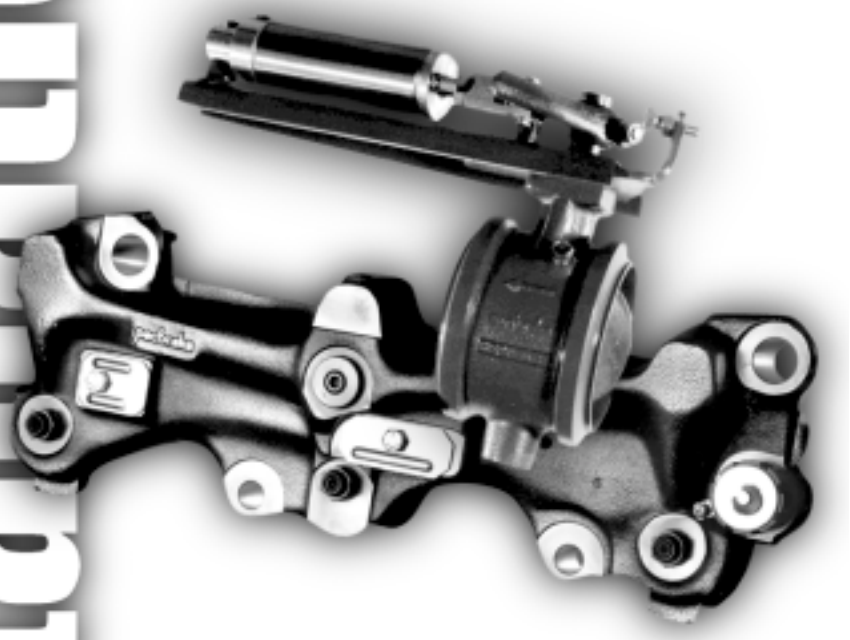
Installation



COMBINATION BRAKES

P-37 SUPERPAC

Application:

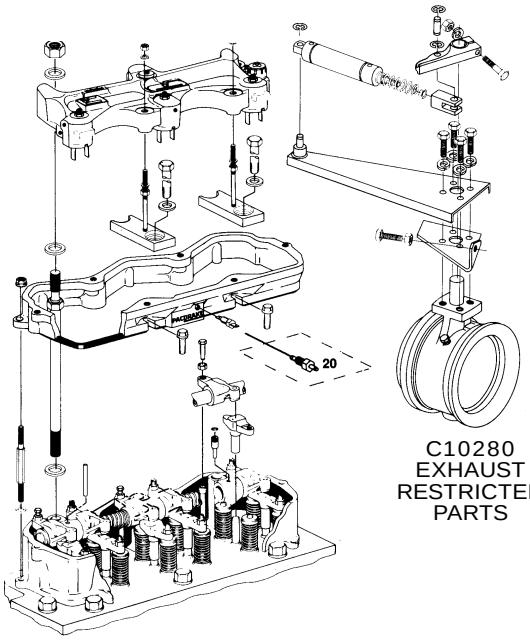
CATERPILLAR 3406B &C
ATAAC & JWAC ENGINES

PACBRAKE
ENGINE BRAKES

BACKGROUND

P34605 HOUSING ASSEMBLY GROUP FRONT
DISTRIBUTOR BODY MARKED FRONT

P34610 HOUSING ASSEMBLY GROUP REAR
DISTRIBUTOR BODY MARKED REAR



C10280
EXHAUST
RESTRICTER
PARTS

The model P-37 Pacbrake represents a new principle in engine braking, called regeneration. All previous engine brakes and engine combinations depend on a sudden compression release at the top of the compression stroke, driving the turbocharger to boost intake pressure and releasing considerable energy into the exhaust manifold to achieve a braking effect. The problem is the turbocharger was not designed to work with the engine brake and is not as effective as it could be. Moreover, just so much braking can be achieved on a single stroke, limiting the available power. To over come these problems, the Pacbrake 37 provides two braking strokes and a boost on the intake stroke without using the turbocharger. Pressure is raised in the exhaust manifold, using an exhaust restricter giving a second braking stroke and a source of high pressure air to boost the intake stroke. This is done by forcing air past the exhaust valve at the bottom of the intake stroke, as the intake valve closes, raising the intake charge, even though the turbo is not functioning. The effect is a strong silent engine brake that maintains normal exhaust and engine temperatures.

