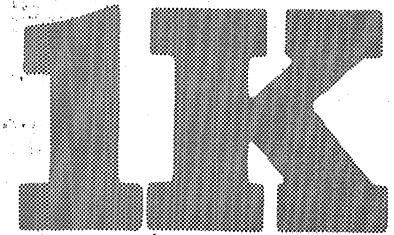


# EXHAUST SYSTEMS



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## EXHAUST MANIFOLDS, MUFFLERS AND PIPES

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### GENERAL

The basic exhaust system for all Jeep vehicles consists of exhaust manifold(s), front exhaust pipe, catalytic converter, muffler and tailpipe.

**NOTE:** All reference to CJ vehicles includes Scrambler vehicles.

CJ vehicles with four- or six-cylinder engines that are designated 49-State use a conventional oxidizing catalytic (COC) pellet-type converter (figs. 1K-1 and 1K-2). Four-cylinder engine CJ vehicles manufactured for sale in California use a three-way catalytic (TWC) pellet-type converter. Six-cylinder engine CJ vehicles manufactured for sale in California and all six-cylinder engine Cherokee, Wagoneer and Truck vehicles use a dual bed (COC and TWC) monolithic-type converter with "downstream" air injection (figs. 1K-2 and 1K-3).

Eight-cylinder engine Cherokee, Wagoneer and Truck vehicles designated 49-State use a conventional oxidizing catalytic (COC) pellet-type converter (fig. 1K-4).

The exhaust system must be properly aligned to prevent stress, leakage and chassis contact. If the system contacts any body panel, it may amplify objectionable noises originating from the engine or the body. When inspecting an exhaust system, inspect for cracked or

loose joints, stripped screw threads, and corrosion damage. Inspect for worn or broken hangers. Replace all components that are badly corroded or damaged. Do not attempt to repair.

### RESTRICTED EXHAUST SYSTEM DIAGNOSIS

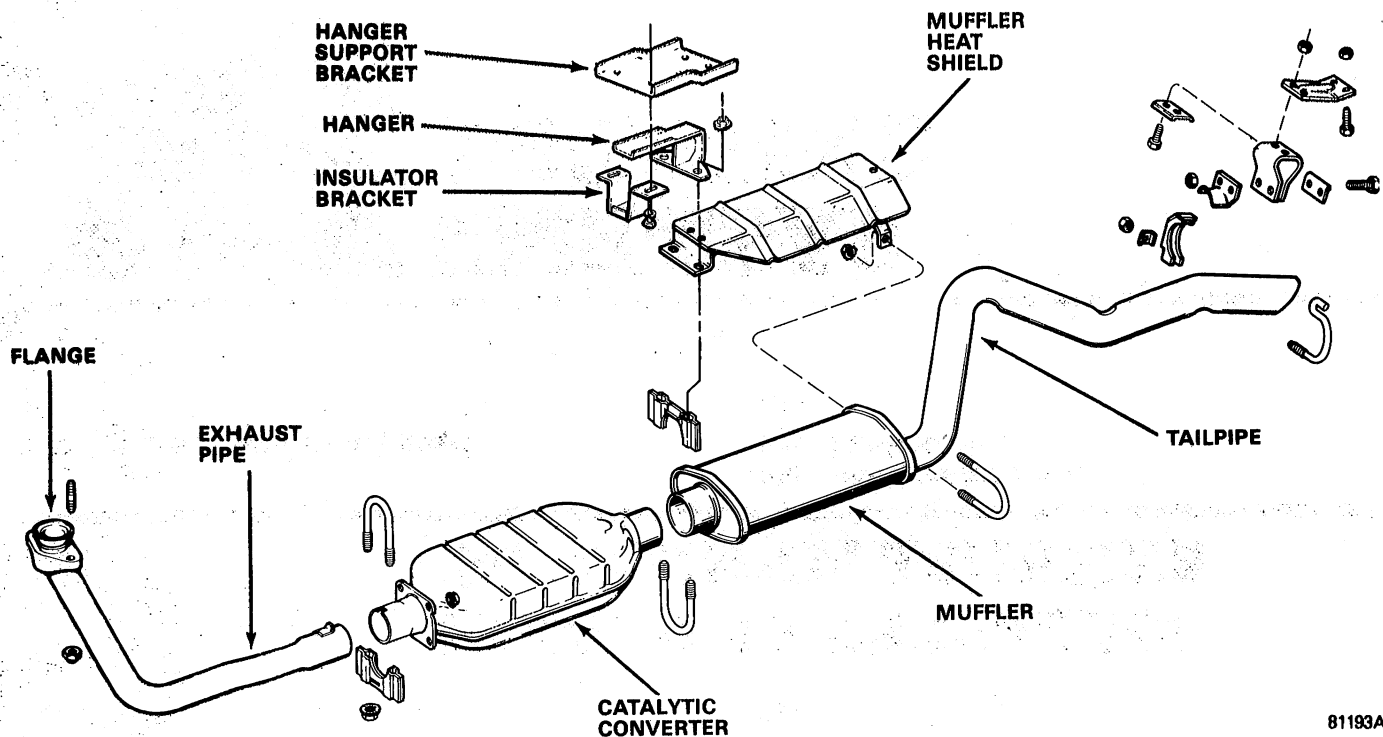
A restricted or blocked exhaust system usually results in loss of power or backfire up through the carburetor. Verify that the condition is not caused by ignition timing or other ignition system malfunctions, then perform a visual inspection of the exhaust system. If the restriction cannot be located by visual inspection, perform the following test procedure:

- (1) Attach vacuum gauge to intake manifold.
- (2) Connect tachometer.

**WARNING:** Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.

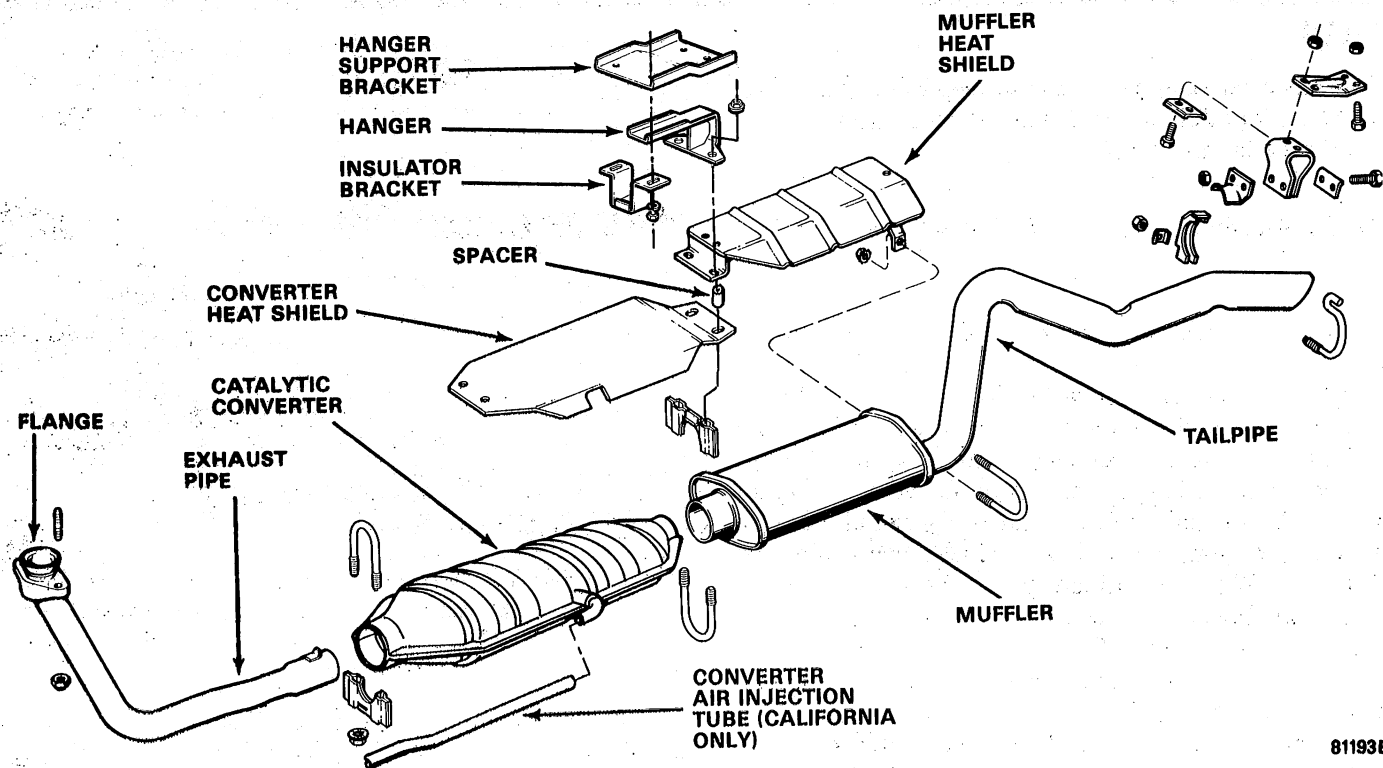
(3) Start engine and observe vacuum gauge. Gauge should indicate 16 to 21 in. Hg (54 to 71 kPa) of vacuum.

