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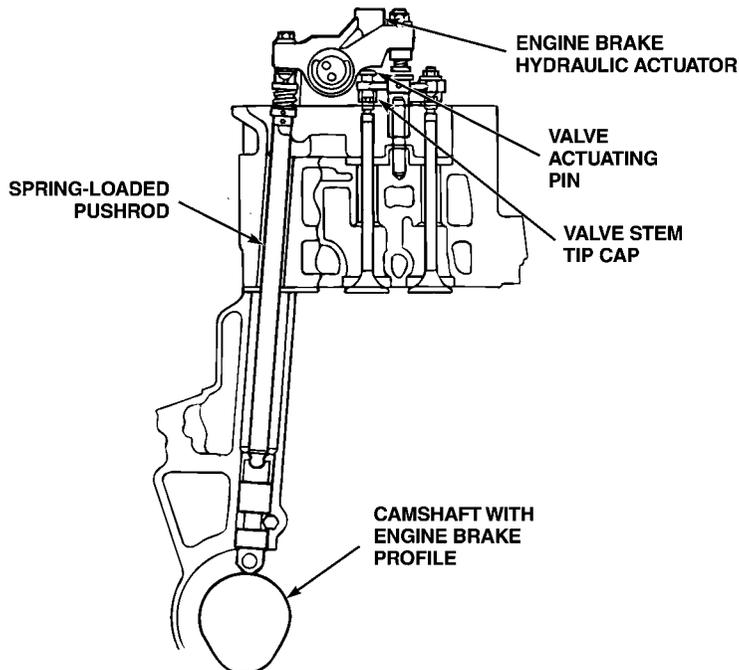
DATE: 5/15/03

**MODEL: E-Tech™,
ASET™**

(Also applies to Mack Trucks Australia)

MACK POWERLEASH™ ENGINE BRAKE

Mack Trucks, Inc. has introduced a new integrated engine brake, designed to deliver higher performance than conventional engine brake technology in a lighter, more reliable package. The new MACK PowerLeash™ engine brake is a compression release-type system that features a hydraulic actuator incorporated into the exhaust rocker arms, and is less sensitive to low or inadequate oil pressure than other engine brakes used on MACK engines. During engine brake operation, the hydraulic actuators fill with oil so that the inboard exhaust valves open as the piston approaches top-dead-center of the compression stroke. This essentially converts the engine into a large air compressor that produces retarding horsepower to aid in slowing the vehicle.



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Figure 1 — MACK Engine Brake Cut-Away View

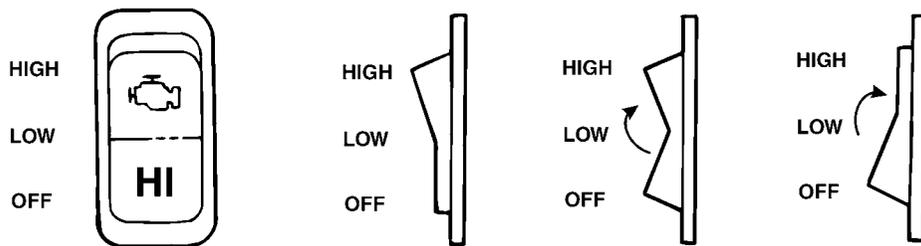
During engine operation, intake air (compressed by the turbocharger) enters the cylinder through the open intake valves. The upward movement of the piston during the compression stroke further compresses the charge of air. The charge of air expands during the power stroke and forces the piston downward.

When the engine brake is activated, however, the inboard exhaust valve is opened just as the piston approaches top-dead-center of the compression stroke, allowing the charge of compressed air to be released and vented into the vehicle exhaust system. The energy of compression is then lost. This loss of energy is what increases the braking effect of the

engine and allows the vehicle to slow down while minimizing the need to use the service brakes to slow the vehicle. The service brakes must always be used to control the vehicle and bring it to a complete stop.

ELECTRICAL CONTROL SYSTEM

Vehicles equipped with a MACK PowerLeash™ engine brake have a switch mounted on the dashboard that allows the operator to turn the system ON and to select the desired amount of retarding power. The dashboard-mounted switch has three positions: OFF (bottom position), LOW (center position) and HIGH (upper position).



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Figure 2 — Dash-Mounted Engine Brake Switch

When the switch is in the LOW position, one-half (three cylinders) of the engine brake retarding capability is applied. In the HIGH position, full retarding power (all six cylinders) is applied.

Engine brake operation is controlled by the V-MAC® system. A constant 12 volts at a low current is supplied to the engine brake solenoids at all times. When the dashboard switch is turned ON and no fuel is requested (0% throttle), the engine electronic control unit (EECU) increases the current to the engine brake solenoids, causing the solenoid coils to energize.

A clutch switch provides a signal to the V-MAC® system to de-energize the engine brake solenoid when the clutch pedal is depressed.

CAUTION

Engine stalling and potential engine damage can occur if the engine brake is operated at cold engine oil temperatures. The V-MAC® III engine control system on vehicles equipped with either the PowerLeash™ or J-Tech™ engine brake, includes a feature that prevents the engine brake from being activated until the engine coolant temperature reaches at least 125°F (52°C). The engine brake will not function until sufficient engine warm-up time has elapsed, regardless of the dashboard engine brake switch setting.

MECHANICAL SYSTEM

The MACK PowerLeash™ engine brake is integrated into the valve train. During normal operation, the exhaust valves open during the exhaust stroke only. During an engine braking event, however, the inboard exhaust valve opens at the top of the compression stroke to provide engine braking. To accomplish this, hydraulic actuators are incorporated into the exhaust rocker arms, and a special “engine brake” profile is incorporated into the exhaust lobes of the camshaft.

The engine brake hydraulic actuator is controlled by engine oil pressure. Oil under pressure is supplied to the actuator through the “control” gallery in the rocker shaft, and the flow of oil is controlled by the engine brake solenoid located on top of the shaft. A second gallery in the rocker shaft, the “constant” oil supply gallery, supplies a constant flow of oil to the inlet and exhaust rocker arms for lubrication.

When the engine brake is activated (dashboard control switch in either the “low” or “high” positions, a no fuel [0% throttle] condition and the clutch pedal released), the engine brake solenoid energizes and directs the flow of “control” oil to the hydraulic actuators. When oil enters the actuator upper cavity, the actuator hydraulically locks with the plunger extended to take up the lash from the valve train. As cam rotation continues and the lifter roller reaches the transition point from sub-base to base circle, the upward movement of the pushrod opens the inboard exhaust valve because the lash has been removed from the valve train due to the hydraulically locked actuator plunger, thus producing the braking event.

MACK PowerLeash™ Engine Brake Components

The MACK PowerLeash™ engine brake consists of the following components:

- **Camshaft** — The engine brake camshaft (part No. 454GC5234A for E-Tech™ CCRS, 454GC5244 for ASET™ AC engines, and 454GC5238 for ASET™ AI and AMI engines) has a 0.125” engine brake lift profile (dimension from sub-base to base circle) on the exhaust lobes, whereas J-Tech™ engine brake camshafts have a 0.100” brake lift.

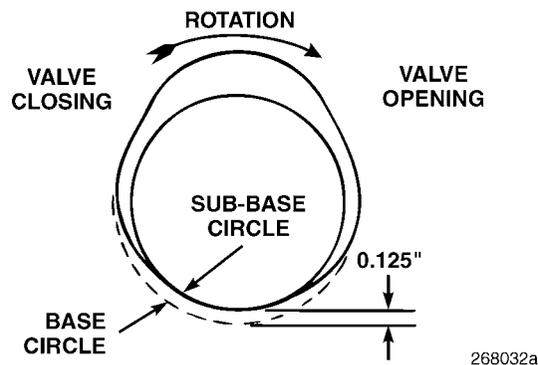
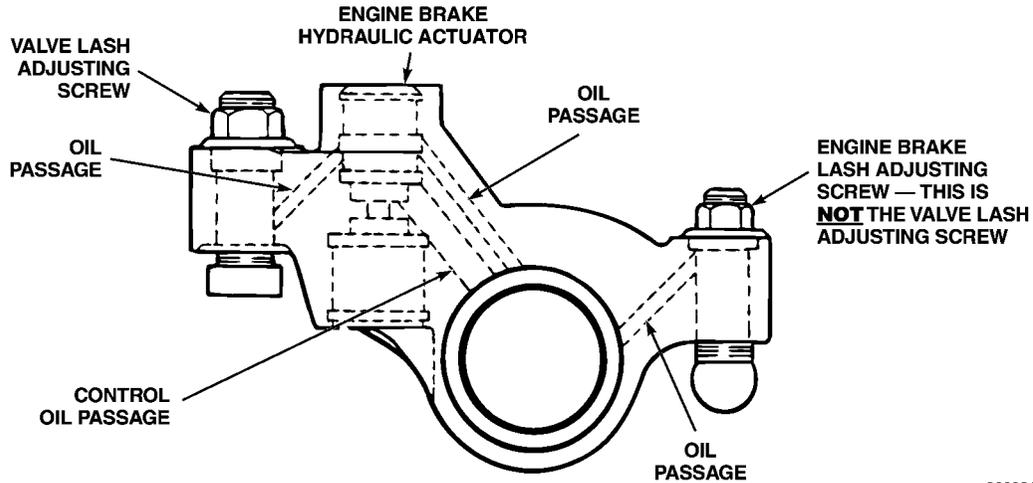


Figure 3 — MACK Engine Brake Exhaust Lobe Profile

- Exhaust Rocker Arm/Hydraulic Actuator** — The exhaust rocker arm (part No. 44GB486M) incorporates a hydraulic actuator that fills with oil and hydraulically locks to remove the clearance between the actuator plunger and the inboard exhaust valve. With clearance between the actuator and the actuating pin removed, the slight movement of the pushrod created when the camshaft rotates to the area of transition from sub-base to base circle, pushes the rocker arm and opens the inboard exhaust valve before piston reaches top-dead-center of the compression stroke.



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Figure 4 — MACK Engine Brake Exhaust Rocker Arm with Hydraulic Actuator

NOTE

The exhaust rocker arm has two adjusting screws. The adjusting screw located at the pushrod end of the rocker arm adjusts engine brake plunger lash. The adjusting screw located at the valve end of the rocker arm adjusts exhaust valve lash.

The hydraulic actuator consists of the following:

- a plunger and spring located in the lower chamber
- a ball check valve located on top of the plunger and spring assembly
- a control piston and spring located in the upper chamber

A constant supply of oil is fed to the actuator to fully lubricate all components. Spring tension holds the control piston down to unseat the check valve ball. With the check valve ball unseated, oil flows freely into and out of the plunger chamber. When the engine brake solenoid is not energized, the plunger assembly can move up and down freely inside the actuator bore, but spring tension keeps the plunger seated against the lower snap ring. This free movement of the plunger provides the necessary clearance between the bottom face of the plunger and the exhaust valve actuating pin during normal engine operation.

