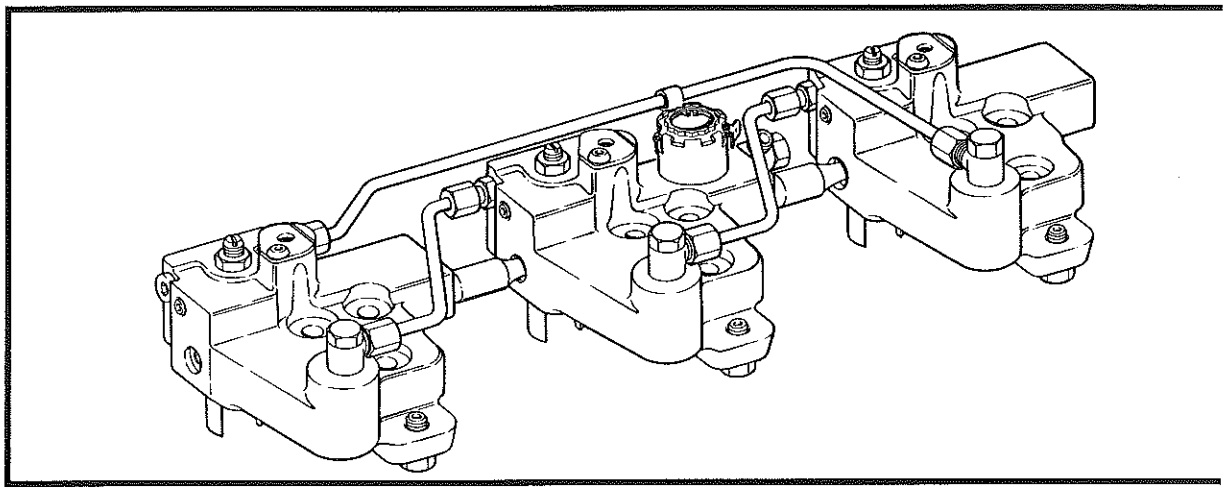
Installation/Maintenance Manual for Model 122 Engine Brake



The Model 122 *Jake Brake*® Engine Retarder is designed for use on Volvo 12 liter diesel engines TD 120, TD 121 and TD 122.

Refer to *Jacobs* Service Letters and instructional literature for specific application information. Information contained in this manual was current at the time of printing and is subject to change without notice or liability.

⚠WARNING

See Jacobs Driver's Manual for proper engine brake driver techniques

The *Jake Brake* Retarder is a vehicle slowing device, not a vehicle stopping device. It is not a substitute for the service braking system. The vehicle's service brakes must be used to bring the vehicle to a complete stop.

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5/92

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SAFETY PRECAUTIONS

The following symbols in this manual signal potentially dangerous conditions 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

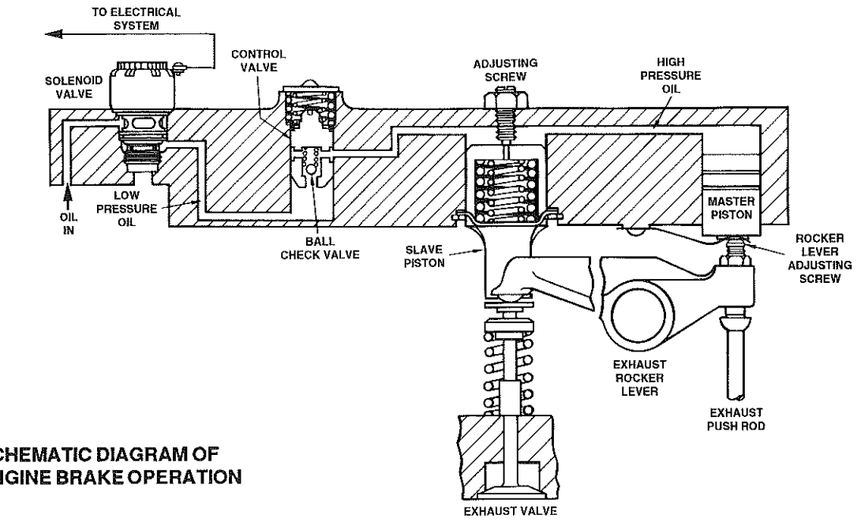
This symbol refers to possible equipment damage.

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 an engine brake. Always wear eye protection. Always use correct tools and proper procedures as outlined in this manual.

SECTION 1
INTRODUCTION



SCHEMATIC DIAGRAM OF ENGINE BRAKE OPERATION

MODEL 122 VOLVO

TABLE 1
MASTER-SLAVE CIRCUIT RELATIONSHIP LISTED IN ENGINE FIRING ORDER

LOCATION OF MASTER PISTON	LOCATION OF SLAVE PISTON
ACTUATES	
NO. 1 PUSHTUBE	NO. 3 EXHUAST VALVE
NO. 5 PUSHTUBE	NO. 6 EXHAUST VALVE
NO. 3 PUSHTUBE	NO. 2 EXHAUST VALVE
NO. 6 PUSHTUBE	NO. 4 EXHAUST VALVE
NO. 2 PUSHTUBE	NO. 1 EXHAUST VALVE
NO. 4 PUSHTUBE	NO. 5 EXHAUST VALVE

THEORY OF OPERATION - Simply stated, energizing the Engine Brake effectively converts a power producing diesel engine into a power absorbing air compressor. This is accomplished, when desired, by motion transfer through a master-slave piston arrangement which opens the cylinder exhaust valve near the top of the normal compression stroke, releasing the compressed cylinder charge to exhaust.

The blowdown of compressed air to atmospheric pressure prevents the return of energy to the engine piston on the expansion stroke, the effect being a net energy loss since the work done in compressing the cylinder charge is not returned during the expansion process.