(4) Increase engine speed to 2,000 rpm and observe vacuum gauge. Vacuum will decrease when engine speed is increased rapidly, but should settle at 16 to 21 in. Hg (54 to 71 kPa) and remain steady. If vacuum decreases



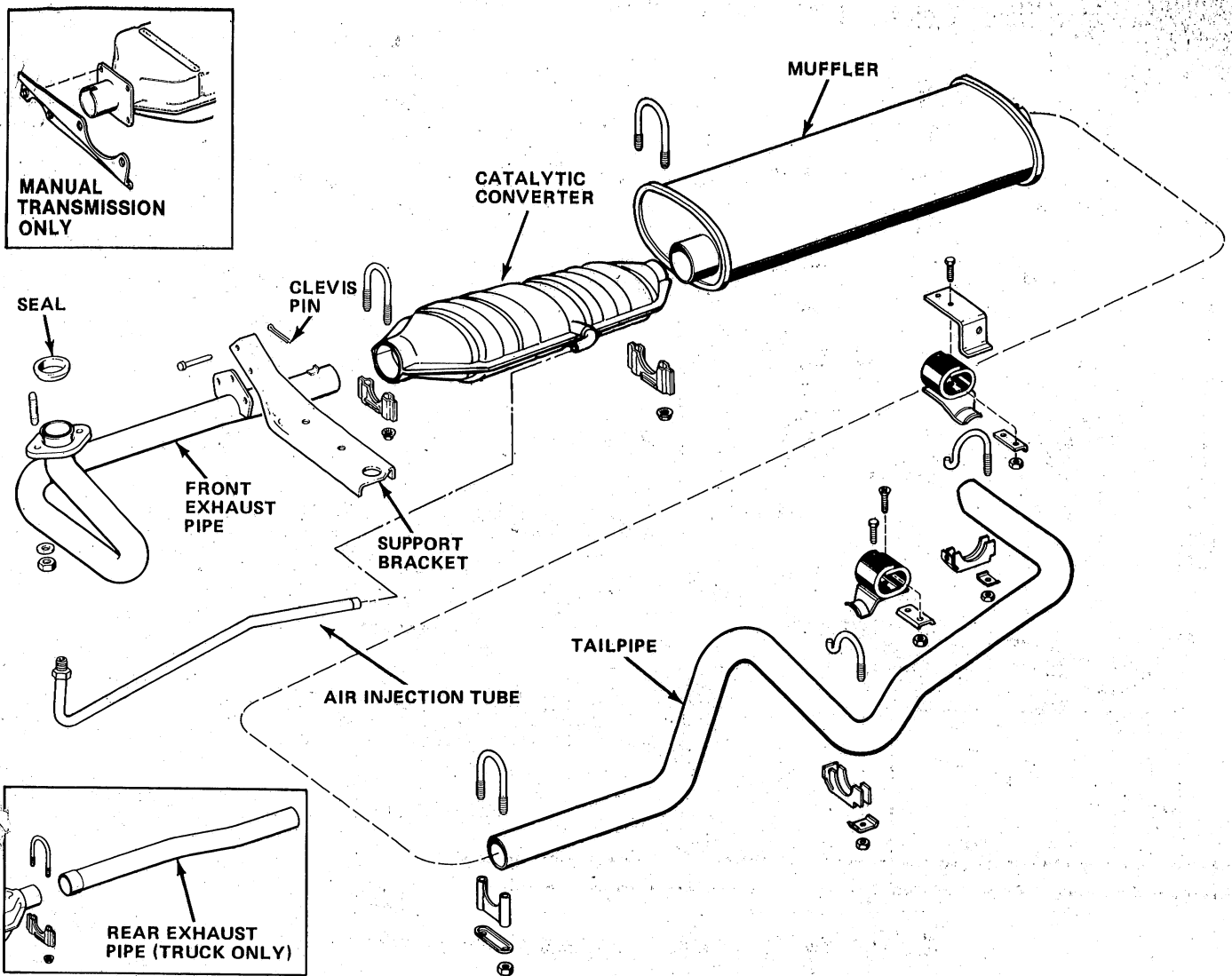
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Fig. 1K-1 Four-Cylinder Engine Exhaust System—CJ Vehicles



81193B

Fig. 1K-2 Six-Cylinder Engine Exhaust System—CJ Vehicles



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Fig. 1K-3 Six-Cylinder Engine Exhaust System—Cherokee-Wagoneer-Truck

below 16 in. Hg (54 kPa), exhaust system is restricted or blocked. Stop engine and proceed to step (5).

(5) Disconnect exhaust pipe at manifold.

(6) Start engine and increase speed to 2,000 rpm. Observe vacuum gauge.

(a) If vacuum settles at 16 to 21 in. Hg (54 to 71 kPa), restriction or blockage is in exhaust pipe, catalytic converter or muffler.

(b) If vacuum decreases below 16 in. Hg (54 kPa) with exhaust pipe disconnected, exhaust manifold is restricted.

(7) Connect exhaust pipe, remove muffler, start engine and observe vacuum gauge.

(a) If vacuum decreases below 16 in. Hg (54 kPa), restriction or blockage is in catalytic converter.

(b) If vacuum is normal, muffler is restricted.

**NOTE:** If the converter has failed, always inspect the muffler to determine if converter debris has entered it.

(8) Stop engine.

(9) Disconnect tachometer and vacuum gauge.

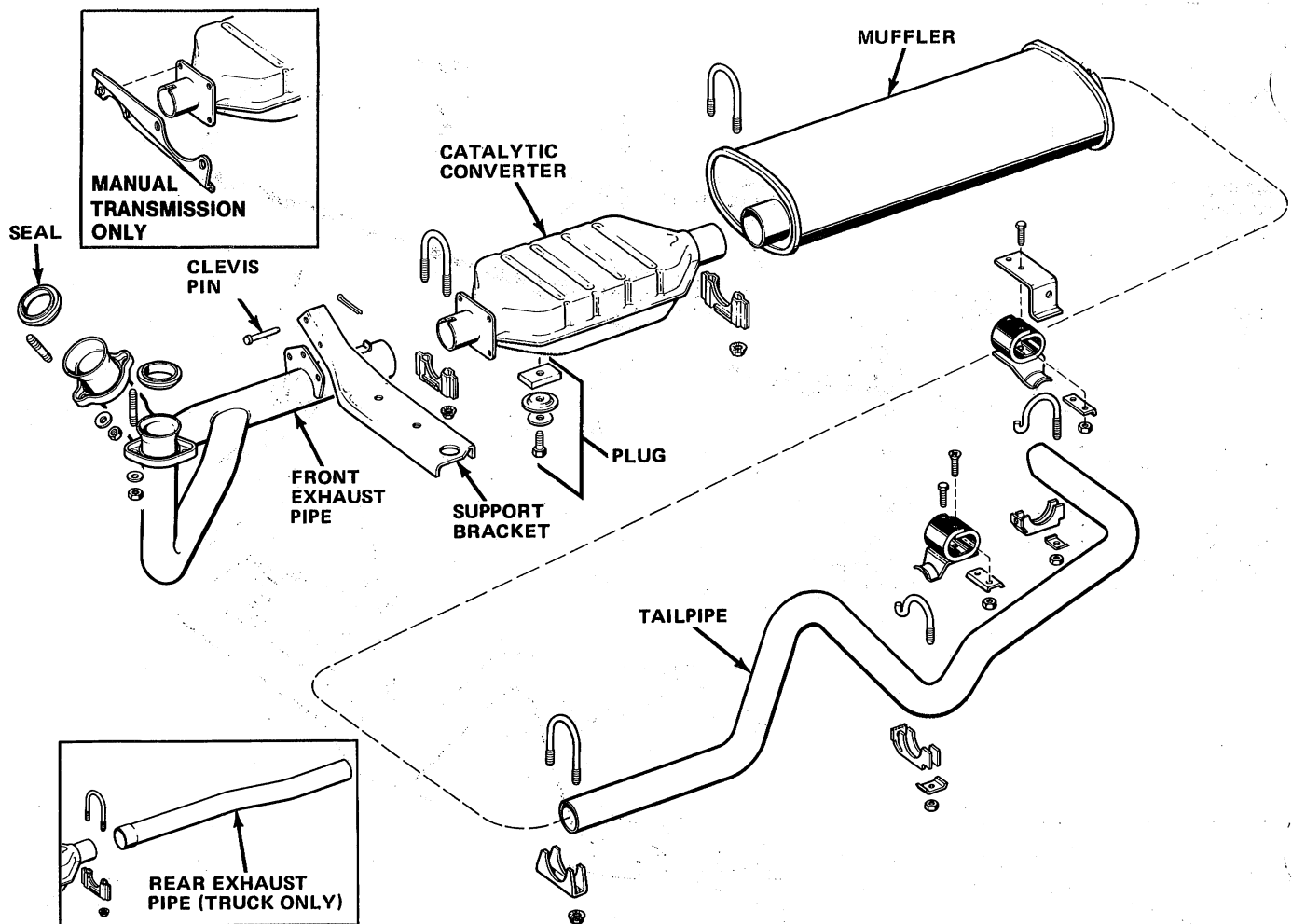
(10) For four- and six-cylinder engines, remove exhaust manifold. For eight-cylinder engines, remove both exhaust manifolds.