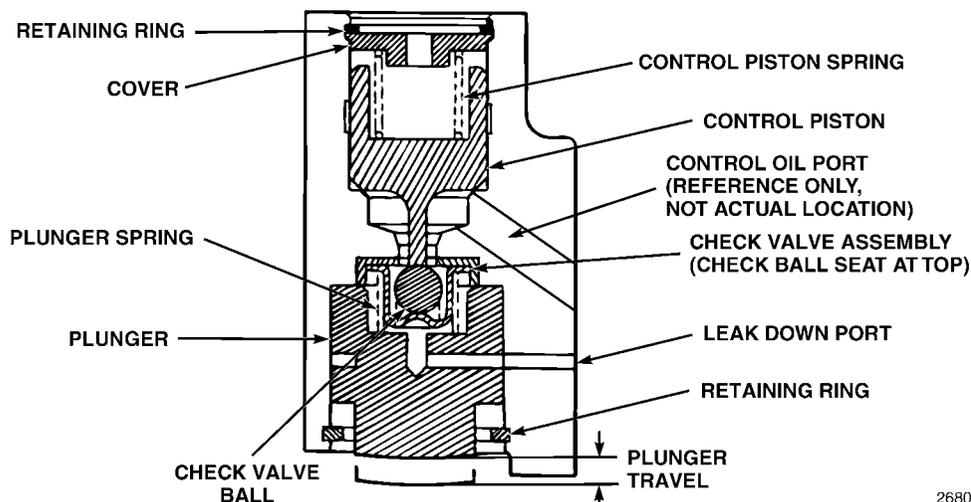


Figure 5 — Hydraulic Actuator Cut-Away View (Viewed from the Rear of the Rocker Arm)

When the engine brake solenoid energizes, oil flows into the rocker shaft “control” gallery, then from there into the actuator control piston cavity inside the rocker arm. The flow of oil moves the control piston upward off its seat and simultaneously fills the lower plunger cavity with oil. With the control piston off its seat, the check valve ball also moves upward. As the rocker arm begins to rotate and force the inboard exhaust valve open, oil pressure in the plunger cavity increases, forcing the check valve ball to seat and hydraulically lock the plunger in the extended position. With the plunger extended, lash between the plunger and the inboard exhaust valve is reduced. Continued rotation of the exhaust rocker arm opens the inboard exhaust valve, thus producing the braking event.

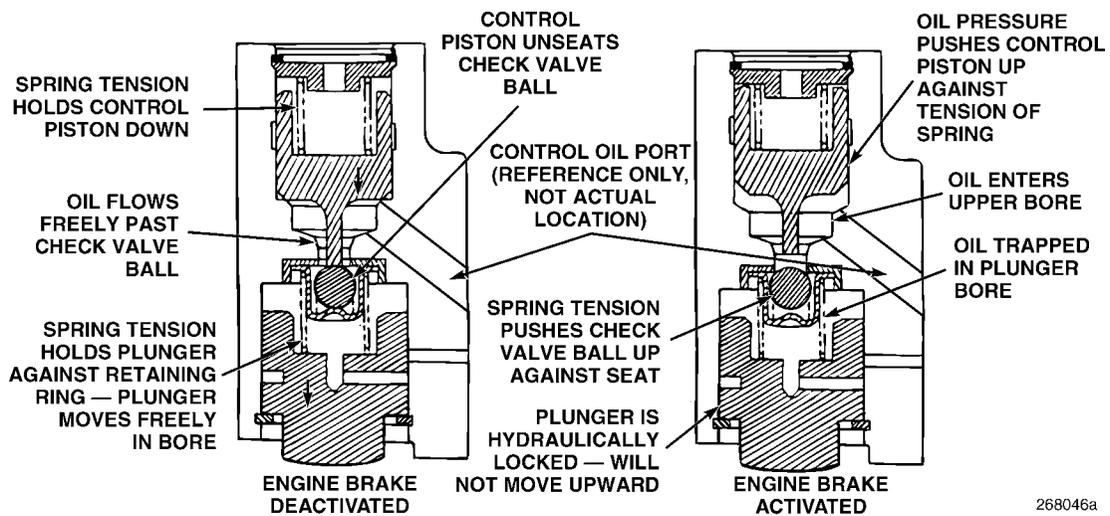


Figure 6 — Hydraulic Actuator Operation (Viewed from the Rear of the Rocker Arm)

When the engine brake solenoid is de-energized, the flow of oil to the actuator upper cavity is removed. Spring tension then pushes the control piston back down and unseats the check valve ball. With the check valve ball unseated, oil can again flow freely in and out of the plunger chamber.

- Rocker Shaft** — The rocker shaft (part No. 466GC495 or 466GC4106M) includes two oil galleries and a port for the solenoid. The upper gallery supplies “control” oil to the exhaust rocker arms, and the lower gallery provides a constant supply of oil to all the rocker arms. When the engine brake solenoid energizes, oil flows from the “constant supply” gallery to the “control” gallery, and in turn, control oil is then supplied to the hydraulic actuator upper (control piston) cavity

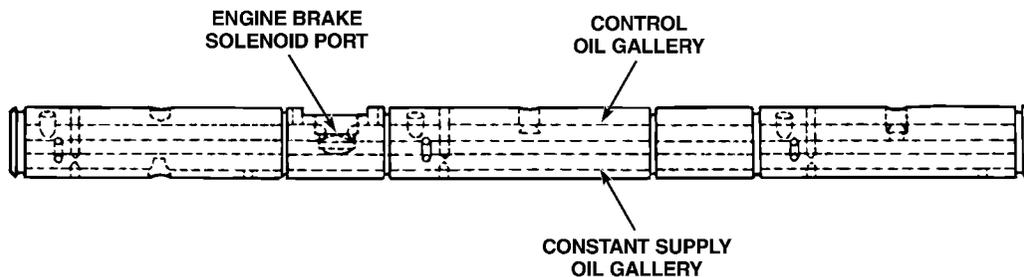
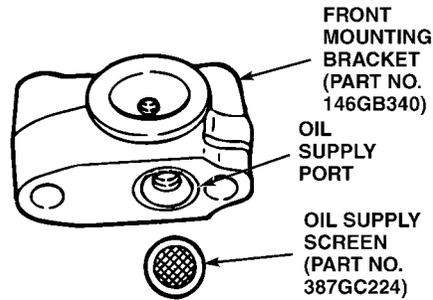


Figure 7 — Rocker Shaft

Oil is supplied to the rocker shaft through an oil supply passage in the front rocker shaft mounting bracket (part No. 146GB340). This mounting bracket is “press-fit” on the rocker shaft, whereas the middle and rear mounting brackets (146GB341) are a new “slip-fit.” An oil supply screen (part No. 387GC224) is located in the counterbore of the oil passage at the bottom of the rocker shaft mounting bracket.

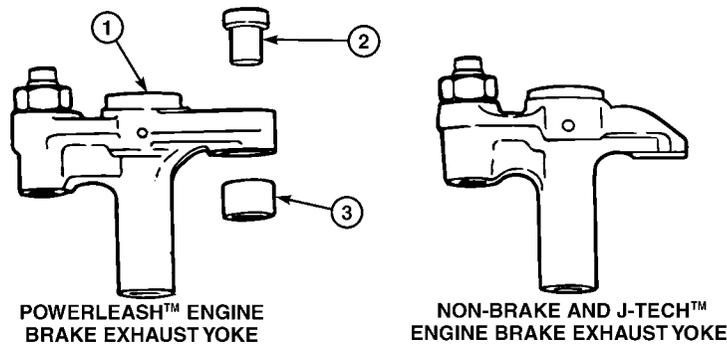


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Figure 8 — Front Rocker Shaft Mounting Bracket with Oil Supply Screen

This screen is a relatively fine (100 x 100 mesh) stainless steel screen with a nominal rating of 40 microns. The purpose of this screen is to protect the engine brake hydraulic actuator against any initial debris that may be circulating with the oil at initial start-up following an engine rebuild, etc. Servicing this screen at any regular service interval is not required. The screen should be cleaned after any type of engine failure that has contaminated the lubrication system, if the rocker shafts have been removed for any reason or after a major engine overhaul. Additionally, the screen should be inspected and cleaned if troubleshooting procedures for engine brake operation indicate a drop in oil pressure at the rocker shafts.

- **Exhaust Valve Yoke** — The inboard side of the exhaust yokes (part No. 891GC224M) contains a hole for the exhaust valve actuating pin. The actuating pin rests on a cap that is installed over the tip of the valve stem on the inboard exhaust valve.

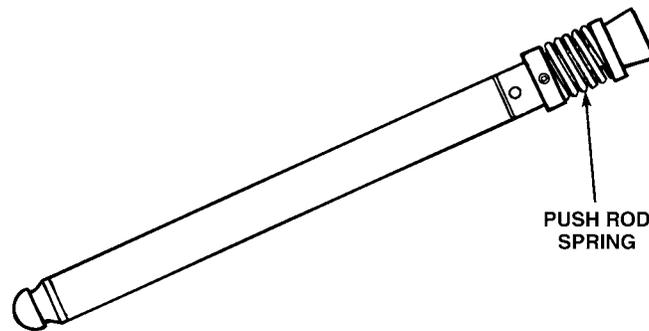


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Figure 9 — Exhaust Yoke, Actuating Pin and Valve Stem Cap

Key	Qty.	Part No.	Description
1	6	891GC224M	Valve yoke, exhaust
2	6	714GB231	Actuating pin
3	6	232GB30	Cap, inboard exhaust valve stem tip

- Spring-Loaded Pushrods** — To prevent excessive valve “clatter” created by the increased exhaust valve lash, and also to keep the lifter roller in contact with the cam lobe, spring-loaded pushrods (part No. 369GC339) are used. These pushrod assemblies contain a spring on the rocker arm end. The spring allows the pushrod to “expand” during the “valve closed” (or cam sub-base circle) cycle, thus eliminating excessive lash in the valve train and keeping the lifter roller in contact with the cam lobe. During the “valve opening” cycle, the spring compresses as the lifter roller travels up the ramp of the cam lobe. The pushrod becomes a “solid assembly” when the internal stops of the upper and lower pushrod seats contact each other. When the pushrod is “solid,” the upward force of the valve lifter is transmitted to the rocker arm.



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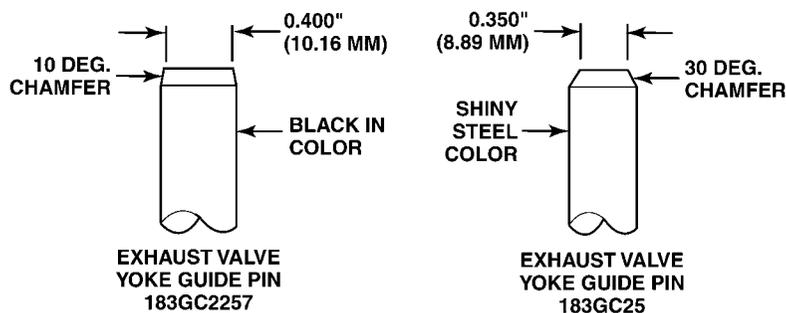
Figure 10 — Spring-Loaded Pushrod Assembly

- Cylinder Heads, Valve Guides and Valve Yoke Guide Pins** — There are different cylinder head part numbers for E-Tech™ CCRS, ASET™ AC, AI and AMI engines equipped with the MACK PowerLeash™ engine brake. The correct part number cylinder head must be used for the engine type.