Exhaust blowdown of the braking cylinder is accomplished by utilizing the pushtube motion of an exhaust valve of another cylinder during its normal exhaust cycle as follows:

1. Energizing the solenoid valve permits engine lube oil to flow, under pressure, through the control valve to both the master piston and the slave piston.
2. Oil pressure causes the master piston to move down, coming to rest on the corresponding exhaust rocker arm adjusting screw. (See Table No. 1 for master-slave operating relationship.
3. The Exhaust rocker pushtube begins upward travel (as in normal exhaust cycle) forcing the master piston upward and creating a high pressure oil flow to the slave piston braking cylinder. The ball check valve in the control valve traps high pressure oil in the master-slave piston circuit.
4. The slave piston under the influence of the high pressure oil flow moves down, momentarily opening the exhaust valve while the engine piston is near its top dead center position, releasing compressed cylinder air to the exhaust manifold.
5. Compressed air escapes to atomsphere, completeing a compression braking cycle.

METHOD OF DRIVING VEHICLE EQUIPPED WITH A *JACOBS* ENGINE BRAKE

It is easy to learn the proper method of driving a vehicle that's equipped with a *Jacobs* Engine Brake. Since the engine brake is most effective at higher engine speeds, gear selection is very important. Gearing down the vehicle within the limits of recommeded engine speed makes the engine brake a more effective retarder. Maximum retarding occurs with the selection of the lowest gear that prevents exceeding the maximum allowable engine speed.

The Engine Brake kits contain a progressive switch that provides three- or six-cyliner operation for greater flexibility in selecting the amount of retarding needed for various road conditions.

For more information on driving with the *Jake* Brake, consult your owners' Driver's Manual. To get a detailed presentation on driving with the *Jacobs* Engine Brake, consult your *Jacobs* Distributor.

SECTION 1
INTRODUCTION (CONTINUED)

Torque Specifications

Part Name	Torque
Stud Nut	30 lbft. (40 N•m)
Bulkhead Adaptor	14 lbft. (19 N•m)
Electrical Connector	10 lbft. (14 N•m)
Spacer Capscrews	14 lbft. (19 N•m)
Brake Hold-down Nuts	30 lbft. (40 N•m)
Brake Positioning Screws	5 lbin. (0.6 N•m)
Brake Positioning Screw Nuts	25 lbft. (35 N•m)
Banjo-fitting Screws	14 lbft. (19 N•m)
Hose Nut	14 lbft. (19 N•m)
Cover Bolt	14 lbft. (19 N•m)

Special Tools Needed

Feeler gauge - 0.059 in. (1.50 mm)
3/16 Hex wrench
Volvo Maintenance Manual

Slave Piston Lash Adjustment

Volvo 12 Liter Engines	Engine Brake Model	Slave Piston Lash Adjustment
TD 120, TD 121, TD 122	122	0.060 in. (1.50 mm)

SECTION 2
ENGINE PREPARATION

NOTE:
No. 1 master piston feeds No. 3 slave piston in front brake assembly. No. 6 master piston feeds No. 4 slave piston in rear brake assembly.

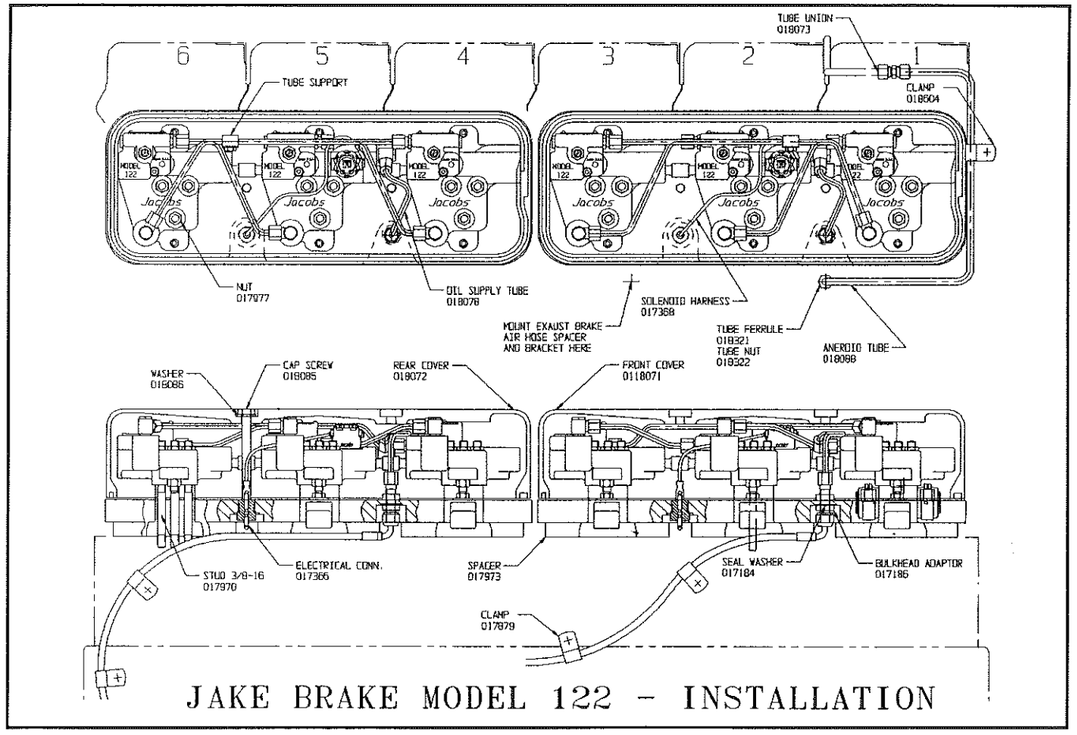


Fig. 1

1. Remove engine front lifting bracket and air filter. Bend free end of air filter support bracket 90 degrees toward rear of engine. Remount air filter and modified braket with first intake manifold screw.
2. Using a tube cutter, cut fuel pump aneroid tube at horizontal section above the cylinder heads between heads No. 1 and No. 2, leaving about 3 in. (76 mm) on the horizontal. Discard end connected to air intake manifold. Bend free end 90 degrees toward front of engine. See Fig. 1.
3. Disconnect exhaust brake air hose and tube at support bracket on intake manifold.
4. Remove six Volvo valve covers, saving capscrews. Discard the washers and gaskets. Remove oil fill cap and install on front *Jacobs* cover.
5. Loosen all rocker adjusting screw nuts and back off screws until loose.

