



Jacobs Exhaust Brake™

For Dodge Ram Trucks with Cummins
ISB5.9 engine and manual transmissions

Installation Manual

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Introduction

The procedures for installing the brake system are organized into five main sections, with each section detailing the installation of related components. We strongly recommend that you perform the procedures in the order in which they are presented. The last section lists troubleshooting procedures, in case you are experiencing problems with the Exhaust Brake.

For additional information or technical support, contact Cummins Customer Assistance Center by calling 1-800-DIESELS (1-800-343-7357).

Application Notes

Jacob Exhaust Brake™ has been specifically engineered to fit your '98 1/2, '99, 2000, 2001 or 2002 Dodge Ram truck equipped with the Cummins ISB5.9 Turbo Diesel engine and a manual transmission. All parts are included in the kit, allowing installation without requiring any fabrication.

Important!

For all 99, 2000, 2001 and 2002 model year trucks, the Engine Control Module (ECM) has been pre-programmed for Exhaust Brake operation. All 98 1/2 trucks may need an ECM Service Calibration performed by an authorized Cummins Distributor before the E Brake will operate. If you have not already had this Service Calibration performed, see your Cummins distributor for details.

For Manual Transmissions only!

Safety Precautions

The following symbols in this manual signal conditions potentially dangerous to the mechanic or equipment. Read this manual carefully. Know when these conditions can exist. Then take necessary steps to protect personnel as well as equipment.



WARNING THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.



CAUTION THIS SYMBOL REFERS TO POSSIBLE EQUIPMENT DAMAGE.

NOTE: INDICATES AN OPERATION, PROCEDURE OR INSTRUCTION THAT IS IMPORTANT FOR CORRECT SERVICE.

Fuels, electrical equipment, exhaust gases and moving engine parts present potential hazards that could result in personal injury. Take care when installing equipment or parts. Always wear safety glasses. Always use correct tools and follow proper procedures as outlined in this manual.

Special Tools and Materials Required

You should have the following tools and materials before you begin this installation:

- Rust penetrant, such as Liquid Wrench®
- Silicone sealer
- Anti-seize compound
- Battery terminal puller
- Common hand tools such as metric wrenches and screwdrivers
- Torque wrenches
- Drill with 5/16", 1/2", #56 and #27 (0.144") bits
- Knife or other tool for cutting the rubber vacuum hose
- Clean shop towels
- Teflon® pipe sealant
- Loctite® 242 or equivalent
- External snap ring pliers (optional)
- 4" Ball End Hex Driver 4 mm

Section 1: Installing the Brake Assembly

1. Preparation.

Use a battery terminal puller to disconnect the negative (-) leads from both batteries.

NOTE: WHEN YOU DISCONNECT THE BATTERIES, THE MEMORY FOR THE CLOCK AND THE STATION PRESETS ON THE RADIO WILL BE LOST. YOU MAY WANT TO RECORD THE RADIO STATION PRESETS ON PAPER BEFORE YOU DISCONNECT THE BATTERY.

2. Remove the Air Filter Box from the vehicle.

- a. Use a screwdriver to loosen the clamp and disconnect the large plastic duct that connects the air filter box to the turbocharger at the turbocharger end (see Fig. 1).
- b. Remove the air filter housing and duct hose as an assembly (see Fig. 2). Gently lift air filter housing from the inner fender. The plastic connectors will remain in the air filter housing and the steel mounting studs will remain in the inner fender.

3. Remove the existing exhaust elbow that mounts to the rear of the turbocharger.

- a. Remove the two bolts that attach the exhaust pipe to the exit side of the elbow (Fig. 3). Spray rust penetrant on bolts before loosening. The turbo outlet pictured is a 98 1/2. Directions are the same for 99, 2000, 2001 and 2002.
- b. Loosen and remove the 5 capscrews that attach the elbow to the exhaust side of the turbocharger (Fig. 4). This will allow you to remove the elbow and gasket from the vehicle. The turbo outlet pictured in Fig. 4 is from 99, 2000, 2001, and 2002 model year trucks. The procedure is the same for 98 1/2.