Effective 3/20/03, cylinder heads used on ASET™ engines equipped with the MACK PowerLeash™ engine brake utilize a new valve guide (part No. 714GB3113) at the inboard exhaust and inboard inlet valve locations. The new guide looks the same as valve guide part No. 714GB3111, but the new guide is made from an alloy which has greater high temperature wear resistance.

It is mandatory that valve guide part No. 714GB3113 be used at the inboard exhaust locations on ASET™ engines equipped with the MACK PowerLeash™ engine brake. Factory production cylinder heads for MACK PowerLeash™ engines have the 714GB3113 valve guides installed at the inboard inlet valve locations (as well as at the inboard exhaust locations) for the convenience of the factory valve guide installation operation.

In addition, all cylinder heads used with the MACK PowerLeash™ engine brake require the MANDATORY use of part No. 183GC2257 valve yoke guide pins. The 183GC2257 guide pins can be identified by the diameter of the pin ends as shown in the following illustration. Also, 183GC2257 guide pins have a surface heat treatment which makes the entire pin either black or gray in color. The 183GC2257 guide pin can be identified by the black color, compared to the shiny metal surface of the standard guide pin, and by the size of the chamfer at the pin ends. Use of this guide pin will be standardized on all engines during June 2003.

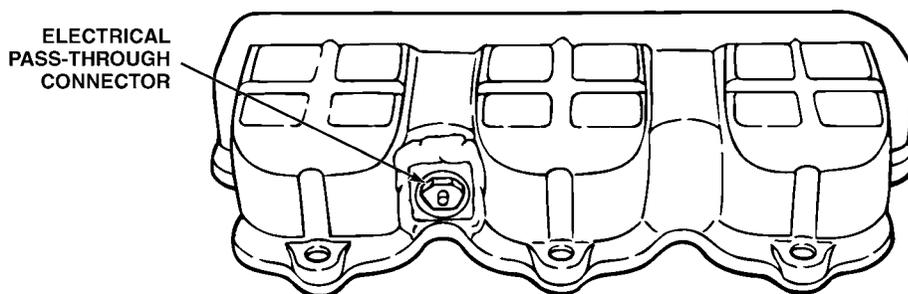


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Figure 11 — Valve Yoke Guide Pins

If a valve yoke guide pin must be replaced on an engine equipped with a MACK PowerLeash™ engine brake, it is MANDATORY that guide pin part No. 183GC2257 be used. If replacement of a cylinder head is necessary on a PowerLeash™ equipped engine manufactured prior to June 2003, special arrangements must be made with the facility supplying the replacement cylinder head (either the Hagerstown manufacturing facility or the Middletown Remanufacturing Center) to have the proper guide pins installed. As an alternative, the guide pins can be ordered separately and installed into the new head by the servicing facility.

- Cylinder Head Cover** — Because the MACK PowerLeash™ engine brake is completely integrated with the valve train, cylinder head cover spacers are not necessary as they are with the J-Tech™ engine brake. The cylinder head cover contains an electrical pass-through connection (part No. 40QE2182) to connect the engine brake solenoid wire to the engine wiring harness.



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Figure 12 — Cylinder Head Cover with Electrical Pass-Through Connection

MACK ENGINE BRAKE ASSEMBLY

The MACK Engine Brake is totally integrated into the valve train. There are no engine brake units or assemblies bolted to the top of the rocker shaft mounting brackets as there were with certain previous engine brakes used by Mack Trucks, Inc. The following information provides assembly instructions for certain components unique to the MACK Engine Brake.

Exhaust Valve Yoke Installation

1. Lubricate the tip of the inboard exhaust valve stem with a small drop of clean engine oil.
2. Install the valve stem cap (part No. 232GB30) on the tip of the inboard exhaust valve stem.

NOTE

The valve stem cap must have a free-fit on the valve stem tip. If there is any binding or tightness, the cap must be replaced. Using a cap that is tight on the valve stem tip will result in brake lash and valve lash mis-adjustment.

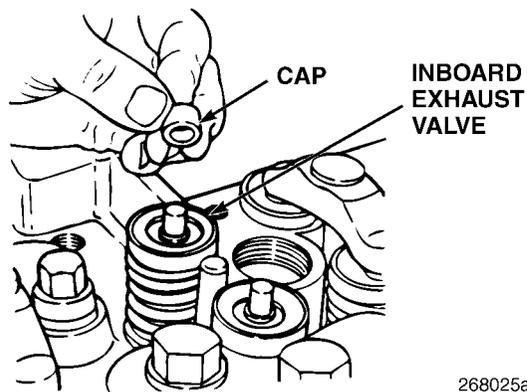
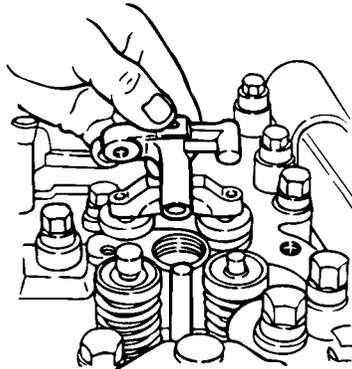


Figure 13 — Installing Valve Stem Cap

3. Lubricate the exhaust valve yoke guide pins with clean engine oil.

- Place the exhaust yoke (part No. 891GC224M) over the guide pin. The adjusting screw end of the yoke goes over the outboard exhaust valve.



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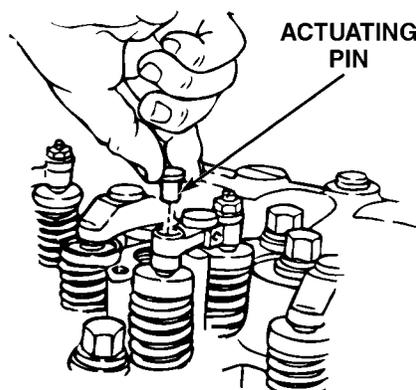
Figure 14 — Installing Exhaust Yoke

- After the exhaust valve yokes have been installed, yoke balance can be adjusted. Refer to the "Valve Adjustment" section of this bulletin.

NOTE

When assembling the cylinder heads, it is easier to adjust exhaust valve yoke balance on all the yokes before the rocker shaft assembly is installed.

- After adjusting exhaust yoke lash, lubricate the brake actuating pins (part No. 714GB231) with clean engine oil and install.

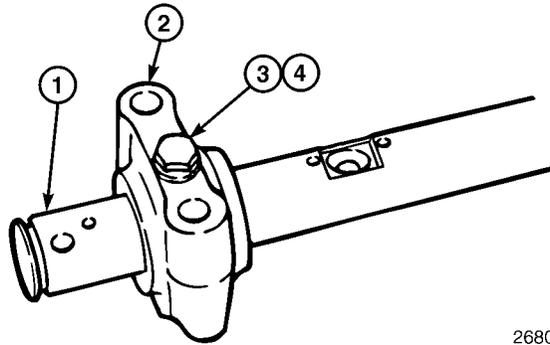


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Figure 15 — Installing Brake Actuating Pin in Exhaust Yoke

Rocker Shaft /Front Mounting Bracket Assembly

The rocker shaft contains oil passages that supply both lubricating oil and control pressure oil to the rocker arms. As with rocker shaft assemblies on non-brake engines, alignment of the oil ports in the front mounting bracket with the ports in the rocker shaft is critical. The first rocker shaft mounting bracket is a press-fit onto the shaft, while the center and rear brackets are a slip-fit. The rocker shaft and front mounting bracket are supplied as an assembly. The assembly (part No. 466GC4111M) consists of the following parts:

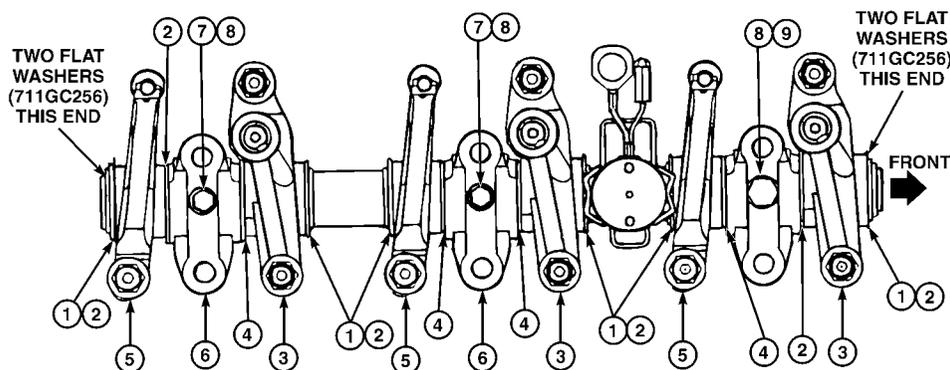


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Figure 16 — Rocker Shaft/Front Mounting Bracket Assembly (Part No. 466GC4111M)

Rocker Shaft/Front Mounting Bracket Assembly (Part No. 466GC4111M)			
Key	Qty.	Part No.	Description
1	1	466GC4106M	Rocker shaft
2	1	146GB340	Mounting bracket, rocker shaft (press-fit)
3	1	421GC244	Bolt, mounting bracket locating
4	1	36AX3	Washer, lock

Rocker Shaft Assembly



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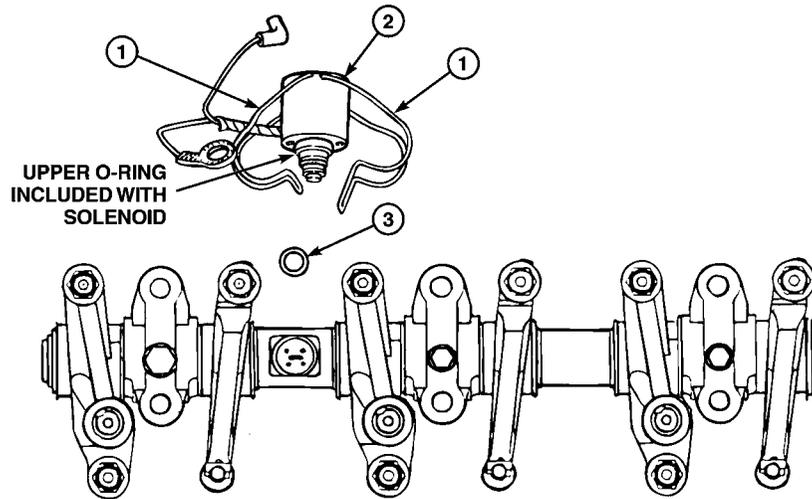
Figure 17 — Rocker Shaft Assembly (Part No. 466GC4107M)