(11) Inspect exhaust manifold ports for casting flash by dropping length of chain into each port.

**NOTE:** Do not use a wire or a light to inspect ports. The restricted opening may be large enough for wire or light to pass through but small enough to cause excessive back pressure at high engine rpm.

(12) Remove casting flash. If flash is at lower end of port, it can usually be chipped out. If flash cannot be removed, replace manifold.

(13) Install exhaust manifold(s).



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Fig. 1K-4 Eight-Cylinder Engine Exhaust System—Cherokee-Wagoneer-Truck

## EXHAUST MANIFOLD REPLACEMENT

### Four-Cylinder Engine

The exhaust manifold is located on the left hand side of the engine (fig. 1K-5). Refer to Chapter 1B—Engines for replacement procedure.

### Six-Cylinder Engine

The intake and exhaust manifolds are attached with common bolts and nuts to the cylinder head on the left side of the engine. A gasket is used between the intake manifold and the cylinder head. No gasket is used between the exhaust manifold and cylinder head or between exhaust manifold and exhaust pipe (fig. 1K-6). Refer to Chapter 1B—Engines for replacement procedure.

### Eight-Cylinder Engine

Refer to Chapter 1B—Engines for replacement procedure.

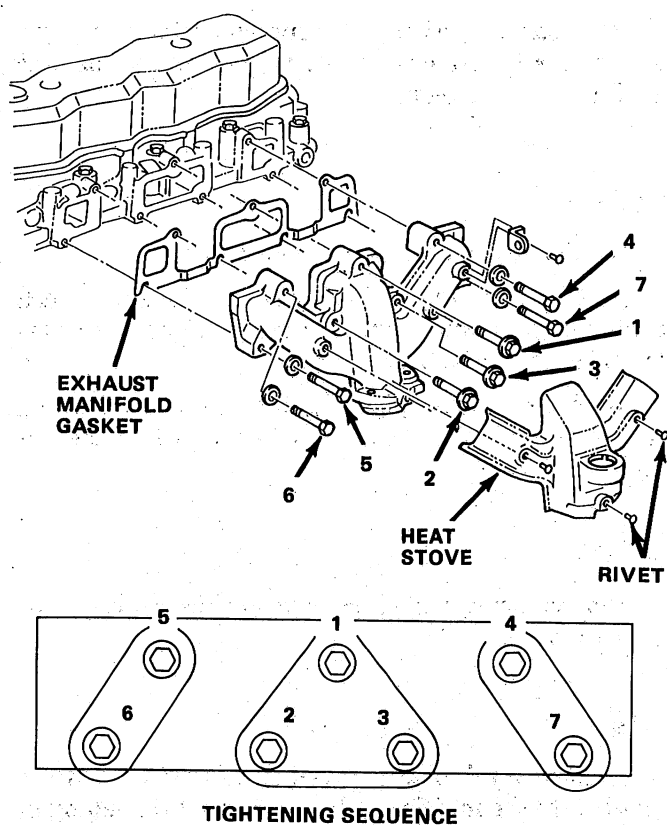
## EXHAUST MANIFOLD HEAT VALVE

Four- and six-cylinder engines are not equipped with heat valves.

### Eight-Cylinder Engine

A thermostatically controlled heat valve mounted between the right exhaust manifold and exhaust pipe directs exhaust heat to the intake manifold for rapid fuel vaporization during engine warmup. When the counterweight is in the horizontal position, the valve is in the heat **On** position, directing exhaust heat through the intake manifold crossover passage (fig. 1K-7). The exhaust heat crosses through the intake manifold and discharges into the left exhaust manifold until the engine attains normal operating temperature. At this time, the heated bimetallic spring loses its tension, the counterweight moves downward and the valve moves to the heat **Off** position. This allows the exhaust heat to discharge completely through the right exhaust pipe.

Examine the manifold heat valve for freedom of movement and lubricate every 30,000 miles (48 000 km) with Jeep Heat Valve Lubricant, or equivalent.



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Fig. 1K-5 Exhaust Manifold—Four-Cylinder Engine

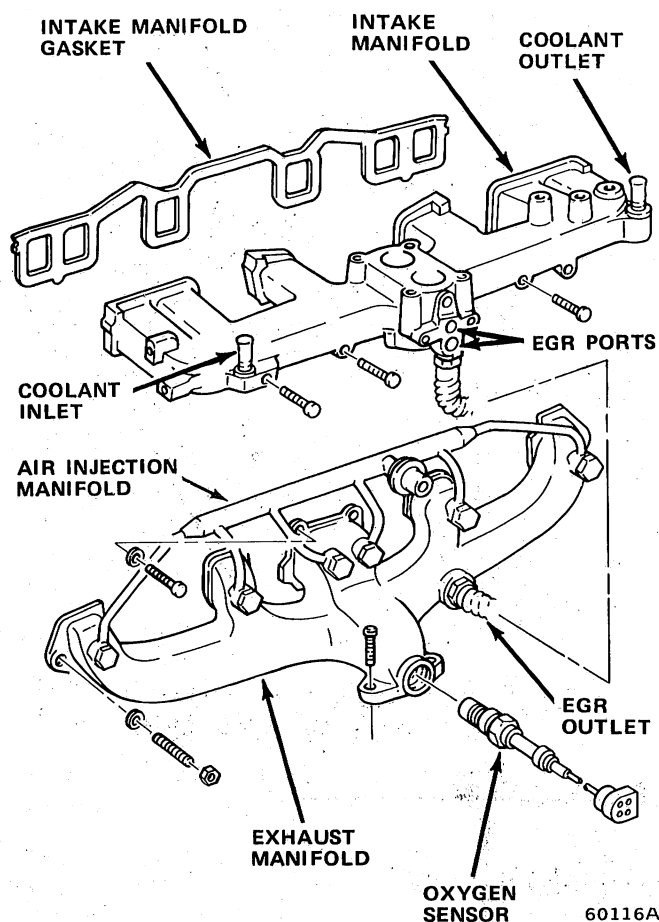
**Replacement**

- (1) Disconnect and lower exhaust pipe.
- (2) Replace manifold heat valve and gasket.
- (3) Replace exhaust pipe gasket.
- (4) Position exhaust pipe and connect to exhaust manifolds.

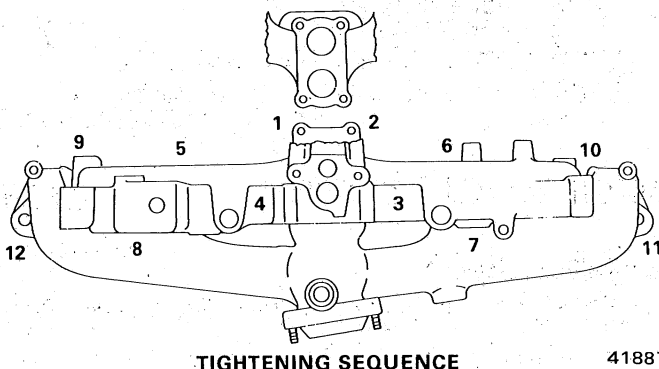
**MUFFLER REPLACEMENT**

**Removal**

- (1) Remove front and rear muffler clamps.
- (2) Support rear of vehicle by side rails and allow axle to hang free.
- (3) Remove tailpipe hanger clamp.
- (4) Insert tool between tailpipe and muffler at several places to loosen pipe from muffler.
- (5) Disconnect rear hanger, if equipped.
- (6) Heat catalytic converter or rear exhaust pipe-to-muffler joint with oxyacetylene torch until cherry red.
- (7) Place block of wood against front of muffler and drive muffler rearward to disengage.
- (8) Drive muffler off tailpipe.



