EXHAUST SYSTEMS 1K

SECTION INDEX

EXHAUST MANIFOLDS, MUFFLERS AND PIPES

GENERAL

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

CJ vehicles with four-, six- or eight-cylinder engines that are designated 49-State use a conventional oxidizing catalytic (COC) pellet-type converter (figs. 1K-1, 1K-2 and 1K-3). 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 use a dual bed (COC and TWC) monolithic-type converter with "downstream" air injection.

Cherokee, Wagoneer and Truck vehicles use a conventional oxidizing catalytic (COC) pellet-type converter except six-cylinder engine models manufactured for sale in California. These models use a dual bed (COC and TWC) monolithic-type converter with "downstream" air injection (figs. 1K-4, 1K-5).

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 parts 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

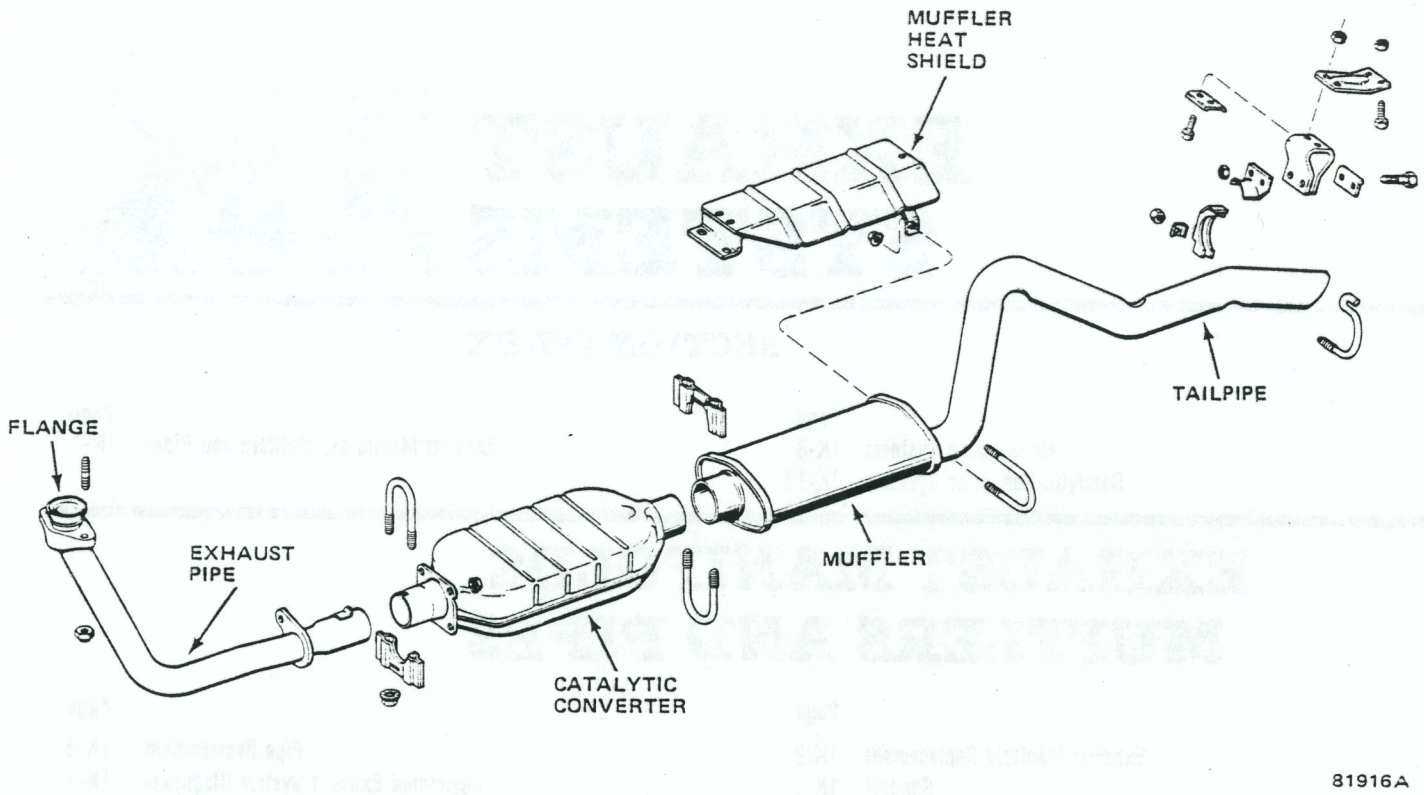


Fig. 1K-1 Four-Cylinder Engine Exhaust System—CJ Vehicles

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).

EXHAUST MANIFOLD REPLACEMENT

Four-Cylinder Engine

The exhaust manifold is located on the left hand side of the engine (fig. 1K-6). 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-7). Refer to Chapter 1B—Engines for replacement procedure.

Eight-Cylinder Engine

Refer to Chapter 1B—Engines for replacement procedure.

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-8). 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.

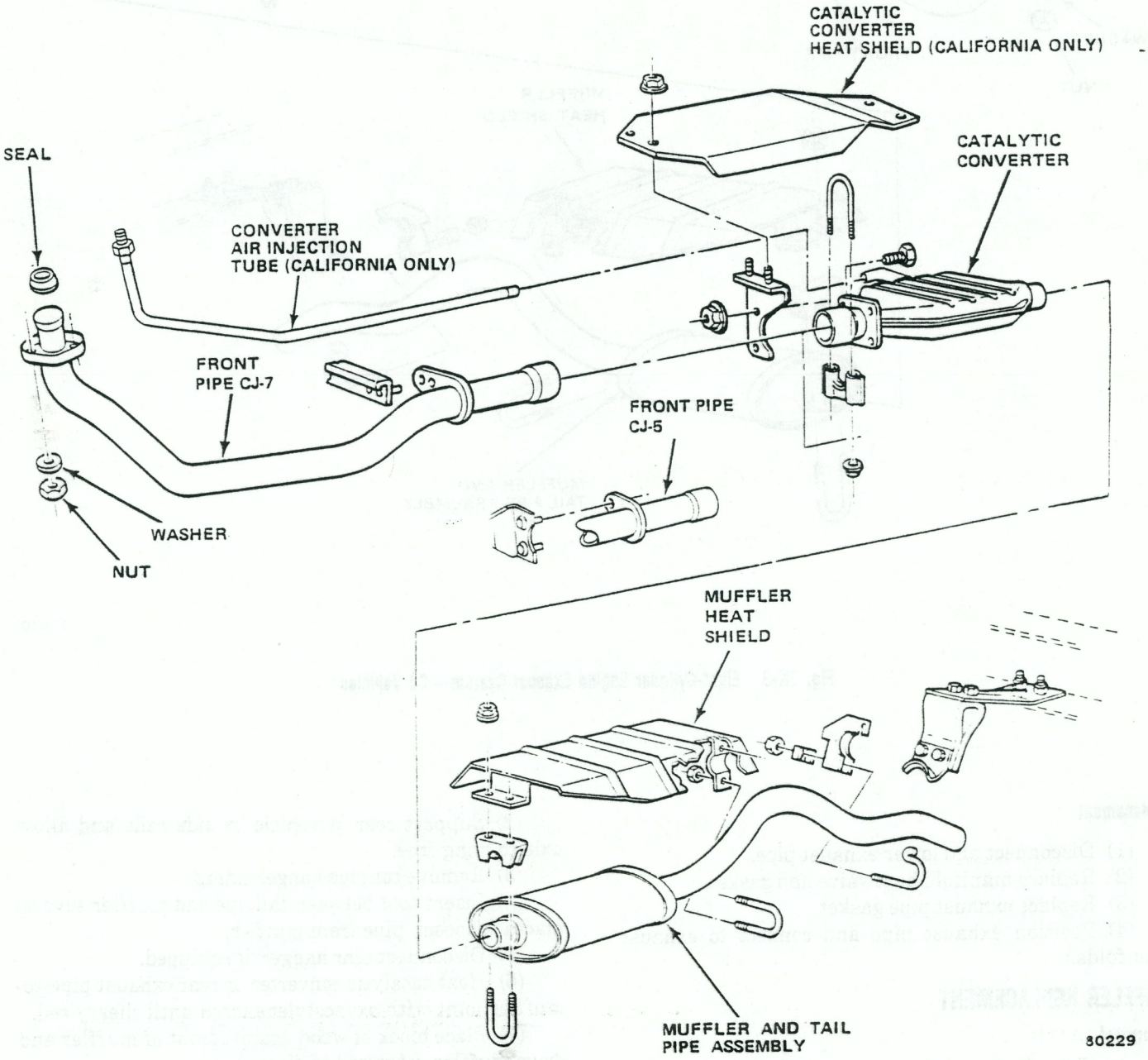


Fig. 1K-2 Six-Cylinder Engine Exhaust System—CJ Vehicles

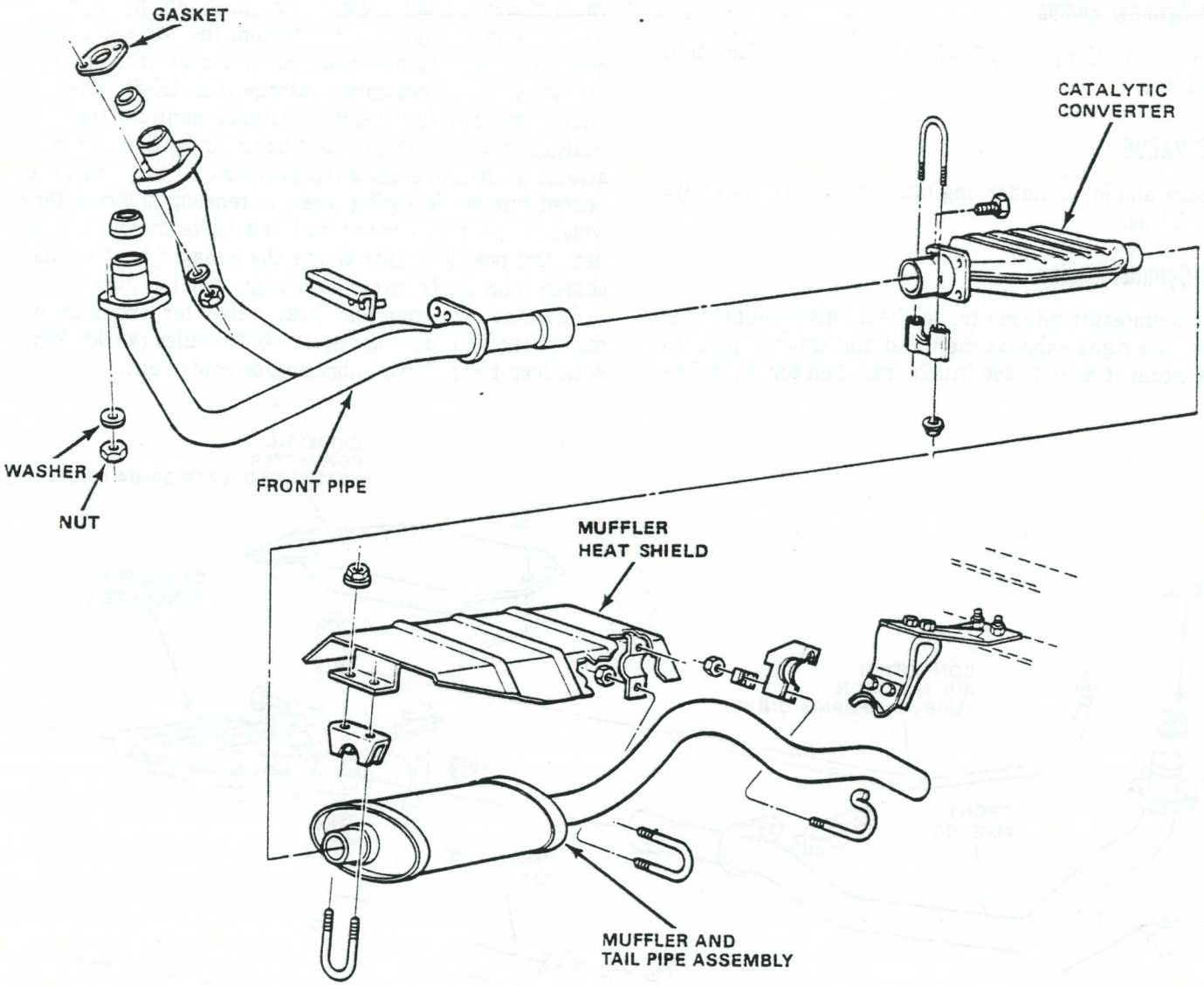


Fig. 1K-3 Eight-Cylinder Engine Exhaust System—CJ Vehicles

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 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.

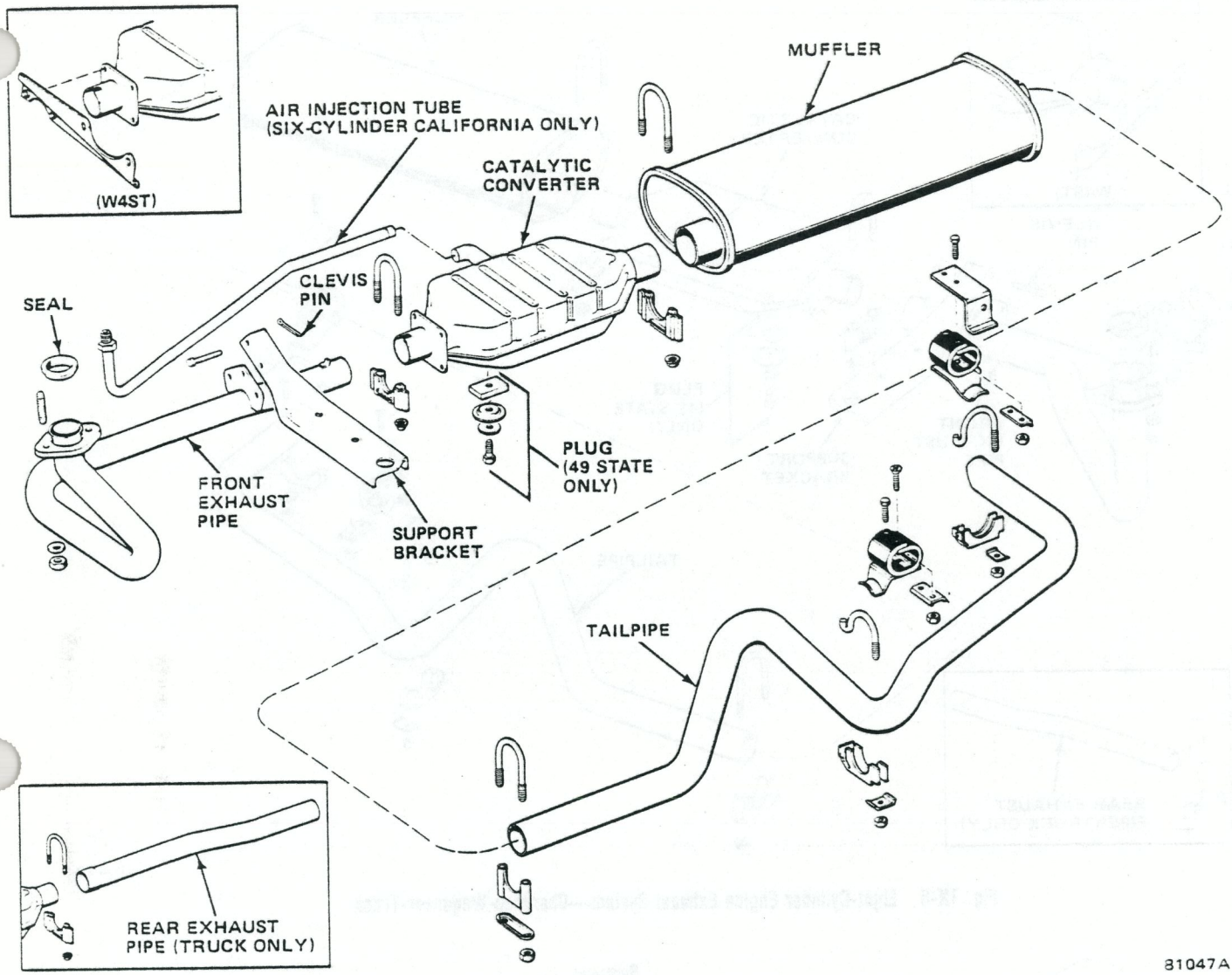


Fig. 1K-4 Six-Cylinder Engine Exhaust System—Cherokee-Wagoneer-Truck

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.

PIPE REPLACEMENT

Front Exhaust Pipe

Removal

(1) Disconnect exhaust pipe from manifold.

(2) Disconnect mounting bracket and/or clamp.

(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.

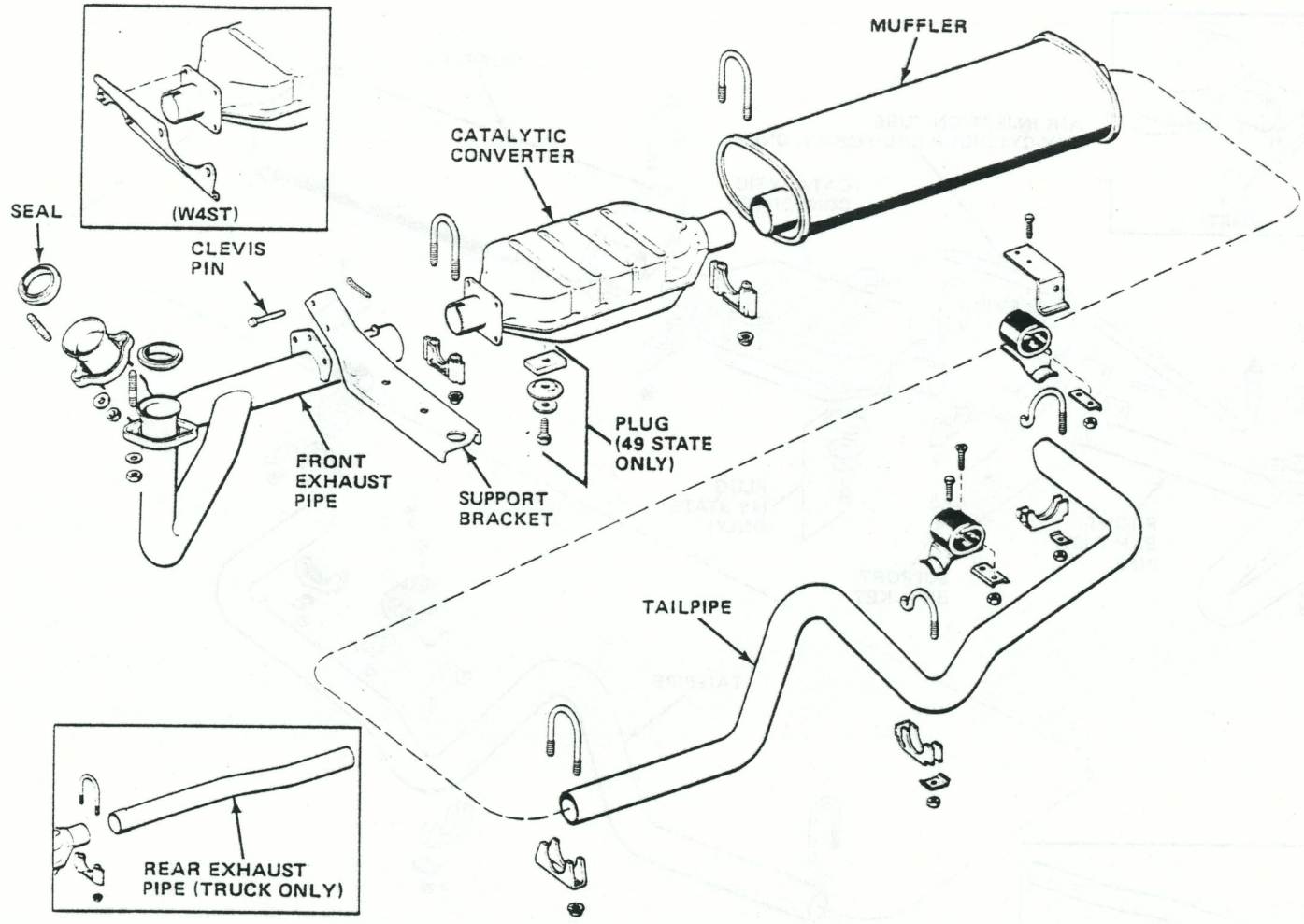
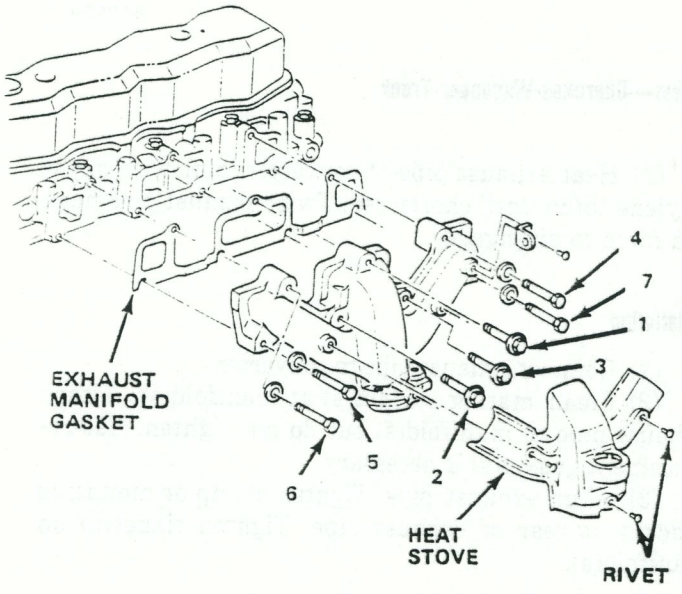


Fig. 1K-5 Eight-Cylinder Engine Exhaust System—Cherokee-Wagoneer-Truck



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.