Key	Qty.	Part No.	Description
1	6	97AX292	Retaining ring
2	10	711GC256	Washer, flat
3	3	44GB2225M	Rocker arm, exhaust, with engine brake hydraulic actuator
4	4	579GC148A	Washer, spring
5	3	44GB54M	Rocker arm, inlet
6	2	146GB341	Mounting bracket, rocker shaft, slip-fit
7	2	1AM13	Bolt, mounting bracket locating
8	2	36AX22	Washer, lock

1. Lubricate a flat washer (part No. 711GC256) with clean engine oil, then slide it on the front end of the rocker shaft.
2. Lubricate the bore of the exhaust rocker arm (part No. 44GB2225M) with clean engine oil.
3. Install the exhaust rocker onto the front of the rocker shaft. The pushrod end of the rocker arm faces the large offset side of the rocker shaft mounting bracket.
4. Lubricate two flat washers (part No. 711GC256) with clean engine oil, then slide them on the front end of the rocker shaft. Install a retaining ring (part No. 97AX292) in the groove at the end of the shaft to secure the rocker arm in place.
5. Lubricate a spring washer (part No. 579GC148A) with clean engine oil, then slide it onto the opposite end of the rocker shaft and position it against the mounting bracket.
6. Lubricate the bore of the inlet rocker arm (part No. 44GB54M) with clean engine oil, then install the rocker arm on the rocker shaft. The pushrod end of the inlet rocker arm faces the long offset side of the rocker shaft mounting bracket.
7. Lubricate a flat washer (part No. 711GC256), then slide it on the rocker shaft. Install a circlip (part No. 97AX292) into the groove of the rocker shaft to secure the inlet rocker arm in place.

8. Install a circlip (part No. 97AX292) in the groove of the rocker shaft at the location for the second exhaust rocker arm.
9. Lubricate a flat washer (part No. 711GC256) with clean engine oil, then slide it onto the rocker shaft, against the circlip.
10. Lubricate the bore of the exhaust rocker arm (part No. 44GB2225M) with clean engine oil, then slide it on the rocker shaft, against the flat washer.
11. Lubricate a spring washer (part No. 579GC148A), then slide it over the end of the rocker shaft, against the second exhaust rocker arm.
12. Lubricate the bore of the rocker shaft mounting bracket (part No. 146GB341), then slide it over the end of the rocker shaft, against the wave washer.
13. Align the locating hole in the mounting bracket with the threaded locating hole in the rocker shaft. Lubricate the threads of the locating bolt (part No. 1AM13). Install the locating bolt and lock washer (part No. 36AX22) to the mounting bracket. **Finger-tighten** only at this time.
14. Continue the assembly by installing the remaining washers, rocker arms and mounting bracket. Make sure that the mounting bracket-to-rocker shaft bolt is only finger tight at this time.
15. Complete the assembly by lubricating a flat washer (part No. 711GC256) with clean engine oil and sliding it over the end of the rocker shaft against the rear mounting bracket, then lubricating the bore of the third inlet rocker arm with clean engine oil and installing it over the end of the rocker shaft.
16. Lubricate two flat washers (part No. 711GC256), then slide them on the rocker shaft. Install a circlip (part No. 97AX292) into the groove at the end of the rocker shaft to secure the assembly.

Engine Brake Solenoid Installation



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Figure 18 — Engine Brake Solenoid Installation

Key	Qty.	Part No.	Description
1	1	326GC313	Solenoid spring retainer set
2	1	805GC54	Solenoid assembly, engine brake
3	1	446GC2127	O-ring, lower, engine brake solenoid

NOTE

The solenoid spring retainers (part No. 326GC313) and upper O-ring (part No. 1899-O15900975) are supplied with the solenoid valve assembly.

The engine brake solenoid is secured to the rocker shaft with two clip-on type spring retainers. A new solenoid supplied through the MACK Parts System includes the spring retainers. The retainers are also available separately (part No. 326GC313). Installation of the solenoid is as follows:

1. Place the lower O-ring (part No. 446GC2127) into position, fully seated in the bottom of the solenoid bore in the rocker shaft.

CAUTION

Do not place the lower O-ring on the solenoid adapter and then install the solenoid assembly to the shaft. Doing so will cut the lower O-ring.

2. Lubricate both of the engine brake solenoid O-rings with clean engine oil.

3. Position the solenoid for installation, with the wire leads on the side of the rocker shaft that faces the valves.
4. Insert the solenoid into the rocker shaft port and push downward firmly with the palm of the hand to fully seat the solenoid.

⚠ CAUTION

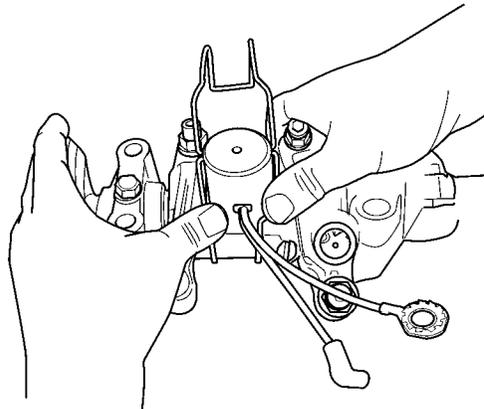
The solenoid must be fully seated by significant hand pressure. The retaining clips will not seat a solenoid that has not already been fully seated.



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Figure 19 — Installing Engine Brake Solenoid

5. Snap both clips around the bottom of the rocker shaft.



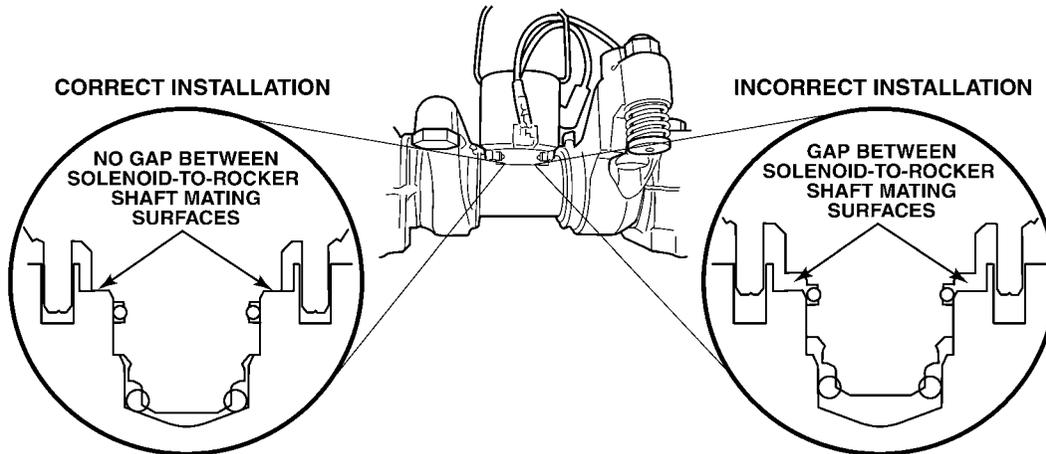
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Figure 20 — Force Solenoid Retaining Clips into Position

CAUTION

Latching and unlatching the solenoid retaining clips requires a great deal of finger pressure to overcome the large amount of spring tension. Care must be used to avoid pinching the fingers or snapping the latches against the fingers.

6. After the retaining clips have been installed, inspect the solenoid-to-rocker shaft mating surfaces. The surfaces of both components must be fully seated against each other.



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Figure 21 — Inspect Solenoid-to-Rocker Shaft Mounting Surfaces

CAUTION

A solenoid that has not been completely seated on the rocker shaft can partially turn the engine brake ON while the engine is under power, resulting in an engine miss and extremely poor engine performance.

Rocker Shaft Assembly to Engine

The rocker shaft assembly is installed on the cylinder head as any rocker shaft would be installed on a MACK engine. Before the shaft assembly is installed, however, make sure the oil supply screen (part No. 387GC224) is positioned in the counterbore at the bottom of the front rocker shaft mounting bracket. If the screen fits loosely in the bore, use some grease to hold the screen in place while the rocker shaft assembly is being installed on the engine.

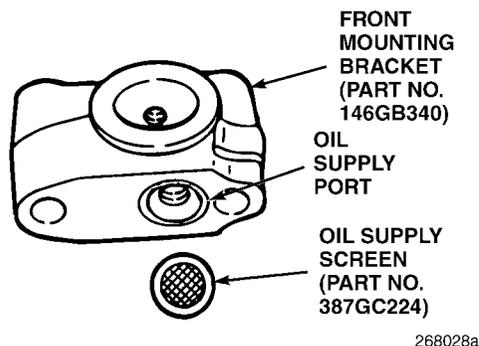


Figure 22 — Oil Supply Screen in Front Mounting Bracket

CAUTION

If the screen should slip out of place during installation of the rocker shaft assembly to the engine, the screen edge may become pinched between the rocker shaft mounting bracket and the surface of the cylinder head. If this occurs, broken hold-down bolts, a broken rocker shaft or both can result with the possibility of major engine damage.

Installation of the rocker shaft assembly is as follows:

1. Make sure all 12 pushrods are properly seated in the respective lifter sockets. When installing pushrods, use care to gently lower them into position in the lifter cups. DO NOT drop the pushrods onto the lifters.

CAUTION

Make sure that all rocker adjusting screws and brake lash adjusting screws are screwed completely upward into the rocker arms before installing the rocker shaft on the engine. If this is not done, tightening the mounting bolts for the rocker shafts or rotating the engine to adjust the valves, can bend the pushrods.

2. Place the rocker shaft assemblies on the cylinder heads and align the rocker bracket mounting holes with the holes in the cylinder head. Depress the adjusting screw end of each rocker arm so that the adjusting screw ball end is fully down into each pushrod cup. With the rocker arm depressed in this fashion, rotate each pushrod to be sure it is fully seated in the lifter cup and at the rocker arm adjusting screw.