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Fig. 1K-6 Manifold Assembly—Six-Cylinder Engine

**Installation**

- (1) Attach muffler to tailpipe. Ensure locator on tailpipe aligns with slot in muffler.
- (2) Attach catalytic converter or rear exhaust pipe to muffler. Ensure pipe has sufficient clearance from floorpan.
- (3) Install clamps and hangers.
- (4) Start engine and inspect for exhaust leaks and contact with body panels.

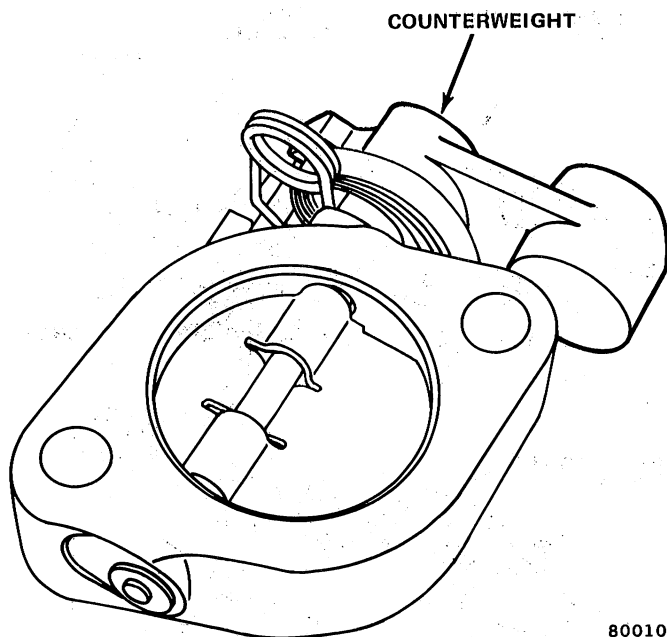


Fig. 1K-7 Exhaust Manifold Heat Valve In Heat On Position—Eight-Cylinder Engine

80010

(3) Heat exhaust pipe-to-converter joint with oxyacetylene torch until cherry red. Twist exhaust pipe back and forth to disengage.

**Installation**

- (1) Connect exhaust pipe to converter.
- (2) Clean mating surface(s) at manifold(s). Attach exhaust pipe to manifold(s) but do not tighten. Use replacement gasket(s) if necessary.
- (3) Align exhaust pipe. Tighten clamp or mounting bracket at rear of exhaust pipe. Tighten flange(s) on manifold(s).

**Tailpipe**

When replacing a tailpipe, support the vehicle with frame rails.

**Removal**

To remove a tail pipe attached to the muffler, cut the pipe close to the muffler. Collapse the part remaining in the muffler and remove.

**Installation**

To install a tailpipe, disconnect the mounting bracket and lower the front of the muffler. Install the tail pipe. Position the mounting bracket and tighten.

**PIPE REPLACEMENT**

**Front Exhaust Pipe**

**Removal**

- (1) Disconnect exhaust pipe from manifold.
- (2) Disconnect mounting bracket and/or clamp.

**SPECIFICATIONS**

**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened item.

	USA (ft.-lbs)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Exhaust Manifold Screws Four-Cylinder Engine	37	34-40	50	47-53
Exhaust and Intake Manifold Screws and Nuts				
Six-Cylinder Engine	23	18-28	31	24-38
Exhaust Manifold Screws — Eight-Cylinder Engine				
Center (2)	25	20-30	34	27-41
Outer (4)	15	12-18	20	20-34
Exhaust Pipe-to-Manifold Nuts	20	27	15-25	20-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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# AIR INJECTION SYSTEMS

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## GENERAL

The basic air injection system for both six- and eight-cylinder Jeep engines incorporates a belt-driven air pump, a vacuum controlled diverter (bypass) valve, air injection manifold(s) with check valve(s) and connecting hoses (figs. 1K-8 and 1K-9).

**NOTE:** Four-cylinder Jeep engines are not equipped with an air injection system.

Air is discharged from the air pump to the diverter valve, which either directs it to the air distribution manifold(s) or vents it to the atmosphere through a bypass vent, depending on engine operating conditions. System air pressure is maintained at approximately 5 psi (35 kPa) by a relief valve located within the diverter valve assembly.

Air is routed through the air injection manifold(s) into the engine exhaust port areas. The air mixes with hot exhaust and promotes additional burning of the mixture. This reduces hydrocarbon and carbon monoxide emission to the atmosphere.

There are two Air Systems used with six-cylinder Jeep engines, the basic (single) air injection system (used for 49-State CJ vehicles) and a dual air injection system (used for California CJ vehicles and all Cherokee, Wagoneer and Truck vehicles).

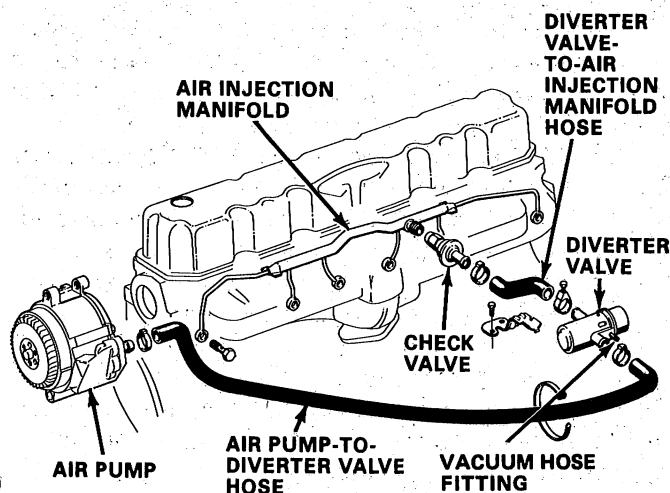


Fig. 1K-8 Basic Air Injection System—Six-Cylinder Engine

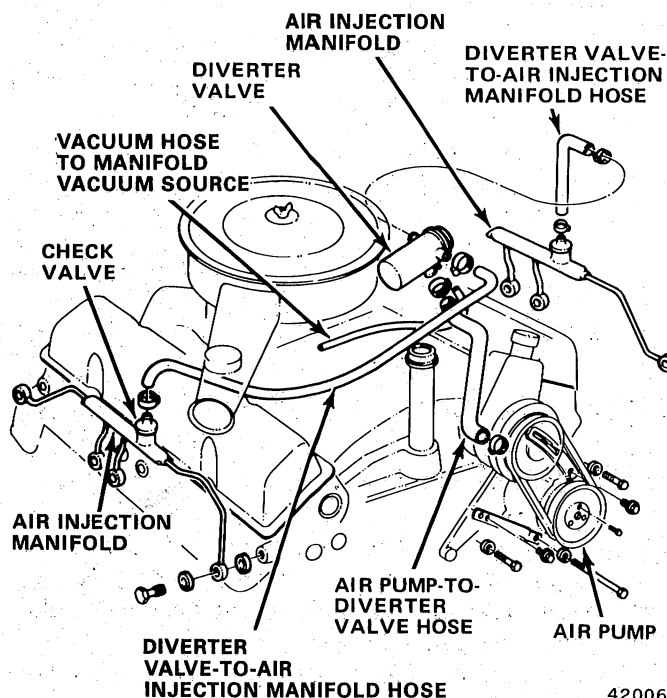


Fig. 1K-9 Air Injection System—Eight-Cylinder Engine

The dual air input is comprised of a belt driven air pump, diverter valve, air control valve, divert and upstream solenoids, reverse and two-way delay valves, coolant temperature switch, air injection manifold, "downstream" air injection tube and connecting hoses (fig. 1K-10). The two air inputs into the exhaust system are:

- upstream air injection via the air injection manifold attached to the exhaust manifold;
- downstream air injection to the dual bed (COC and TWC) converter.

## SINGLE AIR INJECTION SYSTEM

### Air Pump

The same air pump is used for both six- and eight-cylinder engines. The major components of the air pump are enclosed in a die-cast aluminum housing. A filter fan assembly, rotor shaft and drive hub are visible on the pump exterior (fig. 1K-11).