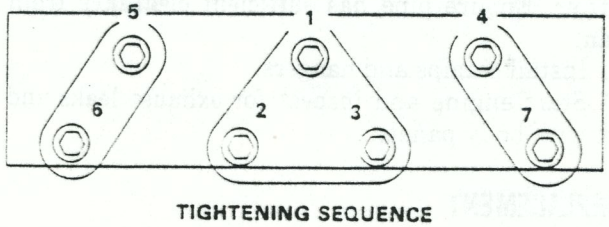


Fig. 1K-6 Exhaust Manifold—Four-Cylinder Engine

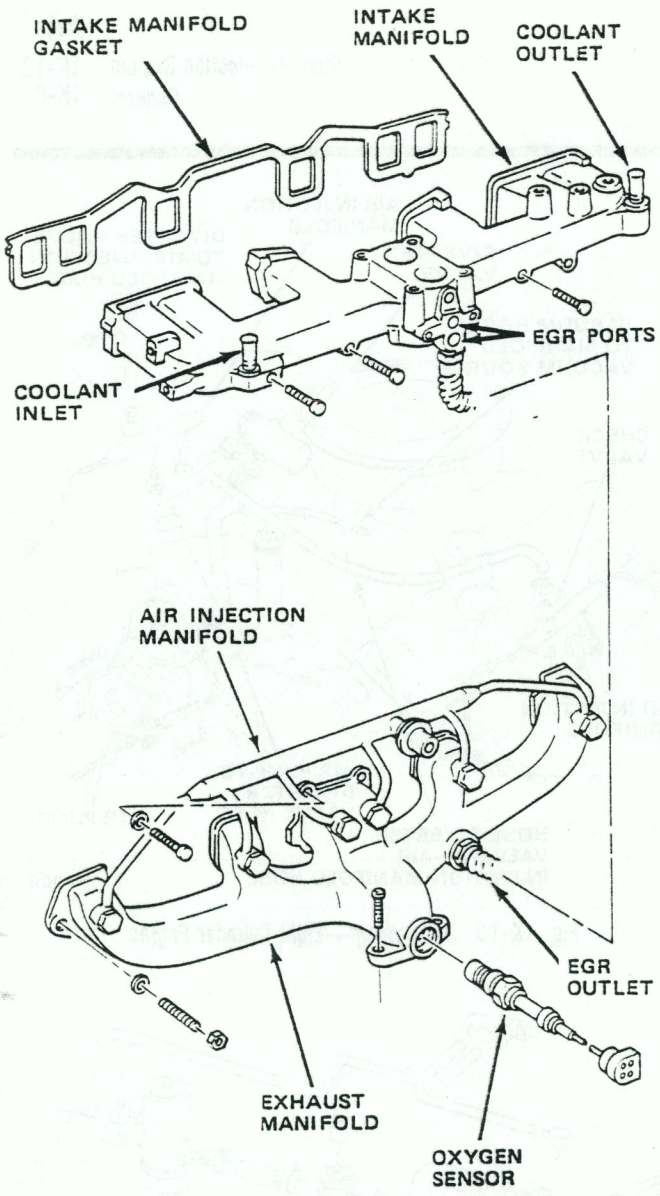


Fig. 1K-7A Manifold Assembly—Six-Cylinder Engine

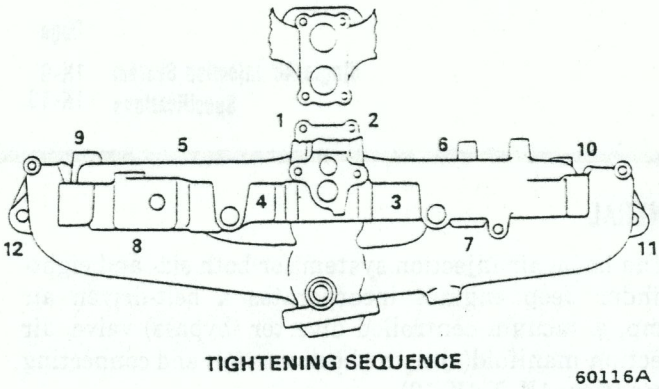


Fig. 1K-7B Manifold Assembly—Six-Cylinder Engine

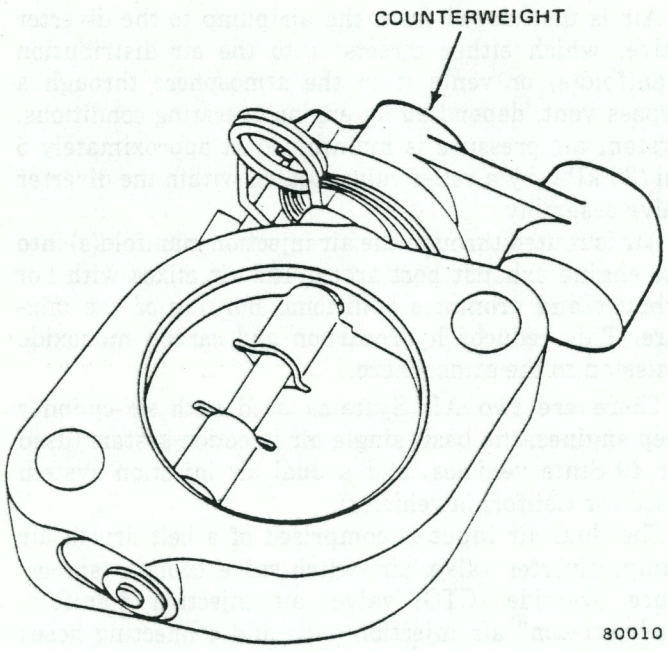


Fig. 1K-8 Exhaust Manifold Heat Valve in Heat On Position—Eight-Cylinder Engine

SPECIFICATIONS

Torque Specifications

Service Set-To Torque Values should be used when assembling components. Service In-Use Recheck Torque Values 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

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-9, 1K-10).

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 vehicles) and a dual air injection system (used for California vehicles).

The dual air input is comprised of a belt driven air pump, diverter valve, air switch valve, coolant temperature override (CTO) valve, air injection manifold, "downstream" air injection tube and connecting hoses (fig. 1K-11). The two air inputs into the exhaust system are:

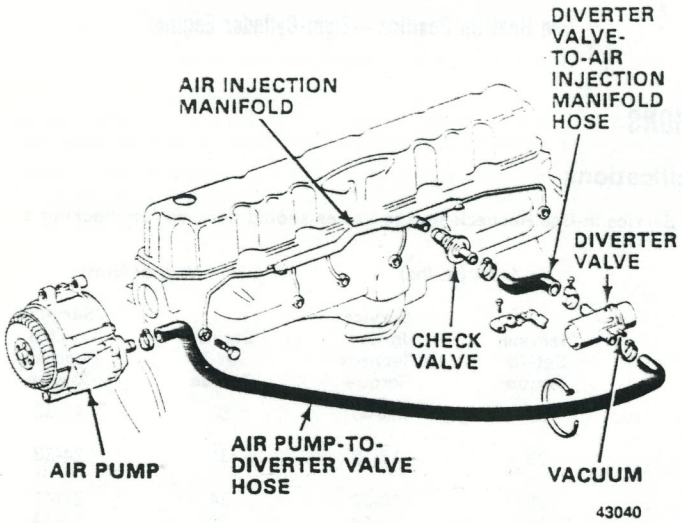


Fig. 1K-9 Air System—Six-Cylinder Engine (49-State)

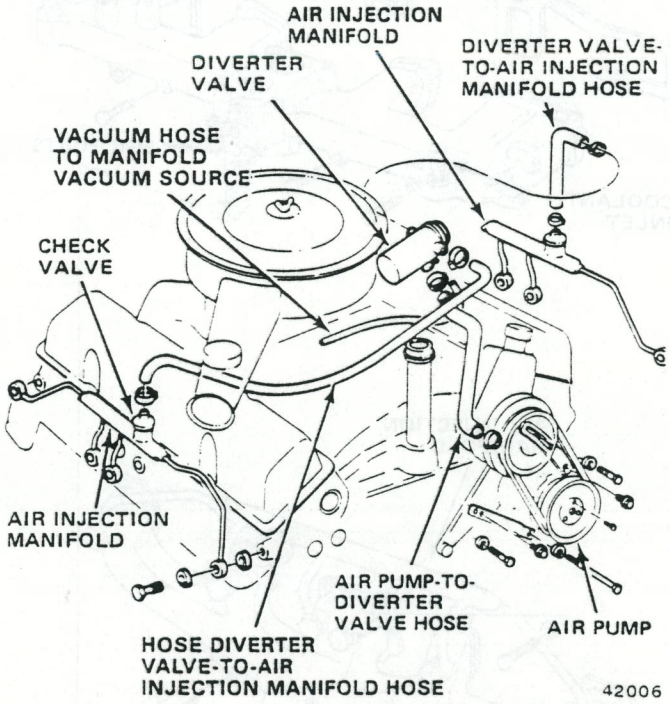


Fig. 1K-10 Air System—Eight-Cylinder Engine

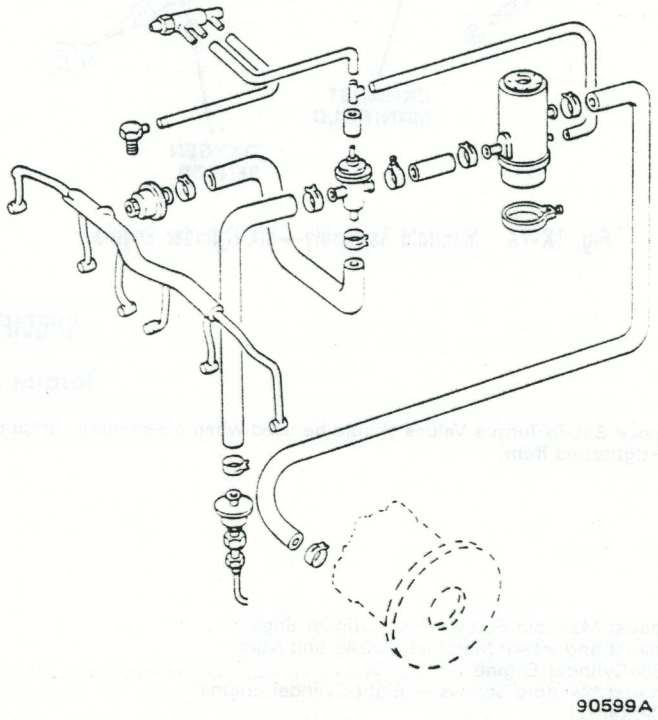


Fig. 1K-11 Air System—Six-Cylinder Engine (Calif.)

- upstream air injection is via the air injection manifold attached to the exhaust manifold.
- downstream air injection is 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-12).

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.

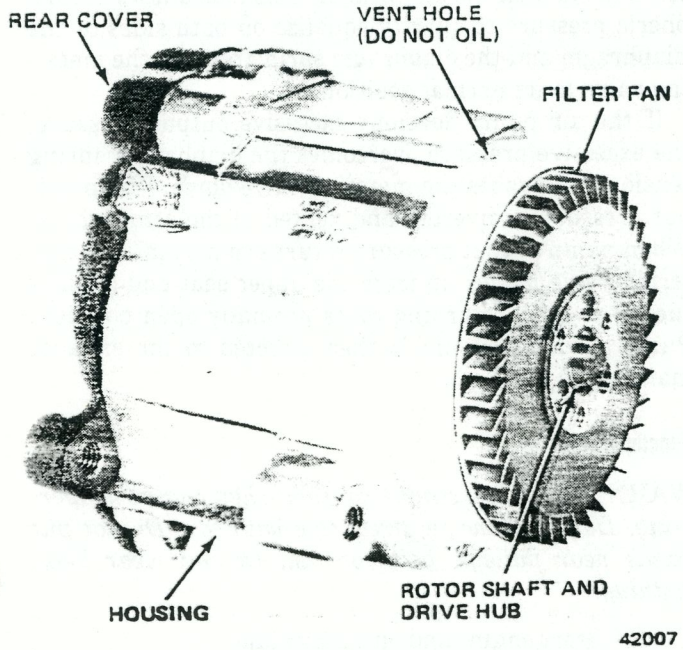


Fig. 1K-12 Air Pump

Operation

The pump vanes are located 180° apart and rotate around the pivot pin, which is located on the centerline 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 air flow 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-13). 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).

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.

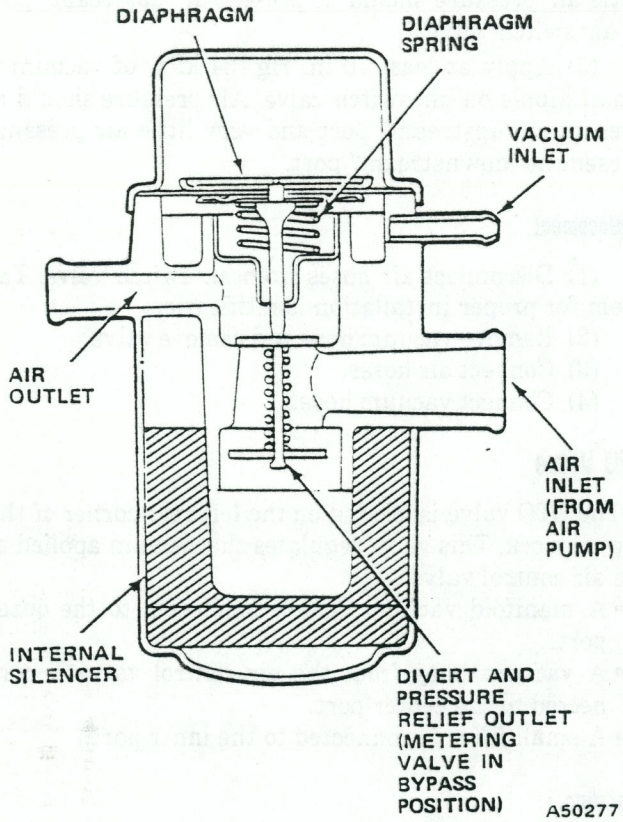


Fig. 1K-13 Diverter Valve—Typical

(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:

- air switch valve,
- coolant temperature override (CTO) valve,
- downstream air injection tube.

NOTE: *The dual air injection system is interrelated with the feedback system and must be diagnosed in conjunction with the feedback system.*

Air Switch Valve

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

The air switch 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_2) and water vapor and reduce undesirable emission into the atmosphere.

Functional Test

(1) Disconnect two output hoses from air switch valve. Note which hose was connected to "downstream" port and which hose to "upstream" port.

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.

(3) Disconnect vacuum hose from small valve nipple.

NOTE: *Vacuum should be present at the vacuum hose 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 hose for air leaks. If no leaks are found, replace the CTO valve.*

(4) Air pressure should be present at air switch valve port that connects to "downstream" hose. Very little air pressure should be present at "upstream" port of air switch valve.

(5) Apply at least 10 in. Hg (34 kPa) of vacuum to small nipple on air switch valve. Air pressure should be present at "upstream" port and very little air pressure present at "downstream" port.

Replacement

(1) Disconnect air hoses from air switch valve. Tag them for proper installation identification.

(2) Remove vacuum hose and remove valve.

(3) Connect air hoses.

(4) Connect vacuum hose.

CTO Valve

The CTO valve is located on the left rear corner of the engine block. This valve regulates the vacuum applied to the air control valve.

- A manifold vacuum hose is connected to the outer port.
- A vacuum hose from the air control valve is connected to the center port.
- A small filter is connected to the inner port.

Operation

Manifold vacuum should be present at the air switch valve 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 hose for air leaks and proper routing. Repair as necessary. If no fault is found, replace the valve.

Replacement

WARNING: *Serious burns can result if hot coolant is not drained before removing the valve from the block.*

(1) Drain coolant from radiator.

(2) Disconnect vacuum hoses.

(3) Use open-end wrench to remove valve from block.

(4) Install replacement valve in block.

(5) Connect vacuum hoses.

(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

GENERAL

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 six- and eight-cylinder engine exhaust systems except those used with CJ, Cherokee and Wagoneer vehicles with six-cylinder engines manufactured for sale in California. These vehicles use a dual bed (COC and TWC) monolithic-type converter with "downstream" air injection.

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

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 (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_2) and water (H_2O) 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_X) and changes it and carbon monoxide (CO) into nitrogen (N_2) and carbon dioxide (CO_2).

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_X. Enrichening the mixture increases converter efficiency for changing NO_X 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-14). 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-14). This is the primary function of the Feedback System used in conjunction with the converter.

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.

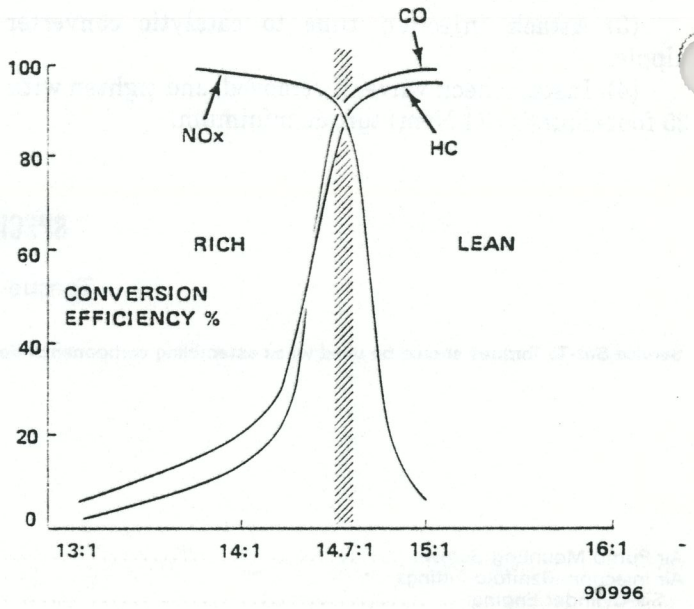


Fig. 1K-14 Optimum Air/Fuel Ratio for Conversion Efficiency

COC Pellet-Type Converter

The pressed-in plug must be removed to replace the pellets. A replacement plug (fig. 1K-15) 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.

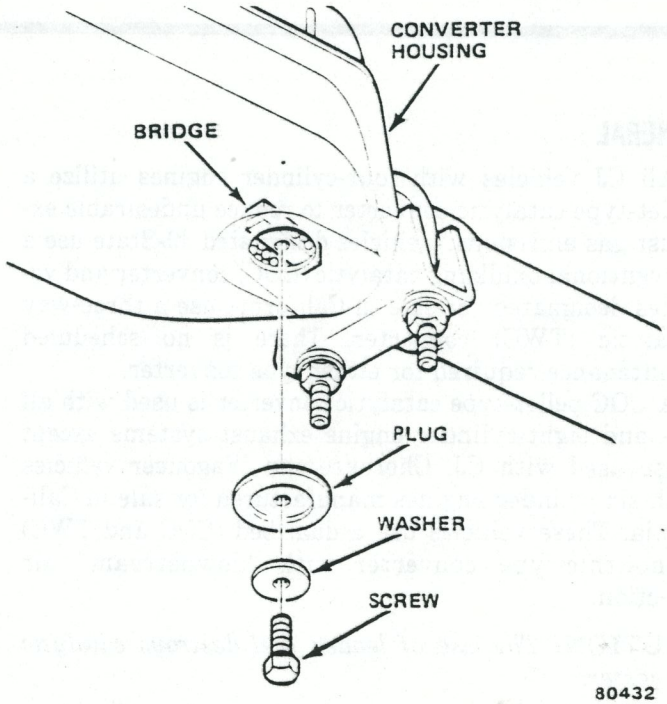


Fig. 1K-15 COC Pellet-Type Converter Plug

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 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-16).

(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-17).

(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.

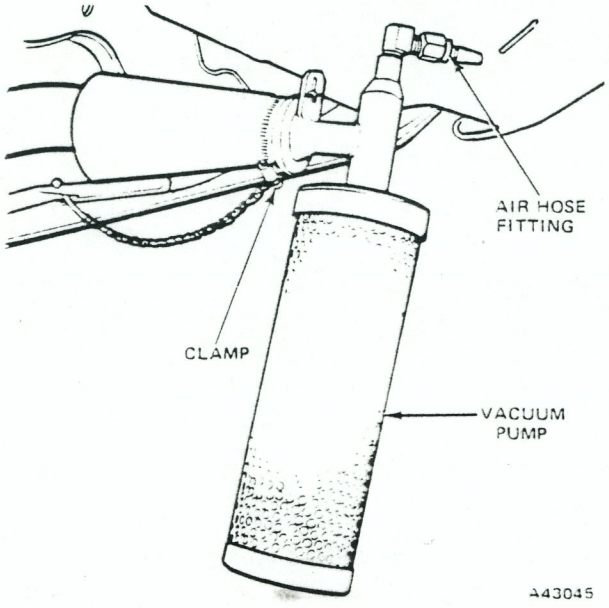


Fig. 1K-16 Vacuum Aspirator

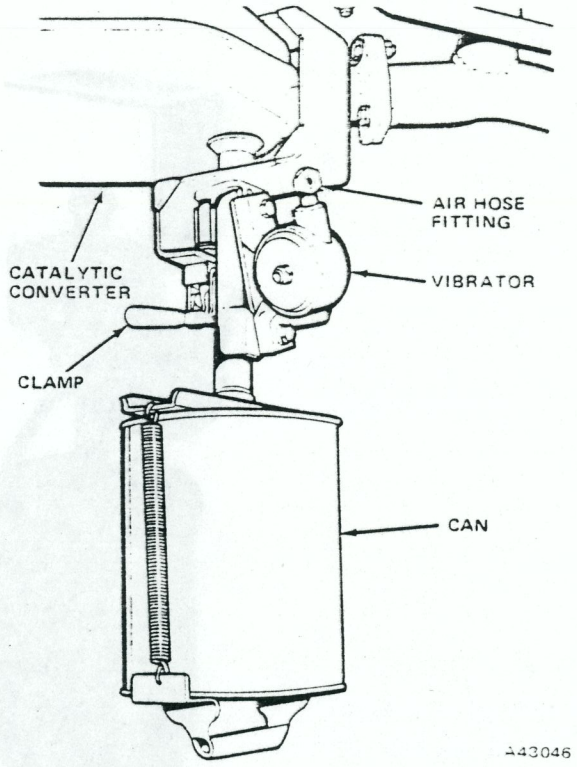


Fig. 1K-17 Container-Unit Vibrator

(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.*

(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.

TWC Pellet-Type Converter

The TWC pellet-type converter catalyst is not serviceable. If the converter fails to function, the complete unit must be replaced.

Tools

J-25077
CATALYTIC CONVERTER
CATALYST CHANGER

70452

POWER PLANT INSTRUMENTATION 1L

SECTION INDEX

GENERAL INFORMATION

GENERAL

This chapter is divided into three sections. The first section, General Information, contains descriptions of all instrumentation, theory of operation, test procedures and replacement procedures. The second section, Diagnosis and Repair Simplification (DARS) Charts, contains pictorial guides for diagnosing instrumentation malfunctions. The third section, Specifications, contains specifications, instrument cluster illustrations, instrument cluster and printed circuit board schematics and separate schematics for each gauge, meter and lamp circuit.

Power plant instrumentation includes all instrument panel gauges, meters and lamps used to monitor the engine-related systems included in part one of this manual. Refer to Chapter 3C—Instrument Panels and Components for speedometer, odometer, clock, illumination lamps, turn signal indicator lamps and high beam indicator lamp. The instrumentation included in this chapter involves: ammeter, voltmeter, constant voltage regulator (CVR), fuel gauge, oil pressure gauge, tachometer, and coolant temperature gauge (fig. 1L-1 and 1L-2). These devices are all electrically operated.

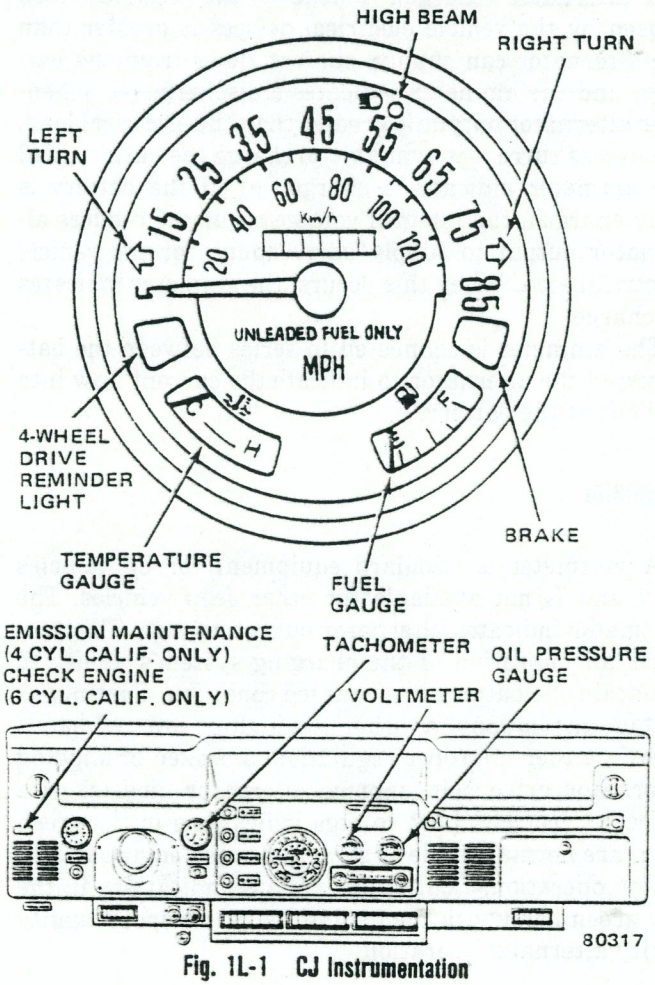


Fig. 1L-1 CJ Instrumentation

OPERATION

Ammeter

Ammeters are standard equipment for Cherokee, Wagoneer and Truck vehicles. They are not available for CJ vehicles.