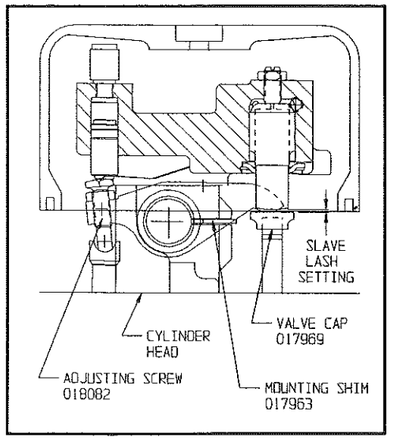


Fig. 2

6. Remove pedestal capscrews and discard. Take pedestals from the engine and place in order, by cylinder, on a workbench.
7. Remove exhaust rocker adjusting screw nuts and replace with *Jacobs* adjusting screws. Reuse Volvo nuts.
8. Replace six exhaust valve caps with *Jacobs* valve caps (Fig. 2).

Spacer Installation

1. Install bulkhead adaptor and seal into each spacer from the bottom; leave loose.
2. Install electrical connector into each spacer from the bottom; torque to 10 lbft. (14 N•m).
3. Install three new gaskets into each spacer.
4. Mount spacers onto engine. Use Volvo cover capscrews and *Jacobs* washers; torque to 14 lbft. (19 N•m). Make sure spacer is centered over heads and that there is no interference with valve springs.

Pedestal Installation

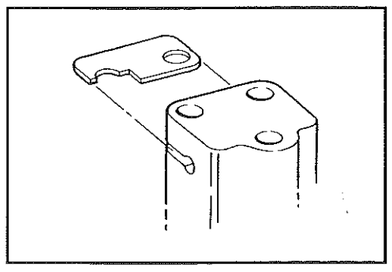


Fig. 3

1. Clean dirt and oil from the pedestal mounting holes in heads.
2. Place each pedestal onto its original cylinder head position.
3. Install a mounting shim into slot in each pedestal. See Fig. 3. One end of shim is notched to clear the dowel pin in the rocker shaft. Visually locate dowel pin in slot before installation. Make sure that shims do not touch the intake or exhaust rocker levers.
4. Install studs with short threaded end down; hand tighten.
5. Center each rocker shaft in pedestal. Check that each rocker lever can move freely.
6. Install nut onto the stud on *unslotted* side of pedestal only.

SECTION 3
BRAKE INSTALLATION

CAUTION

When installing or removing this engine brake, all tube nuts must be tight. Loosen only just before tightening hold-down nuts. (See Section 3 Brake Installation.) Engine brake damage can result.

Torque 30 lbft. (40 N•m).

1. Loosen slave piston adjusting screws (safety screw assemblies.).
2. Refer to Fig. 1 and place brake assemblies over studs. Make sure that *Jake Brake* slave pistons center on the valve caps.
3. Loosen all tube fitting nuts on brake assemblies.
4. Install hold-down nuts. Torque to 30 lbft. (40 N•m).
5. Loosen nuts on anti-rocking set screws. Set anti-rocking set screws to touch heads of spacer capscrews. Use 3/16 (5 mm) hex wrench and torque to 5 lbin. (0.6 N•m). Torque nut to 25 lbft. (34 N•m).
6. Attach inlet oil supply tube from each spacer to supply housing (Fig. 1). Tighten banjo-fitting screws into supply housings. Torque to 14 lbft. (19 N•m). Tighten tube nuts 1/6 turn past hand tight (1 hex flat). Move high pressure tubes as required to make connection.
7. Retighten all tube nuts 1/6 turn past hand tight (1 hex flat).
8. Connect solenoid wires from each solenoid to terminal in the spacer.

Intake/Exhaust Valve and Slave Piston Adjustment

NOTE:
As necessary, rotate engine crankshaft to position where exhaust valve is closed before making these settings.

1. Set intake valve lash and exhaust valve lash per Volvo specification. Torque adjusting screw nuts to 30 lbft. (40 N•m).
2. After exhaust valve adjustment, the slave piston adjustment can be made. With the exhaust valves in the closed position (rocker arm loose), set slave piston lash using a 0.059 in. (1.50 mm) feeler gauge. Torque locknuts to 18.5 lbft. (25 N•m).

Oil Supply Installation

1. Remove existing adaptors and connecting hardware from accessible oil gallery port(s) on engine. Install suitable *Jacobs* adaptors. Reattach Volvo connecting hardware.
2. Connect one oil supply hose (elbow end) to the bulkhead adaptor on each spacer. Then torque the bulkhead adaptors to 14 lbft. (19 N•m).
3. Connect one hose to gallery from bulkhead adaptor on front spacer. Torque each hose nut to 14 lbft. (19 N•m).
4. Connect one hose to gallery from bulkhead adaptor on rear spacer. Torque each hose nut to 14 lbft. (19 N•m).
5. Install clamps on hoses (Fig. 1) or as required.