Fig. 1

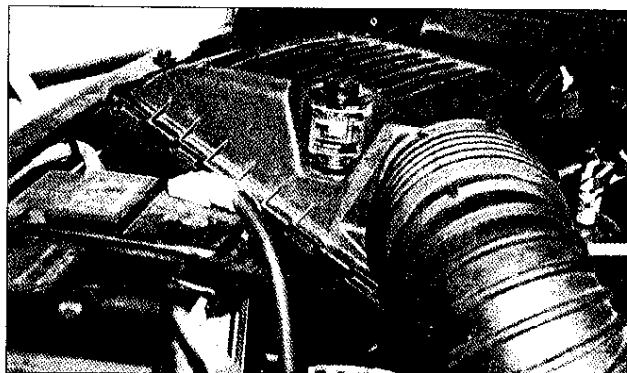


Fig. 2

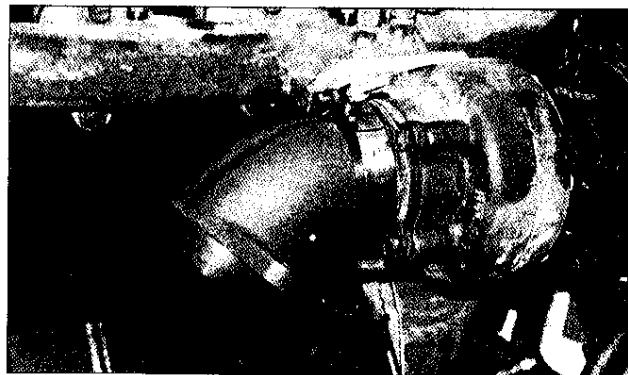


Fig. 3

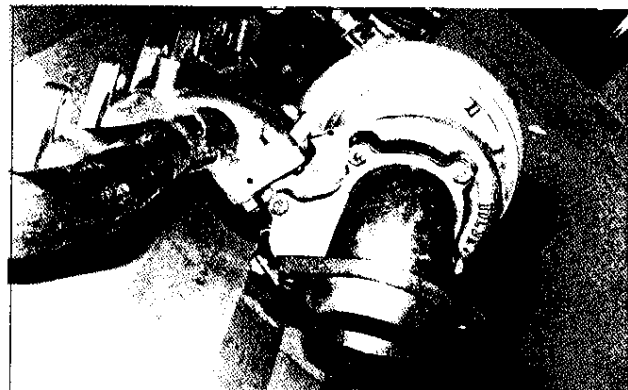


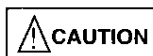
Fig. 4

4. Attach the Brake Assembly to the Turbocharger.

- a. Install the exhaust brake with the new gasket and 5 capscrews supplied in the kit (Fig. 5 & 6). Tighten all the screws finger tight. Then torque the screws in a cross pattern to 18 ft-lbs.
- b. Attach one end of the supplied 30" length of 1/4" vacuum hose to the fitting on the exhaust brake actuator. Use a hose clamp on this connection.

5. Attach the exhaust pipe to the bottom of the exhaust brake housing.

Apply an anti-sieze compound to the original two bolts that held the original elbow in place and tighten them to 19 ft-lbs of torque.



Be certain to torque all vacuum fitting hose clamps.

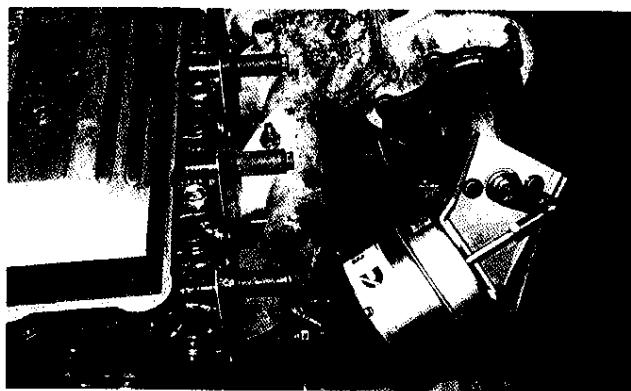


Fig. 5

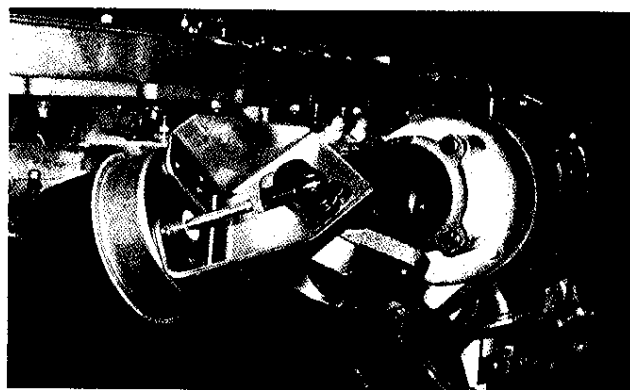


Fig. 6

Section 2 - Installing the Pneumatic Group

1. Drill Mounting Holes.

- In the engine compartment, cut away about 8" of insulation from the upper right (passenger) side of the plenum (Fig. 7).
- Appendix 1 of this manual contains a Solenoid Mounting Bracket Template used to locate mounting holes in the vehicle's plenum. Cut out the template along the solid lines.
- Orient the template on the plenum, using the guidelines indicated on the template (Fig. 8). Place the template so that the upper part of the template fits against the corresponding contour of the plenum.
- Using the template, centerpunch hole locations on the plenum and verify that they match the template. Drill a pilot hole with a #27 drill in the centerpunched locations, then drill to final size with a 1/2" drill.

NOTE: THERE MAY BE A PLUGGED HOLE ON THE PLENUM IN THE AREA EXPOSED WHERE THE INSULATION WAS REMOVED. IF THIS IS TRUE FOR YOUR VEHICLE, REMOVE THE PLUG AND COVER THE HOLE WITH SILICONE SEALER. THE PLUG MUST BE REMOVED AS IT MAY INTERFERE WITH THE SOLENOID MOUNTING PLATE INSTALLATION.

2. Attach Pneumatic Controls.

- Insert the four supplied well nuts into the 1/2" holes drilled into plenum.
- Attach the hose fittings to the solenoid (see Fig. 9). Be sure to orient the 90° fitting with the outlet pointing toward the vacuum solenoid body, as shown in Figure 9.

NOTE: USE PIPE SEALANT ON ALL NPT (PIPE THREAD) CONNECTIONS.

- Insert the isolator grommets and inserts into the large holes in the Solenoid Mounting Plate as indicated in Figure 10.
- Note the orientation of the mounting plate in Figure 10. The distance from the end of the plate to the raised area in the center of the plate is greater on one side than the other. The side with the greater distance is the left side of the plate when the raised portion is facing toward you (when installed, this side points toward the passenger side of the vehicle). Holding the plate in this orientation, insert one M6 x 40 mm screw, washer, and lockwasher into the isolator grommet in the lower left corner of the plate. See Figure 10 for correct orientation of these attaching parts.

NOTE: THIS BOLT MUST BE INSERTED BEFORE ATTACHING THE SOLENOID, SINCE THERE WILL NOT BE SUFFICIENT CLEARANCE TO INSERT THE BOLT AFTER THE SOLENOID ASSEMBLY IS MOUNTED TO THE PLATE.