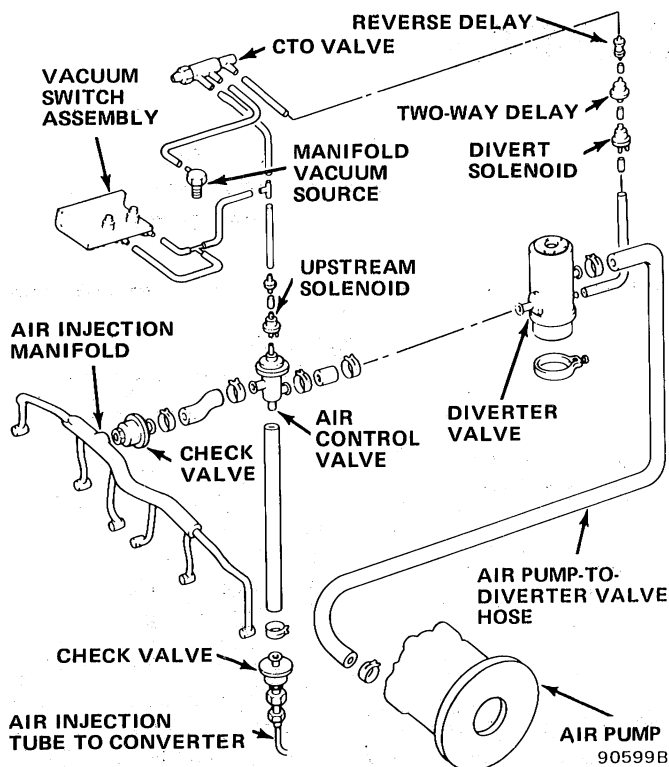


Fig. 1K-10 Dual Air System—Six-Cylinder Engine

The pump is designed for long life and is serviceable only by replacement. Do not remove the rear housing cover for any reason. The internal components of the pump are not serviceable.

The aluminum housing has cavities for air intake, compression and exhaust and a bore for enclosing the front bearing. The housing also includes cast metering areas that reduce the noise of intake and compression. Mounting bosses are located on the housing exterior.

**NOTE:** *The pressure relief valve is located within the diverter valve assembly. If defective, replace the diverter valve assembly.*

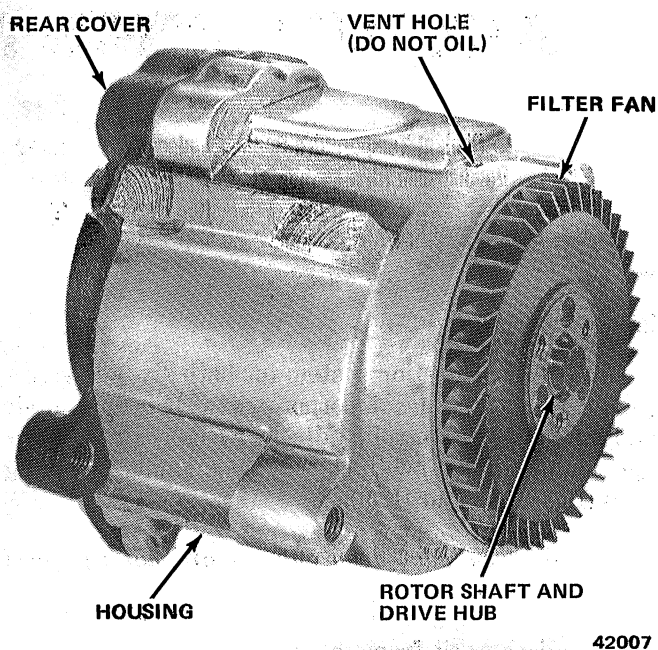
The front bearing supports the rotor shaft. The bearing is secured in position by plastic injected around grooves in the housing and outer bearing race.

The rear cover supports the vane pivot pin, rear inner bearing race and exhaust tube. Dowel pins pressed into the housing correctly position the end cover, which is fastened by four screws.

The rotor positions and drives the two vanes. A stamped steel liner supports the carbon shoes and shoe springs that seal the vanes and rotor. The two plastic vanes are molded to hubs that support the bearings, which rotate on the pivot pin. The pulley drive hub is pressed onto the rotor shaft, and threaded holes in the hub provide for attachment of the pulley.

**Operation**

The pump vanes are located 180° apart and rotate around the pivot pin, which is located on the centerline



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Fig. 1K-11 Air Pump

of the pump housing. The rotor that drives the vanes rotates off the centerline of the pump housing. This creates changes in the distance between the outside of the rotor and the inner wall of the pump housing during rotor rotation. As the leading vane moves past the intake opening, it is moving from a small area to a large area. This creates a partial vacuum that forces air to enter the pump. As the vanes and rotor continue to rotate, the trailing vane passes the intake and traps the air between the vanes. The vanes and rotor move the air into a smaller area to compress it. Compression continues until the leading vane passes the exhaust opening. There the compressed air passes out of the pump to be either distributed or vented.

**Noise Diagnosis**

The air pump is not completely noiseless. Under normal conditions, noise will rise in pitch as the engine speed increases. Allow for normal break-in wear of the pump prior to replacement for excessive noise.

A **chirping or squeaking noise** normally originates from vane rub in the housing bore and is noticeable at low speed intermittently. Vane chirping is often eliminated at increased pump speeds or with additional wear-in time. A chirping noise may also be caused by the drive belt slipping on the pulley of a seized pump.

Bearing noise, a **rolling sound noticeable at all speeds**, is easily distinguished from vane chirping. It does not necessarily indicate bearing failure. If bearing noise reaches an objectionable level at certain speeds, the pump may have to be replaced.

Failure of a rear bearing is identified by a **continuous knocking noise** and replacement of the pump is required.



**Service Precautions**

The following list of service precautions are for preventing damage to the air pump.

- Do not attempt to prevent the pulley from rotating by inserting tools into the centrifugal filter fan.
- Do not operate an engine with the pump belt removed or disconnected except for noise diagnosis.
- Do not attempt to lubricate any part of the pump.
- Do not clean the centrifugal filter.
- Do not disassemble the pump or remove the rear cover.
- Do not exceed 20 foot-pounds (27 N•m) torque when tightening the mounting bolts.
- Do not pry on the aluminum housing to adjust the belt tension.
- Do not clamp the pump in a vise.
- Do not permit liquids to enter the pump when steam or water pressure-cleaning the engine.

**Removal—Six-Cylinder Engine with V-Belts**

- (1) Disconnect air pump output hose at back of air pump.
- (2) Remove adjustment bolt and remove drive belt.
- (3) Remove front mounting bracket.
- (4) Remove adjustment bracket from cylinder head.
- (5) Slide pump from pivot stud.

**Installation—Six-Cylinder Engine with V-Belts**

- (1) Slide pump onto pivot stud.
- (2) Install front mounting bracket.
- (3) Install adjustment bracket and install adjustment screw.

**CAUTION:** *Adjust the belt tension by hand only.*

- (4) Install drive belt and adjust to specified tension. Tighten pivot stud nut.
- (5) Connect air pump output hose to back of pump.

**Removal—Six-Cylinder Engine with Serpentine Belt**

- (1) Release belt tension by loosening alternator adjustment and pivot bolts.
- (2) Disconnect air pump output hose from back of pump.
- (3) Remove air pump mounting bolts/nuts and air pump.

**Installation—Six-Cylinder Engine with Serpentine Belt**

- (1) Position air pump and secure with mounting bolts/nuts.
- (2) Connect output hose to back of pump.
- (3) Tighten belt to specified tension. Refer to Chapter 1C—Cooling Systems for tension specification.

**Removal—Eight-Cylinder Engine**

- (1) Disconnect air pump output hose at pump.
- (2) Loosen mount bracket-to-pump attaching screw and bolt. Remove drive belt.
- (3) Remove pivot screw and brace screws.
- (4) Remove pump.

**Installation—Eight-Cylinder Engine**

- (1) Position pump at mounting location and install pivot and brace attaching screws. Do not tighten.

**CAUTION:** *Adjust the belt tension by hand only.*

- (2) Install drive belt and adjust to specified tension.
- (3) Tighten mounting screws and adjusting strap screw with 20 foot-pounds (27 N•m) torque.