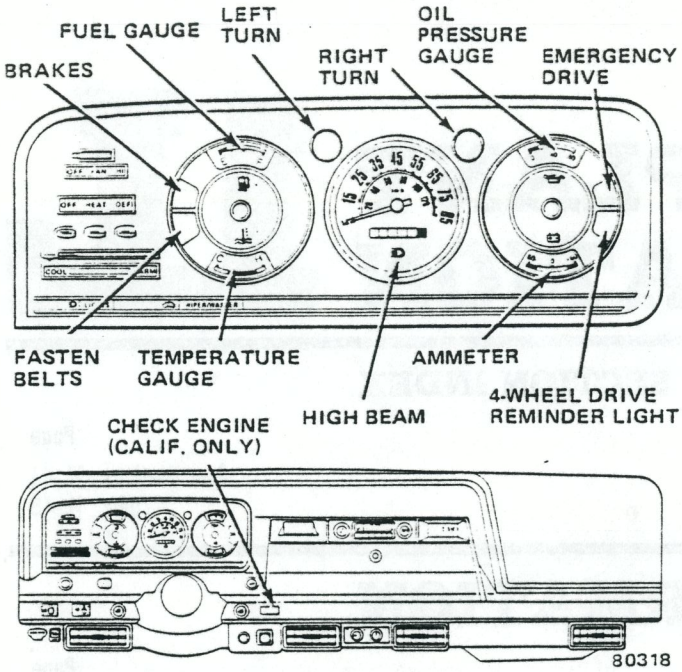


Fig. 1L-2 Cherokee-Wagoneer-Truck Instrumentation

An ammeter is an instrument used to indicate the amount of current flowing from the battery (discharge) and alternator (charge). Whenever the electrical load caused by the vehicle electrical devices is greater than the alternator can supply, current flows from the battery, and the ammeter indicates a discharge (-). Whenever alternator output is greater than the electrical load, the excess current is available to charge the battery, and the ammeter indicates a charge (+). If the battery is fully charged, the integral voltage regulator reduces alternator output to supply only enough for the vehicle electrical load. When this occurs, the ammeter indicates no charge.

The ammeter is connected in series between the battery and the alternator to indicate the current flow into and out of the battery.

Voltmeter

A voltmeter is standard equipment for CJ vehicles only and is not available for other Jeep vehicles. The voltmeter indicates alternator output voltage. This provides an indication of the charging system's ability to maintain the battery in a charged condition. Continuous voltage indications in either the high or low red bands signify either improper regulation, a broken or slipping alternator drive belt, shorted alternator diode(s) or a defective battery. Low voltage indications in the green band are normal at idle or after prolonged engine starter motor operation. Continuous voltage indications in the low green band with the engine above idle speed signify faulty alternator operation.

Constant Voltage Regulator (CVR)

Several vehicle gauges are designed to operate on low voltage. The constant voltage regulator (CVR) provides approximately 5 volts for this purpose. Battery voltage is supplied to the CVR. The CVR contains a small heating coil and thermostatically operated points. With battery voltage applied to the CVR, the points vibrate at a rate that produces an average of 5 volts for the gauges. The CVR is an integral part of the fuel gauge for CJ vehicles and the coolant temperature gauge for Cherokee, Wagoneer and Truck vehicles. An external circuit is used to apply the CVR voltage to the other gauges.

Fuel Gauge

Fuel gauges for all vehicles operate on regulated voltage provided by the constant voltage regulator (CVR). The fuel gauge system consists of a gauge, a variable-resistance sending unit located in the fuel tank, appropriate wiring and the CVR.

The gauge pointer is attached to a bimetallic coil that responds to temperature changes. A heating coil wrapped around the bimetallic coil provides heat that causes the bimetal to expand. Current flows from the CVR through the sending unit in the fuel tank to the heating coil. The sending unit has high resistance at low fuel level and very low resistance at high fuel level.

Oil Pressure Gauge

An oil pressure gauge is standard equipment for all Jeep vehicles.

CJ Vehicles

The oil pressure gauge system consists of an electromagnetic-type gauge, a variable-resistance sending unit and appropriate wiring. Battery voltage is applied to two coils in the gauge. One coil is connected directly to ground. The other coil is connected to the sending unit. The variable resistance in the sending unit is controlled by the oil pressure. Electromagnetic fields expand around both coils in the gauge. The pointer is influenced greater by the coil having the most current flow and the resulting more intense electromagnetic field.

Cherokee-Wagoneer-Truck

The oil pressure gauge system consists of a gauge, a variable-resistance sending unit, appropriate wiring and the constant voltage regulator (CVR). The gauge pointer is attached to a bimetallic strip that reacts to temperature changes. A heating coil wrapped around the bimetallic coil provides heat that causes the bimetal to expand. Current flows from the CVR through the sending unit attached to the engine to the heating coil.

Tachometer

Tachometers are optional instruments available for CJ vehicles only.

Tachometers are wired in series between the ignition switch terminal and the ignition coil negative terminal. The current flow through the coil is turned on and off by the ignition system and the tachometer integrates the interruptions. The engine rpm is directly proportional to the integrated voltage level.

Coolant Temperature Gauge

A coolant temperature gauge is standard equipment for all vehicles.

All temperature gauges operate on regulated voltage provided by the constant voltage regulator (CVR). The temperature gauge system consists of a gauge, a variable-resistance sending unit, appropriate wiring and the CVR.

The gauge pointer is attached to a bimetallic coil that reacts to temperature changes. A heating coil wrapped around the bimetallic coil provides heat that causes the bimetal to expand. Current flows from the CVR through the sending unit attached to the engine to the heating coil. The sending unit has high resistance at low engine coolant temperature and very low resistance at high engine coolant temperature.

Emission Maintenance Indicator Lamp

The emission maintenance indicator lamp is used only with four-cylinder engine vehicles (CJ) manufactured for sale in California. This lamp is illuminated at 30,000 miles (48 280 km) to indicate required service for the oxygen sensor (C4 System). Refer to Maintenance —Chapter B and Exhaust Systems—1K for additional information

After performing the service, the emission maintenance switch must be reset by turning the reset screw on the switch body. The switch is located under the hood between the upper and lower speedometer cables on the left side of the dash panel. Turn the spring loaded reset screw approximately 1/4 turn counterclockwise to the reset detent position.

Check Engine Indicator Lamp

This lamp is used only with six-cylinder engine vehicles manufactured for sale in California. The lamp is illuminated when the computerized emission control self-diagnostic system detects a fault.

As a bulb and system check, the lamp will illuminate when the ignition is turned to the **ON** position with the engine stopped.

The fuel feedback system trouble code diagnosis is described in Fuel Systems—Chapter 1J.

INSTRUMENTATION DIAGNOSIS

General

Improper operation of electrical gauges or meters can be usually traced to either faulty electrical wiring continuity (including printed circuit boards), improperly calibrated components or high resistance caused by loose or corroded connections.

A common diagnostic procedure is to bypass a suspected component, wire, printed circuit, or connection with a jumper wire. If the gauge or meter functions normally with the jumper installed, the problem usually is within the bypassed printed circuit, wire, connection or component.

Test Equipment

Several gauge tests require the use of Universal Gauge Tester J-24538. This instrument provides a wide range of variable resistance. If the tester is not available, a suitable substitute can be constructed with an accurate ohmmeter and a spare fuel gauge sending unit.

(1) Attach one ohmmeter test probe to sending unit terminal.

(2) Attach other ohmmeter test probe to sending unit ground wire.

(3) Refer to applicable Sending Unit Resistance (Ohms) chart for resistance values that apply to gauge being tested. Charts are included in Specifications. To calibrate, move float arm and mark appropriate resistance values on sending unit case.

(4) Remove ohmmeter probes. Attach jumper wire to sending unit terminal. Tester is now calibrated and ready for use.

Printed Circuit Board Test

The following procedure is used to locate suspected breaks or short circuits in the conducting foil.

(1) Remove instrument cluster from vehicle and remove all bulbs and gauges. Refer to Instrument Cluster Replacement for procedure.

(2) Connect one ohmmeter test probe to applicable pin terminal for circuit to be tested. Trace each circuit from pin terminal to bulb or gauge terminal in circuit with other test probe.

NOTE: *Set ohmmeter on low scale (0 to 10 ohms) and zero meter pointer.*

(3) Test for continuity at each uncoated position in circuit. Ohmmeter should indicate zero ohms at each position.

NOTE: *When circuit tracing, starting at the middle of the circuit will eliminate one half of the circuit.*

(4) Trace circuit leading away from bulb or gauge terminal to ground terminal pin or ground screw.

(5) Connect one ohmmeter probe to ground terminal pin and other probe to cluster metal case. Ohmmeter should indicate zero ohms.

(6) Replace printed circuit board if ohmmeter indicates other than zero ohms on any test.

(7) Test for short circuits between circuits. With probe connected to applicable pin for circuit to be tested, move other probe to all other pin terminals on cluster. Ohmmeter should indicate infinite resistance between circuits.

Ammeter Diagnosis

The accuracy of an ammeter may be determined by comparing indications with those of a test ammeter of known accuracy.

(1) Turn ignition switch off.

(2) Disconnect battery positive cable from terminal on starter motor solenoid.

CAUTION: *Test ammeter must be an actual ammeter, not a voltmeter with a calibrated ammeter scale. Connecting voltmeter in series will destroy its internal circuitry.*

(3) Connect test ammeter in series between solenoid terminal and disconnected cable.

(4) Turn ignition switch to On position. Do not start engine. Turn headlamps on. Turn heater blower motor to high speed.

(5) Compare current flow (amps) indication of test ammeter with that of ammeter in vehicle.

(6) Turn headlamps and heater blower motor off. Start engine and operate at high idle. Compare current flow (amps) indication of test ammeter with that of ammeter in vehicle.

(7) Replace ammeter if current flow (amps) indications of vehicle ammeter and test ammeter vary more than calibration tolerance listed in Specifications.

Voltmeter

(1) Connect test voltmeter of known accuracy across battery terminals.

(2) Turn ignition switch on.

(3) Compare voltage indication of test voltmeter with that of voltmeter in vehicle. Replace voltmeter if voltage indications vary more than calibration tolerance listed in Specifications.

Fuel Gauge Diagnosis

Movement of the fuel in the tank can occur when driving up or down hills, driving on rough surfaces or by rapidly accelerating or braking. Erratic up and down motion of the fuel gauge sending unit float may temporarily cause the fuel gauge pointer to fluctuate and indicate incorrectly. Ensure that these possibilities are considered before suspecting an actual abnormal condition in the fuel level indicating system.

Abnormal conditions all result from variations of four basic malfunctions:

- pointer does not move,
- pointer moves but indicates a fuel level that does not correspond with actual fuel level,
- pointer moves to top of scale and remains there,
- pointer pulsates.

Refer to DARS chart 1 for a systematic method of locating the causes of these abnormal conditions. Charts 2 and 3 provide additional procedures that should be used only as directed in chart 1.

Oil Pressure Gauge Diagnosis

An oil pressure gauge malfunction can result in any one of the following conditions:

- pointer does not move,
- pointer moves but indicates an oil pressure that does not correspond with the actual oil pressure,
- pointer moves to top of scale and remains there,
- pointer pulsates.

Refer to DARS chart 4 or 5 for a systematic method of locating the causes of these abnormal conditions.

Calibration Test

If an oil pressure gauge is suspected of indicating pressure that does not correspond with the actual oil pressure, perform a calibration test before performing electrical diagnosis procedures in DARS chart 4 (CJ) or 5 (Cherokee, Wagoneer and Truck).

(1) Remove sending unit from engine. Install T-fitting in sending unit threaded hole in engine. Connect sending unit to T-fitting.

(2) Connect oil pressure test gauge to T-fitting.

(3) Start engine. Compare pressure indicated on vehicle gauge with that on test gauge. Conduct comparison at idle and at higher engine speeds. If both gauge indications are same (within 10 percent), vehicle gauge is acceptable. If gauge is not within specification, perform gauge test as outlined in DARS chart 4 or 5.

(4) After performing test, remove T-fitting, install sending unit and inspect for oil leaks.

Tachometer Diagnosis

Test the accuracy of a tachometer by comparing with rpm indications of a test tachometer of known accuracy. A service (TACH) terminal is located on the ignition coil connector (six- and eight-cylinder engines) for the test tachometer connection. For four-cylinder engines, a service tachometer (TACH) terminal is located adjacent to the ignition switch (BAT) connector on the distributor cap. Refer to Chapter 1G—Ignition Systems. Tachometers are not adjustable. Replace if defective.

NOTE: *Some test tachometers may not be compatible with the High Energy Ignition (HEI) used with four-cylinder engines. Consult the manufacturer of the test tachometer if problems arise.*

Coolant Temperature Gauge Diagnosis

Before performing a coolant temperature gauge diagnosis, ensure the cooling system is functioning normally. Overheating can be caused by low coolant level, restrictions, loose or broken drive belt(s), defective water pump or incorrect ignition timing. Undercooling can be caused by a stuck thermostat. Consider these possibilities before suspecting an actual malfunction in the coolant temperature indicating system. A coolant temperature gauge malfunction can result in any one of the following conditions:

- pointer does not move,
- pointer moves but indicates a coolant temperature that does not correspond with the actual coolant temperature,
- pointer moves to top of scale and remains there,
- pointer pulsates.

Refer to DARS chart 6 for a systematic method of locating the causes of these abnormal conditions. Charts 2 and 3 provide additional procedures that should be used only as directed in chart 6.

INSTRUMENT CLUSTER REPLACEMENT

CJ Vehicles

Removal

(1) Disconnect battery negative cable.
(2) Disconnect speedometer cable from speedometer.
(3) Remove four attaching nuts and pull cluster from mounting studs.
(4) Note positions of all lamps. Note wire colors for use during installation.
(5) Remove gauge wires and lamps.

Installation

(1) Install gauge wires and lamps in cluster.
(2) Position cluster on mounting studs and install attaching nuts.
(3) Connect speedometer cable.
(4) Connect battery negative cable.
(5) Reset clock, if equipped.

Cherokee-Wagoneer-Truck Vehicles

Removal

(1) Disconnect battery negative cable.
(2) Remove cluster retaining screws.
(3) Disconnect speedometer cable at cluster.
(4) Disconnect cluster terminal pin plug by pulling straight off.
(5) Disconnect four-terminal connector.
(6) Tag ammeter wires for installation identification. Disconnect ammeter wires.
(7) Disconnect blower motor wiring connector.
(8) Disconnect vacuum hoses from heater control.

NOTE: *Tag each hose according to its numbered location to ensure proper connection when installing cluster.*

(9) Remove heater control panel lamps.
(10) Disconnect heater temperature control wire from lever.
(11) Remove cluster assembly.

Installation

(1) Connect wiring harness connectors and install lamps in heater control.
(2) Connect heater temperature control wire to lever.
(3) Connect vacuum hoses to heater control.
(4) Connect cluster wire connectors.
(5) Identify and install ammeter wires at original locations. If wires are reversed, ammeter will indicate in reverse (i.e., discharge instead of charge).
(6) Connect speedometer cable.
(7) Position cluster on instrument panel and install screws.
(8) Connect battery negative cable.
(9) Reset clock, if equipped.

GAUGE REPLACEMENT

Ammeter—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from oil pressure gauge and ammeter.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove ammeter.
(5) Install replacement ammeter and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test ammeter for proper operation.

Voltmeter—CJ Vehicles

(1) Disconnect illumination lamp and wire connectors. Note wire locations for installation identification.
(2) Remove retaining nuts and bracket behind instrument panel.
(3) Remove gauge from instrument panel.
(4) Position replacement gauge in instrument panel opening.
(5) Install bracket and nuts.
(6) Connect wires to original locations and install lamp.
(7) Test voltmeter for proper operation.

Fuel Gauge—CJ Vehicles

(1) Remove cluster.
(2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.
(3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.
(4) Remove attaching nuts and remove insulator and fuel gauge.

NOTE: *It may be necessary to carefully move lamp guard aside.*

(5) Install replacement fuel gauge, insulator and attaching nuts. Place toothed lockwasher on A-terminal. Ensure gauge is properly centered in face plate opening, then tighten nuts.
(6) Inspect all lamp guards for correct position. Install speedometer and face plate assembly. Install attaching screws and washers.
(7) Examine glass for fingerprints and debris.Clean as necessary.
(8) Install glass, glass retaining bezel and outer bezel. Crimp outer bezel lip four places.
(9) Install cluster.
(10) Check fuel gauge for proper operation.

Fuel Gauge—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from fuel gauge and coolant temperature gauge.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove fuel gauge.
(5) Install replacement fuel gauge and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test fuel gauge for proper operation.

Oil Pressure Gauge—CJ Vehicles

(1) Remove illumination lamp and disconnect wire connectors.
(2) Remove retaining nuts and bracket behind instrument panel.
(3) Remove gauge from instrument panel.
(4) Position replacement gauge in instrument panel opening.
(5) Install bracket and nuts.
(6) Connect wires and install lamp.
(7) Test oil pressure gauge for proper operation.

Oil Pressure Gauge—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from oil pressure gauge and ammeter.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove oil pressure gauge.
(5) Install replacement oil pressure gauge and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test oil pressure gauge for proper operation.

Tachometer—CJ Vehicles

(1) Disconnect following wires.
(a) Black ground wire.
(b) Orange illumination lamp wire.
(c) Red and red with tracer wires (six-cylinder engines) or three-terminal connector (four-cylinder engines).
(2) Remove screw and retaining cup.
(3) Remove tachometer from instrument panel.

NOTE: *It is possible to start engine with tachometer removed. With jumper wire, connect harness wires together that were originally connected to tachometer.*

(4) Install replacement tachometer, cup and screw.
(5) Connect wire connectors and ground wires.
(6) Test tachometer for proper operation.

Coolant Temperature Gauge—CJ Vehicles

(1) Remove cluster.
(2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.
(3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.
(4) Remove attaching nuts and remove insulator and coolant temperature gauge.

NOTE: *It may be necessary to carefully move lamp guard aside.*

(5) Install replacement gauge, insulator and attaching nuts. Place toothed lockwasher on S-terminal. Ensure gauge is properly centered in face plate opening, then tighten nuts.
(6) Inspect all lamp guards for correct position. Install speedometer and face plate assembly. Install attaching screws and washers.
(7) Examine glass for fingerprints and debris. Clean as necessary.
(8) Install glass, glass retaining bezel and outer bezel. Crimp outer bezel four places.
(9) Install cluster.
(10) Test coolant temperature gauge for proper operation.

Coolant Temperature Gauge—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from fuel gauge and coolant temperature gauge.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove coolant temperature gauge.
(5) Install replacement gauge and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test coolant temperature gauge for proper operation.

PRINTED CIRCUIT BOARD REPLACEMENT

Only Cherokee, Wagoneer and Truck vehicles are equipped with a printed circuit board. CJ vehicles have conventional wiring for all gauges, meters and cluster illumination lamps.

Removal

(1) Remove instrument cluster.
(2) Remove radio noise suppressor (connector strip if not equipped with radio).
(3) Remove all illumination lamps from cluster. Twist counterclockwise to remove.
(4) Remove printed circuit board and gauge assembly.
(5) Remove retaining nuts from ammeter and oil pressure gauge.
(6) Lift ammeter, oil pressure gauge and plate out of cluster as assembly.
(7) Remove retaining nuts from fuel and coolant temperature gauges. Remove large ground screw from printed circuit board above speedometer.
(8) Remove speedometer, fuel gauge, and coolant temperature gauge as assembly.

Installation

(1) Install printed circuit board. Ensure blue illumination lamp diffusers are correctly positioned. Install ground screw and gauge retaining nuts.
(2) Install ammeter and oil pressure gauge assembly on circuit board. Ensure blue lamp diffuser is correctly positioned. Install retaining nuts. Stamped nuts are used for oil pressure gauge. Plain nuts and lockwashers are used for ammeter.
(3) Examine gauge lenses for fingerprints and debris. Clean as necessary.
(4) Install printed circuit board and gauge assembly on bezel.
(5) Install illumination lamps.
(6) Install radio noise suppressor or connector strip.
(7) Install cluster.
(8) Test all gauges and lamps for proper operation.

CONSTANT VOLTAGE REGULATOR (CVR) REPLACEMENT

CJ Vehicles

The CVR is contained in the fuel gauge housing. If the CVR is defective, replace the fuel gauge.

Cherokee-Wagoneer-Truck Vehicles

The CVR is contained in the coolant temperature gauge housing. If the CVR is defective, replace the coolant temperature gauge.

DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

Note: Refer to Chapter A — General Information for details on how to use this DARS chart.