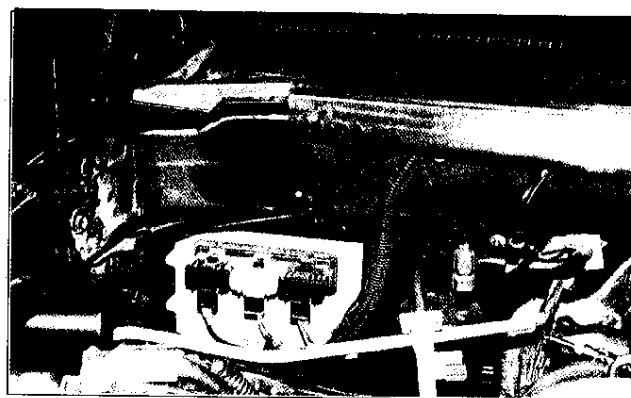


Fig. 7

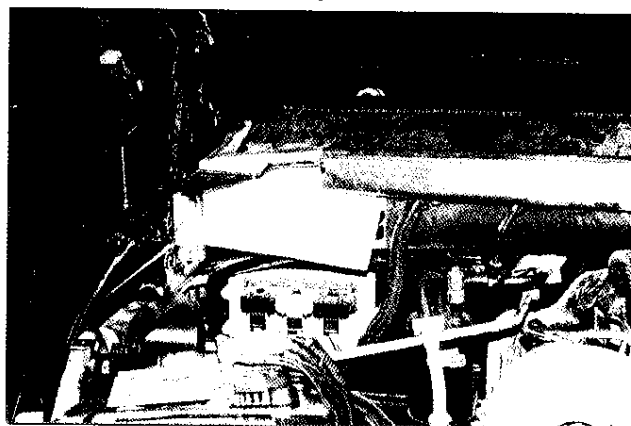


Fig. 8

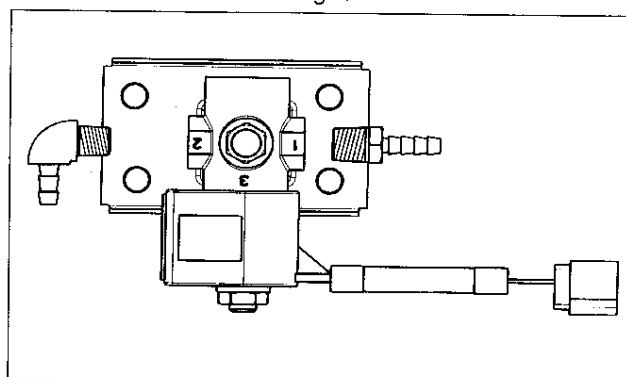


Fig. 9

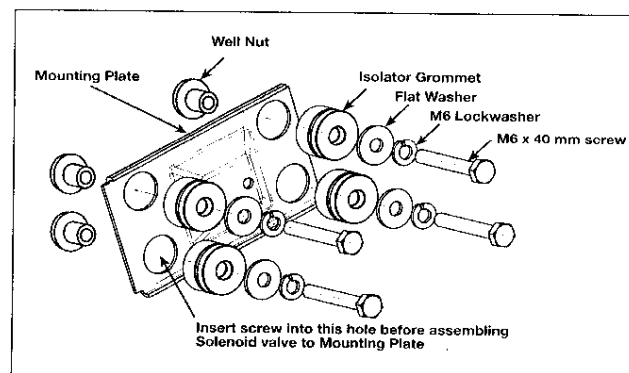


Fig. 10

- e. Attach the Vacuum Solenoid (P/N 3933133) to the mounting bracket using the two #8-32 screws supplied in the kit, using Loctite® 242 on the screw threads. Refer to Fig. 9 for proper orientation of the solenoid on the bracket.
 - f. Attach the mounting bracket to the plenum using the three remaining M6 x 40 screws, washers and lock washers.
3. Connect the Vacuum Actuator on the exhaust brake assembly to the "2" side of the solenoid.
- a. Route the hose attached to the brake assembly over the air conditioning lines, keeping the hose away from the exhaust manifold and the header pipe. Use the P-clip provided to secure the hose to the dash panel (see Fig. 11). Use the M6 locknut provided to fasten the P-clip to an existing dash panel stud.
 - b. Attach the other end of the hose to the 90° elbow connected to the solenoid port marked "2" (see Fig. 9).

4. Connecting the Vacuum Supply

- a. Locate the 1/4" plastic vacuum line from the vacuum pump to the vacuum harness (see Fig. 12).
- b. Disconnect the vacuum line from the vacuum harness below the check valve (arrow, Fig. 12). Attach the supplied 1/4" x 11/2" hose to the plastic vacuum line. Insert the supplied "Y" connector into the 1/4" x 1 1/2" hose (Fig. 13). Attach the Y connector to the vehicle vacuum harness. Attach the supplied 1/4" x 6" Vacuum hose to the remaining end of the Y connector.

NOTE: END OF THE 6" HOSE WILL BE CONNECTED TO POLY TUBE ON THE WIRE HARNESS IN SECTION 3.