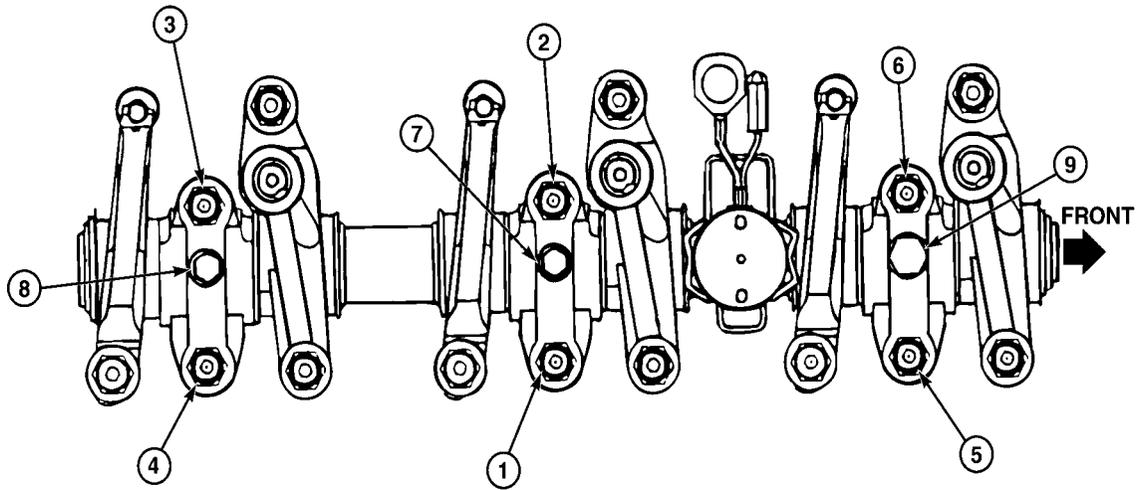
⚠ CAUTION

If the rocker shaft assembly is lifted off, or partially lifted off the cylinder head at anytime during the installation procedures, steps 1 and 2 above must be repeated. Not having the rockers positioned as described in step 2 above, or lifting the rockers are the usual causes of dislodging a pushrod from the lifter cup.

3. Lubricate the threads of the rocker shaft mounting bracket bolts and the undersides of the bolt heads with clean engine oil. Place the bolts into the mounting brackets, then start each bolt by hand and tighten by hand as much as possible.
4. Again, depress the rocker arm screw end of each rocker arm into each pushrod and rotate each pushrod to ensure proper installation.
5. Beginning at the center mounting bracket with bolt No. 1 (as shown in figure 23), tighten each rocker shaft mounting bracket bolt evenly (in the sequence shown in figure 23), keeping the rocker shaft assembly level until the brackets are against the cylinder head. When the brackets have contacted the cylinder head, tighten the mounting bracket bolts in the sequence shown, using a two-step process; first tighten the mounting bolts to 25 lb-ft (34 N-m), then, using the same sequence, tighten the mounting bolts to 40 lb-ft (54 N-m).

⚠ CAUTION

*The mounting bracket-to-rocker shaft bolts at the center and rear mounting brackets must be **finger-tight only** when the rocker shaft assembly is being installed on the engine. This allows the slip-fit mounting brackets to align and properly seat firmly on the cylinder head surface. After the rocker shaft mounting bolts have been tightened to proper specifications, the mounting bracket-to-shaft bolts must then be tightened to proper specifications. This ensures that there is no possibility of any relative motion between the mounting bracket and rocker shaft. Failure to follow this assembly procedure can result in broken hold-down bolts, broken shaft or both, with the possibility of major engine damage.*



268667a

Figure 23 — Tightening Sequence — Rocker Shaft Mounting Bracket and Locating Bolts

6. After the rocker shaft mounting bracket bolts have been properly tightened (bolt Nos. 1 through 6 in figure 23), tighten the center and rear mounting bracket-to-rocker shaft locating bolts (bolt Nos. 7 and 8 in figure 23) to 18 lb-ft (24 N·m). The front mounting bracket-to-rocker shaft bolt (bolt No. 9 in figure 23) can be tightened to 18 lb-ft (24 N·m) anytime during the process.

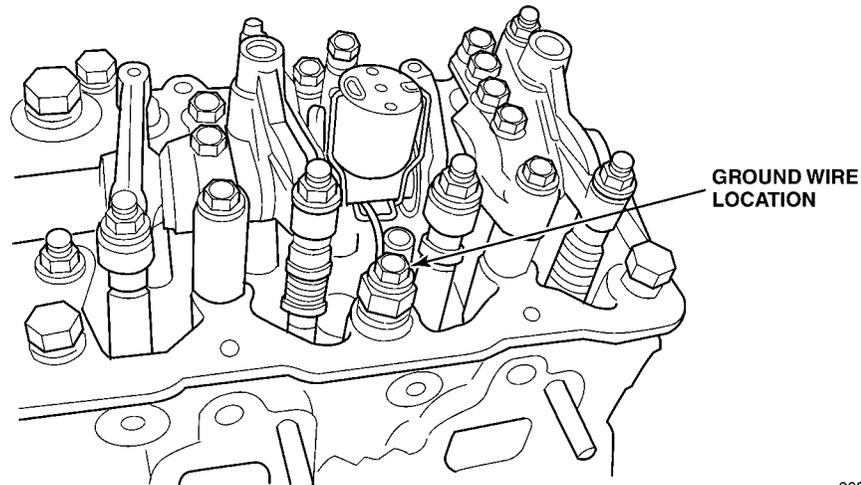
⚠ CAUTION

Whenever the rocker shaft assembly is removed for any type of service procedure, the mounting bracket-to-rocker shaft locating bolts must be loosened. Upon reassembly, the rocker shaft mounting bracket bolts and the mounting bracket-to-rocker shaft locating bolts must be tightened as outlined in the procedures above, or serious engine damage may result.

After the rocker shaft assembly has been installed, route the solenoid ground wire under the rocker shaft and up through the end of the solenoid retainer clip. Secure the ground wire terminal to the cylinder head mounting bolt located directly to the right of the solenoid. This mounting bolt has a threaded hole in the center of the bolt head. Use a bolt (part No. 66AM2) and a flat washer (part No. 270AM9) to secure the ground wire.

NOTE

While tightening the wire terminal retaining bolt, do not allow the terminal to rotate and twist the wire. Use of the flat washer will prevent this from occurring.



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Figure 24 — Engine Brake Solenoid Ground Wire Secured to Cylinder Head Bolt

Valve/Engine Brake Lash Adjustment

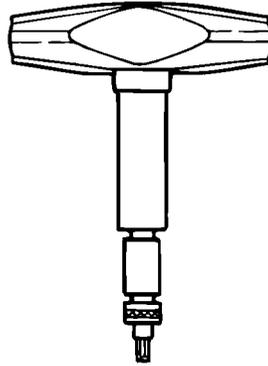
Valve and engine brake actuator lash specifications are as follows:

Inlet	Exhaust	Engine Brake Actuator
0.016" (0.406 mm)	0.024" (0.610 mm)	0.045" (1.14 mm)

Valve yoke balance, engine brake lash and valve lash must be adjusted in the following order:

1. Valve yoke balance is adjusted first.
2. Engine brake actuator lash is adjusted second, using the adjusting screw on the pushrod side of the rocker arm.
3. Valve lash is adjusted last, using the adjusting screw located over the valve yoke.

Spring-loaded pushrods are used at the exhaust valve locations. In order to properly adjust the engine brake hydraulic actuator lash, the pushrod springs must be compressed. In addition to the hand tools normally used to adjust valves, a T-handle torque screwdriver (tool No. J 29919) with a 5 mm internal hex bit is required. This torque screwdriver is preset to 6 lb-in.



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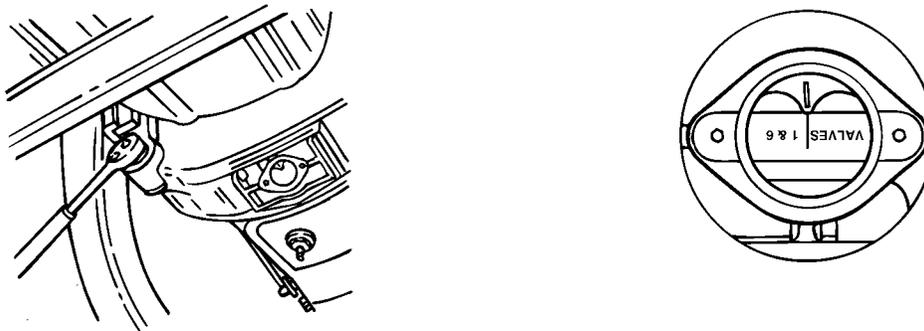
Figure 25 — T-Handle Torque Screwdriver — J 29919

NOTE

The torque screwdriver is mandatory for performing the MACK PowerLeash™ brake lash and valve lash adjustments.

Valve adjustment procedures are as follows:

Valve adjustments are made in firing order sequence (1-5-3-6-2-4) with the engine cold (coolant temperature below 100°F [38°C]), not running and with the piston at 30 degrees after top-dead-center on the compression stroke (inlet and exhaust valves closed). The flywheel is marked in 120-degree increments to indicate engine position at which the valves must be adjusted. Access the valve adjustment markings on the flywheel by removing the cover from the bottom of the flywheel housing. Tool No. J 38587, which engages the flywheel through an access hole in the flywheel housing, is recommended to rotate the engine.



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Figure 26 — Valve Adjustment Markings on Flywheel

Adjustments are made in three stages. The exhaust valve yoke is adjusted first (inlet valve yokes are pinless and do not have an adjusting screw), followed by the engine brake hydraulic actuator, then the exhaust and inlet valve lash. Begin the adjustment procedures at cylinder No. 1 by rotating the engine in the direction of normal rotation until the valve adjustment mark for cylinders 1 and 6 is aligned in the center of the access window.

Valve Yoke Adjustment

NOTE

The following valve yoke adjustment procedures are performed with the rocker shaft assembled on the head, as they would be performed during a normal valve adjustment procedure at the recommended service interval. If the cylinder head has been disassembled, however, it is easier to adjust all the valve yokes prior to installing the rocker shafts. The adjustment procedure for each individual valve yoke, however, remains the same. Once adjusted, valve yokes cannot be moved to another cylinder.

1. Loosen the engine brake hydraulic actuator adjusting screw locknut (located on the pushrod end of the exhaust rocker arm) and back the adjusting screw out several turns.

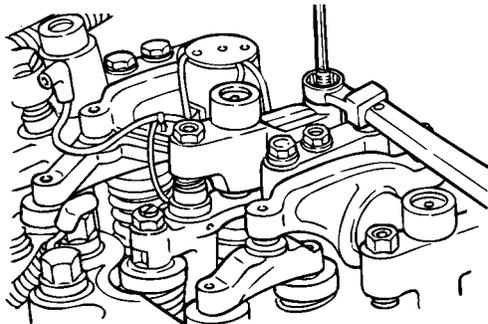


Figure 27 — Loosening Hydraulic Actuator Locknut and Backing Out Adjusting Screw

2. Loosen the exhaust valve yoke adjusting screw locknut.

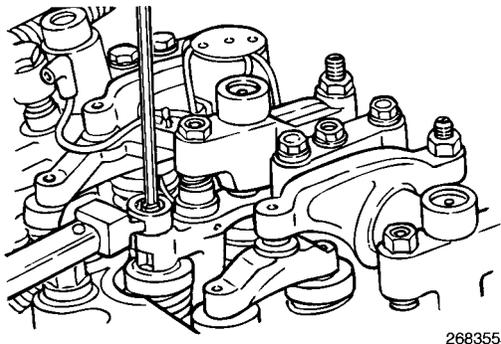
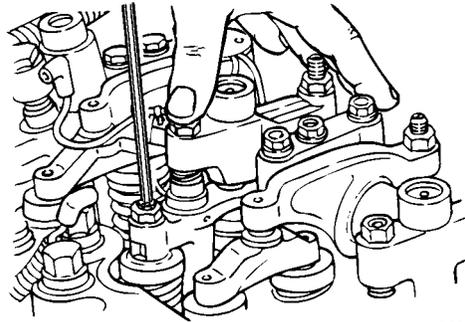


Figure 28 — Loosening Exhaust Valve Yoke Adjusting Screw Locknut

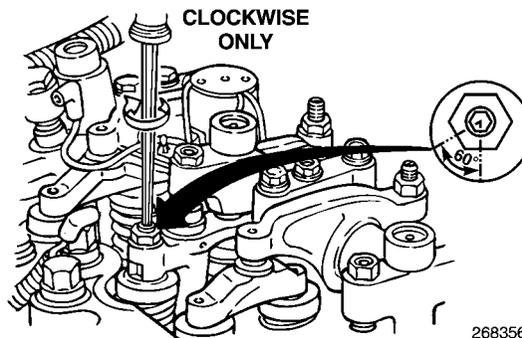
3. Exert moderate force on the exhaust valve yoke by pressing on the end of the exhaust rocker arm above the yoke. Turn the yoke adjusting screw clockwise until it solidly contacts the outboard valve stem tip (a light drag should be felt on the adjusting screw).