PROBLEM: FUEL GAUGE NOT FUNCTIONING PROPERLY

Chart 1

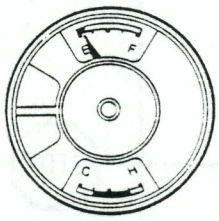
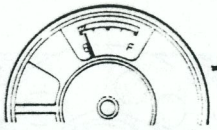
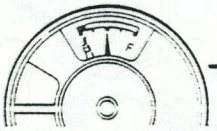
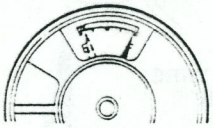
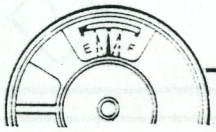
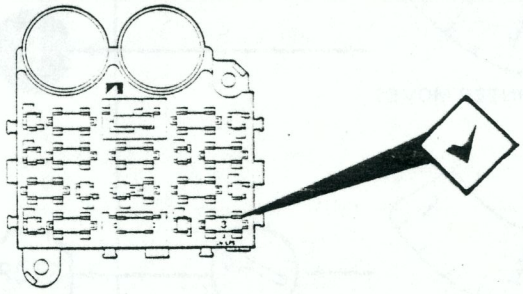
STEP	SEQUENCE	RESULT
1	● NOTE POSITION OF FUEL GAUGE POINTER ● TURN IGNITION ON AND WAIT 2 MINUTES FOR GAUGE TO WARM UP ● OBSERVE POINTER   POINTER DOES NOT MOVE  POINTER MOVES  POINTER MOVES TO MAXIMUM AND STAYS  POINTER PULSATES MORE THAN WIDTH OF POINTER  REPLACE CVR BEFORE STARTING TEST: ✓ ENGINE MUST BE WARM ✓ FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY	2 20 10 STOP
2	 CHECK 3-AMP FUSE AT FUSE PANEL  FUSE BLOWN  FUSE NOT BLOWN	GO TO CHART 2 STEP 1 3
3	OBSERVE TEMPERATURE GAUGE TEMPERATURE GAUGE POINTER DOES NOT MOVE  TEMPERATURE GAUGE POINTER INDICATES PROPERLY  CJ VEHICLES CHEROKEE WAGONEER TRUCK VEHICLES	GO TO CHART 3 STEP 1 4 7

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Chart 1

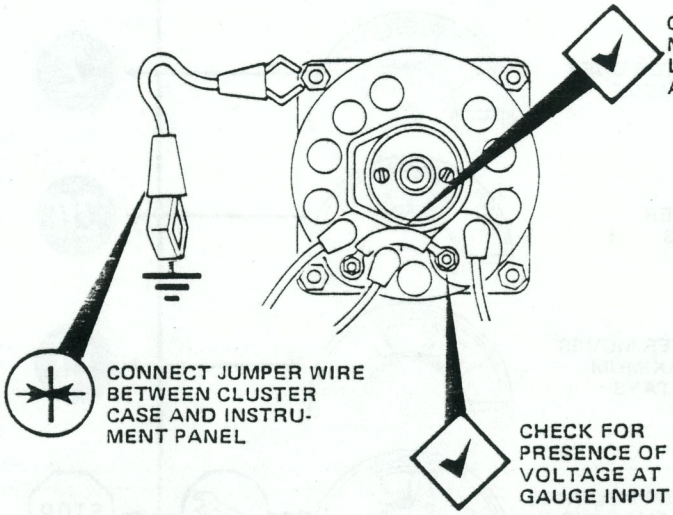
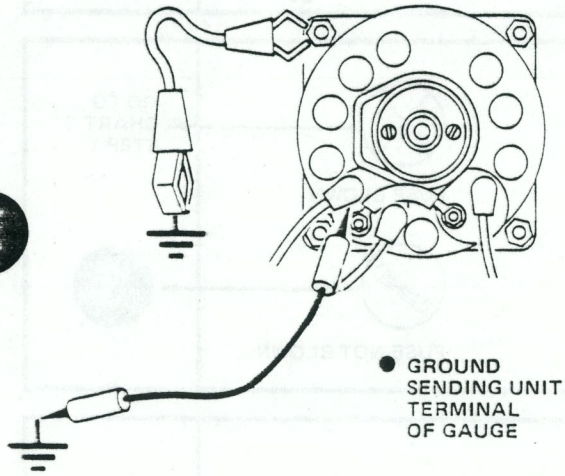
STEP	SEQUENCE	RESULT
4	● REMOVE CLUSTER ● LEAVE INSTRUMENT LEADS ATTACHED  CONNECT JUMPER WIRE BETWEEN CLUSTER CASE AND INSTRUMENT PANEL CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT OK → VOLTAGE NOT PRESENT → LOCATE AND REPAIR FAULT IN JUMPER STRAP → STOP OK → VOLTAGE PRESENT → 5	
5	 ● GROUND SENDING UNIT TERMINAL OF GAUGE  POINTER MOVES → 6  POINTER DOES NOT MOVE → REPLACE GAUGE → STOP	
6	LOCATE AND REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE	STOP

Chart 1

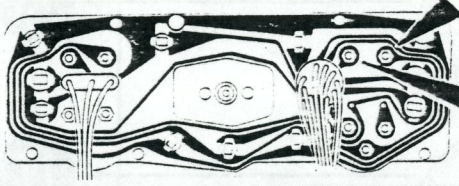
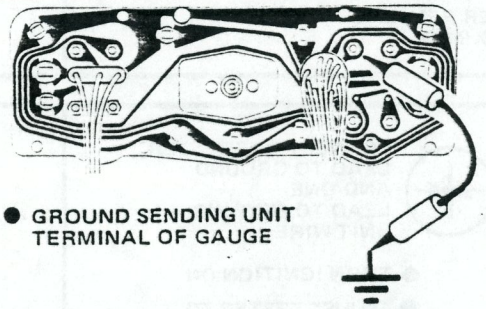
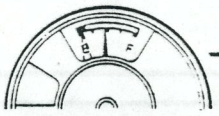
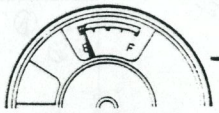
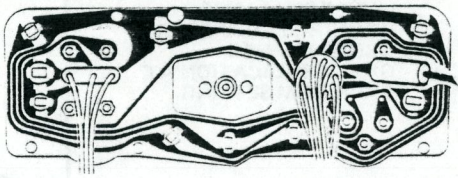
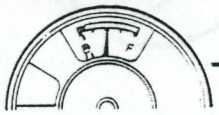
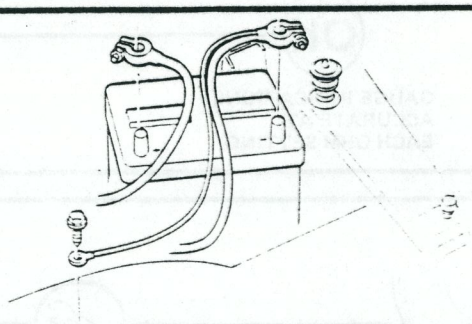
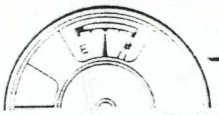
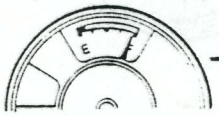
STEP	SEQUENCE	RESULT
7	● REMOVE CLUSTER ● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR  CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION	OK → VOLTAGE NOT PRESENT → REPLACE CIRCUIT BOARD → STOP OK → VOLTAGE PRESENT → 8
8	 ● GROUND SENDING UNIT TERMINAL OF GAUGE	 POINTER MOVES → 9  POINTER DOES NOT MOVE → REPLACE GAUGE → STOP
9	 ● GROUND FUEL GAUGE PIN TERMINAL ON CIRCUIT BOARD	 POINTER MOVES → REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE → STOP  POINTER DOES NOT MOVE → REPLACE CIRCUIT BOARD → STOP
10	CHECK GROUND STRAP ● BROKEN ● MISSING ● CORRODED ● SCREWS LOOSE, MISSING 	OK → GROUND NOT OK → 11 OK → GROUND OK → 12
11	REPAIR GROUND	 POINTER DROPS FROM MAXIMUM → STOP  POINTER REMAINS AT MAXIMUM → 12

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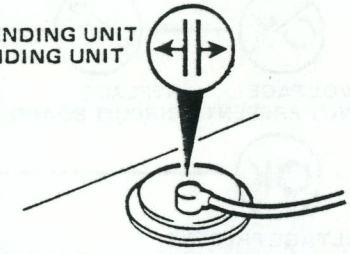
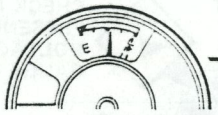
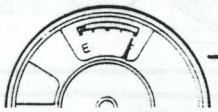
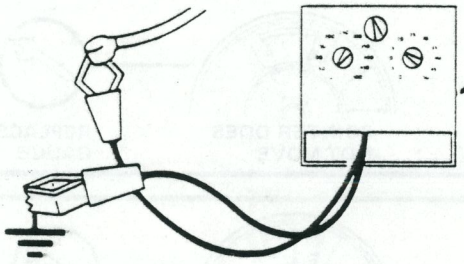
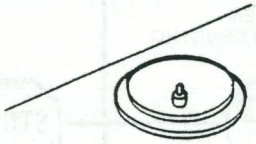
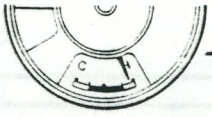
Chart 1

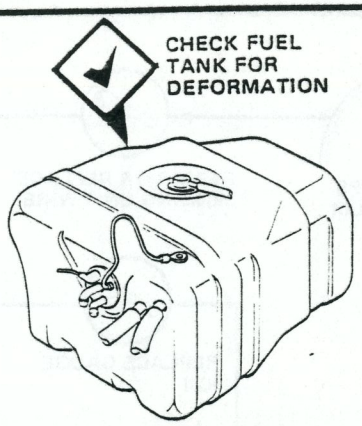
STEP	SEQUENCE	RESULT
12	DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT 	 POINTER DROPS FROM MAXIMUM → 13  POINTER REMAINS AT MAXIMUM → 17
13	 CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE ● TURN IGNITION ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING. 	 GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → 14  GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → 15
14	● OBSERVE TEMPERATURE GAUGE TEMPERATURE GAUGE POINTER IS AT MAXIMUM 	 REPAIR CLUSTER GROUND OR REPLACE CVR → STOP
	TEMPERATURE GAUGE POINTER INDICATES NORMALLY 	 REPLACE FUEL GAUGE → STOP

80311D

Chart 1

STEP | SEQUENCE | RESULT

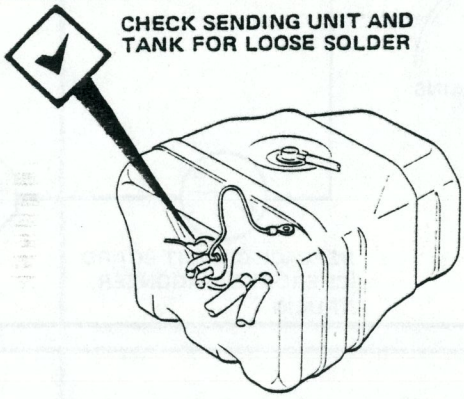
15



OK → FUEL TANK NOT DEFORMED → 16

O.K → FUEL TANK DEFORMED → REPAIR OR REPLACE FUEL TANK → STOP

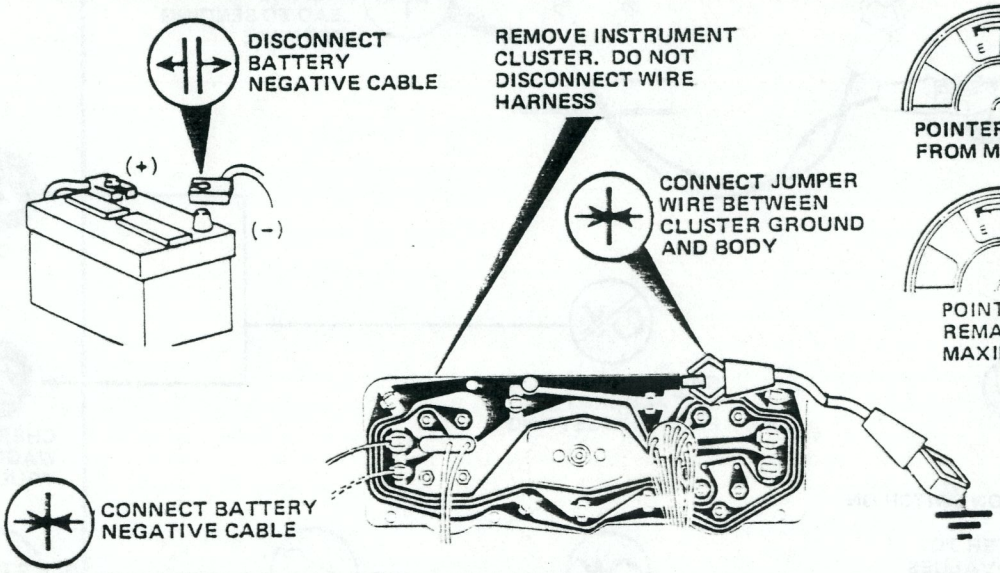
16

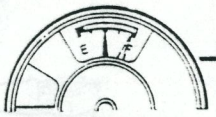


OK → NO LOOSE SOLDER → REPLACE SENDING UNIT → STOP

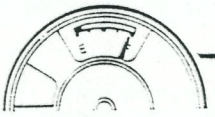
O.K → LOOSE SOLDER PRESENT → REMOVE LOOSE SOLDER → STOP

17





POINTER DROPS FROM MAXIMUM → 18



POINTER REMAINS AT MAXIMUM → 19

18

REPAIR INSTRUMENT GROUND PANEL → STOP

Chart 1

STEP | SEQUENCE | RESULT

19

DISCONNECT SENDING UNIT WIRE FROM CLUSTER

POINTER DROPS FROM MAXIMUM

REPAIR OR REPLACE SENDING UNIT WIRE

STOP

REPLACE GAUGE (CJ)

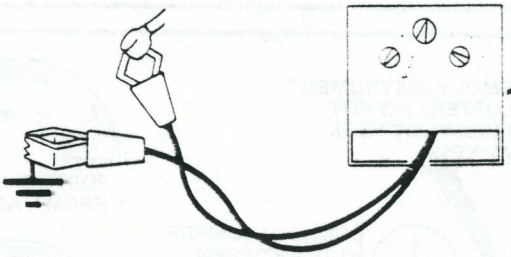
STOP

POINTER REMAINS AT MAXIMUM

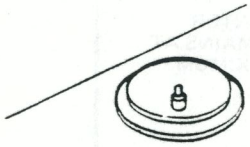
REPLACE CIRCUIT BOARD (CHEROKEE, WAGONEER, TRUCK)

STOP

20



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE



- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING.

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

21 CJ

22 CHEROKEE WAGONEER TRUCK

GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

REPLACE SENDING UNIT

STOP

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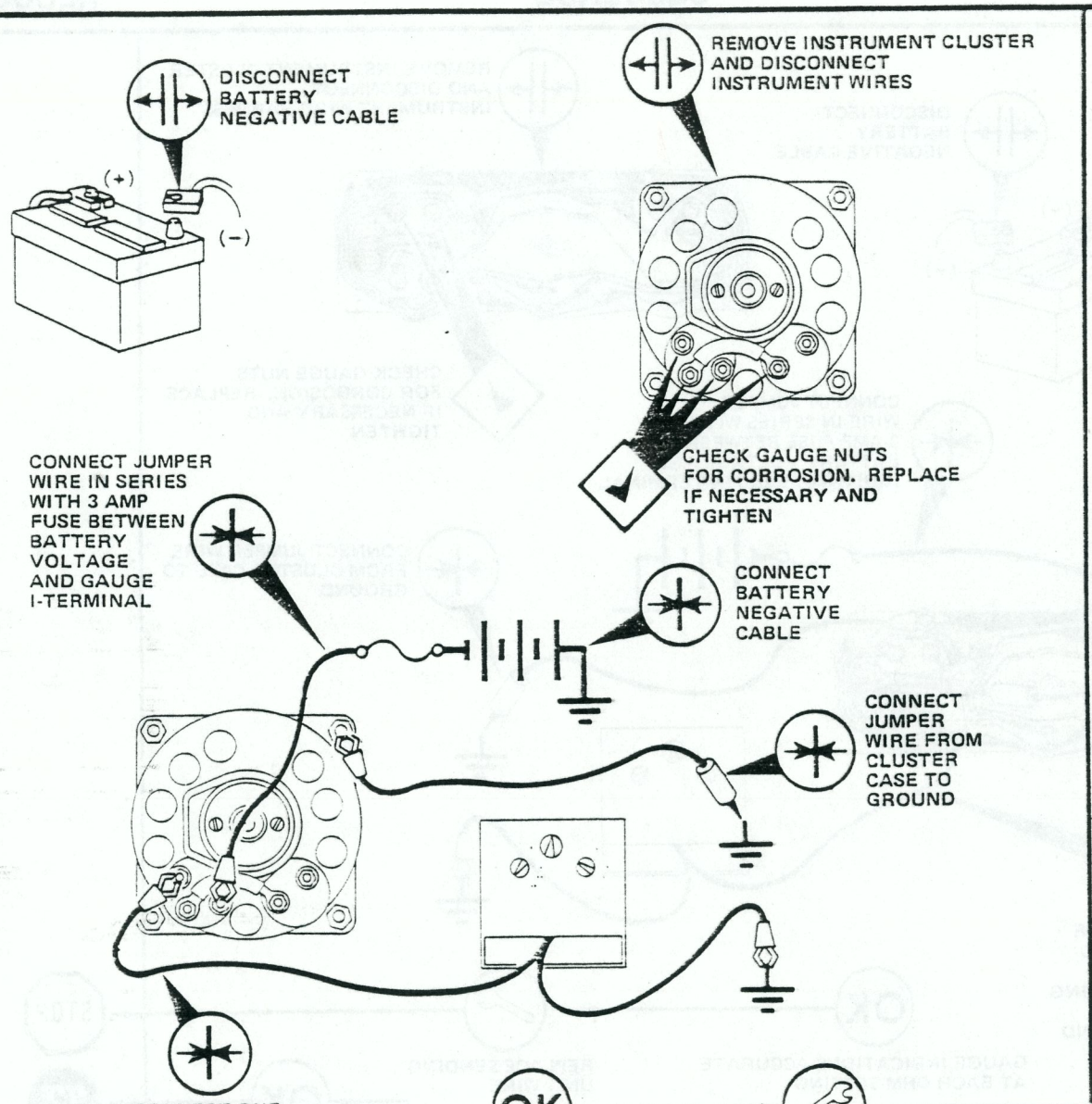
Chart 1

STEP | SEQUENCE | RESULT



80311G

Chart 1

STEP | SEQUENCE | RESULT

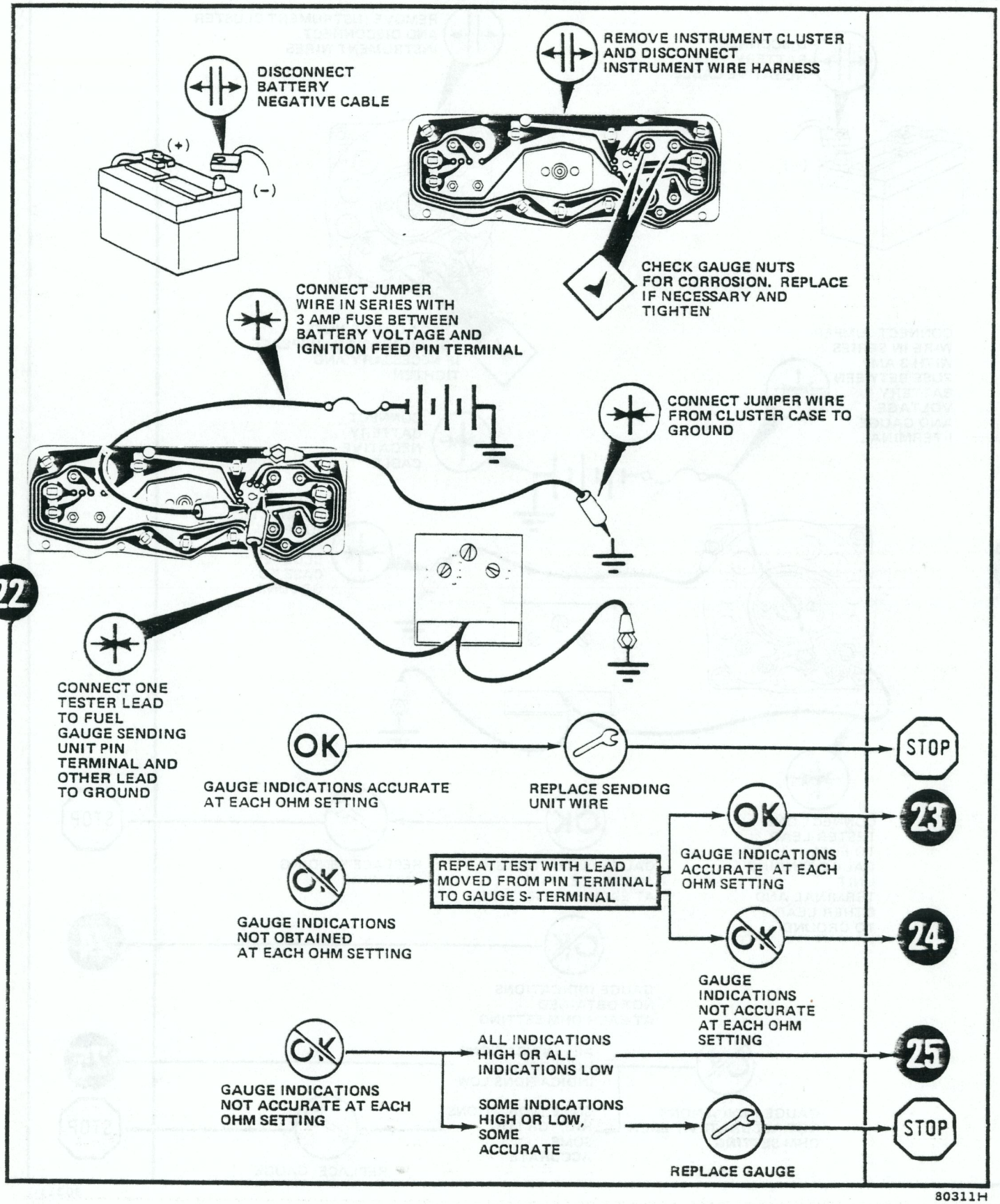


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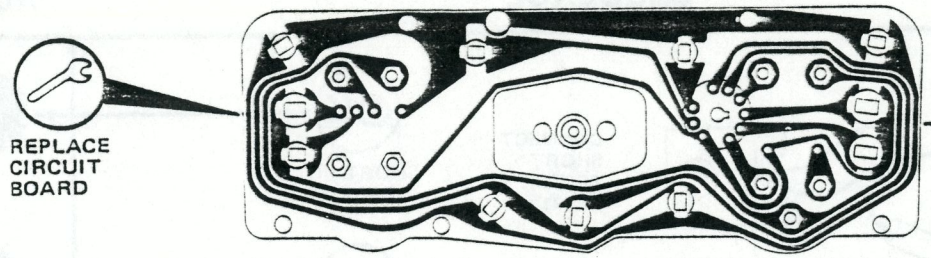
Chart 1

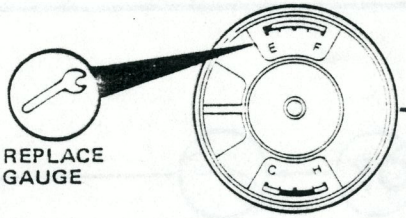
STEP | SEQUENCE | RESULT

23



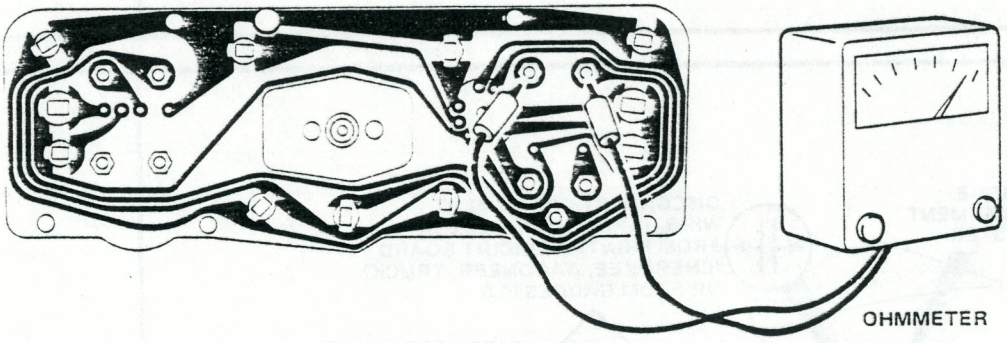
REPLACE CIRCUIT BOARD → STOP

24



REPLACE GAUGE → STOP

25



CONNECT OHMMETER LEADS TO GAUGE INPUT TERMINAL AND GAUGE SENDING UNIT TERMINAL

- COMPARE OHMMETER INDICATIONS WITH VALUES LISTED IN GAUGE RESISTANCE CHART

OK → GAUGE RESISTANCE CORRECT → REPLACE CVR → STOP

OK → GAUGE RESISTANCE INCORRECT → REPLACE GAUGE → STOP

80311J

PROBLEM: GAUGE FUSE BLOWN

Chart 2

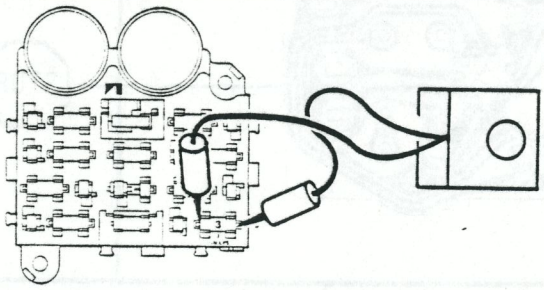
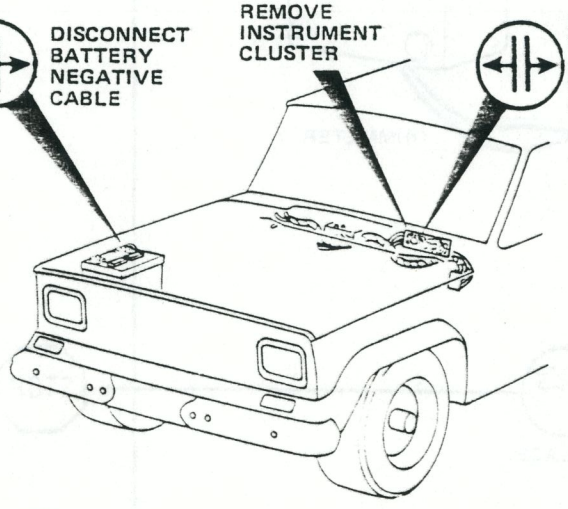
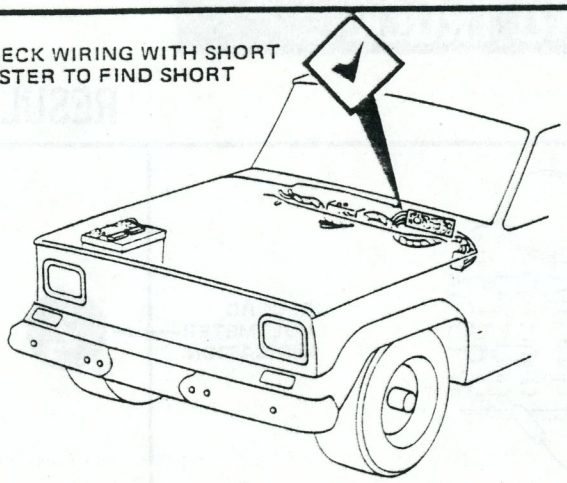
STEP	SEQUENCE	RESULT
1	 CONNECT SHORT TESTER J-8681 → OK: SHORT NOT INDICATED	2
	→ O.K: SHORT INDICATED	3
2	CHECK FOR INTERMITTENT SHORT ● RED IGNITION WIRE TO GAUGES → O.K: SHORT INDICATED → REPAIR AS NECESSARY	STOP
3	 DISCONNECT BATTERY NEGATIVE CABLE REMOVE INSTRUMENT CLUSTER DISCONNECT INSTRUMENT WIRE HARNESS CONNECTOR FROM PRINTED CIRCUIT BOARD (CHEROKEE, WAGONEER, TRUCK) OR FROM GAUGES (CJ) CHECK FOR SHORT AT GAUGE FUSE CONNECT BATTERY NEGATIVE CABLE → O.K: SHORT INDICATED	5
	→ OK: SHORT NOT INDICATED → CHEROKEE WAGONEER TRUCK	6
	→ CJ	7