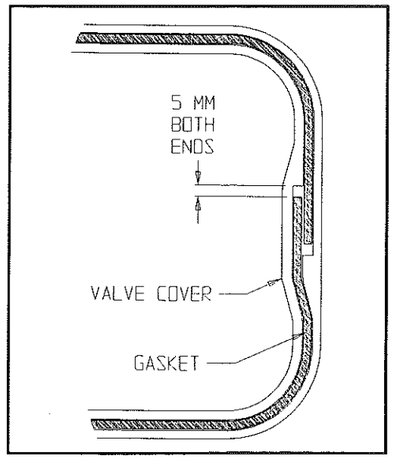


Fig. 4

Installation of Covers

1. Install new *Jacobs* valve cover gasket into the groove in each cover. Overlap the gasket about 1.0 in. (25.4 mm) and cut to appropriate length. Be sure there is a gap at each end of gasket. See Fig. 4.
2. Place covers over brake assemblies. Install bolts and washers. Torque to 14 lbft. (19 N•m).

Aneroid Tube Installation

Connect aneroid tube extension from intake manifold to cut-off end of the original Volvo aneroid tube. Use the tube union to connect the free ends. Cut *Jacobs* aneroid tube to length, as required. Connect to the intake manifold using the loose ferrule and tube nut. Tighten as follows:

1. Oil the ferrule, cone and threads.
2. Place nut and ferrule onto tube.
3. With the end of the tube firmly seated in the mating coupling body, tighten the nut 1 3/4 turns past hand tight. For reuse, tighten 1/6 turn (1 hex flat).
4. Refer to Fig. 1. Install clamp on tube.

On engines without intercooler, install air intake spacer between intake manifold and turbocharger to raise cross-over pipe.

Remove exhaust brake air hose bracket from mount on intake manifold. Reinstall with *Jacobs* spacer tube, washer and capscrew. Reconnect exhaust brake air hose and tube.

SECTION 4
ELECTRICAL SYSTEM INSTALLATION

⚠CAUTION

Before performing any work, disconnect positive battery lead and insulate. Failure to follow this precaution could lead to equipment damage.

Dash Switch

Install the dash switch in a convenient location in the cab. Use available switch mount location (Fig. 5). Bend tabs on dash mounting plate as required. Carefully measure and cut all harnesses to proper length. Install receptacles and connect at locations shown in wiring diagram (Fig. 8).

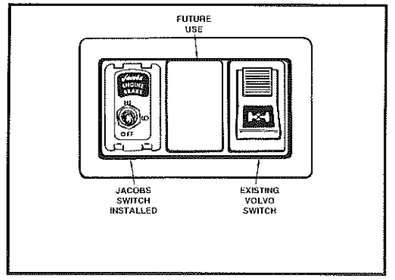


Fig. 5

⚠CAUTION

Exceeding 1.5 in. deflection of the acutator arm may cause switch damage resulting in engine brake malfunction.

Clutch Switch

1. Mount the clutch switch in the most convenient or accessible location possible. Locations may include: in cab under dash, under floor wheel well or in area of the bell housing.
2. Install switch with the switch actuator arm in contact with the clutch pedal arm or other clutch member.
3. Adjust the switch by moving the switch along the mounting bracket. The actuator arm should be deflected 1.0 - 1.5 in. (25-38 mm), measured at the tip of the actuator, when the clutch pedal is in the up (clutch engaged) position.
4. Check installation by moving the clutch pedal. The switch should click in the freeplay motion of the clutch pedal before actual clutch disengagement take place.
5. Cut wires to proper length and secure them with ties. Connect the wires as shown in the wiring diagram (Fig. 8).

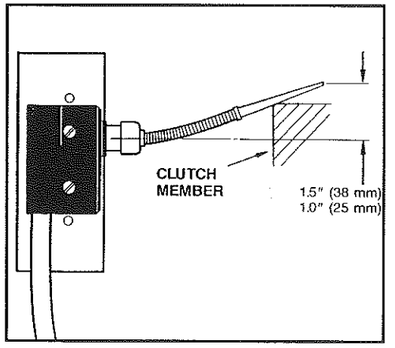


Fig. 6

Low Engine Speed Retarder Cut-Off System

The low engine speed retarder cut-off system is a fully automatic engine brake control system that senses engine speed (RPM) and electrically deactivates the engine brake at speeds below approximately 900 RPM. The low speed cut-off feature ensures fueling will not take place while braking at low engine speeds. It provides added driver convenience in frequent stop/start operations and is useful for operations where several drivers may operate one vehicle.

The kit consists of a low speed retarder cut-off module (Fig. 7), relay and wiring harnesses. The module can be mounted in the engine compartment on the firewall or other convenient location. Installation instructions, P/N 18391, are included in the kit and on page 8 of this manual.