**Diverter (Bypass) Valve**

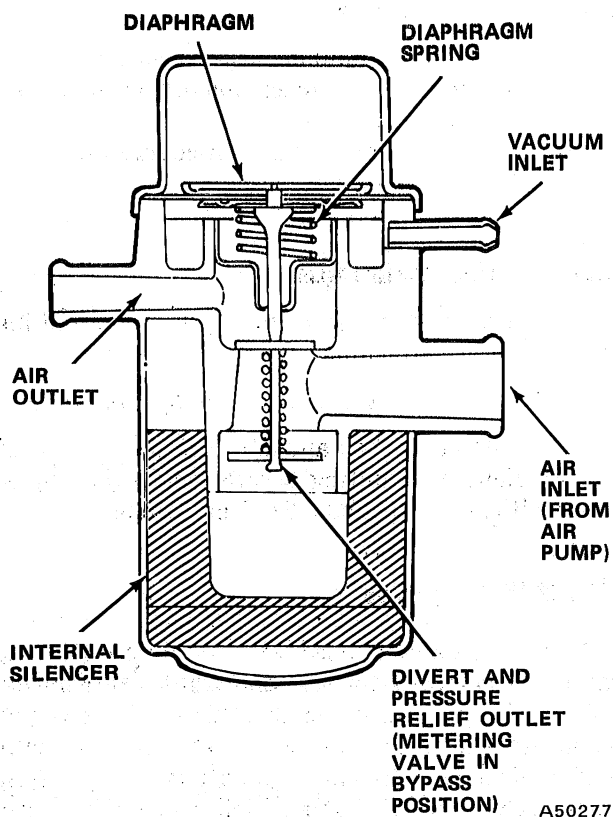
A diverter valve is used with all air injection applications. The valves for six- and eight-cylinder engines differ only in the number of outlets. The six-cylinder engine diverter valve has one outlet. The eight-cylinder engine diverter valve has two outlets. A high flow diverter valve is used on some applications where greater airflow is required for emission control.

The valve momentarily diverts air pump output from the exhaust manifold(s) and vents it to the atmosphere during rapid deceleration. The valve also functions as a pressure release valve for excessive air pump output. An internal silencer is also incorporated in the diverter valve housing to muffle the airflow.

**Operation**

In a rapid deceleration situation, high intake manifold vacuum is applied to the diaphragm in the diverter valve. When the vacuum is 20 in. Hg (68 kPa) or more, the spring tension of the diaphragm is overcome. This moves the metering valve down against its upper seat and away from its lower seat. This diverts and vents air pump output pressure to the atmosphere (fig. 1K-12). Air pump output is diverted only momentarily because of a vent hole in the diaphragm. This hole allows atmospheric pressure to quickly equalize on both sides of the diaphragm and the diaphragm spring returns the metering valve to its normal position.

If the air pump develops excessive output pressure, the excessive pressure overcomes the diaphragm spring tension and pushes the metering valve down. Pump output pressure is diverted and vented to the atmosphere. When pump output pressure returns to normal, the metering valve moves up from the upper seat and against the lower seat, returning to its normally open position. Pump output pressure is then directed to the exhaust manifold(s).



**Fig. 1K-12 Diverter Valve—Typical**

### Functional Test

**WARNING:** Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.

- (1) Start engine and operate at idle.
- (2) Examine diverter valve vent. Little or no air should flow from vent.
- (3) Accelerate engine to 2000-3000 rpm and rapidly close throttle. A strong flow of air should pass from diverter valve vent for approximately three seconds. If air does not flow or if engine backfire occurs, ensure vacuum hose has vacuum and there is no air leak.

**NOTE:** The diverter valve diverts and vents air pump output when a manifold vacuum of 20 in. Hg (68 kPa) or more is applied to the diaphragm. The diverter valve also operates when pump output exceeds 5 psi (35 kPa). Some applications require 8 psi (55 kPa).

- (4) Slowly accelerate engine. Between 2500 and 3500 rpm air should begin to flow from diverter valve vent.

### Replacement

The diverter valve is not serviceable and must be replaced if defective. The valve is either attached to a bracket or suspended by the hoses between the air pump

and air injection manifold(s). Removal involves disconnecting the air hoses, vacuum hose and bracket clamp, if used. Installation entails connecting the air hoses, vacuum hose and bracket clamp, if used.

### Air Injection Manifolds

Air injection manifolds are constructed of cold-rolled steel with zinc plating. They distribute air via the diverter valve from the air pump to each of the exhaust manifold inlet ports.

A check valve, incorporating a stainless steel spring plunger and an asbestos seat, is integral with the air injection manifold. Its function is to prevent the reverse flow of exhaust gas to the pump during pump or belt failure, or diverter valve bypass operation. Reverse exhaust gas flow would damage the air pump and connecting hoses.

The distribution tubes of the air injection manifold are connected directly to the exhaust manifold. The hollow attaching fittings route airflow into the exhaust manifold inlet ports.

### Check Valve Functional Test

To test the air injection manifold check valve for proper operation, disconnect the air supply hose at the injection manifold. With the engine operating above idle speed, listen and feel for exhaust leakage from the check valve. A slight leak is normal.

### Removal—Six-Cylinder Engine

- (1) Disconnect air delivery hose at check valve.
- (2) Remove distribution tube fittings from exhaust manifold inlet ports.

**NOTE:** Some resistance to turning may be encountered because of carbon build-up on the threads.

- (3) Remove air injection manifold.

### Installation—Six-Cylinder Engine

- (1) Connect air injection manifold with fittings to exhaust manifold. Tighten fittings with 20 foot-pounds (27 N•m) torque.
- (2) Connect air delivery hose.

### Removal—Eight-Cylinder Engine

- (1) Disconnect air delivery hose at check valve.
- (2) Remove distribution tube fittings from exhaust manifold inlet ports.

**NOTE:** Some resistance to turning may be encountered because of carbon build-up on the threads.

- (3) Remove air injection manifold.
- (4) Remove sealing gaskets from air injection manifold.

**NOTE:** Duplicate the procedure for the other air injection manifold.

### Installation—Eight-Cylinder Engine

(1) Install air injection manifold using replacement sealing gasket on either side of each inlet port.

(2) Install distribution tube fittings and injection manifold on exhaust manifold. Tighten fittings with 38 foot-pounds (52 N•m) torque.

(3) Connect air delivery hose to check valve.

**NOTE:** Duplicate the procedure for the other air injection manifold.

## DUAL AIR INJECTION SYSTEM

The additional components used with the dual air injection system are:

- divert and upstream solenoids,
- air control valve,
- coolant temperature switch,
- reverse and two-way delay valves,
- downstream air injection tube.

**NOTE:** Diverter valve and air pump operation with the dual air injection system is basically the same as it is with the single air injection system.

**NOTE:** The dual air injection system is inter-related with the feedback system and must be diagnosed in conjunction with the feedback system. Refer to Chapter 1J-Fuel Systems.

### Air Control Circuit Operation

#### Air Control Valve

The air control valve is located between the diverter valve and the air injection manifold. The air control valve is controlled by vacuum regulated by the upstream solenoid.

The air control valve directs system air pressure either "upstream" (into the air injection manifold attached to the exhaust manifold) when vacuum is applied to it or "downstream" (directly into the dual bed monolithic-type converter) when vacuum is not applied to it.

The air mixes with the hot exhaust when it enters the "upstream" input and causes a further burning of the mixture. This reduces hydrocarbons (HC) and carbon monoxide (CO) emission to the atmosphere.

During "downstream" operation, the additional air reacts with hydrocarbons (HC) and carbon monoxide (CO) in the catalytic converter (rear half) to create carbon dioxide (CO<sub>2</sub>) and water vapor and reduce undesirable emission into the atmosphere.

#### Upstream Solenoid

The air control valve circuit vacuum is controlled by the "upstream" solenoid (mounted at the rear of the cylinder head cover). The solenoid is grounded through the feedback (CEC) system.

When current is allowed to flow through the circuit and energize the "upstream" solenoid, it opens the air control valve vacuum to the atmosphere and the air control valve directs system air pressure "upstream" to the exhaust manifold.

When the vacuum is allowed to pass through the "upstream" solenoid (deenergized condition) to the air control valve, air system pressure is directed "downstream" to the rear half of the dual bed catalytic converter.

#### Air Bypass Circuit Operation

The controlling vacuum for air bypass is regulated by the divert solenoid, Open Loop 3 (OL3) vacuum switch (CEC system) and two-way and reverse delay valves.

#### Divert Solenoid

The divert solenoid is grounded via the feedback (CEC) system.

When current flows through the circuit, the energized solenoid allows atmospheric pressure to displace the vacuum, which allows the diverter (bypass) valve to release system air pressure to the atmosphere.

#### Two-Way and Reverse Delay Valves

Two-way and reverse delay valves are used to prevent a sudden loss of vacuum during a rapid vacuum decrease caused by engine acceleration.

#### Coolant Temperature Switch

The coolant temperature switch is located at the rear of the intake manifold. This switch controls the upstream solenoid operation.