A warm-up feature is included with this kit, and will benefit all 3406E engines for quick and efficient warm-up. See page 11 for warm-up operating instructions.

NOTE: P-37 engine brake is designed to run and give maximum performance at 2100 RPM.

BEFORE STARTING

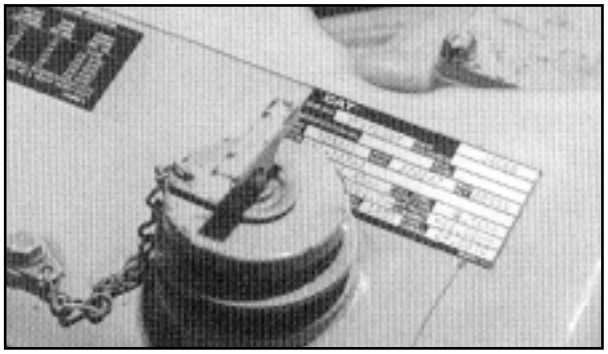
Identify the engine model. The P-37 Engine Brake is designed for 3406B and C, ATAAC & JWAC engine applications.

Examine the valve cover. An identification tag is attached to the valve cover showing all the necessary information.

NOTE The P-37 kit is packaged as a basic kit without most wiring and switch components.

An electrical group must be ordered separately and will have the items necessary for the specific application. i.e. Mechanical, PEEC II or PEEC III.

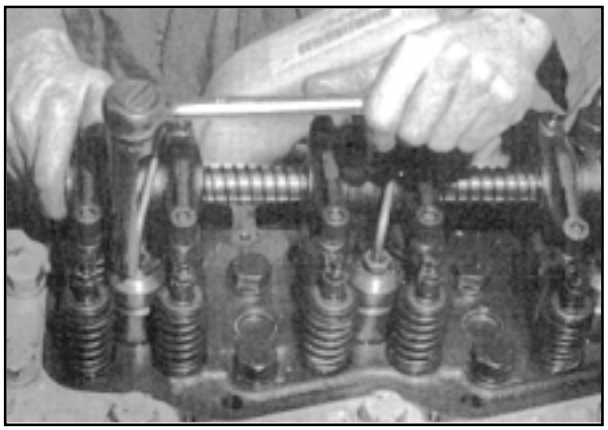
(See step #47)



ENGINE PREPARATION

1-3

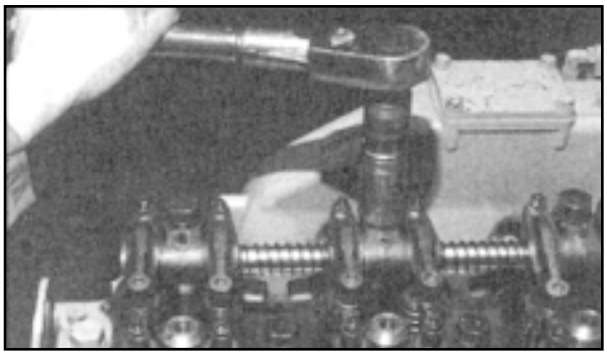
1. Thoroughly clean the top of the engine, and remove the crossover pipe and rocker covers.
2. Loosen and remove the fuel lines, placing them in a protective bag.
3. Loosen the intake and exhaust rocker arm adjusting screw lock-nuts.



4

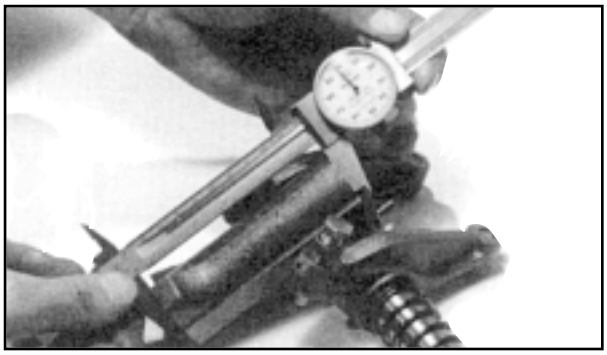
Remove the front rocker shaft group from the engine.