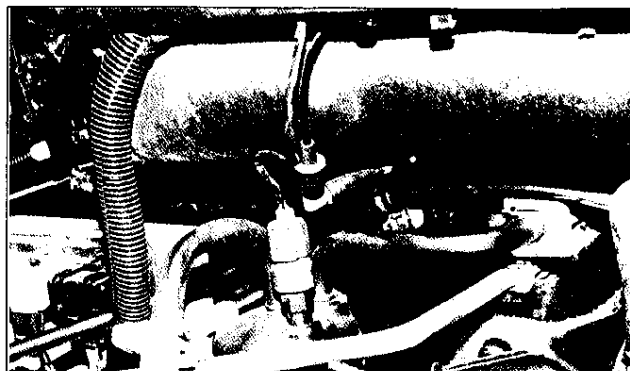


Fig. 11

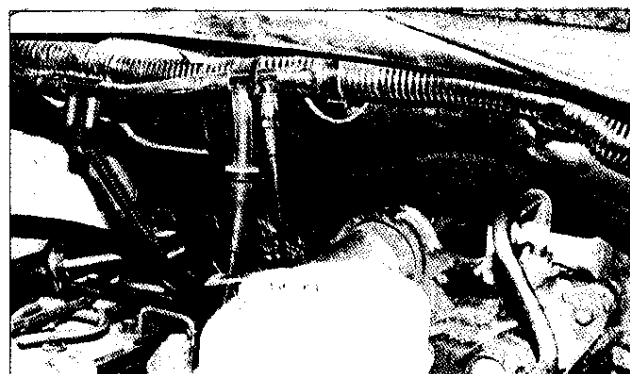


Fig. 12

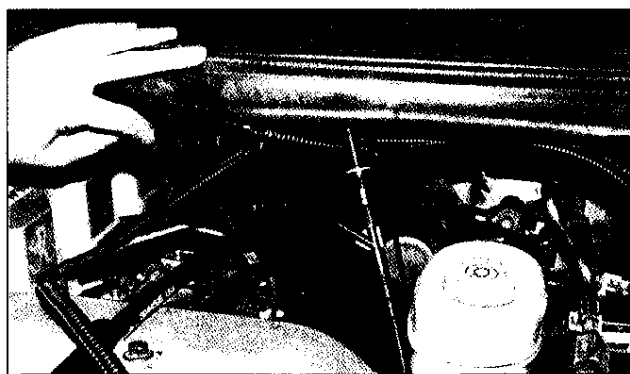


Fig. 13

Section 3 - Installing the Wire Harness

1. Wire Harness

- a. Route the harness along the top of the engine compartment plenum. Refer to Fig. 14 for the general placement of the harness. The harness should be oriented so that the end with the single green wire with the ring terminal is located at the passenger side of the engine compartment, and the end with the yellow, green and red wires is located on the driver's side of the engine compartment.
- b. Attach the male connector with the Yellow and GREEN wires from the harness to the female connector with the two BLACK wires on the solenoid.

NOTE: Y CONNECTOR SHOULD BE POSITIONED (ROTATED) TO ACCOMMODATE WIRE HARNESS LOCATION.

- c. Use the second 1/4" x 6" vacuum hose to connect the straight vacuum fitting on the solenoid port marked "1" to the vacuum fitting on the exhaust brake harness.
- d. Connect the polytube fitting on the driver's side of the exhaust brake harness must be connected to the 1/4" x 6" vacuum hose connected to the vehicle vacuum supply in the previous section. If necessary use a sharp knife to trim the 6" hose as required and connect it to the harness fitting (Fig. 15).
- e. Route the branch of the exhaust brake wire harness with the single red wire along the existing vehicle wiring to the engine control module (ECM). The ECM is located on the driver's side of the engine. This wire will be connected to the engine ECM in step 2.
- f. Route the exposed yellow, red and green wires from the wire harness along the hood release cable on the driver side of the engine compartment, passing the wires through the hood release cable grommet in the dash panel.
- g. Route the ground wire under the air box intake to an existing sheet metal screw on the right inner fender. Remove the sheet metal screw and reinstall with the green wire and ring terminal under the screw. See Figure 16.

2. ECM Connections

Steps a - c for 98 1/2 and 99 trucks.

Model Year 2000, 2001, and 2002 proceed to step d.

- a. Locate the fuel filter canister drain valve (arrow, Fig. 17). Place a drain pan under the drain hose coming from the drain valve. With the engine not running, rotate the drain valve handle forward to the OPEN (DRAIN) position (Fig. 17). Hold the drain valve open until all fuel has been drained from the hose and canister, then close the drain valve and remove the drain hose.



Fig. 14

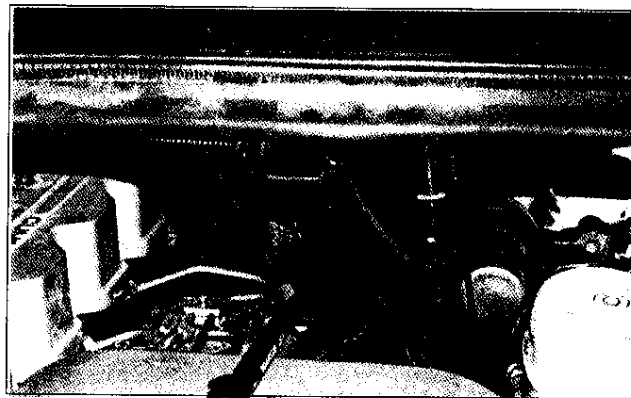


Fig. 15

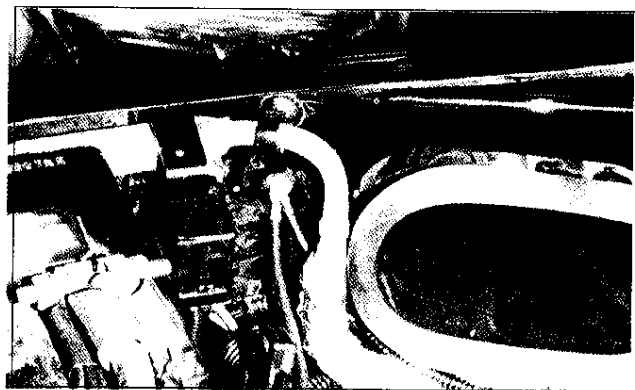
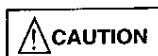


Fig. 16

- b. Disconnect the Water-In-Fuel (WIF) sensor connector at the sensor. The WIF sensor is located at the side of the filter canister.
- c. Loosen the filter canister nut at the top of the header while lowering the canister assembly from the header.



CAUTION TO AVOID DAMAGE TO EITHER THE POWERTRAIN CONTROL MODULE (PCM) OR ENGINE CONTROL MODULE (ECM) YOU MUST ENSURE THE NEGATIVE BATTERY CABLES ARE DISCONNECTED FROM THE BATTERIES.

- d. Using a 4 mm ball hex wrench or screwdriver, remove the bolt securing the 50-pin electrical connector at the ECM (Fig. 18). As the bolt is being removed, very carefully remove the connector from the ECM.
- e. Locate the #20 terminal sealing plug on the connector (Fig. 19). Insert a #56 drill or similar small diameter rod into cavity #20 to push out the sealing plug from the front of the connector toward the wire side.. Pull the sealing plug from the cavity with needle nose pliers.
- f. Insert the terminal on the red wire from the exhaust brake harness into the #20 cavity. Push the terminal straight into the cavity from the wire side of the connector. until a positive stop is felt. Lightly pull on the terminal to ensure that it is properly locked in place.
- g. If necessary clean the pins of the 50-pin connector using a quick-dry electrical contact cleaner. if connector is cleaned reapply DSES lubricant Cummins P/N 3822934.
- h. Very carefully install the 50-pin connector to the ECM. Tighten the connector hex bolt to 25 in-lb.
- i. Fasten the exhaust brake harness to the engine harness with provided wire ties.