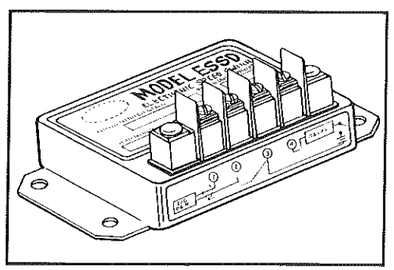
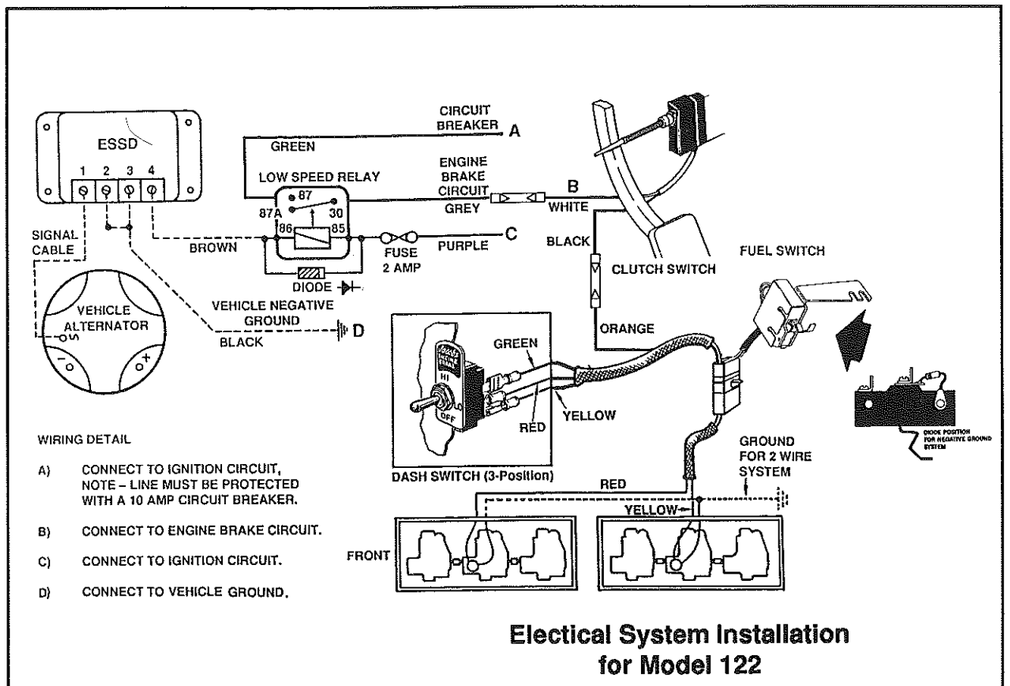


Fig. 7



Electical System Installation for Model 122

Fig. 8

NOTE:
Single lead wire systems require a diode on the fuel switch for switch protection. See Fig. 8. There is no diode required for two wire systems.

⚠CAUTION

DO NOT connect battery voltage directly to the ESSD or it will be destroyed.

Low Speed Switch Instructions

1. Mount the ESSD and Relay Block Assembly inside the vehicle cab with the main vehicle electrical connections.
2. Connect the BROWN wire from the Relay Block to Number "4" terminal on the ESSD.
3. Connect the GREY wire from the Relay Block to the main feed of the engine brake circuit.
4. Connect the GREEN wire from the Relay Block to the vehicle's positive ignition feed via a circuit breaker or fuse (10 Amp).
5. Connect the PURPLE wire from the Relay Block to the vehicle's positive ignition feed.
6. Connect one end of the BLACK wire to terminals Number "2" and "3" on the ESSD; connect the other end to a negative vehicle ground.
7. Connect one end of the Signal Cable to Number "1" terminal on the ESSD; connect the other end to the signal source (vehicle alternator AC output).
8. Check that all connections are secure.

Fuel Switch

Refer to wiring diagram on page 10 and (Fig. 9).

1. Mount fuel switch and bracket assembly to idle stop linkage at end of throttle arm from the cab. Loosen the two screws holding the vehicle idle stop bracket and slide *Jacobs* bracket into place. Tighten the bracket screws.
2. Check engine idle speed. Adjust, if necessary, per Volvo specifications.
3. Loosen the two mounting screws on the fuel switch. Position the switch actuator arm to touch the throttle lever by moving the switch along the mounting bracket. Carefully bend the actuator arm on the switch to make a final adjustment, if necessary. Move the switch into the throttle lever until a *click* is heard. Then move the switch in an additional 0.125 in. (3 mm). Tighten the switch mounting screws.

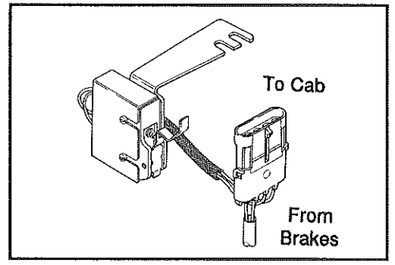


Fig. 9

SECTION 5
OPERATION CHECK

Check Solenoid - With engine shut down and the electrical system turned on (key switch on and clutch engaged), turn the engine brake dash switch on. The solenoid valve armatures (discs) should move down.

Bleed Brake Assemblies and Check Operation - Start engine and allow to run 5 to 10 minutes. With the engine brake switch off, accelerate engine to approximately 1800 RPM. Release throttle and electrically activate or manually depress each solenoid valve disc. Repeat this procedure five or six times to permit engine oil to fill the brake housings.

Engine oil pressure must be at least 20 psi to operate the engine brake. See Chart in Maintenance/Specifications Section.

Check Low Speed Control - With brake switched off, increase engine RPM slowly and verify that the low speed relay activates at approximately 900 RPM.

Failure to Activate - If a solenoid valve fails to activate or any of the master pistons or slave pistons do not move when solenoid valves are activated, shut down the engine and check:

1. Solenoid Valve - If a solenoid valve does not activate, use a volt/amp/ohm meter to check the voltage to the solenoid valve. Refer to the solenoid valve specifications chart in Maintenance/ Specifications Section.

   • If there is not proper voltage to the solenoid valves, check all wiring and connections. Repair as required.

   • If there is proper voltage to the solenoid valve and it does not activate, disconnect the wire to the solenoid valve. Check the ground strap on the side of the solenoid valve. If it is broken or loose, replace the solenoid valve.

   • If the solenoid valve does not meet specifications, replace it. Check the solenoid valve specifications chart in Maintenance/ Specifications Section.

2. If any of the pistons fail to activate, check master piston, control valve and slave piston according to the Maintenance/Specifications Section.