Chart 2

STEP | SEQUENCE | RESULT

4

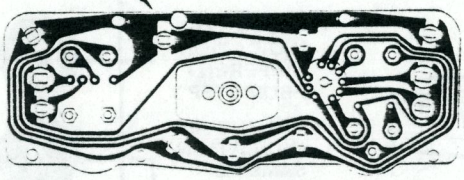
CHECK WIRING WITH SHORT TESTER TO FIND SHORT



REPLACE SHORTED WIRE HARNESS → STOP

5

CHECK CIRCUIT BOARD FOR OBVIOUS DAMAGE

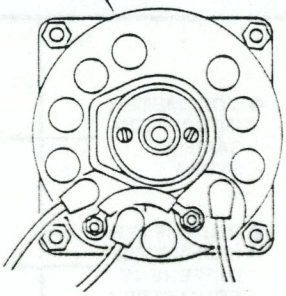


OK — CIRCUIT BOARD NOT DAMAGED → REPLACE CVR → STOP

O.K — CIRCUIT BOARD DAMAGED → DETERMINE CAUSE OF DAMAGE: CVR OR GAUGE FAULTY; REPLACE CIRCUIT BOARD AND FAULTY COMPONENT → STOP

6

CHECK INSTRUMENT CLUSTER AND INDIVIDUAL GAUGES FOR OBVIOUS DAMAGE

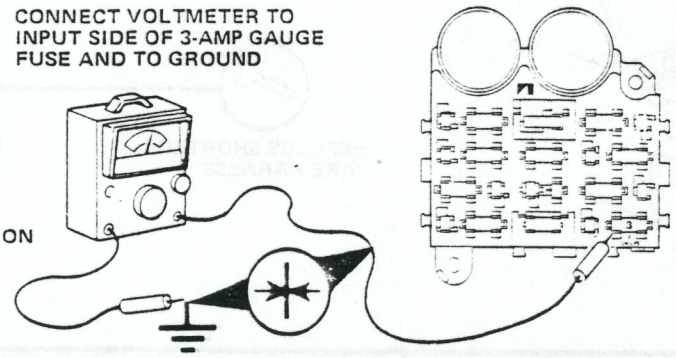
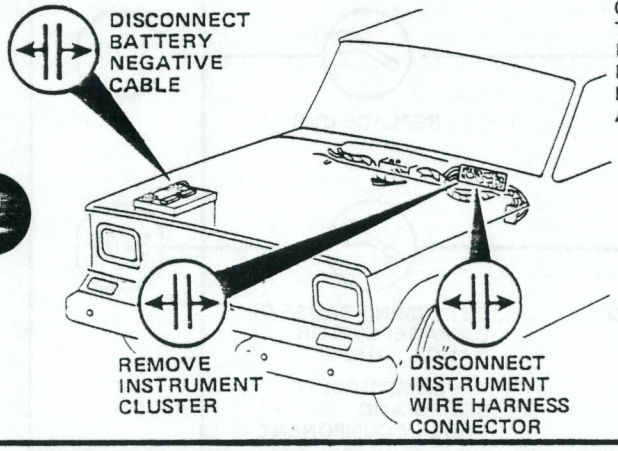
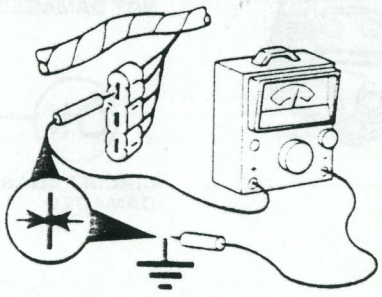
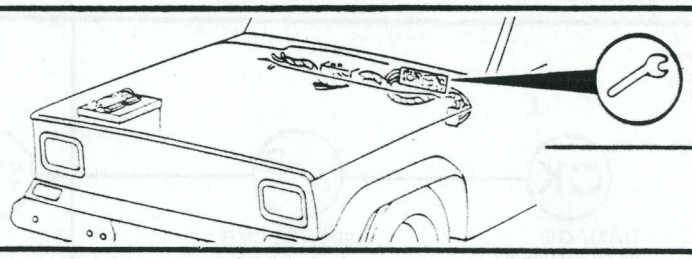
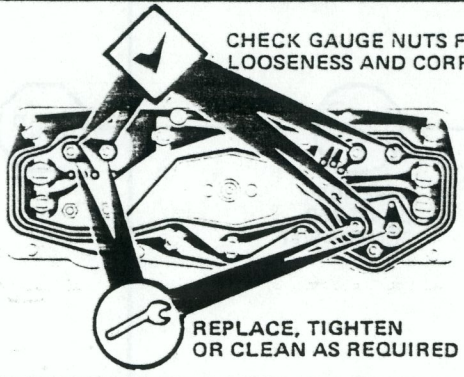


OK — DAMAGE NOT EVIDENT → REPLACE CVR → STOP

O.K — DAMAGE EVIDENT → REPLACE DAMAGED COMPONENT → STOP

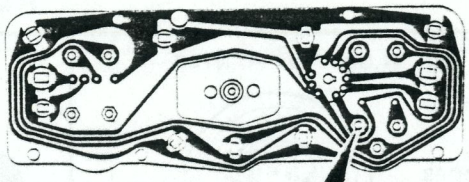
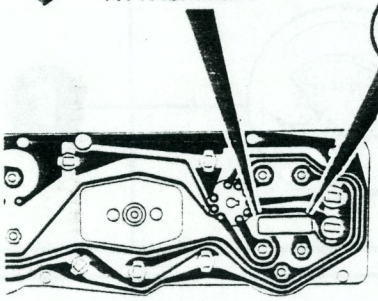
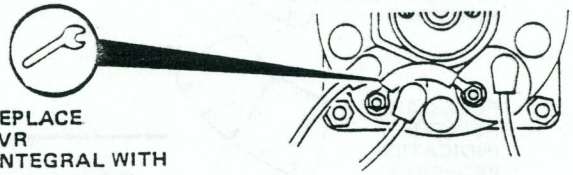
PROBLEM: FUEL GAUGE AND COOLANT TEMPERATURE GAUGE BOTH MALFUNCTION (ALSO OIL PRESSURE GAUGE ON CHEROKEE, WAGONEER AND TRUCK

Chart 3

STEP	SEQUENCE	RESULT
1	TURN IGNITION SWITCH ON  CONNECT VOLTMETER TO INPUT SIDE OF 3-AMP GAUGE FUSE AND TO GROUND 	RECORD VOLTMETER INDICATION → 2
2	DISCONNECT BATTERY NEGATIVE CABLE  REMOVE INSTRUMENT CLUSTER DISCONNECT INSTRUMENT WIRE HARNESS CONNECTOR CONNECT VOLTMETER TO IGNITION FEED WIRE FEMALE CONNECTOR IN INSTRUMENT WIRE HARNESS CONNECTOR AND TO GOOD GROUND CONNECT BATTERY NEGATIVE CABLE 	● VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 3 ● VOLTMETER INDICATION SAME AS STEP 1 → 4 CHEROKEE, WAGONEER, TRUCK → 7 CJ → 7
3	REPAIR OR REPLACE INSTRUMENT PANEL WIRE HARNESS 	STOP
4	CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION  REPLACE, TIGHTEN OR CLEAN AS REQUIRED CONNECT JUMPER WIRES AND VOLTMETER ● JUMPER WIRE BETWEEN CLUSTER CASE AND GROUND ● JUMPER WIRE IN SERIES WITH A 3-AMP FUSE BETWEEN BATTERY VOLTAGE SOURCE AND IGNITION FEED PIN TERMINAL ON CLUSTER ● VOLTMETER LEAD TO CVR INPUT TERMINAL ● VOLTMETER LEAD TO GROUND	● VOLTMETER INDICATION SAME AS STEP 1 → 5 ● VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 6

80313A

Chart 3

STEP	SEQUENCE	RESULT
5	 REPLACE CVR (INTEGRAL WITH TEMPERATURE GAUGE)	STOP
6	CHECK RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP FOR PROPER ATTACHMENT  USING SAME TEST SET-UP AS STEP 4, MOVE VOLTMETER CONNECTOR FROM CVR TERMINAL TO RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP OUTPUT TERMINAL	VOLTMETER INDICATION SAME AS STEP 1 → 8 VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 9
7	 REPLACE CVR (INTEGRAL WITH FUEL GAUGE)	STOP
8	REPLACE CIRCUIT BOARD	STOP
9	REPLACE RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP	STOP

80313B

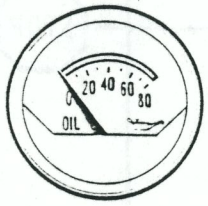
PROBLEM: OIL PRESSURE GAUGE NOT FUNCTIONING PROPERLY (CJ)

Chart 4

STEP | SEQUENCE | RESULT

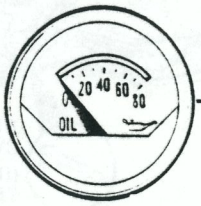
1

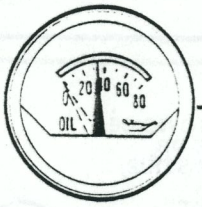
- NOTE POSITION OIL PRESSURE GAUGE POINTER
- START ENGINE
- OBSERVE POINTER

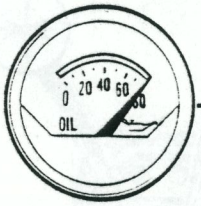


BEFORE STARTING TEST:

- OIL PAN MUST BE FILLED TO SPECIFICATION
- FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY

POINTER DOES NOT MOVE →  → **2**

POINTER MOVES →  → **11**

POINTER MOVES TO MAXIMUM AND STAYS →  → **6**

NOTE: Indicated Oil Pressure Observed from Driver's Seat

2

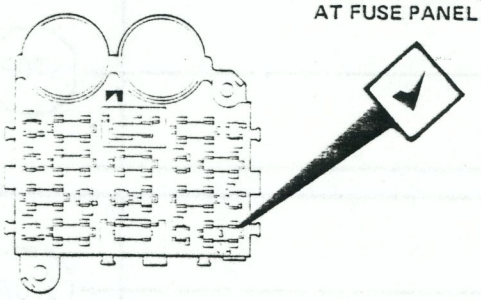
- OBSERVE FUEL GAUGE

FUEL GAUGE POINTER DOES NOT MOVE →  → **3**

FUEL GAUGE POINTER INDICATES PROPERLY →  → **4**

3

CHECK 3-AMP FUSE AT FUSE PANEL



FUSE BLOWN → GO TO CHART 2 STEP 1

FUSE NOT BLOWN → LOCATE AND REPAIR FAULT IN IGNITION FEED TO INSTRUMENTS → STOP

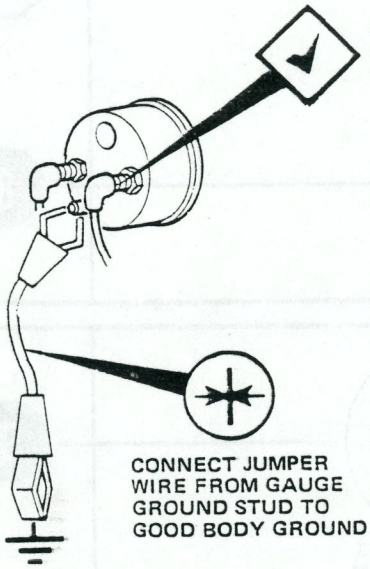
80314A

Chart 4

STEP | SEQUENCE | RESULT

4

- REMOVE OIL PRESSURE GAUGE
- LEAVE GAUGE WIRES CONNECTED



CHECK FOR PRESENCE OF VOLTAGE AT GAUGE I-TERMINAL

TURN IGNITION ON

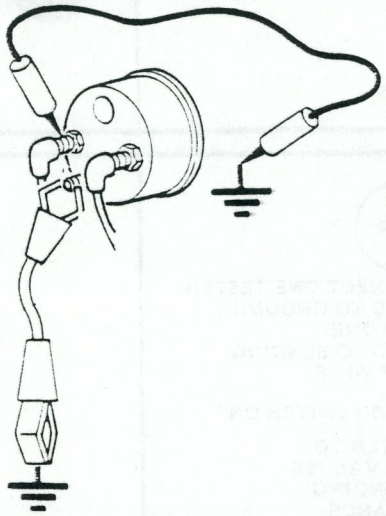
CONNECT JUMPER WIRE FROM GAUGE GROUND STUD TO GOOD BODY GROUND

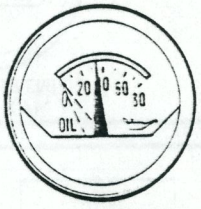
VOLTAGE NOT PRESENT → O.K. → STOP

LOCATE AND REPAIR FAULT IN IGNITION FEED TO OIL PRESSURE GAUGE

VOLTAGE PRESENT → OK → **5**

5





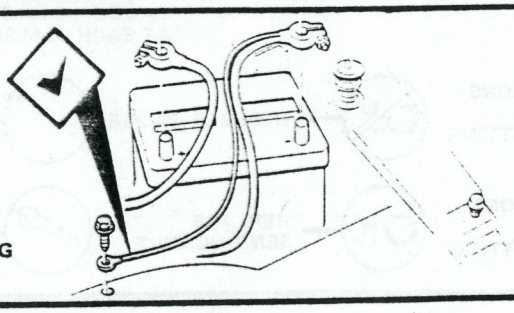
POINTER MOVES → LOCATE AND REPAIR OPEN IN SENDING UNIT CIRCUIT → STOP

POINTER DOES NOT MOVE → REPLACE GAUGE → STOP

6

CHECK GROUND STRAP

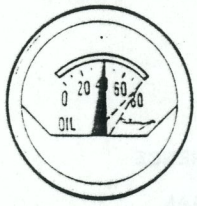
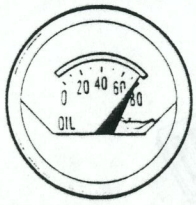
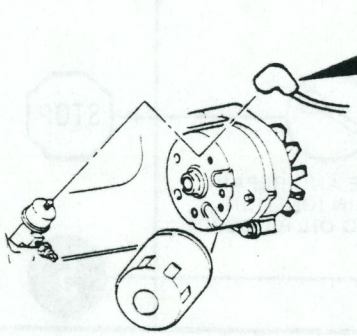
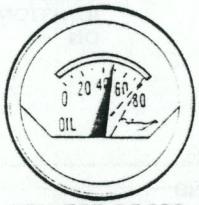
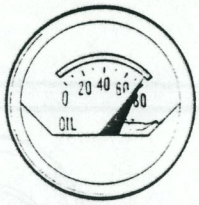
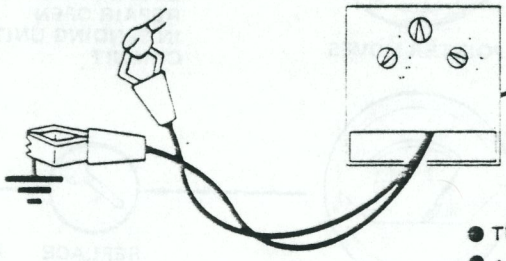
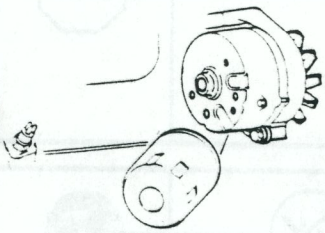
- BROKEN
- MISSING
- CORRODED
- SCREW LOOSE, MISSING



O.K. GROUND NOT OK → **7**

OK GROUND OK → **8**

Chart 4

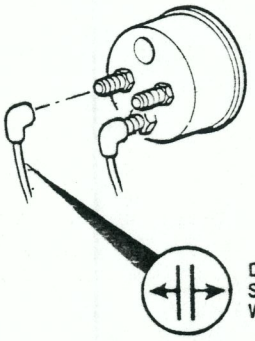
STEP	SEQUENCE	RESULT
7	REPAIR GROUND  START ENGINE  POINTER DROPS FROM MAXIMUM	STOP
	 POINTER REMAINS AT MAXIMUM	8
8	 DISCONNECT SENDING UNIT WIRE  POINTER DROPS FROM MAXIMUM	9
	 POINTER REMAINS AT MAXIMUM	10
9	 CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE  ● TURN IGNITION SWITCH ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING	
	GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → O.K → REPLACE GAUGE	STOP
	GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → OK → REPLACE SENDING UNIT	STOP

80314C

Chart 4

STEP | SEQUENCE | RESULT

10

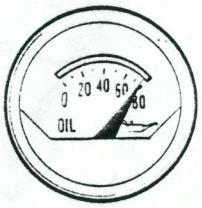


DISCONNECT SENDING UNIT WIRE FROM GAUGE

POINTER DROPS FROM MAXIMUM

REPLACE SENDING UNIT WIRE

STOP

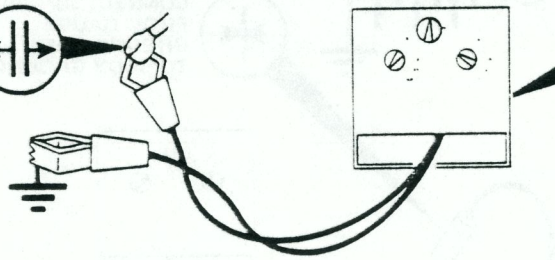


POINTER REMAINS AT MAXIMUM

REPLACE GAUGE

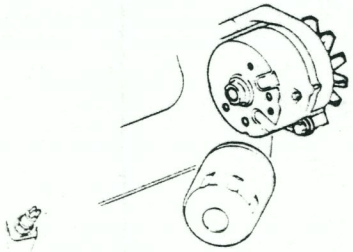
STOP

DISCONNECT SENDING UNIT WIRE



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

11



- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING.

OK

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

12

OK

GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

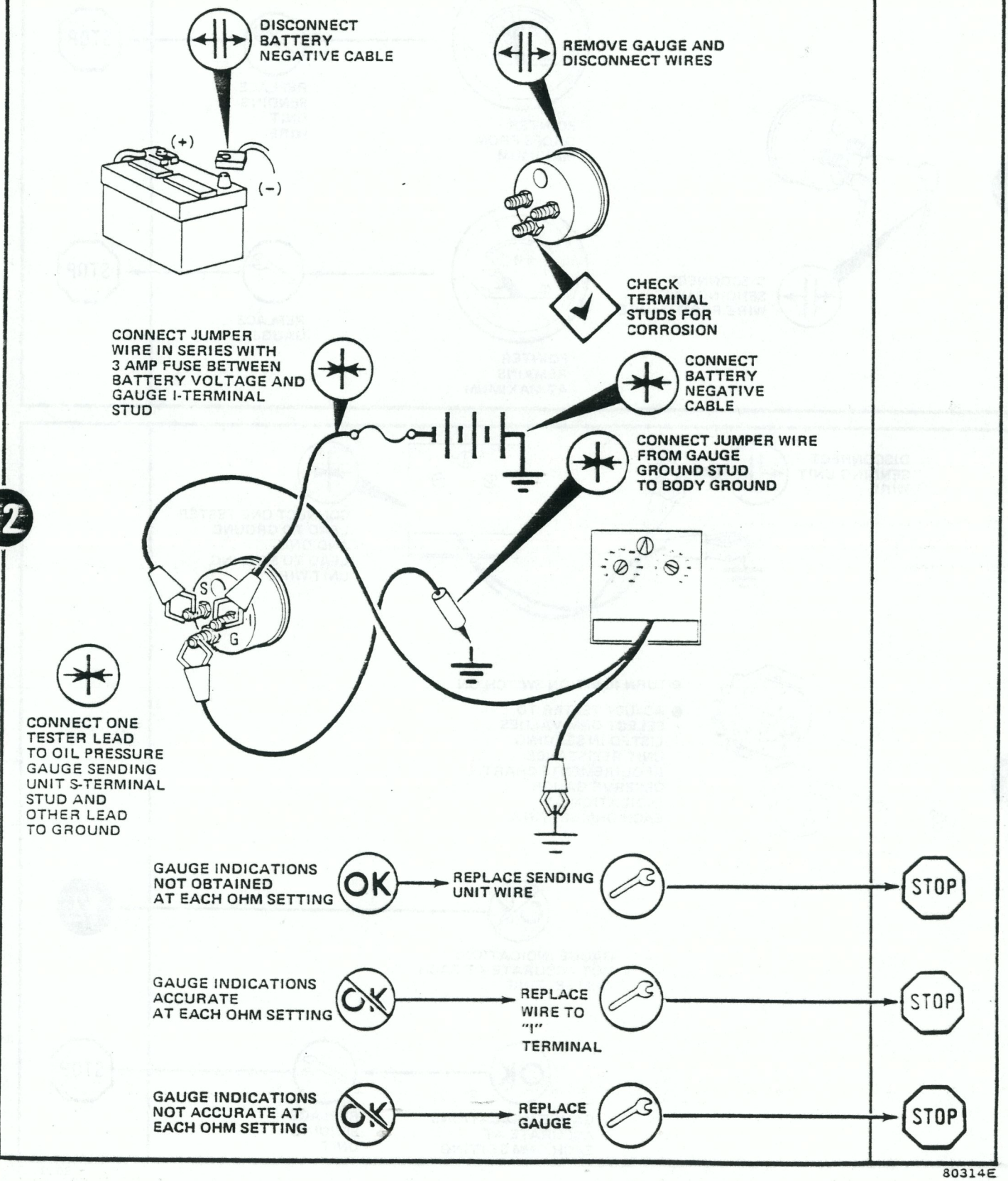
REPLACE SENDING UNIT

STOP

80314D

Chart 4

STEP | SEQUENCE | RESULT



80314E

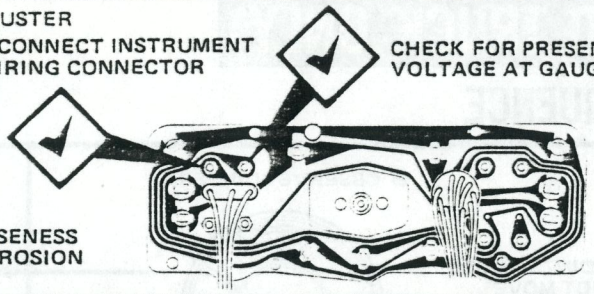
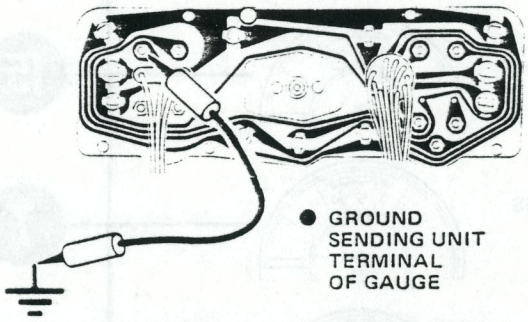
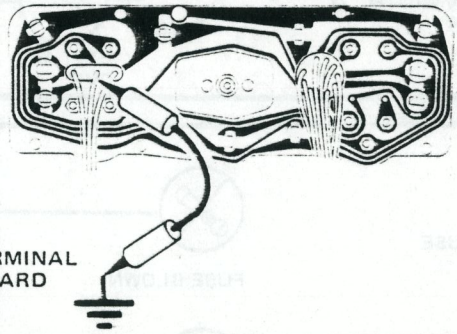
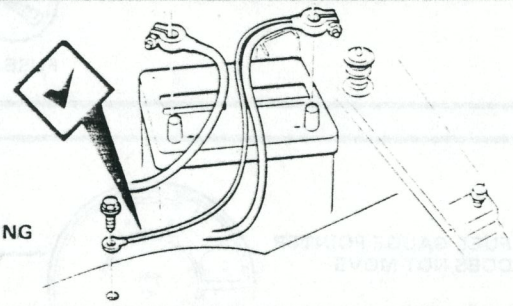
PROBLEM: OIL PRESSURE GAUGE NOT FUNCTIONING PROPERLY (CHEROKEE, WAGONEER AND TRUCK ONLY)

