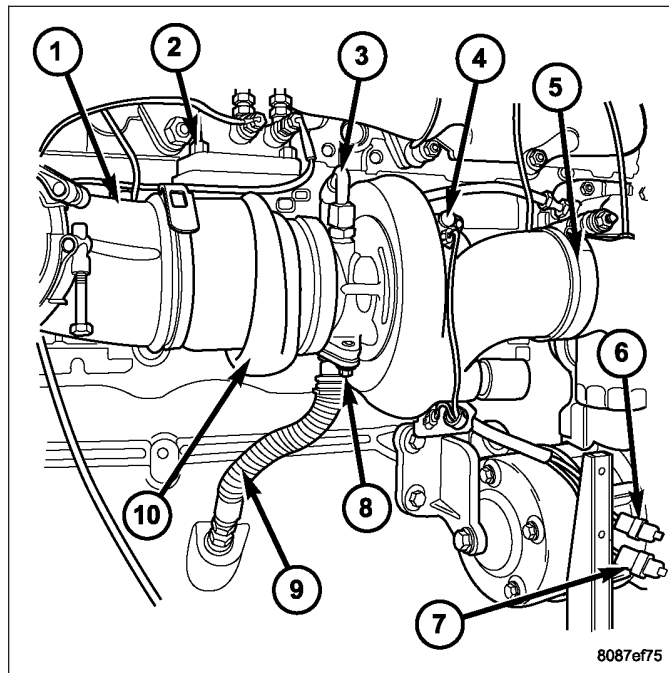
2. Install new turbocharger oil drain tube O-rings. Lubricate O-rings with engine oil.
3. Install turbocharger oil drain tube into engine block.
4. Using a new gasket, install two oil drain tube mounting bolts. Tighten to 24 N·m (18 ft. lbs.).
5. Lower vehicle.
6. Connect negative battery cable.
7. Start engine and check for leaks.



WASTEGATE - ELECTRONIC ACTUATOR

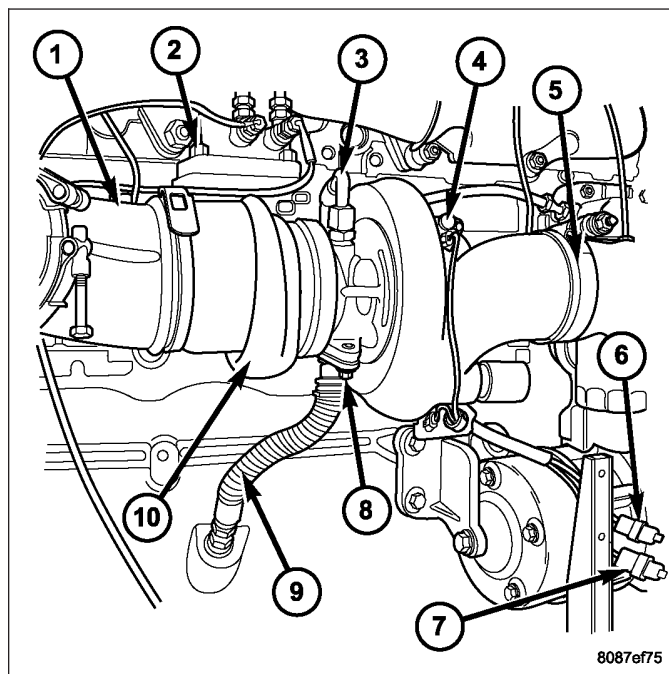
REMOVAL

1. Disconnect battery negative cable.
2. Remove air inlet tube.
3. Disconnect wastegate command valve connector.
4. Remove wastegate command valve.
5. Inspect wastegate command valve O-rings for cuts, nicks, or damage.
6. Inspect valve tip and body for damage or debris.
7. Inspect threads in turbocharger housing for damage.



INSTALLATION

1. Install new wastegate command valve O-rings onto the wastegate command valve. Do not lubricate O-rings.
2. Install wastegate command valve. Tighten to 34 N·m (25 ft. lbs.).
3. Connect wastegate command valve connector.
4. Install air inlet tube.
5. Install negative battery cables.