SECTION 6
ENGINE BRAKE MAINTENANCE/SPECIFICATIONS

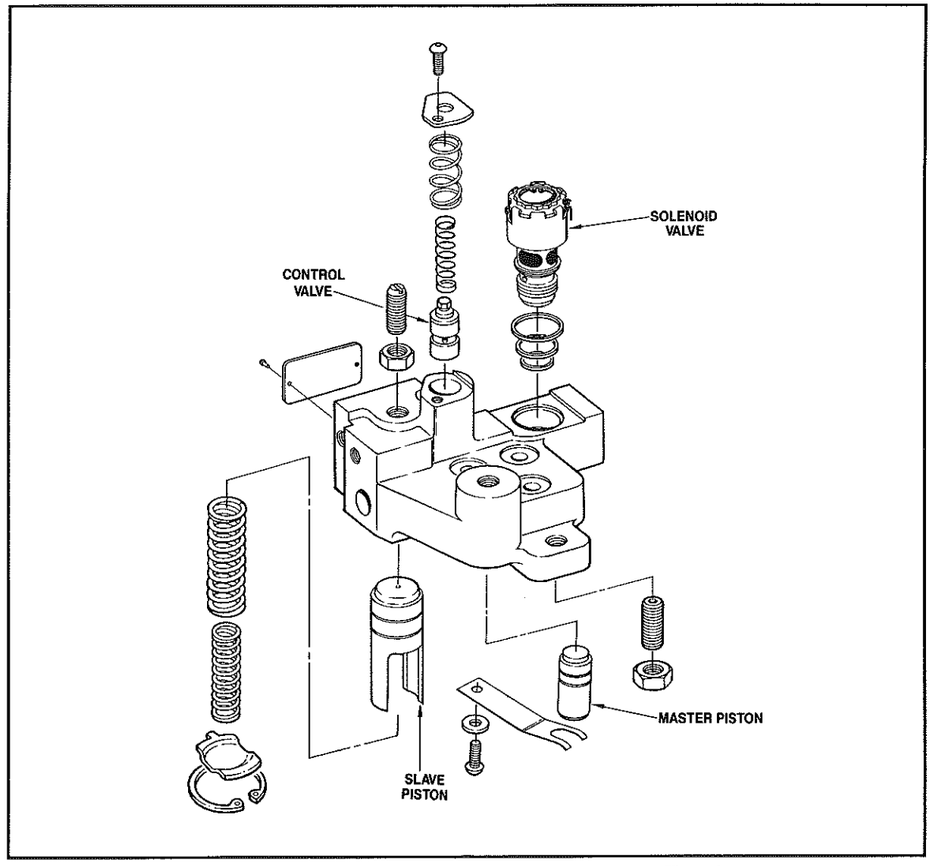


Fig. 10

The *Jacobs* Engine Brake is typically trouble-free. However, periodic inspections are recommended and some maintenance may be required. *Jacobs* recommends the following maintenance at the time of engine overhaul.

This section covers how to properly remove, clean and reinstall engine brake components. Use cleaning solvent to clean parts. Be sure to coat parts with clean engine oil when reinstalling them.

Brake assemblies must be removed from the engine to perform maintenance operations for the slave piston and master piston.

⚠WARNING

Never remove any engine brake component with engine running. Personal injury may result.

⚠CAUTION

When installing or removing this engine brake, all tube nuts must be tight. Loosen only just before tightening hold-down nuts. See Section 3 Brake Installation. Engine brake damage can result.

Control Valve

WARNING

Remove control valve covers carefully. Control valve covers are under load from the control valve springs. Remove with care to avoid personal injury.

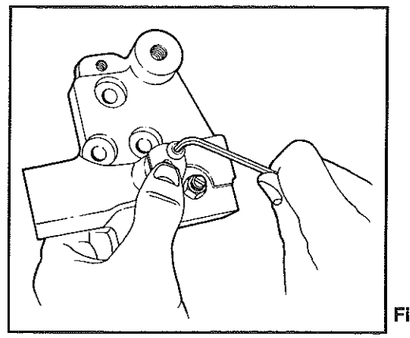


Fig. 11

1. Press down on control valve cover to relieve spring pressure and remove screw. See Fig. 11.
2. Slowly remove the cover until spring pressure is relieved.
3. Remove the two springs and use needle-nose pliers to remove the control valve (Fig. 10).
4. Wash the control valves with cleaning solvent and inspect as follows:

   Push a wire through the hole in the base of the control valve to ensure that the check ball is free. The ball should lift with light pressure on the wire. If the ball is stuck or there is no spring pressure, replace the control valve with a new one.
5. Thoroughly clean the control valve bore in the housing, using clean paper towels. Dip the control valves in clean lube oil and replace the valve into its bore. If there is any binding, replace the control valve with a new one.
6. Reinstall the springs, cover and screw. Torque the screw to 9 lbft. (12 N•m).

Slave Piston

WARNING

Wear safety glasses.

Remove slave piston carefully. The slave piston is retained by springs that are under heavy compression. If these instructions are not followed and proper tools not used, the spring could be discharged with enough force to cause personal injury.

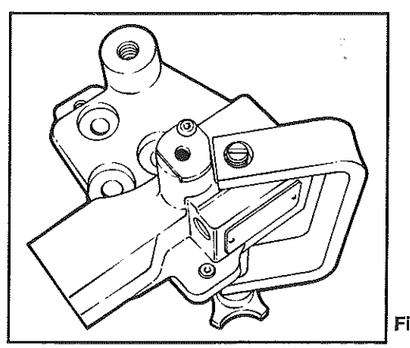


Fig. 12

1. Remove the locknut from the safety screw assembly. Back out the safety screw assembly until the slave piston is fully retracted (screw is loose).
2. Place the hole in the *Jacobs* slave piston tool, P/N 17397, (Fig. 12) over the safety screw assembly.
3. Turn the handle slowly until the retainer is depressed about 1 mm, relieving pressure against the retaining ring.
4. Remove the retaining ring with retaining ring pliers. Back out the holder until the springs are loose. Remove the tool.
5. Remove all components, checking that there is no binding or burrs. Clean in a cleaning solvent or replace as necessary.
6. Check the top surface of the slave piston. If the contact area with the adjusting screw has a depth larger than 0.002 in. (0.05 mm), replace the slave piston and adjusting screw.