Chart 5

STEP	SEQUENCE	RESULT
1	● NOTE POSITION OF OIL PRESSURE GAUGE POINTER ● START ENGINE AND WAIT 2 MINUTES FOR GAUGE TO WARM UP ● OBSERVE POINTER	
	BEFORE STARTING TEST: OIL PAN MUST BE FILLED TO SPECIFICATION FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY	
	POINTER DOES NOT MOVE	2
	POINTER MOVES	15
	POINTER MOVES TO MAXIMUM AND STAYS	7
	POINTER PULSATES MORE THAN WIDTH OF POINTER	REPLACE CVR → STOP
2	CHECK 3-AMP FUSE AT FUSE PANEL	
	FUSE BLOWN	GO TO CHART 2 STEP 1
	FUSE NOT BLOWN	3
3	● OBSERVE FUEL GAUGE	
	FUEL GAUGE POINTER DOES NOT MOVE	GO TO CHART 3 STEP 1
	FUEL GAUGE POINTER INDICATES PROPERLY	4

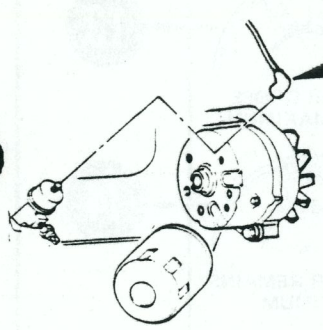
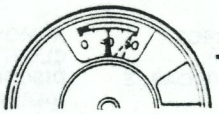
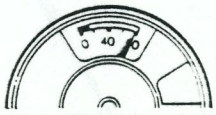
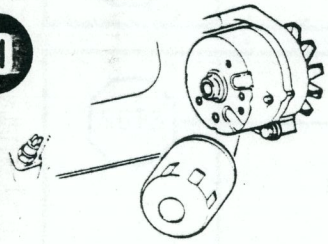
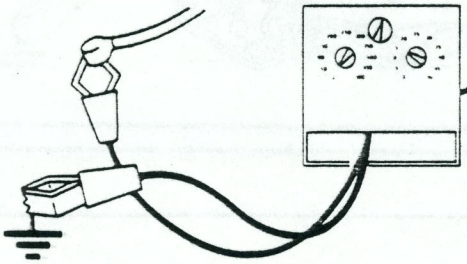
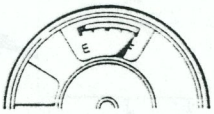
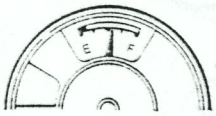
80315A

Chart 5

STEP	SEQUENCE	RESULT
4	● REMOVE CLUSTER ● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR ● CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION  CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT OK → VOLTAGE NOT PRESENT → REPLACE CIRCUIT BOARD OK → VOLTAGE PRESENT	STOP 5
5	 ● GROUND SENDING UNIT TERMINAL OF GAUGE POINTER MOVES POINTER DOES NOT MOVE → REPLACE GAUGE	6 STOP
6	 ● GROUND GAUGE PIN TERMINAL ON CIRCUIT BOARD POINTER MOVES → REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE POINTER DOES NOT MOVE → REPLACE CIRCUIT BOARD	STOP STOP
7	CHECK GROUND STRAP ● BROKEN ● MISSING ● CORRODED ● SCREWS LOOSE, MISSING  OK → GROUND NOT OK OK → GROUND OK	8 9
8	REPAIR GROUND POINTER DROPS FROM MAXIMUM POINTER REMAINS AT MAXIMUM	STOP 9

80315B

Chart 5

STEP	SEQUENCE	RESULT
9	 DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT	 POINTER DROPS FROM MAXIMUM → 10  POINTER REMAINS AT MAXIMUM → 12
10	  CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE ● TURN IGNITION SWITCH ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING.	OK → 11 GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING OK → STOP GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING REPLACE SENDING UNIT
11	● OBSERVE FUEL GAUGE	 FUEL GAUGE POINTER IS AT MAXIMUM → STOP REPAIR CLUSTER GROUND OR REPLACE CVR  FUEL GAUGE POINTER INDICATES NORMALLY → STOP REPLACE OIL PRESSURE GAUGE

80315C

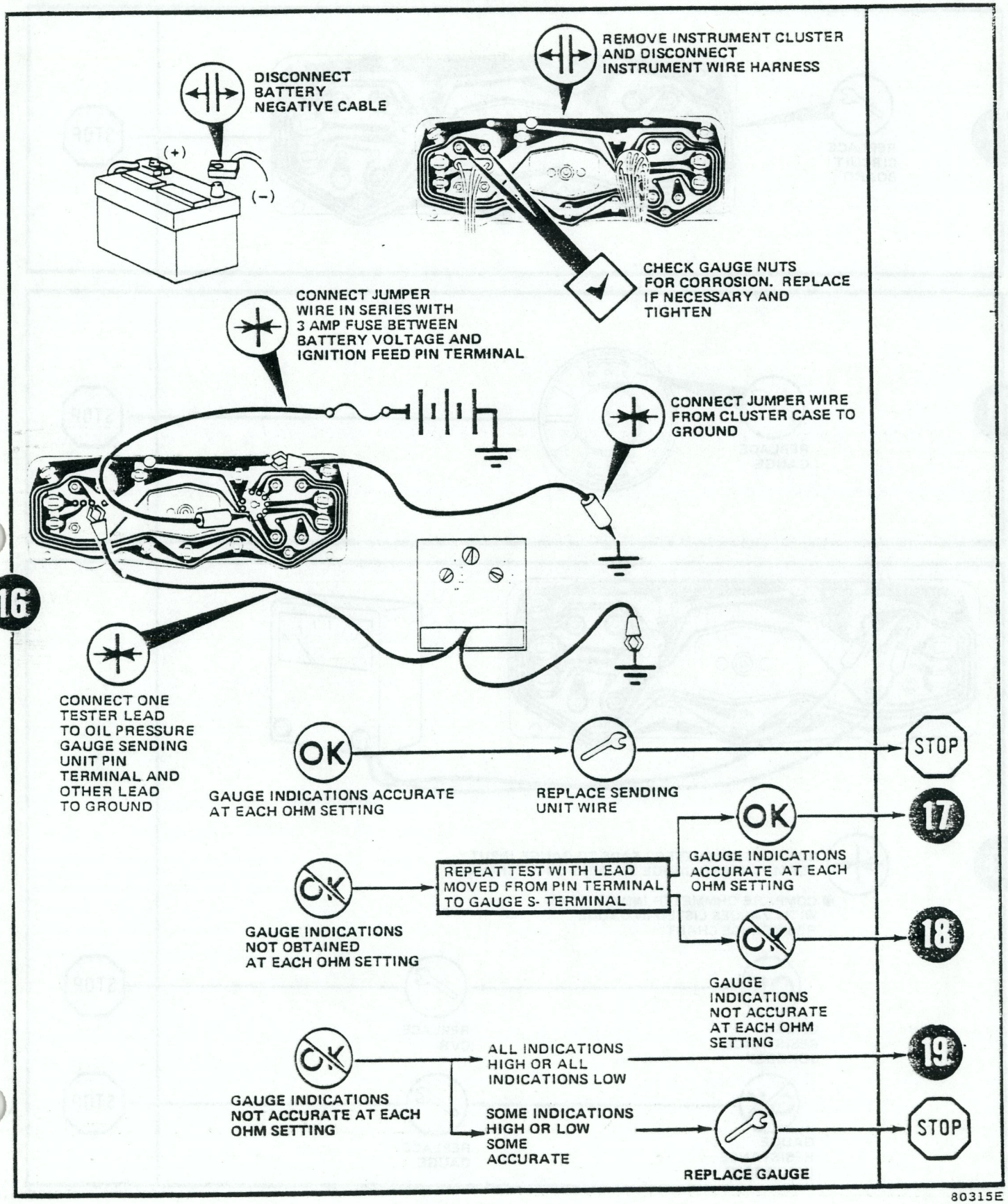
Chart 5

STEP	SEQUENCE	RESULT
12	DISCONNECT BATTERY NEGATIVE CABLE REMOVE INSTRUMENT CLUSTER. DO NOT DISCONNECT WIRE HARNESS CONNECT JUMPER WIRE BETWEEN CLUSTER GROUND AND BODY CONNECT BATTERY NEGATIVE CABLE	POINTER DROPS FROM MAXIMUM → 13 POINTER REMAINS AT MAXIMUM → 14
13	REPAIR INSTRUMENT PANEL GROUND	STOP
14	DISCONNECT SENDING UNIT WIRE FROM CLUSTER	POINTER DROPS FROM MAXIMUM → REPAIR OR REPLACE SENDING UNIT WIRE → STOP POINTER REMAINS AT MAXIMUM → REPLACE CIRCUIT BOARD → STOP
15	DISCONNECT SENDING UNIT WIRE CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE ● TURN IGNITION SWITCH ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING.	GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → OK → 16 GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → OK → REPLACE SENDING UNIT → STOP

80315D

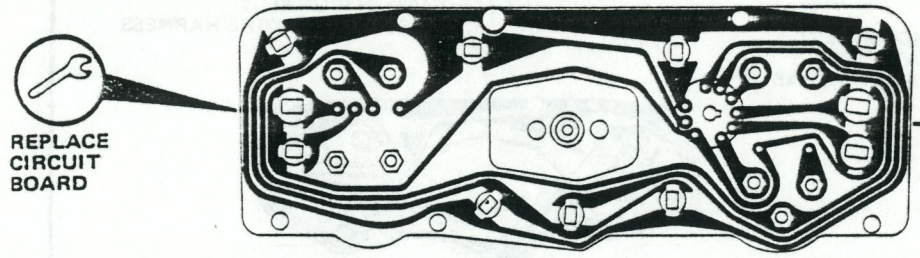
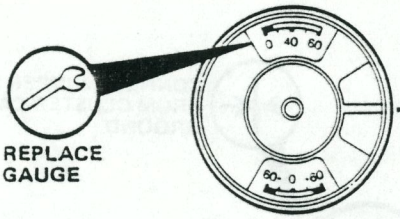
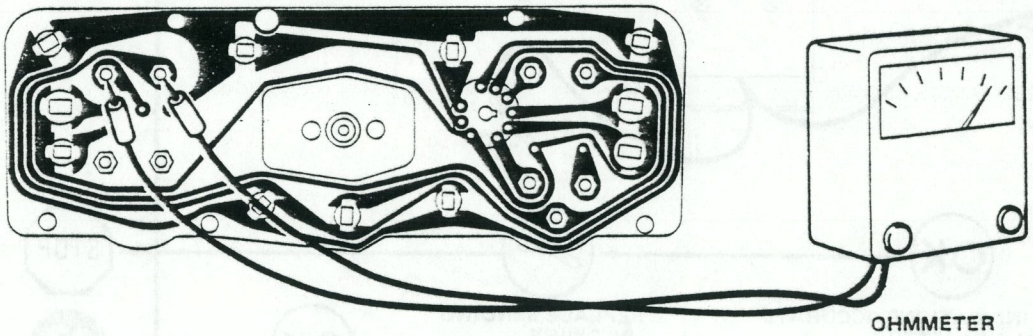
Chart 5

STEP SEQUENCE RESULT



80315E

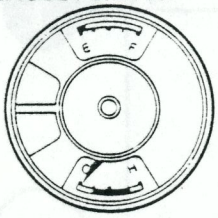
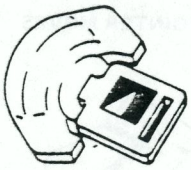
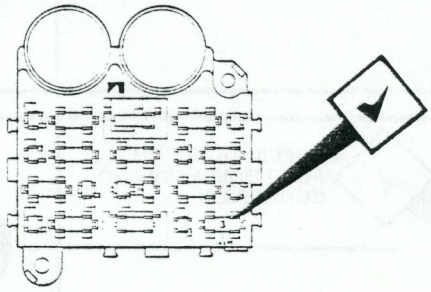
Chart 5

STEP	SEQUENCE	RESULT
17	 REPLACE CIRCUIT BOARD	STOP
18	 REPLACE GAUGE	STOP
19	 OHMMETER CONNECT OHMMETER LEADS TO GAUGE INPUT TERMINAL AND GAUGE SENDING UNIT TERMINAL ● COMPARE OHMMETER INDICATIONS WITH VALUES LISTED IN GAUGE RESISTANCE CHART OK — GAUGE RESISTANCE CORRECT → REPLACE CVR → STOP OK — GAUGE RESISTANCE INCORRECT → REPLACE GAUGE → STOP	

80315F

PROBLEM: COOLANT TEMPERATURE GAUGE NOT FUNCTIONING PROPERLY

Chart 6

STEP	SEQUENCE	RESULT
1	● NOTE POSITION OF COOLANT TEMPERATURE GAUGE POINTER ● TURN IGNITION SWITCH ON AND WAIT 2 MINUTES FOR GAUGE TO WARM UP ● OBSERVE POINTER	
	 	POINTER DOES NOT MOVE → 2
		POINTER MOVES → 17
	BEFORE STARTING TEST: ENGINE MUST BE WARM FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY	POINTER MOVES TO MAXIMUM AND STAYS → 9
		POINTER PULSATES MORE THAN WIDTH OF POINTER → REPLACE CVR → STOP
2	 CHECK 3-AMP FUSE AT FUSE PANEL	FUSE BLOWN → GO TO CHART 2 STEP 1
		FUSE NOT BLOWN → 3
3	● OBSERVE FUEL GAUGE	FUEL GAUGE POINTER DOES NOT MOVE → GO TO CHART 3 STEP 1
		FUEL GAUGE POINTER INDICATES PROPERLY → CJ MODELS → 4
		FUEL GAUGE POINTER INDICATES PROPERLY → CHEROKEE WAGONEER TRUCK MODELS → 6

80316A

Chart 6

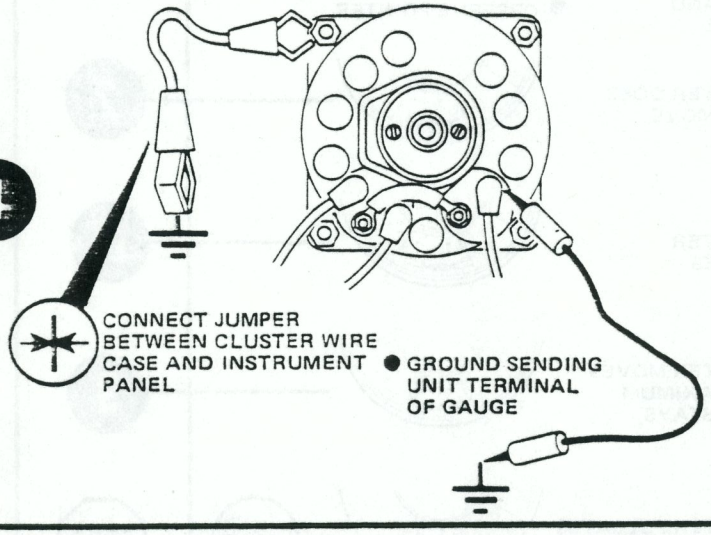
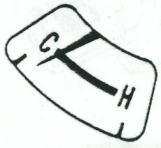
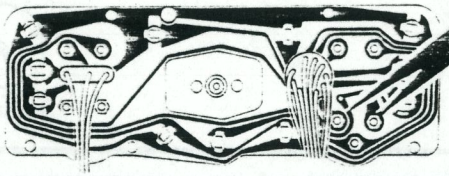
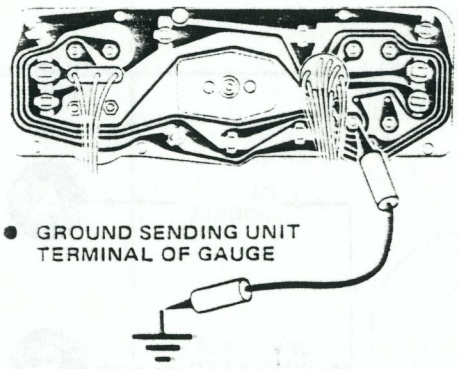
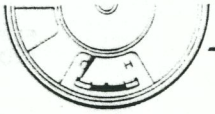
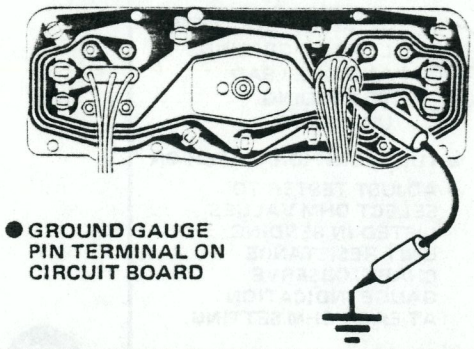
STEP	SEQUENCE	RESULT
4	● REMOVE CLUSTER ● LEAVE INSTRUMENT WIRES ATTACHED  CONNECT JUMPER BETWEEN CLUSTER WIRE CASE AND INSTRUMENT PANEL ● GROUND SENDING UNIT TERMINAL OF GAUGE	 POINTER MOVES → 5  POINTER DOES NOT MOVE → REPLACE GAUGE → STOP
5	LOCATE AND REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE	STOP
6	● REMOVE CLUSTER ● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR  ● CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION	7
7	 ● GROUND SENDING UNIT TERMINAL OF GAUGE	 POINTER MOVES → 8  POINTER DOES NOT MOVE → REPLACE GAUGE → STOP

Chart 6

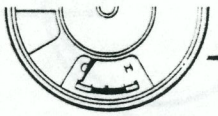
STEP | SEQUENCE | RESULT

8



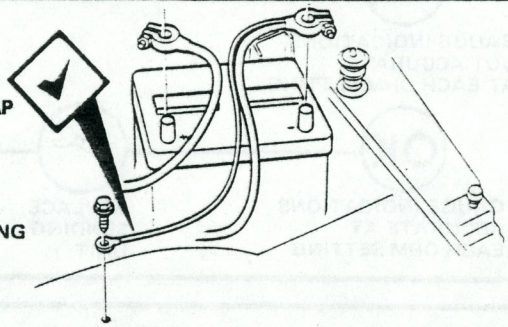
● GROUND GAUGE PIN TERMINAL ON CIRCUIT BOARD

POINTER MOVES → REPAIR OPEN CIRCUIT IN SENDER WIRE → STOP



POINTER DOES NOT MOVE → REPLACE CIRCUIT BOARD → STOP

9



CHECK GROUND STRAP

- BROKEN
- MISSING
- CORRODED
- SCREWS LOOSE, MISSING

OK → GROUND NOT OK → **10**

OK → GROUND OK → **11**

10

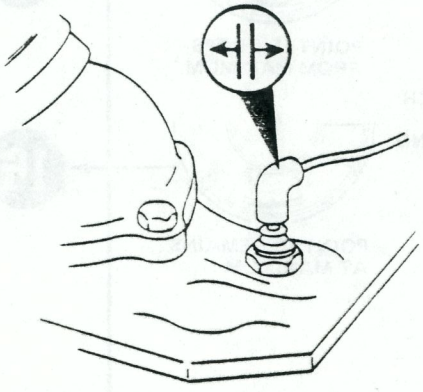
REPAIR GROUND

POINTER DROPS FROM MAXIMUM → STOP

POINTER REMAINS AT MAXIMUM → **11**

11

DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT



POINTER DROPS FROM MAXIMUM → **12**

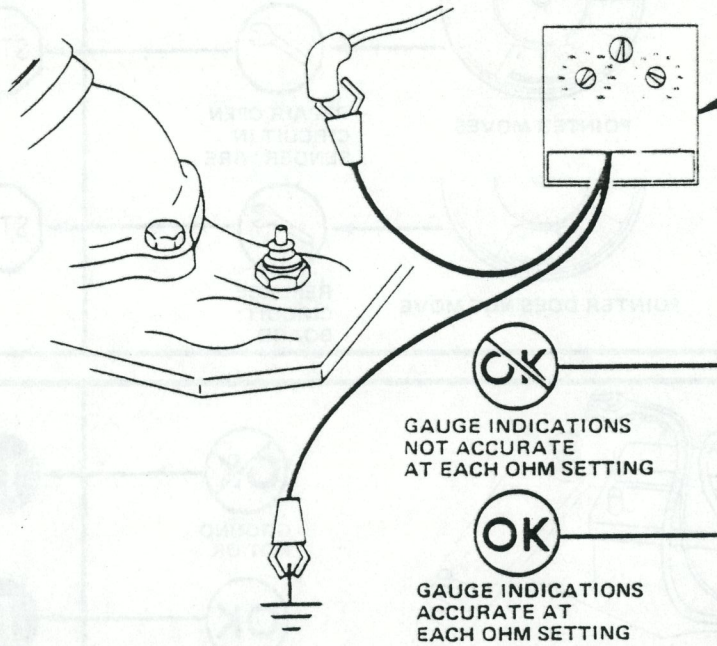
POINTER REMAINS AT MAXIMUM → **14**

80316C

Chart 6

STEP | SEQUENCE | RESULT

12



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING.