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Figure 29 — Turning the Exhaust Valve Yoke Adjusting Screw Until it Contacts Valve Stem Tip

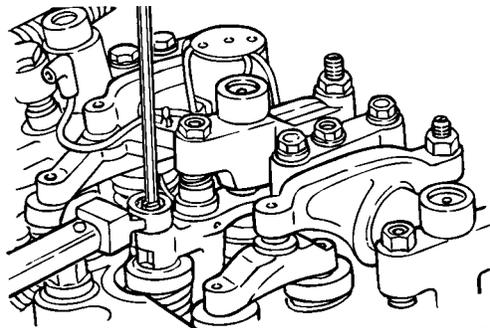
4. After the adjusting screw solidly contacts the valve stem tip, turn the screw clockwise an additional 1/6 turn (60 degrees). A 1/6 turn is equal to one flat on the adjusting screw locknut.



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Figure 30 — Turning Adjusting Screw an Additional 1/6 Turn

5. Holding the valve yoke adjusting screw in this position, tighten the adjusting screw locknut to 33 lb-ft (44 N·m).



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Figure 31 — Tightening Valve Yoke Locknut

6. Check the valve yoke adjustment by inserting 0.010" (0.25 mm) thickness gauges between the inboard and outboard valve stem tips and the valve yoke. It will be necessary to pull the valve yoke up to insert the thickness gauge between the valve stem tip and the yoke.

NOTE

Inserting the thickness gauges may be made easier if the gauge is inserted under the inboard portion of the valve yoke first, then under the outboard portion.



Figure 32 — Inserting Thickness Gauge

While exerting a moderate force on the rocker arm end above the yoke, check that an equal "drag" is felt on both thickness gauges. If drag is not equal, readjust the valve yoke.

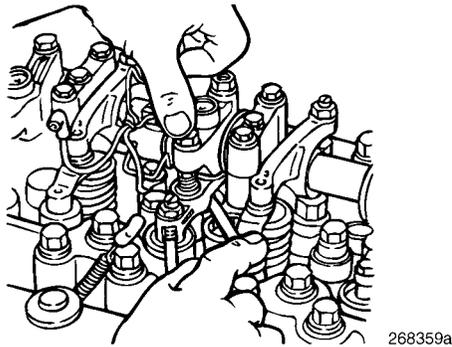


Figure 33 — Checking Valve Yoke Adjustment

Engine Brake Hydraulic Actuator Adjustment

NOTE

It is mandatory that the T-handle torque screwdriver (tool No. J 29919) be used to adjust the MACK PowerLeash™ engine brake hydraulic actuator.

The engine brake hydraulic actuator must be adjusted prior to adjusting the exhaust valve lash.

1. Loosen the engine brake adjusting screw (located above the pushrod) locknut and back the adjusting screw out several turns.
2. Loosen the swivel-head adjusting screw locknut (located on the valve actuating side of the exhaust rocker arm) and back the adjusting screw out a couple of turns.

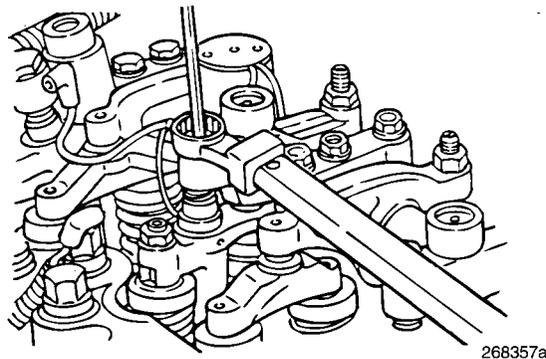


Figure 34 — Loosening Swivel-Head Adjusting Screw

3. Push down on the pushrod end of the exhaust rocker arm to fully depress the pushrod spring, then insert a 0.045" (1.14 mm) thickness gauge between the hydraulic actuator plunger and the actuator pin located above the inboard exhaust valve.

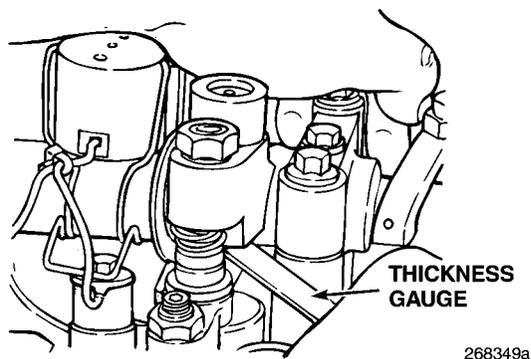


Figure 35 — Inserting Thickness Gauge Between Brake Plunger and Actuator Pin

NOTE

It is recommended that a dull knife-edge be ground onto the leading edge of the 0.045" (1.14 mm) thickness gauge to facilitate inserting it between the brake plunger and the actuator pin. Doing this will eliminate the need for backing off the adjusting screw to insert the thickness gauge. A relief is cut in the lower surface of the rocker arm to provide clearance for inserting the thickness gauge. The thickness gauge must be installed from the side of the rocker arm that faces the rear of the engine, and at the angle shown in the above illustration.

4. Using the T-handle torque screwdriver (tool No. J 29919), slowly turn the actuator adjusting screw clockwise. As the screwdriver is being turned, the pushrod spring will compress. Continue tightening the adjusting screw until the screwdriver clicks. At the point where the screwdriver clicks, the pushrod spring seats are in contact and the pushrod is solid. At that point, hydraulic actuator lash is properly set. Do not tighten the screwdriver any further.

NOTE

The torque screwdriver may allow the adjusting screw to loosen slightly when it "clicks" at the pre-set torque. It is important to develop a "feel" for when the screwdriver click occurs and a feel for the actual setting of the lash. To develop a feel for when the screwdriver will click, slowly turn the screwdriver through the function once or twice, and for the third time, bring the screwdriver just to the point before it clicks. Also, at no time should the screwdriver be turned clockwise after the click has occurred. Always recheck the adjustment.

NOTE

When tightening the adjusting screw, it is important to make sure that the adjusting screw jam nut is NOT bottomed against the rocker arm, and that the swivel-head adjusting screw at the nose end of the rocker arm is NOT in contact with the valve yoke.

NOTE

If either the pushrod spring or the brake actuator plunger are not compressed, brake lash is not set correctly and the adjustment procedure must be repeated.

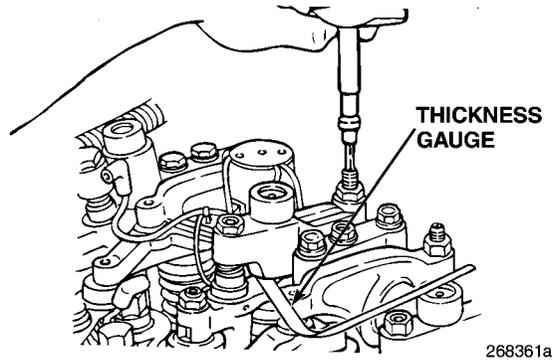


Figure 36 — Adjusting Engine Brake Hydraulic Actuator Lash

5. Remove the T-handle torque screwdriver, then use a hex-bit screwdriver to hold the adjusting screw in position. Use an accurately calibrated torque wrench to tighten the jam nut to 45 lb-ft (61 N·m).

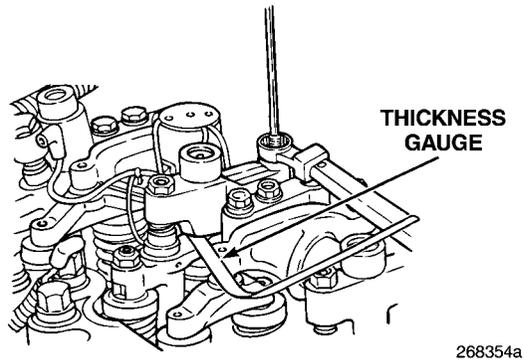


Figure 37 — Tightening Adjusting Screw Jam Nut

NOTE

After completing the brake plunger lash adjustment, leave the 0.045" (1.14 mm) thickness gauge in place. This keeps the plunger and pushrod spring compressed so that the exhaust valve lash can be adjusted.

Exhaust Valve Lash Adjustment

1. With the 0.045" (1.14 mm) thickness gauge in place between the valve yoke and the hydraulic actuator plunger, insert a 0.024" (0.610 mm) thickness gauge between the adjusting screw "foot" and the valve yoke. Using a 5 mm Allen wrench, turn the adjusting screw until a light "drag" is felt on the thickness gauge.

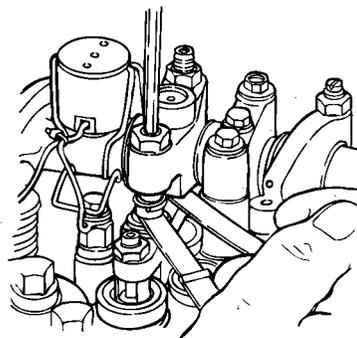


Figure 38 — Adjusting Exhaust Valve Lash

2. Holding the adjusting screw in position, use an accurately calibrated torque wrench to tighten the jam nut to 45 lb-ft (61 N·m).

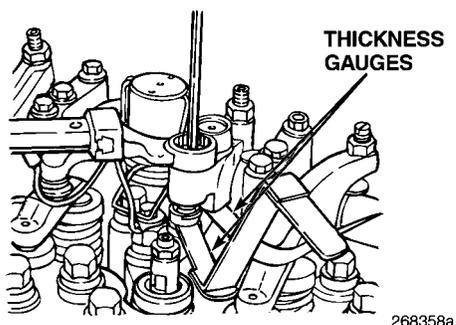


Figure 39 — Tightening Swivel-Head Adjusting Screw Jam Nut

3. Remove the thickness gauges from between the swivel-head adjusting screw and valve yoke, and from between the brake lash adjuster plunger and the actuating pin.
4. Recheck the exhaust valve lash adjustment by pressing down on the pushrod end of the exhaust rocker arm and inserting the 0.024" (0.610 mm) thickness gauge between the swivel-head adjusting screw and the valve yoke. If the adjustment is not correct, both engine brake and exhaust valve lash must be readjusted.