   Run a small wire through the hole. Replace the piston if the outside diameter is scratched or scored.

   NOTE:
   Be sure components are reassembled in proper order (Fig. 10).
7. Use clamp fixture to reinstall piston and springs. Be sure retaining ring is placed on the retainer before screwing the clamp holder down over the slave piston.
8. Compress the slave piston springs until the retainer is about 1 mm below the retaining ring groove. Reinstall the retaining ring. Be sure the retaining ring is fully seated in the groove.
9. Remove the clamp fixture slowly to properly seat retaining ring.
10. Assemble safety screw assembly and nut; do not tighten.

Safety Screw Assembly

CAUTION

Do not disassemble or tamper with the adjusting screw. Engine damage could result.

1. Loosen the safety screw assembly locknut and remove from housing. See Fig. 10.
2. Inspect the screw. The plunger should protrude from the bottom of the screw 0.1765 +/- 0.0085 in. (4.48 +/- 0.22 mm) and should reset itself quickly from a fully depressed condition.
3. Clean with a cleaning solvent before reusing or replace, if necessary. The safety screw assembly is not to be serviced.

NOTE:
Hold spring while loosening screw to prevent spring legs from bending.

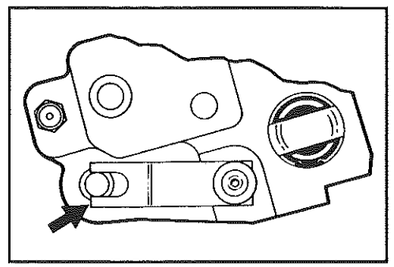


Fig. 13

NOTE:
The tabs should be equally spaced from the raised piston area (Fig. 13).

Master Piston

1. Remove the screw, washer and master piston spring from the bottom of housing.
2. Remove master piston from its bore (Fig. 10) using needle nose pliers. If binding occurs, check for burrs or excessive wear on its outer surface. Inspect the hard face surface. Pitted, chipped, cracked or galled pistons should be replaced.

NOTE:
If hard facing is damaged, inspect the corresponding rocker arm adjusting screws for excessive wear or pitting. Replace, if damaged.

3. Check master piston bore for wear. If damaged, replace the housing.
4. Reassemble in reverse order. When tightening the capscrew, make certain the two spring tabs are centered on and do not interfere with the sides of the master piston center raised portion. Torque the capscrew to 9 lbft. (12 N•m).

⚠CAUTION
Do not disassemble or tamper with the solenoid valve. Engine damage could result.

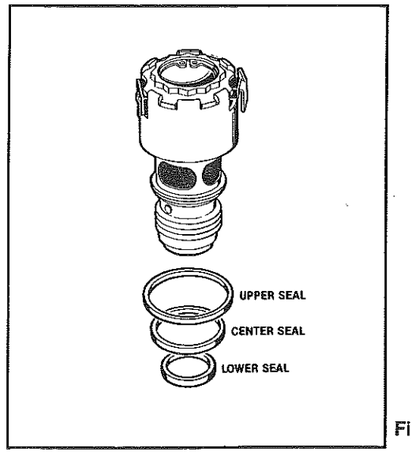


Fig. 14

Solenoid Valve

1. Disconnect wire(s) from the solenoid valves. Using a 7/8 in. (22 mm), 12 point socket and extension, unscrew solenoid valves.
2. Remove and discard the three rubber seal rings from each solenoid valve (Fig. 14). If the lower ring stays in the bottom of the housing solenoid valve bore, remove with a seal pick.
3. Wash out the solenoid valve with approved cleaning solvent. Use a brush to clean the oil screen and rinse in solvent.
4. Clean out the solenoid valve bore in the housing. Use clean paper towels. Never use rags, as they may leave lint and residue which can plug the oil passageways.
5. Using new solenoid valve seal rings, coat them with clean lube oil. Install the upper and center seal ring on the solenoid valve body and the lower seal ring into the bottom of the solenoid valve bore in the housing.
6. Be sure the seal rings are seated properly and carefully screw the solenoid valve into housing without unseating the seals. Torque to 5 lbft. (7 N•m). Be careful not to twist the seals while installing.

Solenoid Valve Specifications

The solenoid valve cannot be overhauled or repaired in the field. If other than a seal ring failures occurs, the solenoid valve must be replaced. The only way to determine a properly operating solenoid valve coil is with a volt/amp/ohm meter. If your readings do not compare with the specifications in Chart 1, the solenoid valve must be replaced.

Chart 1

Resistance Check (Ohms) (must be checked at the solenoid valve)	**24 VDC**	**12 VDC**
Cold 70 deg. F (20 deg. C)	31.5-38.5	9.75-10.75
Hot (80-100 deg. C)	43.3-51.3	11.8-14.3
Current Draw with 24 VDC applied (Amps)		
Cold 70 deg. F (20 deg. C)	0.62-0.69	1.12-1.23
Hot (80-100 deg. C)	0.47-0.55	0.84-1.02
Pull-in Voltage (min.) (Volts DC)		
Cold 70 deg. F (20 deg. C)	17	7.5
Hot 175-212 deg. F (80-100 deg. C)	21	8.5

Oil Pressure Specifications

Proper operation of the engine brake can only occur when the engine oil pressure supplied to the engine brake housing is within the operating range of the control valve/spring combination. See Chart 2. Oil pressure below minimum will cause erratic brake operation. Oil pressure above maximum cause the engine brake to stop functioning entirely.