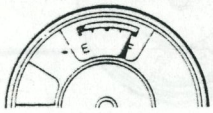
OK → GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → **13**

OK → GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → REPLACE SENDING UNIT → STOP

13

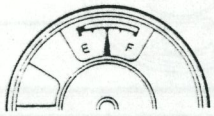
- OBSERVE FUEL GAUGE

FUEL GAUGE POINTER IS AT MAXIMUM



→ REPAIR CLUSTER GROUND OR REPLACE CVR → STOP

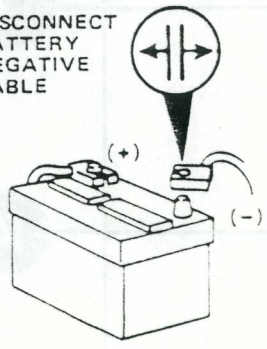
FUEL GAUGE POINTER INDICATES NORMALLY



→ REPLACE TEMPERATURE GAUGE → STOP

14

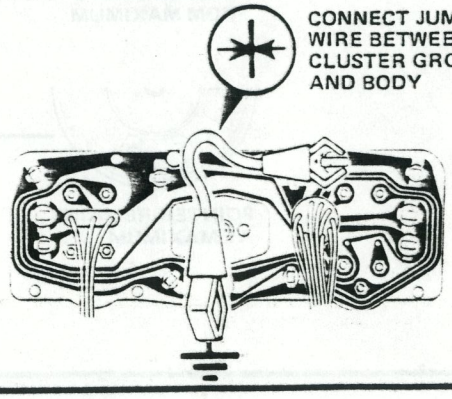
DISCONNECT BATTERY NEGATIVE CABLE



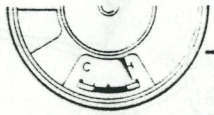
REMOVE INSTRUMENT CLUSTER. DO NOT DISCONNECT WIRE HARNESS

CONNECT BATTERY NEGATIVE CABLE

CONNECT JUMPER WIRE BETWEEN CLUSTER GROUND AND BODY



POINTER DROPS FROM MAXIMUM → **15**



POINTER REMAINS AT MAXIMUM → **16**

80316D

Chart 6

STEP | SEQUENCE | RESULT

15

REPAIR INSTRUMENT PANEL GROUND → STOP

16

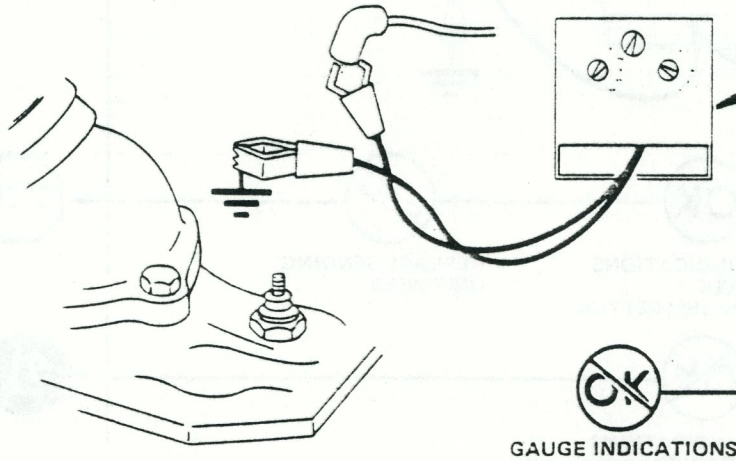
DISCONNECT SENDING UNIT WIRE FROM CLUSTER

POINTER DROPS FROM MAXIMUM → REPAIR OR REPLACE SENDING UNIT WIRE → STOP

POINTER REMAINS AT MAXIMUM → REPLACE GAUGE (CJ) → STOP

POINTER REMAINS AT MAXIMUM → REPLACE CIRCUIT BOARD (CHEROKEE, WAGONEER, TRUCK) → STOP

17



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING

O.K. GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → CJ → **18**

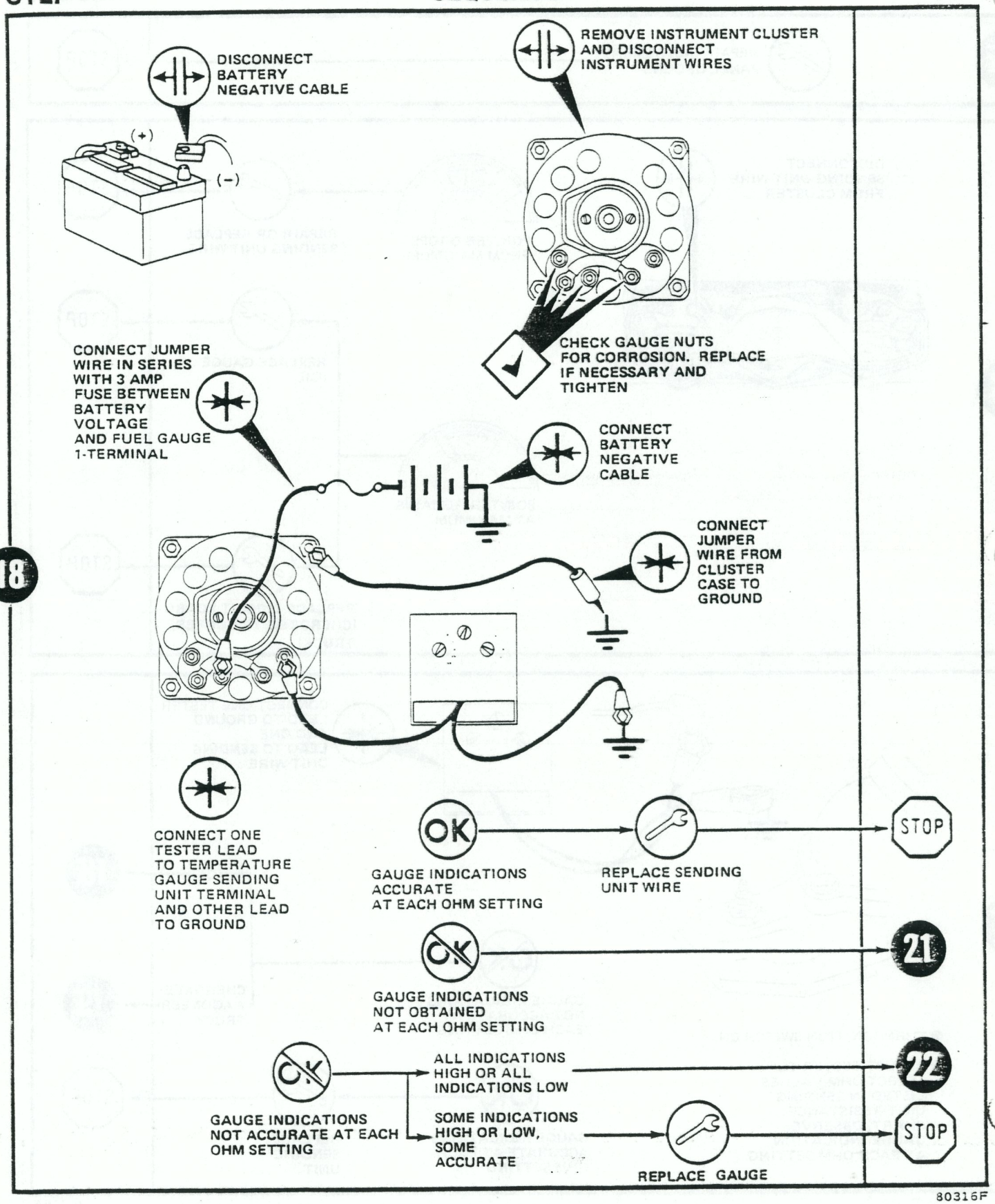
O.K. GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → CHEROKEE WAGONEER TRUCK → **19**

OK GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → REPLACE SENDING UNIT → STOP

80316E

Chart 6

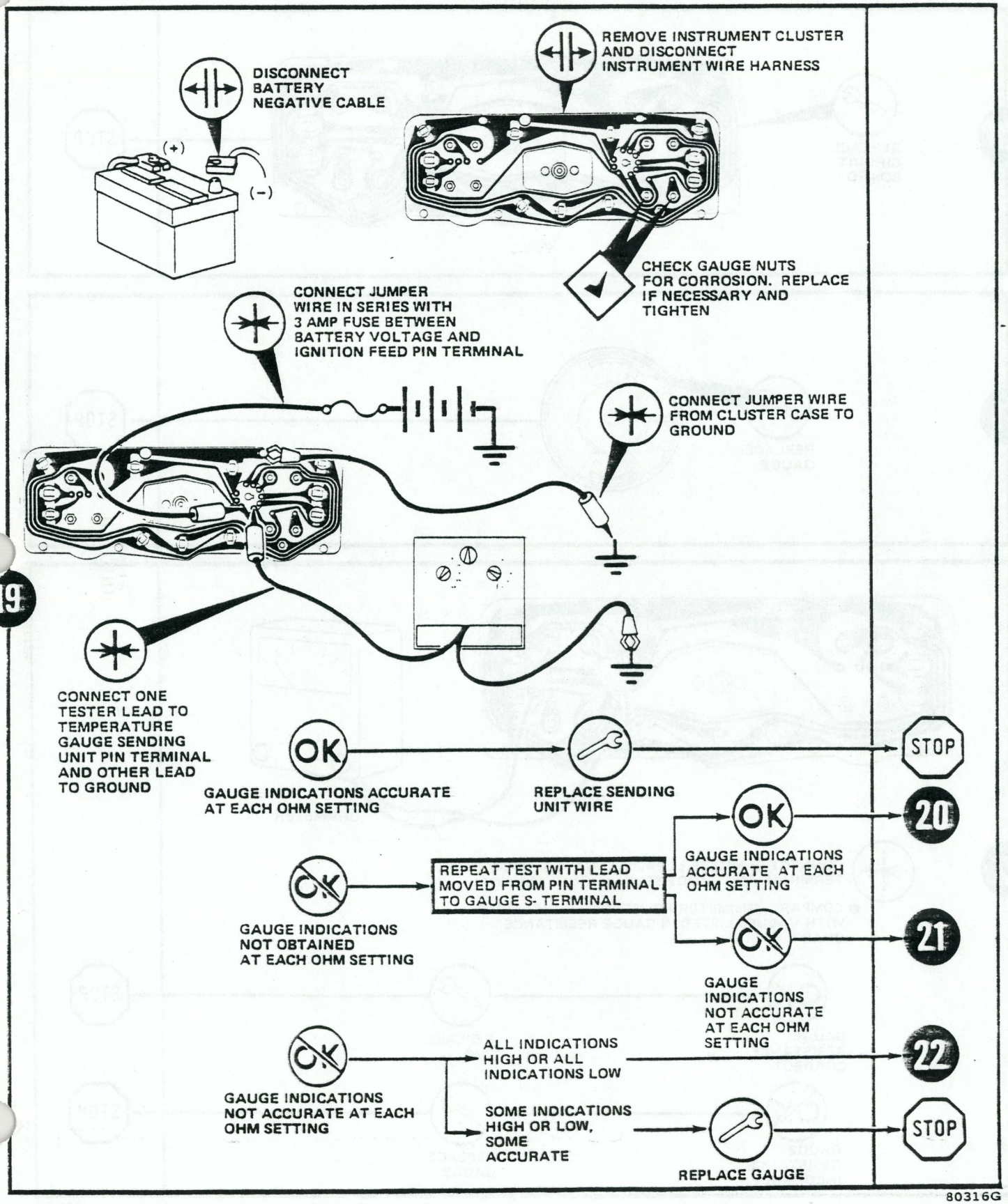
STEP | SEQUENCE | RESULT



80316F

Chart 6

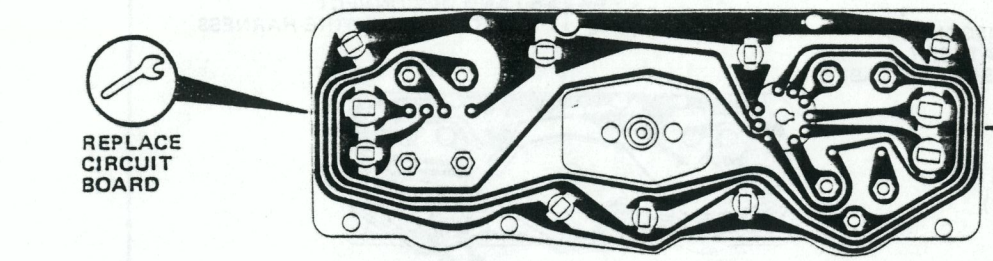
STEP | SEQUENCE | RESULT

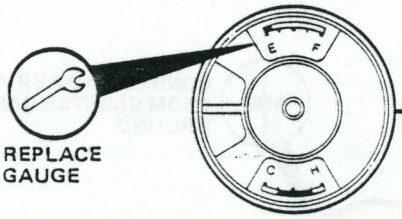


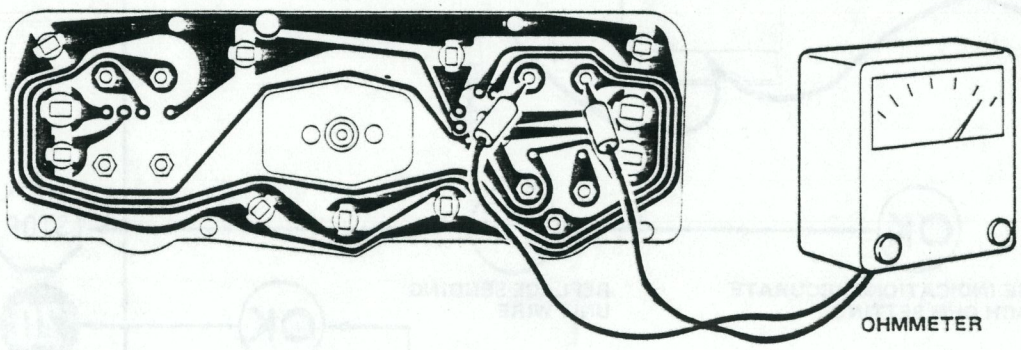
80316G

Chart 6

STEP	SEQUENCE	RESULT
20	REPLACE CIRCUIT BOARD	STOP
21	REPLACE GAUGE	STOP
22	CONNECT OHMMETER LEADS TO GAUGE INPUT TERMINAL AND GAUGE SENDING UNIT TERMINAL ● COMPARE OHMMETER RESISTANCE INDICATIONS WITH VALUES LISTED IN GAUGE RESISTANCE CHART	
	OK — GAUGE RESISTANCE CORRECT	REPLACE CVR — STOP
	OK — GAUGE RESISTANCE INCORRECT	REPLACE GAUGE — STOP







80316H

SPECIFICATIONS

SPECIFICATIONS—CJ VEHICLES

Fuel Gauge Sending Unit Resistance (Ohms)

E	1/2	F
73	23	10

80670

Fuel Gauge Resistance (Internal)

TEST POINTS	OHMS
S to Ground	68 to 72
S to I	19 to 21
S to A	19 to 21
I to A	ZERO
I to Ground	49 to 51
A to Ground	49 to 51

80671

Oil Pressure Gauge Sending Unit Resistance (Ohms)

PSI	0	20	40	60	80
OHMS	234-246	149-157	100.5-105.5	65-69	32.5-34.5

80672

Coolant Temperature Gauge Resistance (Internal)

S to A	19 to 21 ohms

80673

Coolant Temperature Gauge Sending Unit Resistance (Ohms)

C	BEGINNING OF BAND	END OF BAND	H
73	36	13	9

80674

Tachometer Calibrations (RPM)

ACTUAL	INDICATED
500	380 to 620
1500	1380 to 1620
4500	4330 to 4620

80675

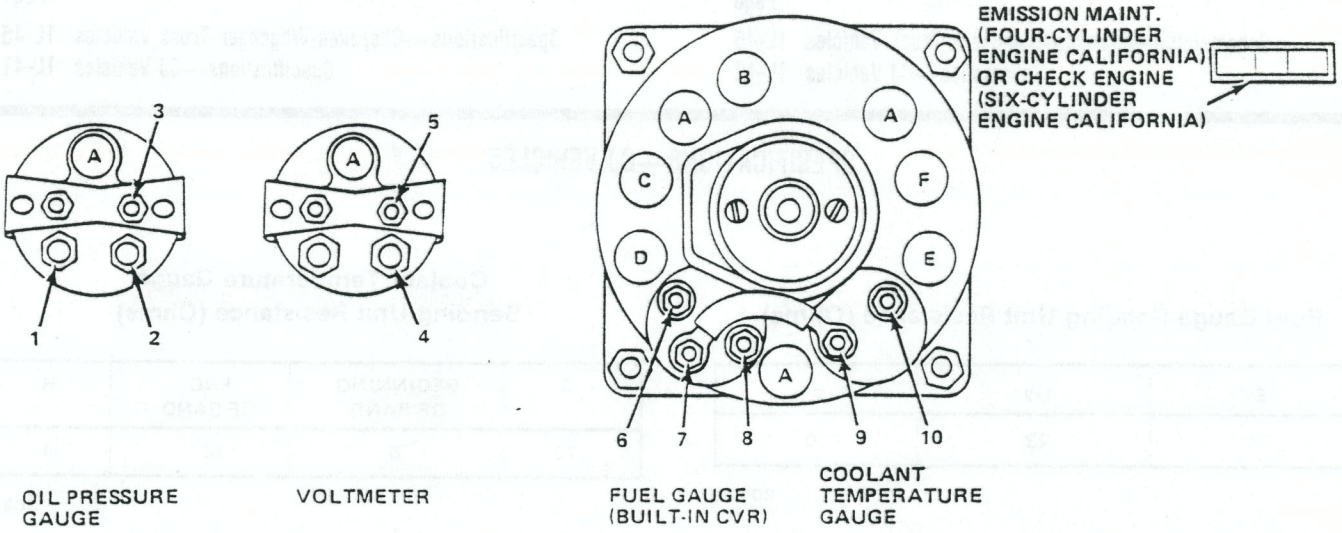
Voltmeter Calibrations (Volts)

ACTUAL	INDICATED
12.4	11.7 to 12.3
14.4	13.8 to 14.2

NOTE: Indicated Voltage Observed from Drivers Seat

80676

SCHEMATICS—CJ VEHICLES



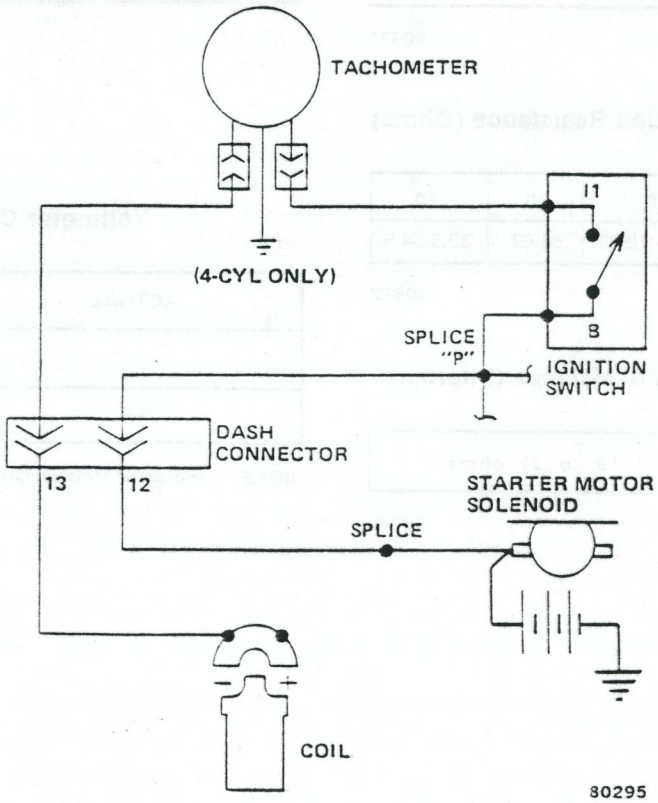
TERMINAL STUDS

1. OIL PRESSURE GAUGE S-TERMINAL
2. OIL PRESSURE GAUGE I-TERMINAL
3. OIL PRESSURE GAUGE GROUND
4. VOLTMETER +-TERMINAL
5. VOLTMETER GROUND
6. FUEL GAUGE S-TERMINAL
7. FUEL GAUGE A-TERMINAL
8. FUEL GAUGE I-TERMINAL
9. COOLANT TEMPERATURE GAUGE S-TERMINAL
10. COOLANT TEMPERATURE GAUGE A-TERMINAL

LAMPS

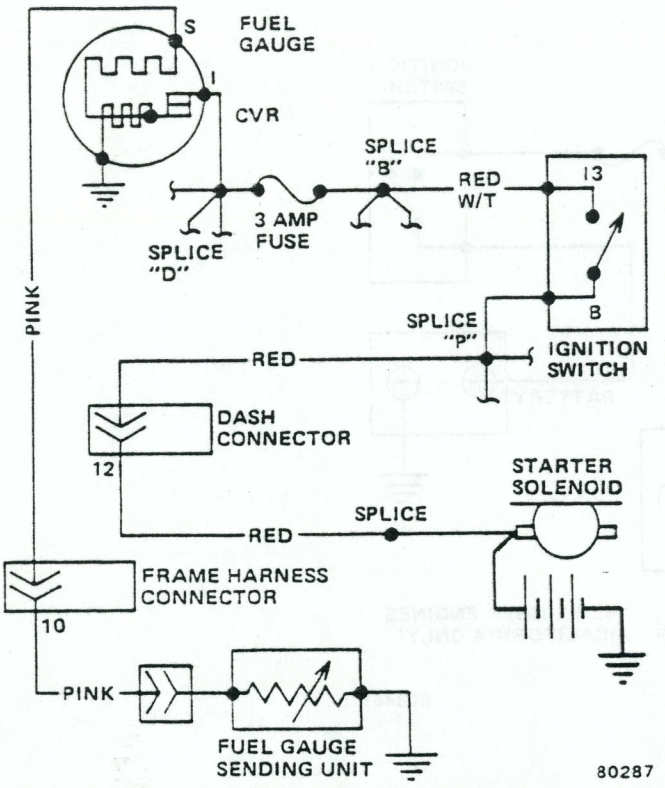
A ILLUMINATION
B HIGH BEAM
C RIGHT TURN
D FOUR-WHEEL DRIVE
E BRAKE
F LEFT TURN

80125

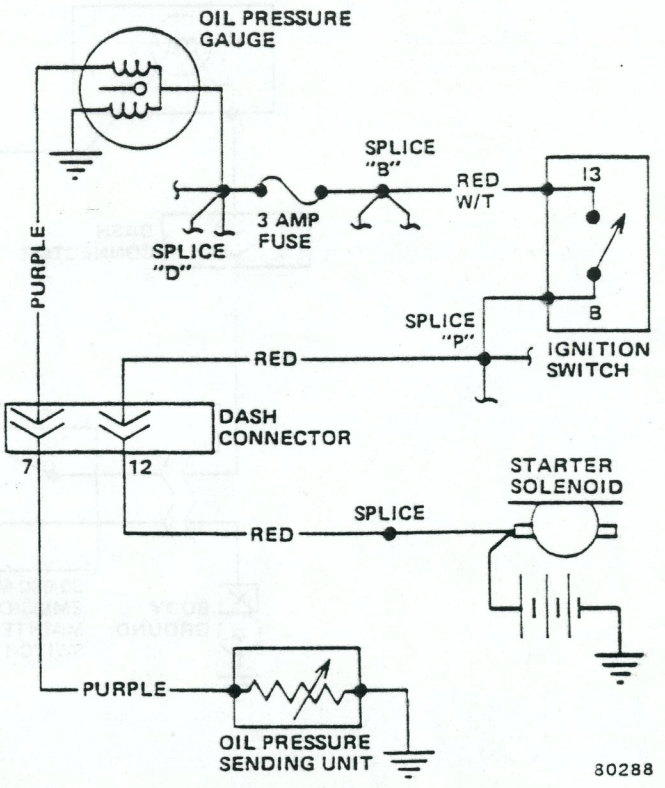


80295

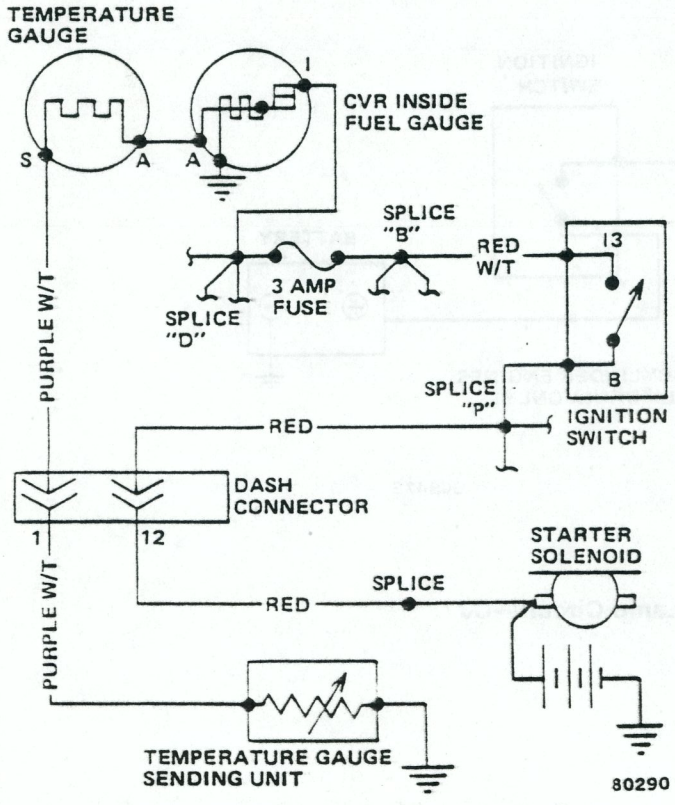
Tachometer Circuit—CJ (Typical)