Inlet Valve Adjustment

Inlet valve lash is adjusted in the same manner as on non-brake engines.

After properly setting the valve yoke, engine brake, exhaust and inlet valve lash for cylinder No. 1, continue the adjustment procedures by rotating the engine in the direction of normal rotation until the valve adjustment marking for the next cylinder in firing order sequence is aligned in the center of the access window, then adjusting the valves for that cylinder.

ENGINE BRAKE TESTS

Operational Tests

Before beginning any troubleshooting procedures, attempt to determine the exact nature of the problem. Talk to the operator to pinpoint the complaint or problem. The following tests may be helpful in attempting to determine the nature of the problem.

Before Starting the Engine

If there is a report of engine or engine brake noise, remove the cylinder head covers to determine the cause. Check the following items:

1. Check for loose or broken components.
2. Check and verify valve and engine brake plunger lash settings.
3. Check for bent pushrods. If bent pushrods are found, check for possible bent valves, and if the engine is equipped with ceramic roller lifters, check for broken ceramic rollers. Possible causes of bent valves or pushrods could be:
 - *Engine overspeeding* — Usually several valves are affected.
 - *One bent exhaust valve or pushrod at a single cylinder* — This indicates the possibility of incorrect valve adjustment. A bent exhaust valve can also be caused by the valve stem stuck in the guide, incorrect valve, brake or yoke adjustment, or broken or weak valve springs.

Test Drive

1. Test drive the vehicle and measure intake boost pressure while operating the engine brake. Refer to the following tables for boost pressure specifications depending upon engine model.

E-TECH™ ENGINE BOOST PRESSURE SPECIFICATIONS	
Horsepower ranges up to 355/380	
Engine Speed (rpm)	Boost Pressure (psi)
2100	21
1900	20
1700	19
1500	16
1300	11
1100	7
Horsepower ranges 380/410 and above	
Engine Speed (rpm)	Boost Pressure (psi)
2100	25
1900	25
1700	23
1500	18
1300	12
1100	7

ASET™ AI ENGINE BOOST PRESSURE SPECIFICATIONS	
Engine Models AMI-300, AMI-300A, AMI-335, AMI-370, AI-350 and AI-400	
Engine Speed (rpm)	Boost Pressure (psi)
2100	26
1900	24
1700	20
1500	15
1300	9
1100	6
Engine Models AI-427 and AI-460E	
Engine Speed (rpm)	Boost Pressure (psi)
2100	21
1900	20
1700	17
1500	14
1300	8
1100	5

ASET™ AC ENGINE BOOST PRESSURE SPECIFICATIONS	
All Horsepower Ranges	
Engine Speed (rpm)	Boost Pressure (psi)
2100	27
1900	27
1700	25
1500	19
1300	11
1100	6

NOTE

If the vehicle does not have a boost pressure gauge, one must be installed. A pipe plug is provided in the inlet manifold for this purpose. Slightly lower boost pressures than those listed above may be normal at higher altitudes.

It is best to conduct this test with a loaded vehicle, engine at maximum rated RPM and the engine brake ON. Downhill operation is desirable to stabilize engine RPM.

2. Record the maximum boost pressure with the engine brake switch in the HIGH position.
3. Record the boost pressure with the engine brake switch in the LOW position.
4. Disconnect the wire lead from the LOW position terminal of the engine brake switch and rerun the test with the switch in the HIGH position. Record the results.

NOTE

The individual boost pressure readings should be approximately the same as recorded in steps 3 and 4 above.

5. Compare the maximum boost pressure with the values given in the previous *Boost Pressure* table. A low boost pressure reading indicates a possible problem. Readings at sea level should be within 3 psi of the values shown (at higher altitudes, slightly lower boost pressure readings are normal).

General Inspection and Adjustment Verification

1. Inspect for missing or loose mounting bracket-to-rocker shaft bolts. The front rocker shaft mounting bracket is an interference-fit on the rocker shaft, and the front mounting bracket-to-shaft locating screw is the same screw as is used in all E7, E-Tech™ and ASET™ rocker shaft assemblies. The mounting bracket locating screw hole is threaded, and the screw has an un-threaded tip that goes into a positioning hole in the rocker shaft. The positioning hole in the shaft does not intersect with any oil passages in the shaft.

The center and rear rocker shaft mounting brackets are a slip-fit on the shaft, and are retained on the shaft by the mounting bracket-to-shaft retaining bolts. The mounting bracket bolt holes are not threaded. The retaining bolts thread into tapped holes in the top of the shaft. The tapped holes in the shaft intersect with the “control” oil gallery inside the shaft. If the center or rear rocker shaft mounting bracket retaining bolts are loose or missing, a loss of control oil pressure and loss of brake function will occur.

2. Visually inspect the rocker shaft, exhaust rocker arms, hydraulic actuators, solenoid valve, etc., for obvious signs of damage or missing components. Repair or replace as necessary.
3. Check hydraulic actuator lash. Lash should be 0.045” (1.14 mm). Refer to the “*Valve Adjustment*” section.
4. Check solenoid operation. The solenoid used with the MACK PowerLeash™ engine brake has a 0.200” diameter hole in the top that provides a means of troubleshooting solenoid operation. To check solenoid operation, insert a pin (having a diameter less than 0.200”) into the hole, then activate the engine brake. The pin should rise approximately 0.100” (2.54 mm) when the solenoid turns ON.

NOTE

An actuator pin from a J-Tech™ actuating pin adjusting screw (screw assembly part No. 421GC41M, AM, BM or CM) works well for this test.

Determine Minimum Engine Oil Pressure for Engine Brake Operation

Minimum oil pressures for proper MACK PowerLeash™ engine brake operation are as follows:

NOTE

When determining minimum oil pressure, the oil temperature must be at least 200°F (93°C) when the test is performed. The pressure reading from the dashboard oil pressure gauge is sufficient.

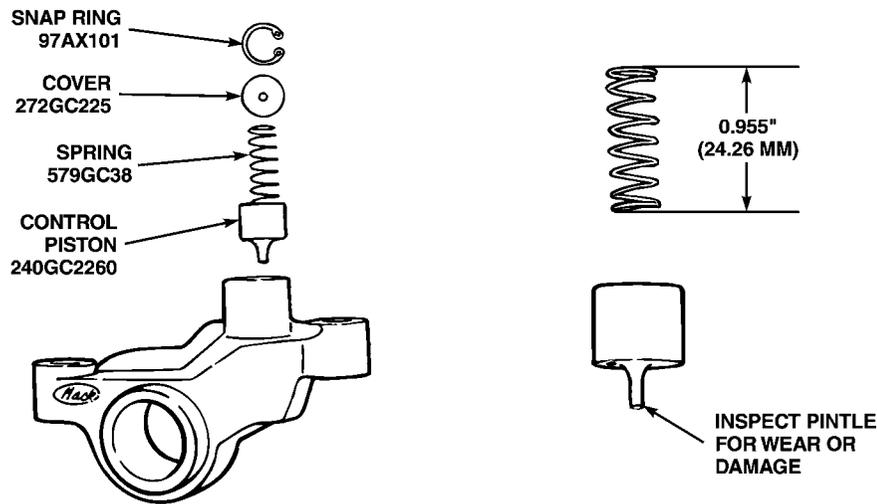
Engine Speed (rpm)	Minimum Oil Pressure (psi) (Main Gallery)
2100	35 psi at 200°F (93°C) or above
1100	25 psi at 200°F (93°C) or above

Inspection of Engine Brake Hydraulic Actuator

If oil pressure to the rocker shaft is not sufficient for engine brake operation, inspect the oil supply screen in the bottom of the front rocker shaft mounting bracket for debris, and clean or replace as necessary.

If oil pressure at the rocker shafts is sufficient for engine brake operation, then inspect the engine brake hydraulic actuator components for wear or damage.

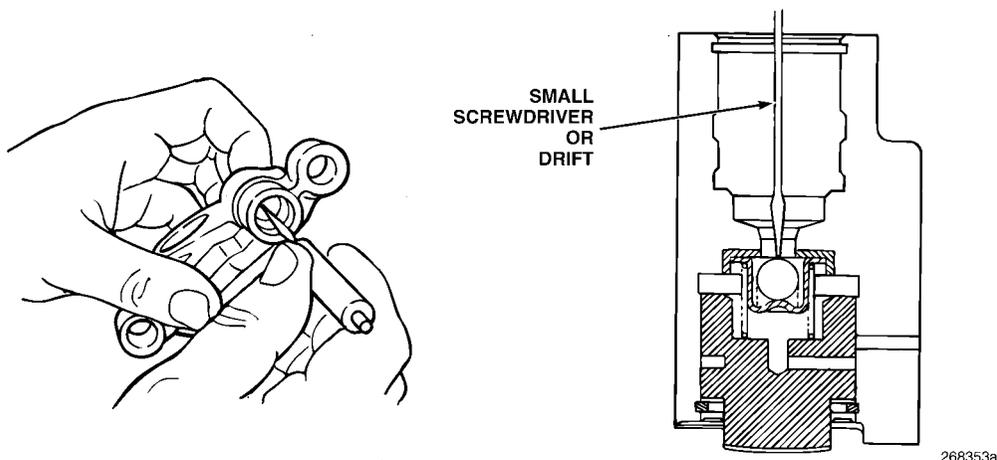
1. Remove the retaining ring that retains the control piston cap in place on the top of the actuator. Remove and inspect the control piston spring. Free length of the spring should be 0.955" (24.3 mm). If the spring is broken or free length is not within specifications, replace the spring (part No. 579GC38).
2. Check the control piston for freedom of movement in the actuator bore. The control piston must move freely. If the piston binds or sticks, or if there are burrs on the piston or in the bore, or if there is evidence of scuffing, replace the piston. Check the pintle on the end of the piston and replace if broken or showing evidence of wear.



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Figure 40 — Check Control Piston Spring Free-Length and Piston Pintle Wear

3. Verify check valve function by inserting a small screwdriver, drift pin or similar type of tool into the control piston bore and pushing on the check valve ball. There should be spring tension against the check ball, and ball travel should be approximately 3/16" (4.763 mm). If the check ball does not move down freely, and if spring tension does not return the check ball to its seat, replace the rocker arm assembly (part No. 44GB486M).