NOTE: BE SURE TO FOLLOW THE DRIP LOOP IN THE ENGINE HARNESS WITH THE EXHAUST BRAKE HARNESS.

Steps j and k for 98 1/2 and 99 trucks. Not required for model year 2000, 2001 and 2002.

- j. The kit includes a new O-ring for the canister lid. This O-ring must be replaced before reassembly. Position the canister assembly to the canister header.

NOTE: LOCATING TABS ON THE CANISTER SHOULD ALIGN WITH THE NOTCH IN THE CANISTER HEADER.

- k. Install the canister nut and tighten to 10 ft-lb. Reconnect the WIF sensor to the canister and the drain hose to the drain valve.

NOTE: REFER TO OPERATION CHECK FOR REPRIMING INSTRUCTIONS (SECTION 5).

3. Secure the Wire harness

Route the wire harness under the rubber gasket at the top of the vehicle's plenum, and along the vehicle's existing wire harness. Use cable ties to secure the wire harness to the vehicle's existing wire harness.

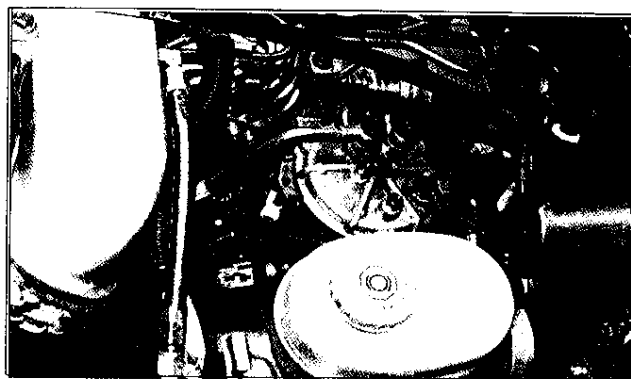


Fig. 17



Fig. 18

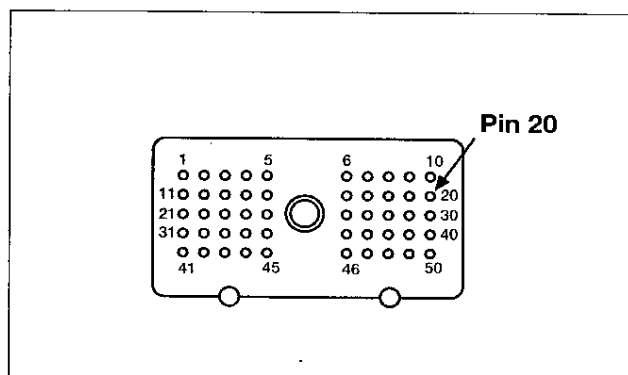


Fig. 19

4. Install Air Cleaner Box

- a. Place the air filter housing back in position on to the mounting studs (see Fig. 2 on page 3).
- b. Install large plastic duct that connects the air filter box to the turbo charger at the turbo charger end. Tighten the clamp. (see fig 1 on page 3)

Section 4. Dashboard Switch Installation

1. Cut Switch Hole in Panel

- a. Locate the Dashboard Switch Template in Appendix 2. Use this template to locate and cut a rectangular hole in the dashboard for the exhaust brake On/Off rocker switch. The switch should be located in the dash panel, below the power accessory plug (Fig. 20). Drill holes in the dash panel as indicated on the template and saw or file the edges to the template dimensions.

NOTE: BE SURE TO CUT THE SWITCH HOLE TO THE TEMPLATE DIMENSIONS. IF THE HOLE IS OVERSIZE, THE SWITCH TABS WILL NOT PROPERLY LOCK IN PLACE.

- b. Insert the harness that is preinstalled on the switch through the switch hole in the dash. Do not lock the switch in place at this time.

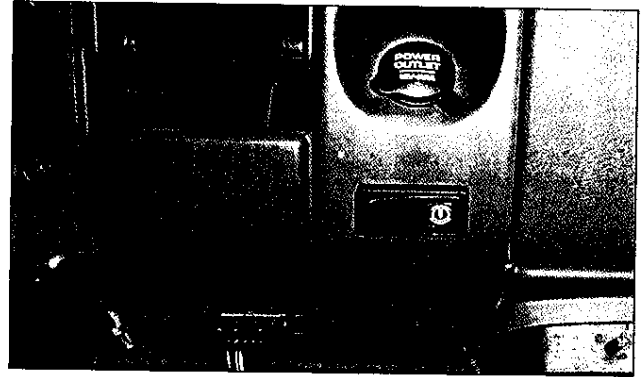


Fig. 20

2. Switch Power Lead Connection

- a. Remove the cigar lighter from its receptacle base. Locate the PLASTIC retaining tabs that secure the receptacle base to the receptacle mount on the dashboard. These plastic tabs lock into openings positioned approximately 3/4" from the end of the receptacle base, indicated by arrow #1 in Figure 21. Use external snap ring pliers, a small screwdriver or an angled scribe to disengage the tabs from the receptacle, then gently pull the receptacle out of the dashboard into the passenger compartment.

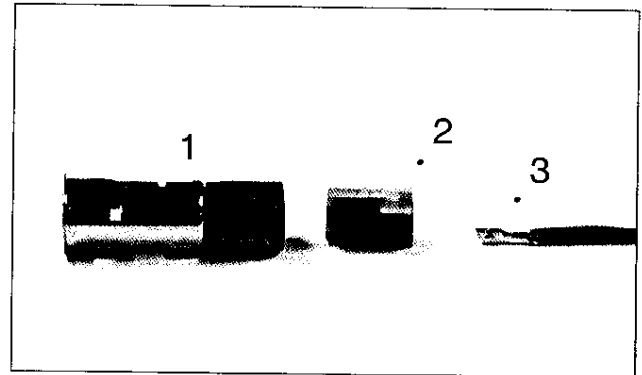


Fig. 21

CAUTION WHEN REMOVING THE RECEPTACLE BASE FROM THE MOUNT, DO NOT PRESS ON THE METAL TABS ON THE RECEPTACLE BASE OR DAMAGE MAY RESULT.