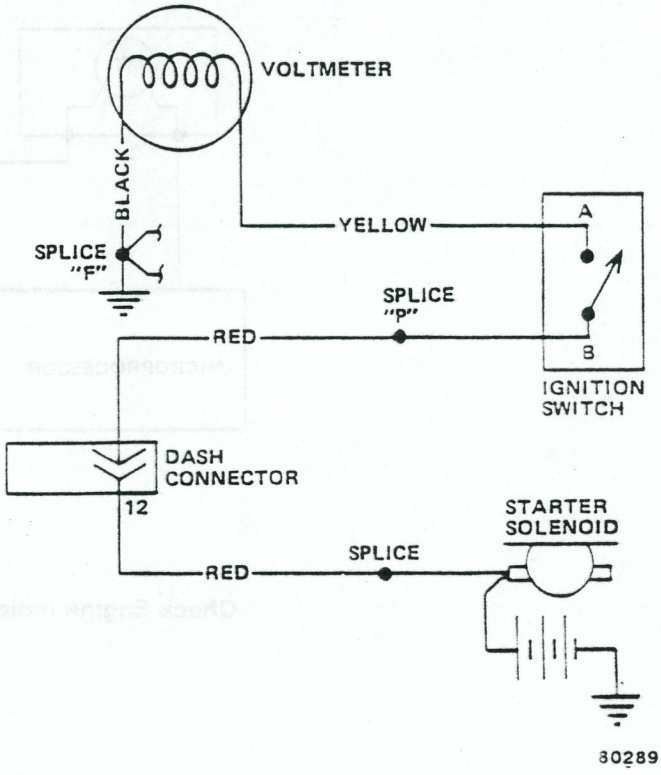
Fuel Gauge Circuit—CJ



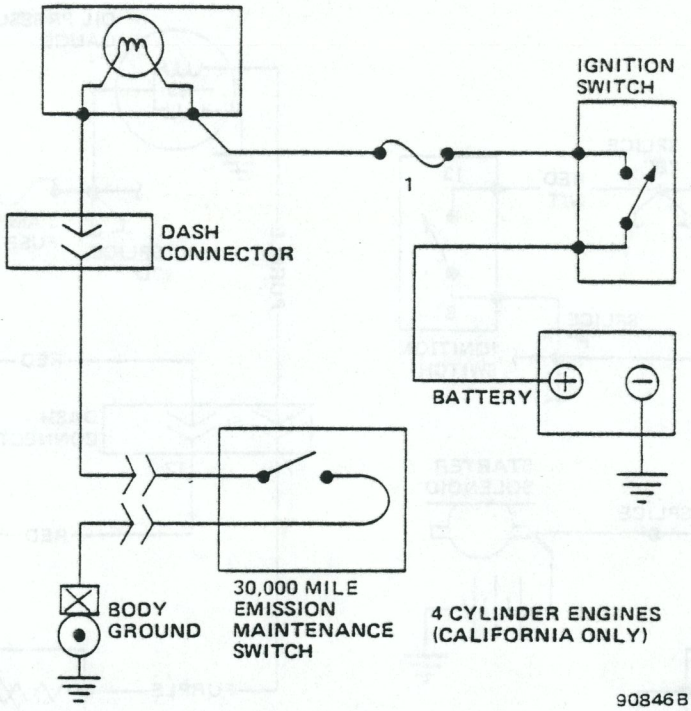
Oil Pressure Gauge Circuit—CJ



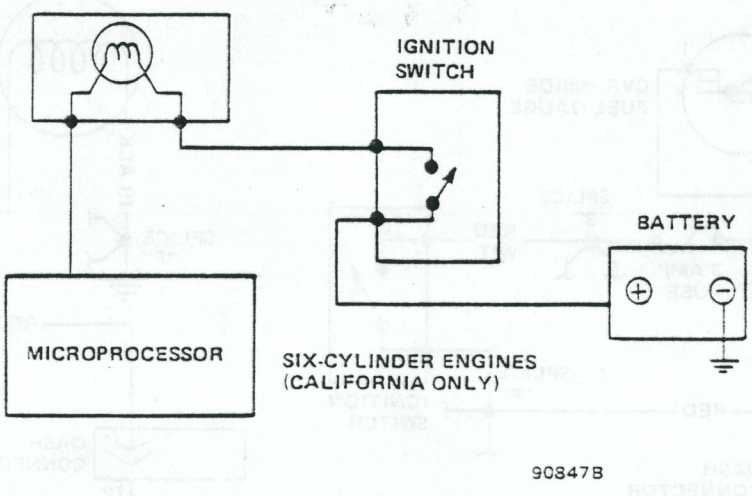
Coolant Temperature Gauge Circuit—CJ



Voltmeter Circuit—CJ



Emission Maintenance Indicator Lamp Circuit—CJ



Check Engine Indicator Lamp Circuit—CJ

SPECIFICATIONS—CHEROKEE-WAGONEER-TRUCK VEHICLES

Ammeter Calibrations

ACTUAL	INDICATED
-60	-48 to -72
0	0± Pointer Width
+60	+48 to +72

80677

Fuel Gauge Sending Unit Resistance (Ohms)

E	1/2	F
61	23	10.3

80670

Fuel Gauge Resistance (Internal)

S to A	19 to 21 ohms

80673

Oil Pressure Gauge Sending Unit Resistance (Ohms)

PSI	0	10	60	80
OHMS	69-77	35-38	13-15	9.5-10.5

80678

Coolant Temperature Gauge Sending Unit Resistance (Ohms)

C	BEGINNING OF BAND	END OF BAND	H
73	36	13	9

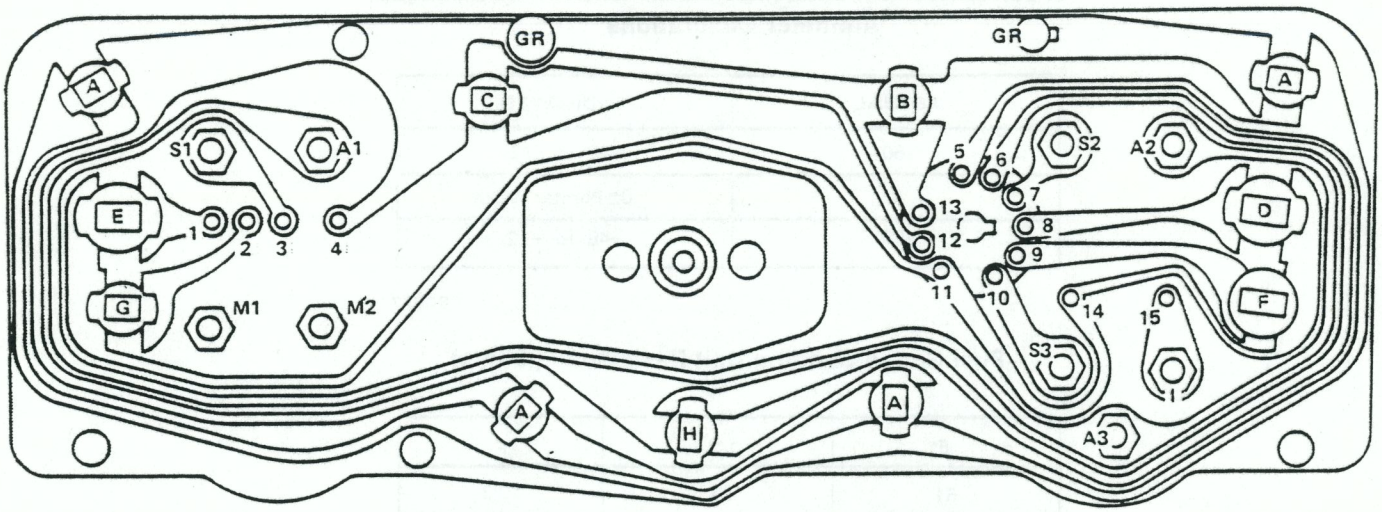
80674

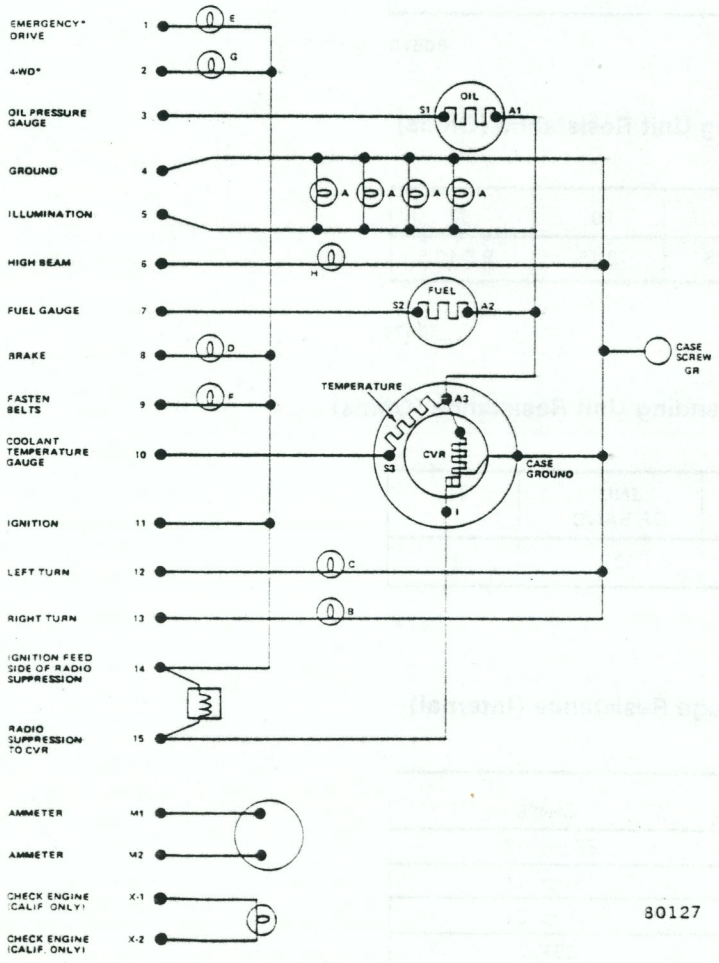
Coolant Temperature Gauge Resistance (Internal)

TEST POINTS	OHMS
S to Ground	68 to 72
S to I	19 to 21
S to A	19 to 21
I to A	ZERO
I to Ground	49 to 51
A to Ground	49 to 51

80671

SCHEMATICS—CHEROKEE-WAGONEER-TRUCK VEHICLES





80127

PIN TERMINALS

1. EMERGENCY DRIVE
2. 4-WHEEL DRIVE.
3. OIL PRESSURE GAUGE
4. GROUND
5. ILLUMINATION
6. HIGH BEAM
7. FUEL GAUGE
8. BRAKE
9. FASTEN BELTS
10. COOLANT TEMPERATURE GAUGE
11. IGNITION
12. LEFT TURN
13. RIGHT TURN
14. IGNITION FEED SIDE OF RADIO SUPPRESSION
15. RADIO SUPPRESSION TO CVR

LAMPS

A ILLUMINATION
B RIGHT TURN INDICATOR
C LEFT TURN INDICATOR
D BRAKE INDICATOR
E EMERGENCY DRIVE INDICATOR* (QUADRA TRAC)
F FASTEN BELT INDICATOR
G 4-WD REMINDER INDICATOR*(MODEL 208)
H HIGH BEAM INDICATOR

OTHER

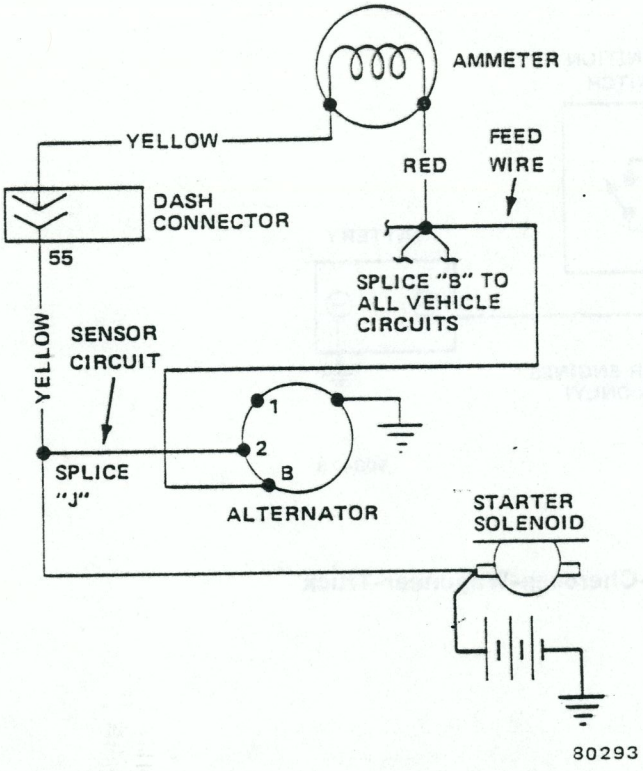
A1 OIL GAUGE A TERMINAL
S1 OIL GAUGE S TERMINAL
A2 FUEL GAUGE A TERMINAL
S2 FUEL GAUGE S TERMINAL
A3 TEMPERATURE GAUGE A TERMINAL
S3 TEMPERATURE GAUGE S TERMINAL
I CVR I TERMINAL (CVR INSIDE TEMPERATURE GAUGE)
M1 AMMETER STUD
M2 AMMETER STUD
GR GROUND SCREW
X-1 CHECK ENGINE LAMP**
X-2 CHECK ENGINE LAMP**

*Light used determined by type of transfer case installed. Lamp is plugged into applicable socket.

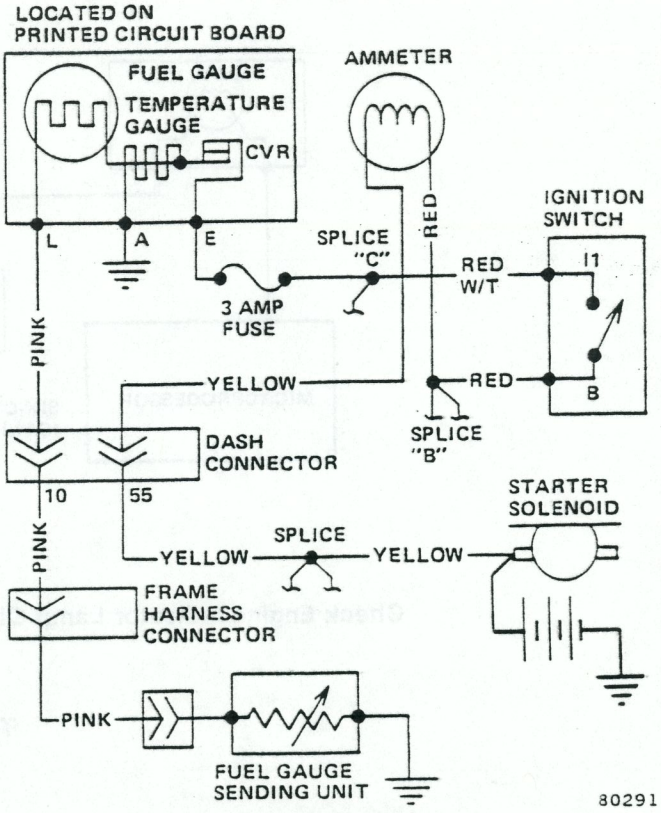
** California six-cylinder engines only

80126

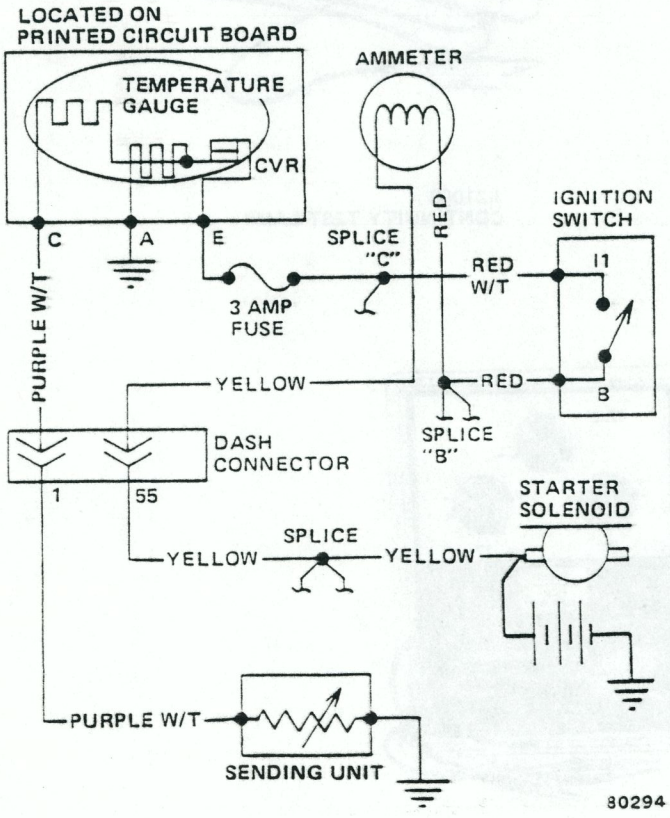
Instrument Printed Circuit Board Cluster and Schematic—Cherokee-Wagoneer-Truck



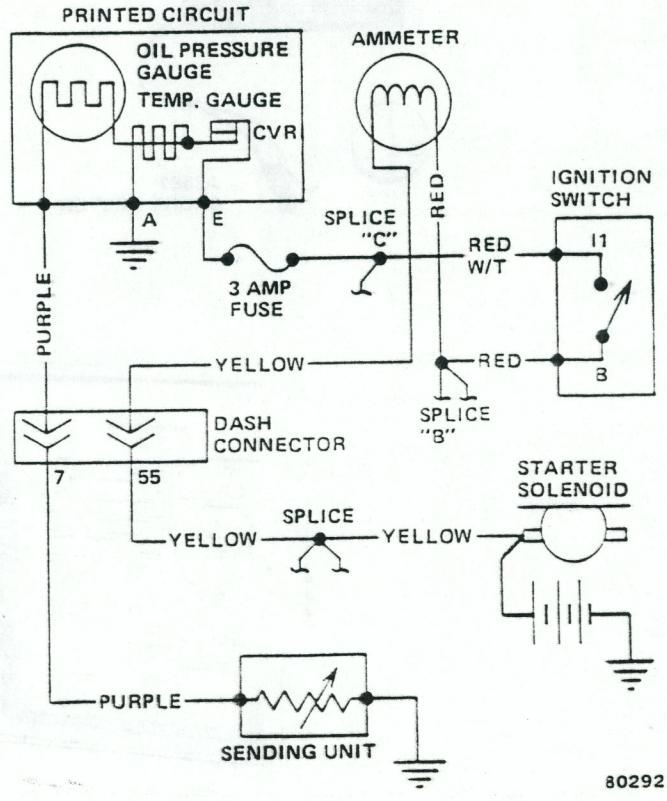
Ammeter Circuit—Cherokee-Wagoneer-Truck



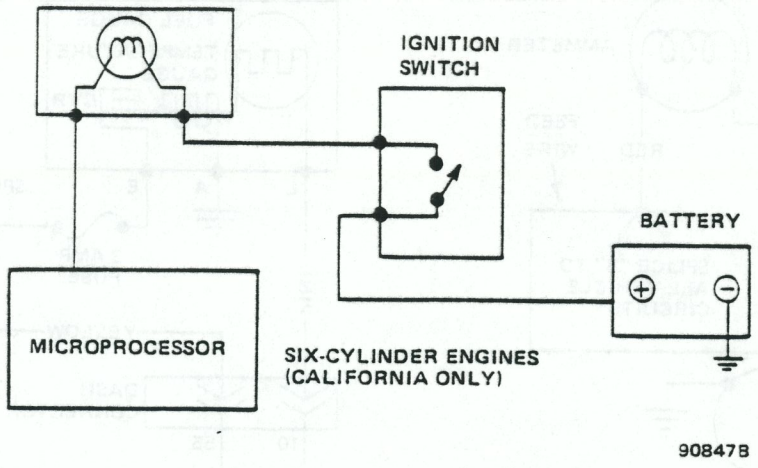
Fuel Gauge Circuit—Cherokee-Wagoneer-Truck



Coolant Temperature Gauge Circuit—Cherokee-Wagoneer-Truck

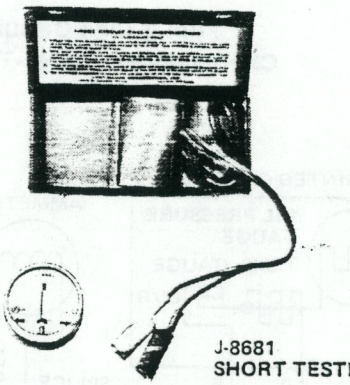


Oil Pressure Gauge Circuit—Cherokee-Wagoneer-Truck

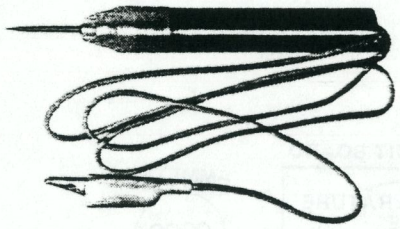


Check Engine Indicator Lamp Circuit—Cherokee-Wagoneer-Truck

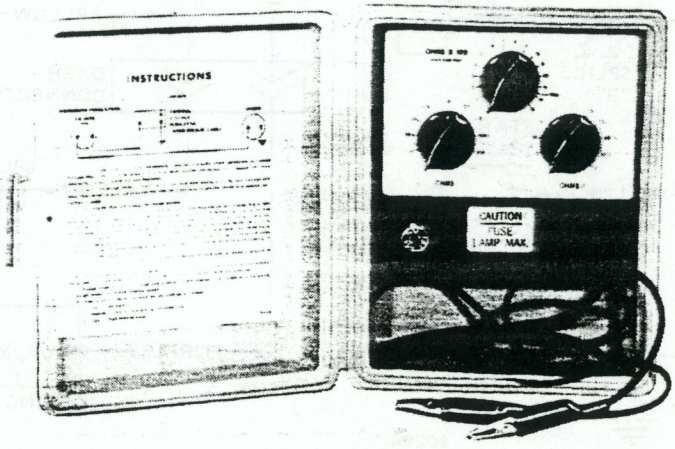
Tools



J-8681
SHORT TESTER



J-21008
CONTINUITY TEST LAMP



J-24538
UNIVERSAL
GAUGE TESTER