**NOTE:** The coolant switch (dual function) also provides a ground for the intake manifold heater.

#### Operation

Manifold vacuum should be present at the air control valve via the upstream solenoid when the coolant temperature is lower than 160°F (71°C) (approximately) and should not be present if the coolant temperature is above 160°F (71°C) (approximately). If the coolant temperature is lower than 160°F (71°C) and vacuum is not present, inspect the vacuum hoses for air leaks and proper routing. Repair as necessary. If no fault is found, replace the switch or microprocessor.

## DUAL AIR INJECTION SYSTEM DIAGNOSIS

### General

The dual air injection system should be diagnosed in conjunction with the CEC System. Refer to Chapter 1J—Fuel Systems.

### Diverter Valve

Test the diverter valve as outlined in Single Air Injection System Components.

**NOTE:** *If the engine is at normal operating temperature, manifold vacuum will have to be temporarily connected to the valve during the test because the control valve circuit will be in operation.*

### Air Bypass Circuit

#### Functional Test

(1) Disconnect air hoses from ports A and B of air control valve. Hose A is connected to air injection manifold. Hose B is connected to catalytic converter.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Start engine and warm to normal operating temperature. Turn ignition off.

(3) Restart engine and increase speed to 1500 rpm. Air should exhaust from port A of air control valve for approximately 30 seconds, then exhaust from port B.

(a) If no air exhausts, inspect diverter valve vents for air exhaust.

1. If air is being exhausted, increase engine speed to 1500 rpm and determine if vacuum is being applied to diverter valve.

2. If vacuum is present, replace diverter valve and retest. If no vacuum is present, refer to Chapter 1J—Fuel Systems and test divert solenoid.

3. If air is not being exhausted, inspect air pump for proper operation.

(b) If air exhaust from air control valve is normal, depress accelerator pedal to floor, return engine to idle and inspect diverter valve vents for air exhaust.

1. If air is exhausted, circuit is operating normally.

2. If air is not exhausted, check diverter valve vacuum hose for vacuum. If no vacuum, replace diverter valve. If vacuum is present, refer to Chapter 1J—Fuel Systems and test divert solenoid.

### Air Control Circuit

**NOTE:** *Engine must be at normal operating temperature.*

#### Functional Test

(1) Disconnect air hoses from ports A and B of air control valve. Hose A is connected to air injection manifold. Hose B is connected to catalytic converter.

**WARNING:** *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Start engine and warm to normal operating temperature. Turn ignition off.

(3) Restart engine and increase speed to 1500 rpm. Air should exhaust from port A of air control valve for approximately 30 seconds, then exhaust from port B.

(a) If no air exhausts, inspect diverter valve vents for air exhaust.

1. If air is exhausted, with engine at 1500 rpm, determine if vacuum is being applied to diverter valve.

2. If vacuum is present, replace diverter valve and retest.

3. If vacuum is not present, refer to Chapter 1J—Fuel Systems and test divert solenoid.

4. If air is not exhausted, inspect air pump for proper operation.

(b) If air exhausts from both ports, replace air control valve and retest system.

(c) If air exhausts only from port B, remove vacuum hose and check for vacuum during first 30 seconds of operation.

1. If vacuum is not present, replace air control valve and retest.

2. If vacuum is present, refer to Chapter 1J—Fuel Systems and test upstream solenoid.

(d) If air exhaust is normal, depress accelerator pedal to floor, return engine to idle and inspect diverter valve vents for air exhaust.

1. If air is exhausted, system is operating normally.

2. If air is not exhausted, check diverter valve vacuum hose for vacuum. If no vacuum, replace diverter valve. If vacuum is present, refer to Chapter 1J—Fuel Systems and test divert solenoid.

## COOLANT TEMPERATURE SWITCH REPLACEMENT

**WARNING:** *Serious burns can result if hot coolant is not drained before removing the switch from the intake manifold.*

- (1) Drain coolant from radiator.
- (2) Disconnect wire connector.

- (3) Use open-end wrench to remove switch from intake manifold.
- (4) Install replacement valve in intake manifold.
- (5) Connect wire connector.
- (6) Install coolant and purge air from cooling system. Refer to Chapter 1C—Cooling Systems.

**DOWNSTREAM AIR INJECTION TUBE REPLACEMENT**

- (1) Disconnect air delivery hose at check valve.

**NOTE:** Remove check valve if it is to be reused.

- (2) Remove clamp connecting “downstream” air injection tube to catalytic converter nipple.

**NOTE:** It may be necessary to heat the joint for removal.

- (3) Attach injection tube to catalytic converter nipple.

- (4) Install check valve, if removed, and tighten with 25 foot-pounds (34 N•m) torque minimum.

- (5) Connect air delivery hose to check valve.

- (6) Install clamp to secure “downstream” air injection tube to catalytic converter nipple. Tighten clamp with 3 to 4 foot-pounds (4 to 5 N•m) torque.

**SPECIFICATIONS**

**Torque Specifications**

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened item.

	USA (ft.-lbs)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Air Pump Mounting Screws .....	20	15-22	27	20-30
Air Injection Manifold Fittings				
Six-Cylinder Engine .....	20	15-22	27	20-27
Eight-Cylinder Engine .....	38	30-45	52	41-61

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified. 70296

**CATALYTIC CONVERTER SYSTEMS**

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**GENERAL**

**NOTE:** All reference to CJ vehicles also pertains to Scrambler vehicles.

All CJ vehicles with four-cylinder engines utilize a pellet-type catalytic converter to reduce undesirable exhaust gas emissions. Vehicles designated 49-State use a conventional oxidizing catalytic (COC) converter and vehicles designated for sale in California use a three-way catalytic (TWC) converter. There is no scheduled maintenance required for either type converter.

A COC pellet-type catalytic converter is used with all eight-cylinder engine exhaust systems. All Cherokee, Wagoneer and Truck vehicles with six-cylinder engines and CJ vehicles with six-cylinder engines manufactured

for sale in California use a dual bed (COC and TWC) monolithic-type converter with “downstream” air injection.

**CAUTION:** The use of leaded fuel destroys catalytic converters and oxygen sensors.

All Jeep vehicles are designed for unleaded fuel and are equipped with a fuel filler neck restrictor that prevents the insertion of the larger leaded fuel-filler hose nozzle.

**CONVENTIONAL OXIDIZING CATALYTIC (COC) PELLET-TYPE CONVERTER**

The pellet-type conventional oxidizing catalytic (COC) converter contains beads of alumina coated with

platinum and palladium catalyzing agents. Thousands of pellets are contained in a steel canister. A plug is provided in the converter to permit replacement of the pellets should they become ineffective.

This type converter promotes the oxidation of incompletely burned fuel (HC) and carbon monoxide (CO). The chemical process involved changes HC and CO into harmless carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) vapor before the exhaust gas is emitted into the atmosphere. The catalysts that cause the chemical changes are platinum and palladium.

With pellet-type COC converters, all exhaust gases flow through the catalytic converter.

The temperature inside a converter is somewhat higher than the temperature of the exhaust gases when they are exhausted from the engine. Insulation in the pellet-type converter keeps the outside skin of the converter at approximately the same temperature as the muffler. Because of its larger mass, the converter stays hot much longer than the muffler.

The 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. A carburetor, air pump or ignition problem that permits unburned fuel to enter the converter will usually cause overheating. If a converter is heat-damaged, the carburetor, air pump, or ignition problem should be corrected at the same time the converter is replaced. All other components of the exhaust system should also be inspected for heat damage.

### THREE-WAY CATALYTIC (TWC) PELLET-TYPE CONVERTER

This type converter utilizes rhodium in addition to platinum and palladium as oxidizing agents. Rhodium is a catalyst for oxides of nitrogen (NO<sub>x</sub>) and changes it and carbon monoxide (CO) into nitrogen (N<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>).

Operationally, as the air/fuel mixture is leaned out, the converter efficiency for changing HC and CO is increased but is decreased for changing NO<sub>x</sub>. Enriching the mixture increases converter efficiency for changing NO<sub>x</sub> but decreases it for HC and CO. For this reason, to optimize the simultaneous conversion of all three, the carburetor must provide an air/fuel mixture ratio of approximately 14.7:1 (fig. 1K-13). This is the primary function of the C4 System that is used in conjunction with the Three-Way Catalytic (TWC) Converter.

### DUAL BED (COC AND TWC) MONOLITHIC-TYPE CONVERTER

The dual bed monolithic-type converter used with six-cylinder engines is two converters in one container. The

rear half is a conventional oxidizing catalytic (COC) converter. The front half is a three-way catalytic (TWC) converter.