NOTE 1: No more than three rocker assembly head bolts should be removed at one time.



NOTE 2: At this time, for all 3406B engines with serial numbers prior to 7FB-39279, a measurement of the two end pedestals must be made using a vernier caliper or a micrometer. The height of each pedestal must be recorded. If more than a .005 difference is noted, then it is recommended that the Top face of the higher pedestal, be machined down to the same height as the shorter of the two.

Alternatively, shimming may be used. SEE NOTE: at 20.

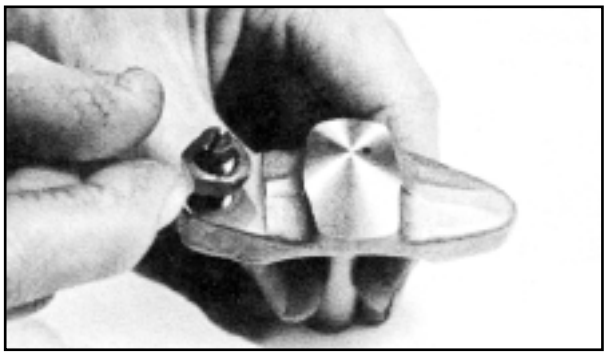


5

Remove the Caterpillar exhaust rocker arm adjusting screws and replace them with the hardened hexhead Pacbrake screws. Reuse the Caterpillar lock-nuts.

6

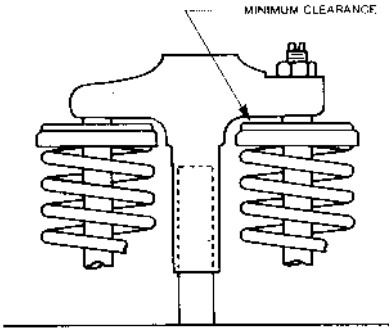
Remove the exhaust valve crossheads. Remove the crosshead adjusting screws and locknuts, then loosely install them into the Pacbrake crosshead.



OVERHEAD ADJUSTMENTS

7

Apply clean oil to the crosshead bore. Install on the engine and adjust according to the Caterpillar manual.



8

CAUTION! After cross-head installation and adjustment it is imperative that a clearance check is made between the underside of the cross-head on the adjusting screw side and the top of the valve rotocoil.

Minimum clearance is .020".

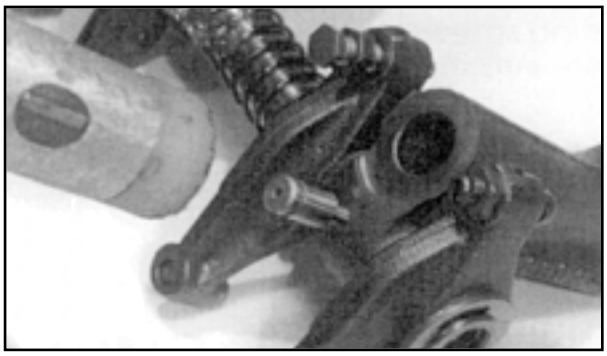
Providing the cross-head is properly leveled there will be adequate clearance, however, improper leveling and contact with the rotocoil will cause severe engine damage.

9

Each rocker arm assembly has a front and rear dowel pin. Remove the front pin. Locate and lubricate the Pacbrake oil supply adapter and install it leaving a slight gap (approximately .020) between the rocker arm pedestal and the main body of the oil supply adapter. This ensures that the adapter is neither bent nor broken upon mating with the uneven surface of the pedestal.

10

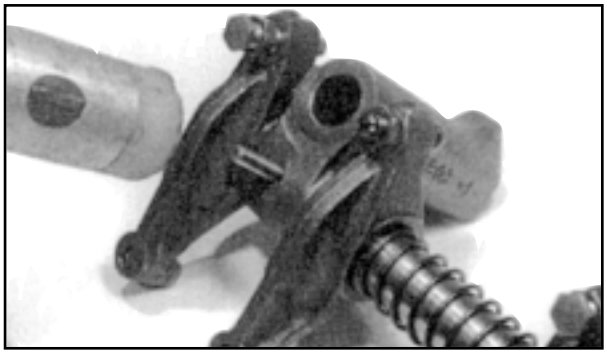
Remove the rear locating pin and replace it with the longer Pacbrake pin, taking care that the chamfered end is down. This pin should be lightly driven until it stops on the bottom inside of the rocker shaft.