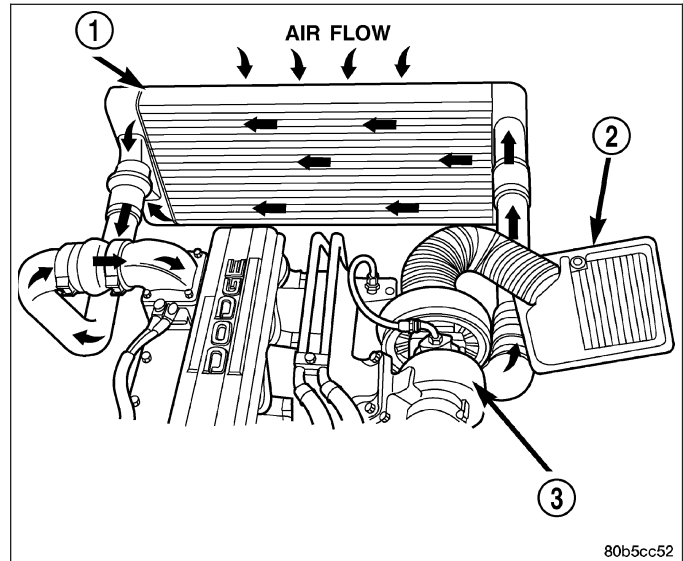


CHARGE AIR COOLER AND PLUMBING

DESCRIPTION

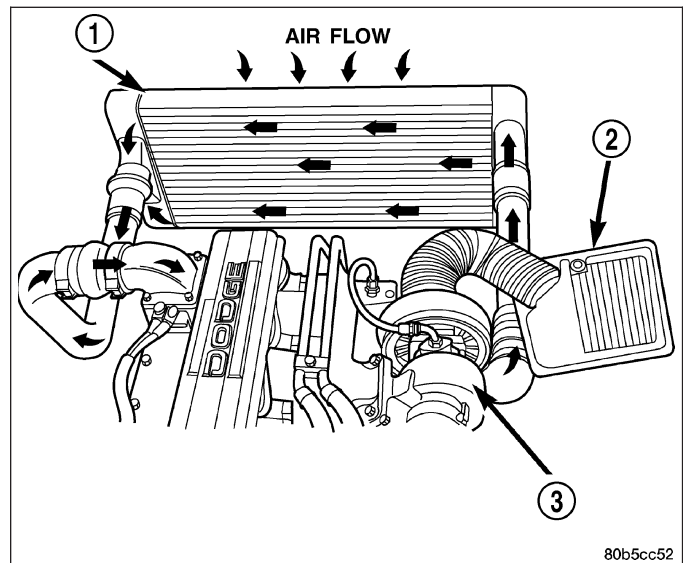
The charge air system consists of the charge air cooler piping, charge air cooler and intake air grid heater.

The charge air cooler is a heat exchanger that uses air flow from vehicle motion to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases engine efficiency and power.



OPERATION

Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the charge air cooler located in front of the radiator. From the charge air cooler the air flows back into the intake manifold.



DIAGNOSIS AND TESTING

CHARGE AIR COOLER SYSTEM - LEAKS

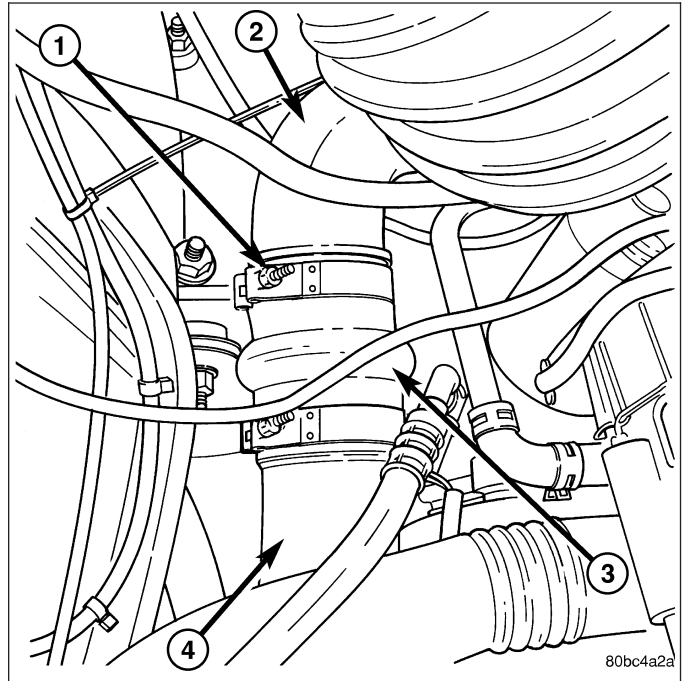
Low turbocharger boost pressure and low engine performance can be caused by leaks in the charge air cooler or plumbing. Fuel staining on the exhaust manifold can also be an indication that there are leaks in the air system. The following procedure outlines how to check for leaks in the charge air cooler system.

This procedure can also be used to check for leaks in the wastegate signal line or the wastegate canister.

1. Loosen clamp and remove air inlet hose from turbocharger.
2. Insert Special Tool 9022 Adapter into the turbocharger inlet. Tighten tool clamp to 8 N·m (72 in. lbs.).

CAUTION: Do not apply more than 138 kPa (20 psi) air pressure to the charge air cooler system, severe damage to the charge air cooler system may occur.