As with the TWC pellet-type converter (above), maintaining high conversion efficiency for this type converter requires that the carburetor provide an air/fuel mixture ratio of approximately 14.7:1 (fig. 1K-13). This is the primary function of the Feedback System used in conjunction with the converter.

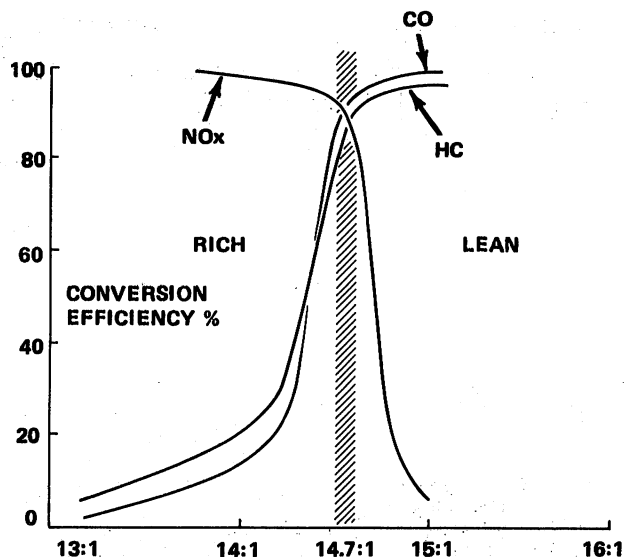


Fig. 1K-13 Optimum Air/Fuel Ratio for Conversion Efficiency

### CATALYST REPLACEMENT

#### Dual Bed (COC and TWC) Monolithic-Type Converter

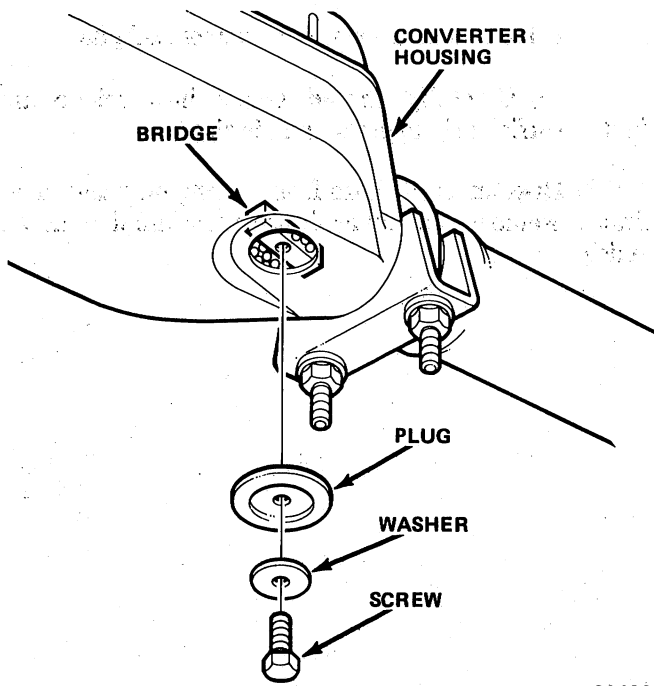
This type converter is not serviceable. The entire unit must be replaced if defective. Remove by disconnecting the air injection tube and detaching converter from the front exhaust pipe and the muffler (or rear exhaust pipe, if equipped). Install replacement converter.

#### COC and TWC Pellet-Type Converter

The pressed-in plug must be removed to replace the pellets. A replacement plug (fig. 1K-14) is required to seal the converter after the pellets have been replaced.

On-vehicle servicing is the only factory approved method of replacing pellets because catalytic converters are difficult to remove from most vehicles, especially after a large number of miles have accumulated, without damaging the converter assembly or exhaust connections.

The catalyst replacement tool includes an emptying and fill mechanism, a vacuum aspirator and two hand tools used for removal of the converter drain plug. The emptying and fill mechanism clamps directly to the



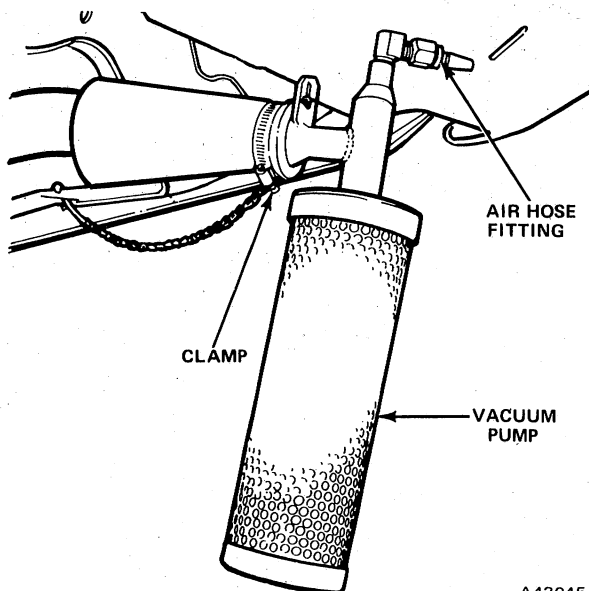
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Fig. 1K-14 COC and TWC Pellet-Type Converter Plug

catalytic converter and consists of an air turbine vibrator unit and discharge-fill container. The vibrator induces a rotary motion to the catalytic converter case causing the catalyst pellets to flow out the drain port and into the attached container.

An adapter is included to adapt the exchanger to the newer-type converters, which have an unthreaded (pressed-in) access plug.

- (1) Raise vehicle.
- (2) Clamp vacuum aspirator (part of Tool J-25077-01) on tailpipe outlet (fig. 1K-15).



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Fig. 1K-15 Vacuum Aspirator

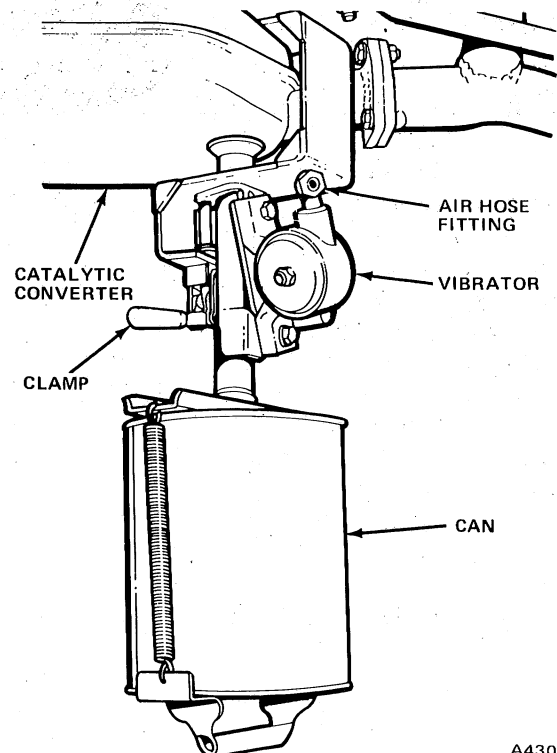
- (3) Connect air hose (80 psi minimum) to fitting on vacuum aspirator.

**NOTE:** Vacuum aspirator must be in operation prior to removing plug to prevent pellets from spilling out on shop floor.

**CAUTION:** Use care to prevent damaging converter housing when removing plug. If the drain-fill hole cannot be sealed with the replacement plug, the converter must be replaced.

- (4) Remove plug from bottom of converter with removal tools provided with Tool Kit J-25077-01.
- (5) Clamp container-vibrator unit (using Adapter J-25077-6) on converter (fig. 1K-16).
- (6) Remove air hose from vacuum aspirator.
- (7) Connect air hose (80 psi or 550 kPa minimum) to fitting on vibrator. Approximately ten minutes is required to empty pellets from converter.
- (8) Disconnect air hose, remove container and discard pellets.
- (9) Fill container with replacement pellets and attach to converter.
- (10) Connect air hose (80 psi or 550 kPa minimum) to fitting on vacuum aspirator. Pellets will be forced into converter and packed in place.

**NOTE:** If any pellets pass through the converter and into the tailpipe, the converter is defective and must be replaced.



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Fig. 1K-16 Container-Unit Vibrator

(11) When full of pellets, remove container-vibrator unit from converter. Maintain air pressure at vacuum aspirator.

(12) Plug converter with replacement plug (fig. 1K-15).

(a) Thread screw into bridge and position bridge inside opening. Remove screw without disturbing bridge position.

(b) Insert screw through washer and plug.

(c) Carefully thread screw into bridge and tighten sufficiently to create an air-tight seal.

(13) Disconnect air hose from fitting on vacuum aspirator. Remove vacuum aspirator from tailpipe. Lower vehicle

### Tools