NOTE 1: This locating pin, as it is fitted into the milled groove on the undersurface of the housing, ensures proper alignment of the housing with the rocker arm shaft. CAUTION! The studs do not provide this alignment. Adverse wear to the master piston bore will result if you leave this important step out.

NOTE 2: If for any reason the engine should be run with the Pacbrake housings un-installed, each adapter and the locating pin should be replaced with original Caterpillar dowels.

NOTE 3: 9&10 are easier to do with the rocker shaft installed on the engine. This allows the use of a slide hammer pin extractor, and also ensures bore alignment when installing the new parts.



11

Using air pressure, remove oil trapped in the holddown bolt holes.

CAUTION: Eye protection must be worn.

12

Re-install the front rocker assembly taking care to ensure that the push-tubes are in place.

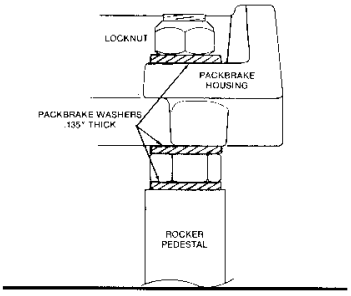
13

Install the two Pacbrake studs complete with Pacbrake washers in the outside locations on the rocker shaft, using engine oil to lubricate the threads and stud heads. Re-use the Caterpillar bolt and washer in the center locations.

NOTE: There are 12 washers in this kit, all the same thickness, Ensure that 8 of them are correctly positioned here, one below and one above the hex on all 4 Pacbrake studs, (see diagram)

14

Center the rocker assembly and snug the studs and bolts firmly. Starting with the center bolt, torque evenly the bolts as well as the studs to 200 lbs.ft. (270 N•m). Torque them again to 330 lbs.ft. (450 N•m) in 50 lb. (70 N•m) increments.



15

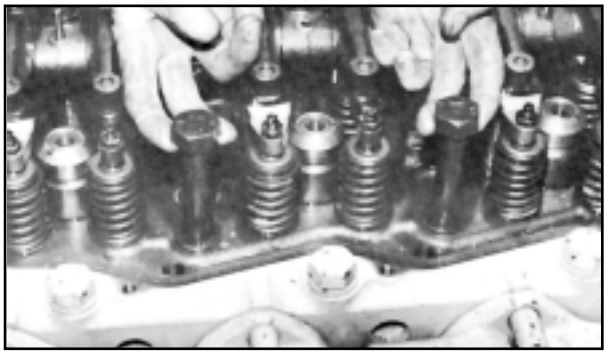
Repeat steps 4 through 14 on rear.

16

Remove Cat head bolts (see illustration for location) on the front of the engine.

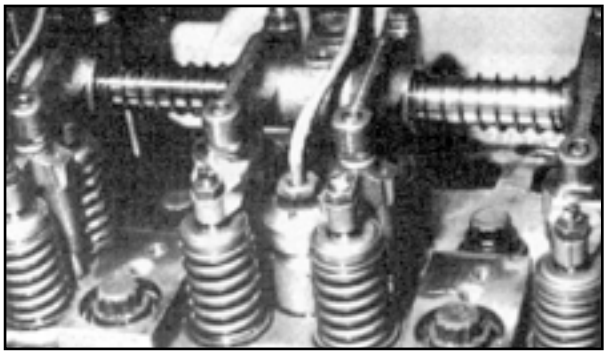
Repeat the oil blow-out procedure on the engine. Lubricate the threads of the Caterpillar bolts and their bearing surfaces.

IMPORTANT: This kit may contain an alternative design of support bases which have the studs attached to the bases.



17

Install the Pacbrake support base in these locations reusing the Cat head bolts and washers, and torque to 330 lb.ft. (450 N•m).