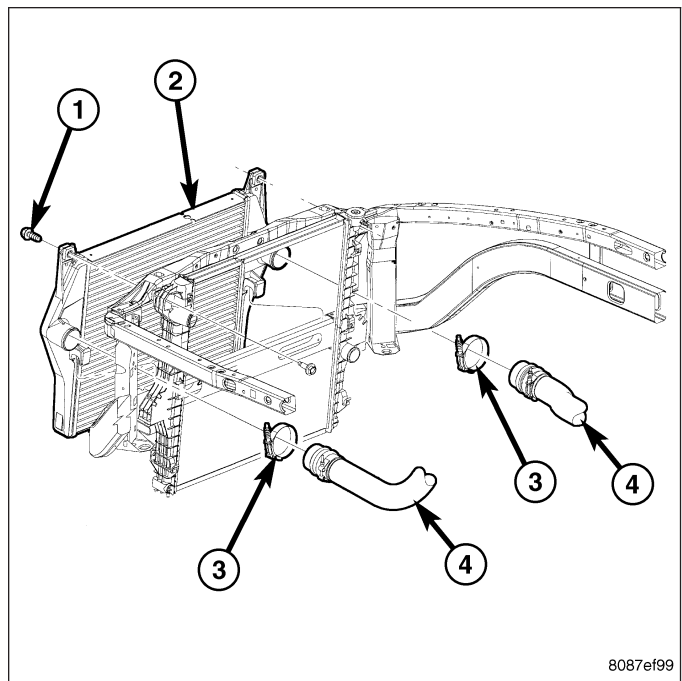
3. Connect a regulated air supply to air fitting on Tool 9022 Adapter. Set air pressure to a Maximum of 138 kPa (20 psi).
4. Using soapy water check the rubber sleeves, charge air cooler and intake manifold for leaks.
5. Using soapy water check for leaks at the wastegate signal line, wastegate canister and wastegate command valve.



REMOVAL

WARNING: IF THE ENGINE WAS JUST TURNED OFF, THE AIR INTAKE SYSTEM TUBES MAY BE HOT.

1. Disconnect the battery negative cables.
2. Discharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE) and remove the A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL) (if A/C equipped).
3. Remove the transmission auxiliary cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - REMOVAL).
4. Remove intake air tubing from the charge air cooler.
5. Remove the charge air cooler bolts. Pivot the charge air cooler forward and up to remove.



CLEANING

CAUTION: Do not use caustic cleaners to clean the charge air cooler. Damage to the charge air cooler will result.

NOTE: If internal debris cannot be removed from the cooler, the charge air cooler **MUST** be replaced.

1. If the engine experiences a turbocharger failure or any other situation where oil or debris get into the charge air cooler, the charge air cooler must be cleaned internally.
2. Position the charge air cooler so the inlet and outlet tubes are vertical.
3. Flush the cooler internally with solvent in the direction opposite of normal air flow.
4. Shake the cooler and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris.
5. Continue flushing until all debris or oil are removed.
6. Rinse the cooler with hot soapy water to remove any remaining solvent.
7. Rinse thoroughly with clean water and blow dry with compressed air.

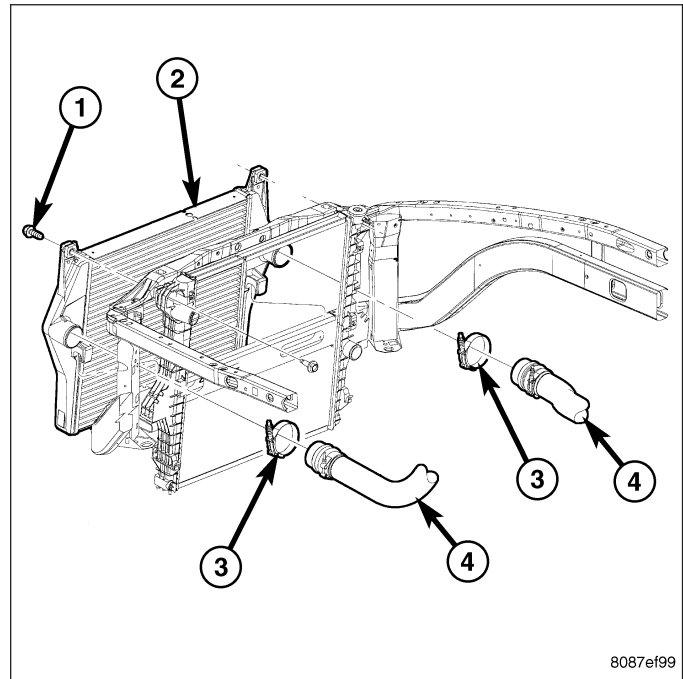
INSPECTION

Visually inspect the charge air cooler for cracks, holes, or damage. Inspect the tubes, fins, and welds for tears, breaks, or other damage. Replace the charge air cooler if damage is found.

Pressure test the charge air cooler, using Charge Air Cooler Tester Kit No. 3824556. This kit is available through Cummins® Service Products. Instructions are provided with the kit.

INSTALLATION

1. Position the charge air cooler. Install the bolts and tighten to 2 N·m (17 in. lbs.) torque.



2. Install the air intake system tubes to the charge air cooler. With the clamps in position, tighten the clamps to 11 N·m (95 in. lbs.) torque.
3. Install the transmission auxiliary cooler (if equipped) (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - INSTALLATION).
4. Install the A/C condenser (if A/C equipped) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION). Recharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).
5. Connect the battery negative cables.
6. Start engine and check for boost system leaks.