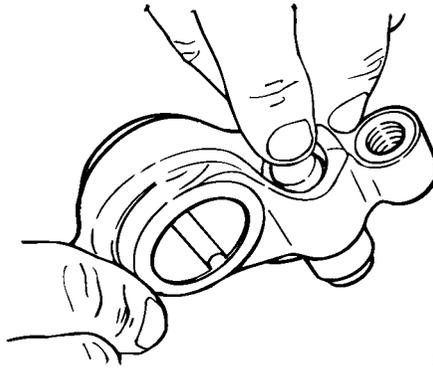
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Figure 41 — Verifying Check Valve Function

NOTE

The check valve is not replaceable. Any problems found with the check valve require that the complete rocker arm assembly be replaced.

4. If the check valve, control piston and control piston spring are OK, remove the rocker arm and check the hydraulic actuator plunger as follows:
 - a. Make sure the plunger retaining ring is in place.
 - b. Spring tension holds the plunger down against the retaining ring. Check for a broken spring by making sure the plunger is seated against the retaining ring.
 - c. Push the plunger to make sure it moves freely in the bore and that spring tension seats the plunger against the retaining ring. If the plunger sticks or binds in the bore, or if spring tension does not keep the plunger seated against the retaining ring, replace the rocker arm.



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Figure 42 — Check Plunger Movement and Plunger Spring Tension

NOTE

The plunger is not serviceable. Any problems found with the plunger or plunger spring require that the complete rocker arm assembly be replaced. **DO NOT** attempt to remove any components from the rocker arm with the exception of those components shown in figure 40.

5. Check the valve actuating pin located in the valve yoke, to ensure that the pin is not damaged. The pin should not stick in the yoke at any point in its travel. There should be no signs of “mushrooming” or other damage where the plunger contacts the head of the actuating pin.

Final Tests

1. After installing the rocker assemblies and adjusting exhaust valve and engine brake lash, start the engine and run at an idle for several minutes.

NOTE

The engine brake requires a minimum oil pressure of 25 psi. When troubleshooting engine brake operation, it is desirable to do any test procedures with the engine operating at an idle. Make sure engine oil pressure at idle is sufficient to support the engine brake minimum oil pressure requirement. If engine oil pressure is not sufficient at idle, increase engine speed until the minimum oil pressure requirement is obtained.

2. Check for oil leaks at the oil supply screen and solenoid valve. If leakage is noticed, shut the engine down and repair the leaks.

NOTE

Some leakage will be seen at the hydraulic actuator plunger and the control piston cap. This leakage is normal. Excessive leakage, however, must be investigated (refer to the "*Troubleshooting Guide*").

3. After these final inspections and necessary repairs, install the cylinder head covers.
4. Test drive the vehicle to verify any problems have been corrected.

Troubleshooting

NOTE

The MACK PowerLeash™ engine brake is designed so that individual rocker arms can easily be removed and replaced simply by removing the rear and/or center slip-fit rocker shaft mounting brackets. A complete rocker shaft assembly should never be used to repair a failed rocker arm(s).

ENGINE DOES NOT START

Possible Causes

1. Solenoid stuck in ON position which would allow oil flow to the hydraulic actuator and open the exhaust valves on the affected head.
2. Solenoid valve lower O-ring damaged or missing which could allow oil flow to the hydraulic actuator and open the exhaust valves on the affected head.

Corrections

1. Ensure that electrical current at the engine brake solenoid is "off" (current low).
If the solenoid is "stuck" open with low current applied, replace the solenoid.
2. Remove solenoid valve from rocker shaft and inspect lower O-ring. Replace if damaged or missing.

NOTE

A constant 12 volts is supplied to the engine brake solenoid at a low current. A "pull-down" resistor (internal to the EECU) increases current to the solenoid to energize the solenoid during an engine braking event.

ENGINE BRAKE WILL NOT OPERATE	
<p>Possible Causes</p> <ol style="list-style-type: none"> 1. Blown fuse, open electrical circuit. 2. Dashboard control switch or clutch switch defective or out of adjustment (clutch switch only). 3. Mounting bracket-to-rocker shaft mounting screws loose or missing. 4. Blocked oil supply screen at the bottom of the front rocker shaft mounting brackets (rocker shaft mounting bracket Nos. 1 and 4). 5. Brake lash not adjusted properly. 6. Engine oil pressure low. 	<p>Corrections</p> <ol style="list-style-type: none"> 1. If 12 volts is not present at the engine brake solenoid, check for an "open" in the circuit. Replace any broken, chafed or brittle wires. Check the solenoid leads (both ground and power) for signs of shorts and replace as required. Check fuse and replace as necessary. 2. Use a multi-meter to test for voltage at switches. Disconnect switches and test switch function by checking continuity in the various switch positions. Replace as required. Check and adjust clutch switch as required. 3. Inspect for missing or loose mounting bracket-to-rocker shaft screws. Repair as required. 4. Remove rocker shaft assemblies and clean oil supply screens. 5. The MACK PowerLeash™ engine brake is very sensitive to adjustment. Incorrect adjustment may hold the valve open during positive power, leading to engine failure, or may cause the engine brake to work poorly or not at all. Confirm that the engine brake hydraulic actuator is properly adjusted to specifications (0.045" [1.14 mm]). 6. The MACK PowerLeash™ engine brake requires 25 psi (172.4 kpa) at 1100 rpm to operate. Check oil pressure registered on the dashboard gauge. If low, determine the cause.

ENGINE BRAKE ACTIVATES WITH DASHBOARD SWITCH TURNED OFF	
<p>Possible Causes</p> <ol style="list-style-type: none"> 1. Solenoid lower O-ring damaged or missing. 2. Solenoid not fully seated in rocker shaft bore. 3. Engine brake system wired improperly. 	<p>Corrections</p> <ol style="list-style-type: none"> 1. Remove the solenoid and inspect lower O-ring for damage. Replace as required. 2. Remove the solenoid, inspect and replace the O-rings as required. Reinstall the solenoid to its full seated position before snapping the retaining spring clips in place. The clips must require a moderate force to snap them around the rocker shaft and must provide enough spring tension to prevent any free-movement of the solenoid or spring clips. If spring clip tension cannot be maintained, replace the clips. 3. Compare engine brake wiring with chassis wiring diagram. Correct wiring as required.

 CAUTION

The solenoid must be fully seated by significant hand pressure. The retaining clips will not seat a solenoid that has not already been fully seated.

ENGINE BRAKE SLOW TO OPERATE OR WEAK IN EFFECT	
<p>Possible Causes</p> <ol style="list-style-type: none"> 1. Engine oil cold and thick. 2. Hydraulic lash adjuster plunger not moving in bore. 3. Control pistons binding in rocker arm bores. 4. Defective ball check valve. 5. Switch operation sluggish. 6. Solenoid valve operation erratic. 	<p>Corrections</p> <ol style="list-style-type: none"> 1. Allow engine to warm before operating engine brake. Change engine oil if viscosity indicates that the oil has thickened. 2. Inspect engine brake hydraulic actuator plunger for freedom of movement in the bore. Spring pressure should keep the plunger seated against the lower snap ring. If the plunger does not move freely, replace the rocker arm assembly. 3. Remove control piston from rocker arm. Inspect piston and bore for scoring or burrs. If any are present, replace rocker arm assembly. 4. Remove the control piston, then remove the ball check valve. Make sure that the check ball is seated in the bore and can be moved off its seat. Make sure there is spring tension against the check ball. Flush the ball check valve in a suitable, non-flammable solvent. If the ball check valve does not function properly, replace the rocker arm assembly. 5. Check operation of dash switch and clutch switch. Readjust or replace as required. 6. Check current draw of solenoid when engine brake is activated. Current should be approximately 1.59 amps.

OIL PRESSURE DROPPING BELOW MINIMUM REQUIRED FOR ENGINE BRAKE OPERATION	
<p>Possible Causes</p> <ol style="list-style-type: none"> 1. Loose or missing mounting bracket-to-rocker shaft bolts. 2. Plugged or damaged oil supply screen. 3. Aeration of engine oil. 4. Engine oil diluted by fuel oil. 5. Engine oil level too low. 6. Worn rocker arm shaft bores or rocker shaft. 7. Worn main and/or rod bearings or camshaft bushings. 	<p>Corrections</p> <ol style="list-style-type: none"> 1. Inspect mounting bracket-to-rocker shaft bolts. Replace and retorqued as required. 2. Remove the rocker shaft assembly and inspect the oil supply screen located in the oil supply port of the number one rocker shaft mounting bracket. Clean or replace as required. 3. Check for aeration of engine oil. With the engine running, activate, then deactivate the engine brake and observe oil escaping from the rocker arm, in the area of the hydraulic actuator. If there are bubbles in the oil or the oil is foamy, air is present. Aeration of engine oil can be caused by an overfilled or under-filled crankcase, or a crack or leak in the oil pump pickup tube. Correct or repair as necessary. 4. Perform an oil analysis to determine fuel dilution. Correct source of fuel dilution as required. 5. Consult the engine manual or the maintenance and lubrication manual for oil capacities. Add oil and/or recalibrate dipstick as required. 6. Inspect rocker arm shaft bores and rocker shaft for wear. Replace components as required. 7. Inspect/measure main bearings, rod bearings and camshaft bushings. Replace as required.

ONE OR MORE CYLINDERS FAIL TO STOP BRAKING OR ENGINE STALLS	
Possible Causes <ol style="list-style-type: none"> Control piston spring broken. One or more control pistons stuck in the ON or UP position. Solenoid O-ring missing or damaged (allows oil to enter the hydraulic actuators with the solenoid valve closed). Solenoid valve exhaust port plugged. Clutch switch stuck in ON position or out of adjustment. 	Corrections <ol style="list-style-type: none"> Remove control piston from hydraulic actuator and inspect spring. Replace rocker arm if spring is broken. Inspect control pistons for freedom of movement in the actuator bore. If binding is evident, replace the rocker arm. Check engine oil for contamination. Remove solenoid valve and inspect O-ring. Replace if missing or damaged. Remove solenoid valve and inspect exhaust port for restrictions. Clean exhaust port as required. Check clutch switch for proper operation. Readjust or replace as required.
<div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;">  CAUTION </div> <p><i>Engine stalling and potential engine damage can occur if the engine brake is operated at cold engine oil temperatures. The V-MAC® III engine control system on vehicles equipped with a MACK PowerLeash™ engine brake includes a feature that prevents the engine brake from being activated until the engine coolant temperature reaches at least 125°F (52°C). The engine brake will not function until sufficient engine warm-up time has elapsed, regardless of the dashboard engine brake switch setting.</i></p>	

ENGINE MISSES OR LOSES POWER	
Possible Causes <ol style="list-style-type: none"> Hydraulic actuator adjustment too tight. 	Corrections <ol style="list-style-type: none"> Readjust engine brake lash in accordance with procedures outlined in this bulletin.

Solenoid Valve Specifications

Specifications for the solenoid valve are as follows:

Part No. 805GC54	
Solenoid Voltage	12 volts
Pull-In Voltage	9 volts
Resistance	9.62–10.75 ohms (cold) 11.8–14.3 ohms (hot)
Current Draw	0.84–1.66 amps (cold) 0.63–1.36 amps (hot)