Chart 2

Control Valve P/N	**Control Valve Springs P/N**	**Min. Operating Pressure**	**Maximum Pressure**
11930	11823/10843	20 psi	100 psi

SECTION 7
TROUBLE SHOOTING

Problem	Possible Cause	Correction
Engine fails to start.	1. Solenoid valve "on".	1. Turn electrical current off to engine brakes.
	2. Solenoid valve stuck in "on" position.	2. Replace solenoid valve.
Engine brake will not operate.	1. Blown fuse, open electrical leads.	1. Before replacing fuse (10 amp), look for short circuit in wiring. Replace any broken, brittle or chafed wires. Check solenoid valve terminal for signs of shorting; replace solenoid valve if necessary.
	2. Dash switch, clutch switch, throttle switch out of adjustment or defective.	2. Use a volt/ohm meter to make certain that there is electrical current available at both terminals of each switch. Readjust if needed or replace if voltage will not pass through switch. **WARNING** **Do not touch electrical connection when system is energized.**
	3. Incorrect electrical power source.	3. Power supply must be within specifications shown in solenoid valve specifications, chart 2. Recommended power source is from the key switch "on" position. Check that power is not taken from a source with an additional on-off switch, i.e., light switch.
	4. Low engine oil pressure.	4. Determine oil pressure at *Jake Brake*. See Chart 1 for oil pressure requirements in Maintenance/Specifications Section. If oil pressure is below specification, engine should be repaired in accordance with manufacturer's procedures.
Engine brake activates with switches open (off).	1. Engine brake improperly wired.	1. Check wiring in accordance with engine brake wiring diagrams.
	2. Center seal ring for solenoid	2. Remove solenoid. Replace all seal rings.

Problem	Possible Cause	Correction
Engine brake slow to operate or weak in effect.	1. Lube oil cold and thick.	1. Allow engine to warm before operating brakes.
	2. Improper slave piston adjustment or slave piston binding in bore.	2. Readjust in accordance with *Jacobs* procedures for this brake model. Check that the slave piston responds smoothly to the adjusting screw by loosening jam nut and screwing the screw through its full travel. Make sure slave piston travels full range without binding or sticking. **WARNING** **Remove slave piston carefully when disassembly is necessary. Use slave piston removal tool, if available, or an arbor press or c-clamp. Slave piston springs are under heavy compression.**
	3. Upper or lower solenoid seal ring damaged, allowing oil to exit housing.	3. Remove solenoid valve and replace all seal rings.
	4. Solenoid screen clogged, restricting supply of oil to *Jake Brake*.	4. Remove solenoid valve and clean the screen.
	5. Master piston not moving in bore.	5. Inspect master piston and bore for scoring or burrs. If any present, clean surface with crocus cloth. If binding continues, replace master piston or housing.
	6. Control valves binding in housing bore.	6. Remove control valve. Clean housing and control valve. If binding continues, replace control valve and/or housing as required.
	7. Control valve defective.	7. Remove control valve. Make sure check ball is seating in bore and can be moved off seat. Make sure there is spring pressure against ball. Flush in cleaning solvent. Replace if necessary.
	8. Switch operation sluggish; check: • Dash switch • Clutch switch • Throttle switch	8. Readjust or replace switch. Check throttle or clutch return springs for proper operation.

Problem	Possible Cause	Correction
Engine brake slow to operate or weak in effect. (Cont'd.)	9. Weak solenoid valve.	9. Check solenoid valve using electrical specifications explained in this manual. **⚠WARNING** **Do not touch electrical connection when system is energized.**
	10. Engine brake housing plugs leaking.	10. Check plugs for signs of leaks. If leaks are present, remove plug, clean threads and reinstall.
	11. Outer control valve spring broken.	11. If spring is broken, replace.
	12. Engine oil pressure extremely high. See Chart 1 in Maintenance/Specifications Section.	12. Consult appropriate engine repair manual for causes of high lube oil pressure.
	13. Oil pressure dropping below minimum required for *Jake Brake* operation.	13. See 13a through 13f below.
	13a. Aeration of lubricating oil.	13a. Check for aeration of the oil. Activate then deactivate *Jake Brake*. Watch oil coming from control valve cover. If oil has bubbles or appears foamy, air is present in system. Aeration can be caused by an overfilled or underfilled crankcase, crack in oil pickup tube or leaks in oil suction tube or hose. Correct in accordance with engine manufacturer's procedures.
	13b. Lubricating oil being diluted by fuel oil.	13b. Have an oil analysis of lube oil done to determine if fuel is present. Correct per engine manufacturer's procedures.
	13c. Low engine oil level.	13c. Consult engine manual for specifications. Add oil as required.
	13d. Worn engine rocker lever bushings.	13d. Replace bushings in accordance with engine manufacturer's procedures.
	13e. Restrictions in the oil passages leading to *Jake Brake*.	13e. Inspect all the passageways; remove any items restricting oil flow.

Problem	Possible Cause	Correction
One or more cylinders fail to stop braking or engine stalls. Slow brake turn-off.	1. Control valve inner spring broken.	1. Replace inner spring.
	2. One or more control valves stuck in "on" or up position.	2. Check control valves for binding. Remove and clean or replace if necessary. Inspect lube oil for contaminants.
	3. Solenoid valve sticking in "on" position.	3. If solenoid valve cap remains down with no electric current being supplied, replace solenoid valve.
	4. Solenoid valve exhaust plugged.	4. Remove any restrictions at exhaust (bottom) of solenoid valve.
	5. Clutch switch or throttle switch stuck in "on" position or out of adjustment.	5. Check for proper operation. Readjust or replace as needed.
Engine misses or loses braking power.	1. Slave piston lash (clearance) out of adjustment.	1. Readjust slave piston lash (clearance).
	2. Improper engine valve(s) clearance.	2. Check according to the engine manual.
Sudden drop in engine lube oil pressure.	1. Upper solenoid valve seal ring damaged.	1. Remove solenoid valve and replace all seal rings.
	2. Solenoid loose.	2. Check seal rings and retighten per spec.