- b. Press down on the electrical connector terminal lock (arrow #2, Figure 21) and disengage the connector from the receptacle.
- c. To remove the power lead from the connector, you must first release the terminal lock on the connector. To release the terminal lock, pull up on the sides of the terminal lock until the locking tabs clear the pins on the side of the connector, then slide the terminal lock forward (away from the wires). Continue lifting on the sides of the terminal lock until the pins on the underside of the lock clear the slots in the top of the connector body, then slide the lock off the connector body.
- d. The wire terminals are held in place in the connector body by an internal locking tab. Insert a small punch or scribe tip into the end of the connector body opposite the wires and pull back on the locking tab for position 1 on the connector. Holding this tab, pull firmly on the red/orange power lead wire to remove the wire and its terminal from the connector. When the wire has been removed, cut the terminal off the wire and discard it, taking care to preserve as much of the wire as

possible. Strip approximately 1/4" from the end of the red/orange wire just removed from the connector.

- e. Locate the switch power supply lead on the switch/harness assembly. This lead is a single white wire, with approximately 1/4" of insulation removed from the end. Pull this wire from behind the dash through the cigar lighter hole. Crimp the end of this wire ALONG WITH the red/orange wire into one of the terminals provided in the kit (arrow #3, Figure 21), making sure the connection is secure.

NOTE: THE KIT CONTAINS TWO TERMINALS. ONLY ONE IS NEEDED FOR INSTALLATION. THE OTHER TERMINAL MAY BE USED IN CASE OF DAMAGE TO THE OTHER TERMINAL, OR IT MAY BE DISCARDED IF NOT NEEDED.

- f. Insert the new terminal with the two wires crimped into it into position 1 on the connector. Slide the retainer back on the connector until it securely engages the pins on the connector body. Insert the connector into the back of the lighter receptacle. Insert the lighter receptacle into the dashboard, making sure the locking tabs engage the corresponding openings in the receptacle.

3. Making the Switch Connections

- To ease harness installation and connections, remove the three screws retaining the dashboard panel below the steering wheel and remove the dashboard panel (Fig. 22).
- Slip the supplied 16 1/2" section of protective plastic conduit over the green, yellow, and red wires inserted into the hood release cable grommet in the previous section. After the conduit has been installed, insert the green, red, and yellow wires into the 3-cavity male connector supplied. Insert the green wire into the center cavity, the red wire into the right cavity, and the yellow wire into the left cavity. See Figure 23.
- Push the dash switch into the hole completely to engage the locking tabs on the switch body.
- Route the switch harness behind the dash, under the steering column, and over to the three pin male connector installed in step 4b. Insert the male connector into the female connector. See Figure 24.
- Secure the wire harnesses to the dashboard supports with wire ties. Reattach the dash panel removed previously.

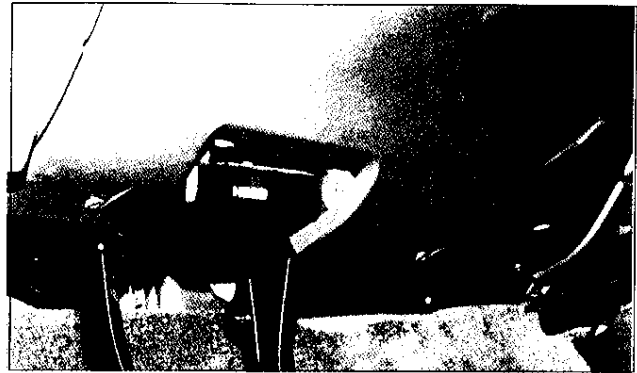


Fig. 22

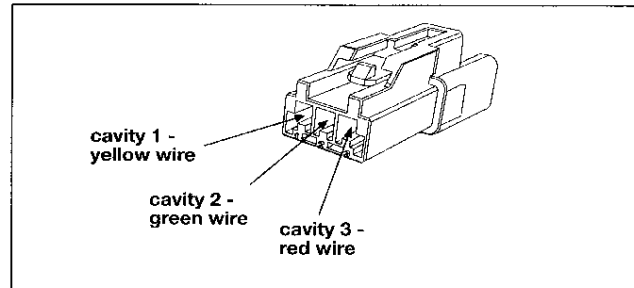


Fig. 23

⚠ WARNING ENSURE THAT THE WIRE HARNESS IS KEPT AWAY FROM PEDAL LINKAGES TO PREVENT INTERFERENCE WITH PEDAL OPERATION OR HARNESS DAMAGE BY THE LINKAGE MECHANISMS.

Reconnect the vehicle battery cables. The installation is now complete. Proceed to Section 5 - Operational Check.



Fig. 24

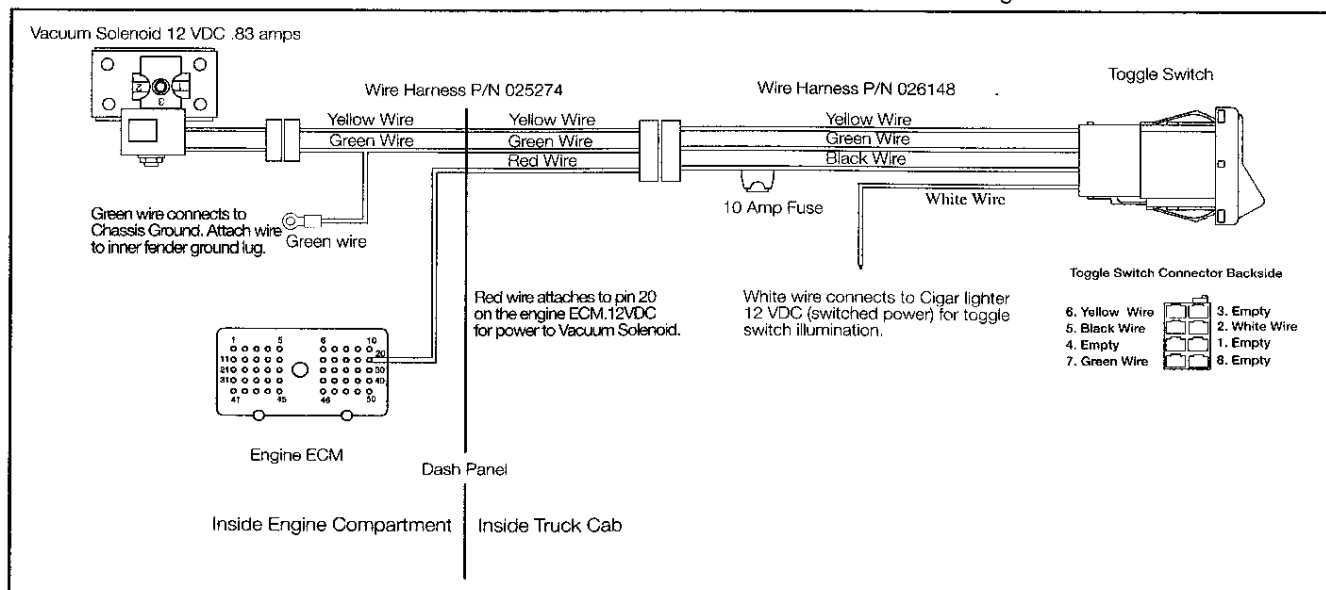


Fig. 25

Section 5 - Operational Check

Once you have completed the installation of the kit, the final step before the test drive is to check the operation of the brake.



WARNING KEEP HANDS, TOOLS AND ELECTRICAL CORDS AWAY FROM THE COOLING FAN AND OTHER MOVING PARTS. INJURY COULD RESULT.

1. Start the vehicle and let it warm up. Check for leaks at the fuel filter canister and correct as required.

NOTE: IF THE ENGINE DOES NOT START, THEN RELEASE THE KEY BACK TO THE "RUN" POSITION (DO NOT TURN THE KEY BACK TO THE "OFF" POSITION). THE ELECTRIC FUEL TRANSFER PUMP WILL CONTINUE TO RUN AND PURGE AIR FROM THE SYSTEM FOR ABOUT 25 SECONDS. AFTER 25 SECONDS ATTEMPT TO START THE ENGINE AGAIN.

2. Open the vehicle hood so that you can observe the movement of the vacuum actuator to make sure the brake is operating correctly. With the engine running at idle, turn the dashboard ON/OFF switch to the "ON" position. The dashboard switch should illuminate and the brake valve should close.

NOTE: THERE WILL BE A ONE TO TWO SECOND DELAY BETWEEN THE TIME THE SWITCH IS TURNED ON AND THE CLOSING OF THE BRAKE VALVE. THIS IS NORMAL OPERATION OF THE EXHAUST BRAKE.

3. Carefully operate the accelerator pedal to bring the engine off idle. The exhaust brake valve should open. Watch the movement of the vacuum actuator to tell if the brake opens.

If the brake does not operate as described above, turn the switch to the "OFF" position and check the Troubleshooting section for details on how to proceed.

Section 6 - Troubleshooting

If the exhaust brake does not perform properly:

1. With the engine running at idle and the system ON/OFF switch in the ON position, check to ensure the butterfly valve is completely closing. Either bring the engine off idle or have someone manually activate the ON/OFF switch as you observe the operation of the actuator piston rod. It should move about 1.5".
2. Check for exhaust leaks at the points where the exhaust brake housing is attached to the turbo-charger. Look for signs of exhaust residue from leaking exhaust gas. With the engine running, listen for exhaust leaks which may make a hissing or whistling sound.
3. Check for exhaust leaks at the exhaust manifold, both in the manifold itself and at the gasket surfaces where it bolts to the cylinder head. Leaks may not be readily apparent; it may be helpful to use a strip of paper attached to the end of a pair of pliers or a probe to locate the leaks. Replace exhaust manifold gaskets if necessary.

Also check for leaks between the turbocharger and the exhaust manifold.

4. Test the vacuum pressure to the solenoid. Detach the 1/4" vacuum hose that is connected to solenoid port #1. Attach the hose to a vacuum gage. With the engine running, check to see that the vacuum system is operating in the range from 15 in. Hg to 29 in. Hg. If the reading is less, check for hose/connection leaks. If none are found, the vacuum pump or check valve may need to be replaced.
5. Test the vacuum pressure to the vacuum actuator. Detach the hose from the vacuum actuator. With the

engine running at idle and the system ON/OFF switch ON, check to ensure that the vacuum system is operating in the range from 15 in. Hg to 29 in. Hg.

- If proper vacuum pressure is present, the electrical and pneumatic connections are OK.
- If vacuum pressure is present at the solenoid but not at the vacuum actuator, then the problem is probably electrical.

If the system doesn't appear to work at all, it is most likely an electrical problem.

NOTE: BEFORE YOU BEGIN TESTING THE ELECTRICAL PORTION OF THE SYSTEM, PERFORM THE VACUUM TEST TO ENSURE THE PNEUMATIC AND MECHANICAL COMPONENTS ARE WORKING CORRECTLY.

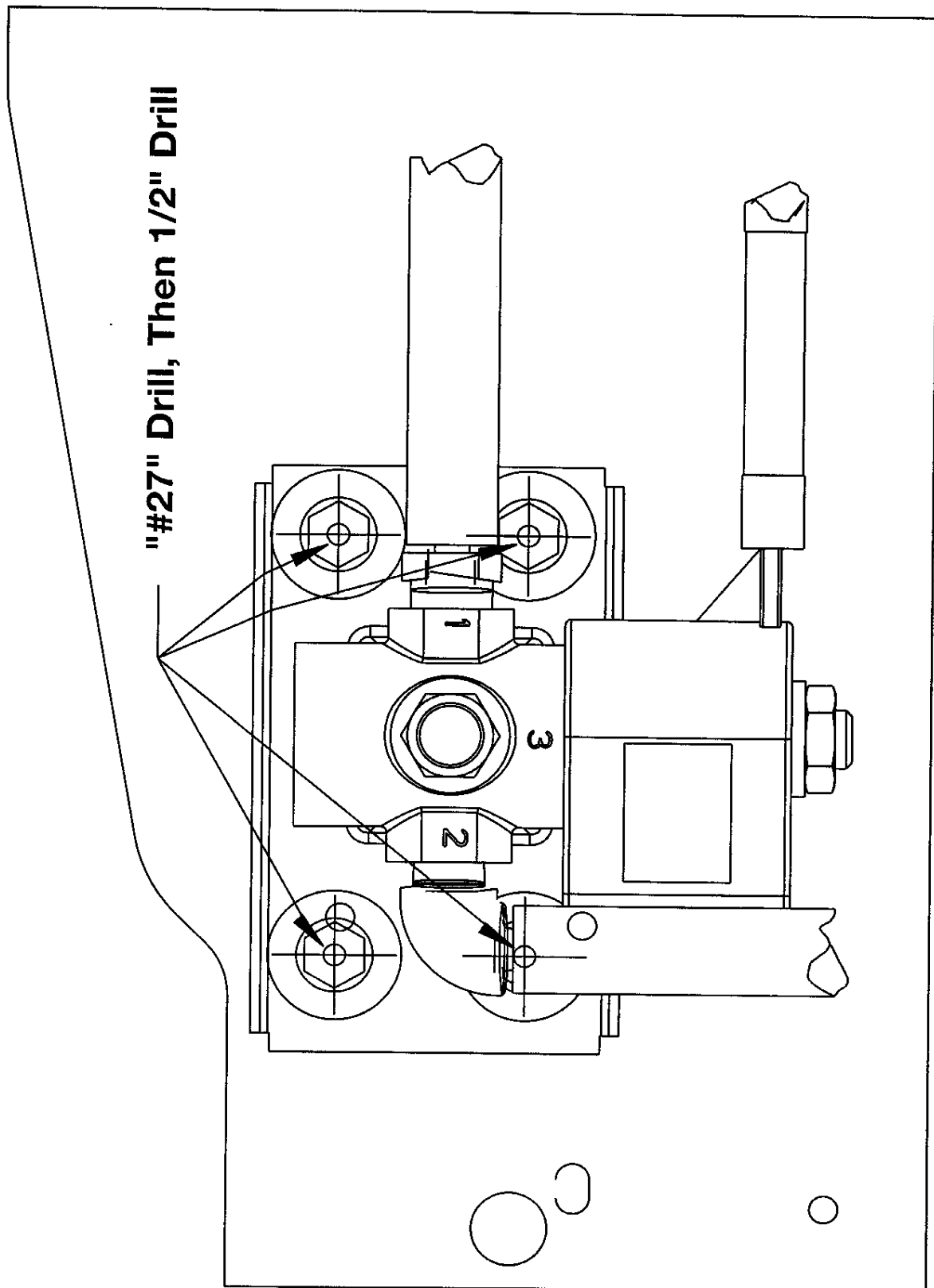
1. Make sure the system ON/OFF switch is turned "ON".
2. Check all connections to verify that they are tight and correct.
3. Use a test light or multimeter to ensure the solenoid is working when current is applied. It should make an audible clicking sound when it turns on.
4. Check the green ground wires for a good ground connection to the vehicle chassis.
5. Check the connection and operation of the ECM output signal. With the engine running at idle, use a volt meter or test light to verify there is positive (+) battery voltage at the ECM going to the red wire. If there is no voltage at the red wire, check the ECM.

6. Check the connections and operation of the ON/OFF Dashboard rocker switch. Use a volt meter or test light to verify positive (+) voltage to the switch's black wire when the ignition key switch is ON and the engine is at idle.

- If there is power to the black wire, turn the toggle switch "ON" and verify there is voltage to the yellow wire. If voltage is not present at the yellow wire, the toggle switch is defective and must be replaced.
- If there is no power to the black wire, check the connection at the main harness and check for a blown fuse at the fuse housing on the switch harness behind the dash.

7. Check the solenoid for proper operation. With the engine at idle and the exhaust brake Dashboard switch in the ON position, there should be [positive voltage/12 volts] at the yellow wire. If there is no positive voltage, check the harness connections to the yellow wire.

Appendix 1 - Solenoid Mounting Template



Appendix 2 - Dash Switch Template

The template below will assist installers in determining switch placement in Dodge Ram Trucks with ISB engines. To determine switch hole location, cut out the template along the dashed lines. Align the template on the dash panels as indicated by the dashed lines in Figure 1, securing the template with tape. Note: to properly align the template along the dash panel, position the edge of the template at the center of the curved radius of the panel edge, as shown in Figure 2.

Carefully check the position of the template. When the template is properly positioned, cut the hole for the switch along the lines indicated on the template. The preferred method of cutting the switch hole is to use a rotary tool and small cutoff wheel, being careful to cut the hole along the template lines. An alternative method is to drill out the corners of the switch hole as indicated on the template, then use a small saw or some other device to carefully cut the hole in the dash panel.

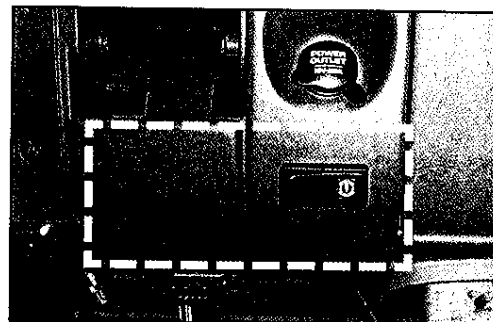


Fig 1

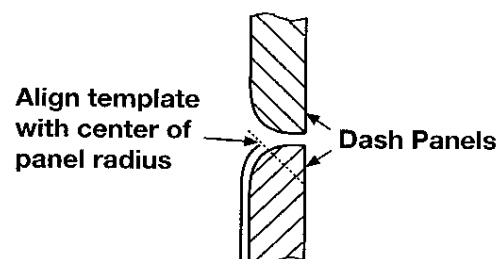


Fig 2