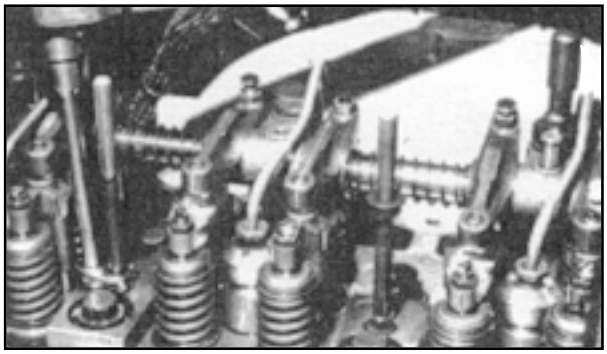
18

A) Install the housing support studs into the support bases (hex nut end into base) and using a 9/16 crowfoot wrench, torque to 50 lb.ft. (70 N•m).

B) Install the 7/16 NF nuts and washers on the studs. CAUTION: Run the nuts to the bottom of the threads. This is necessary to prevent interference with the installation of the housing wear.

19

Repeat steps 16 through 18 on rear.



20

Set intake and exhaust valves at this time according to the Caterpillar manual.

NOTE: If a shim is used to correct a low pedestal, it must be added now, directly above the stud hex and below the hardened steel washer, prior to installing the brake housing.

21

Re-install fuel tubes and torque to Caterpillar specifications 35 lb.ft. (50 N•m).

BRAKE HOUSING INSTALLATION

22

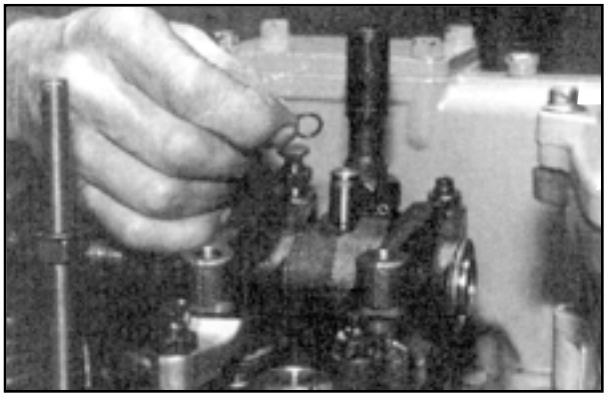
Before installing engine brake housings note that each housing is designed FRONT or REAR. This designation is marked clearly on the distributor body centered in each housing.

23

Install and lubricate the oil supply adapter o-ring. Lubricated the housing oil supply adapter bore.

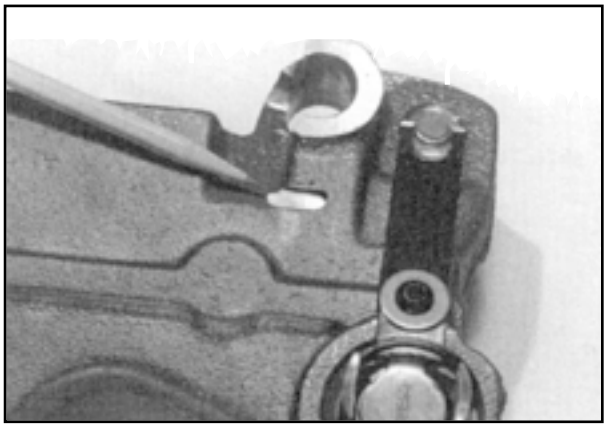
24

Install the front housing over the studs and oil supply adapter taking care that the housing is held level to minimize possible damage to the oil supply o-ring.



25

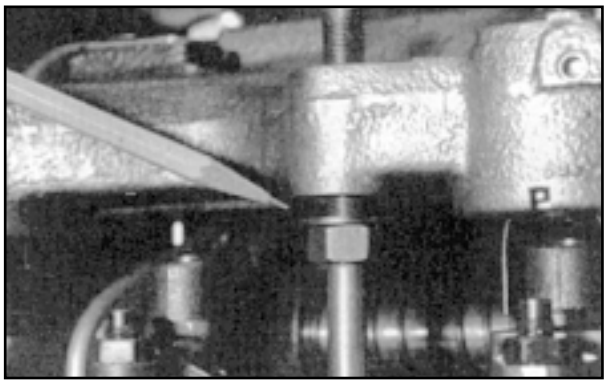
Ensure that the housing is fully down and that the location pin has engaged with the milled locating groove on the undersurface of the housing.



26

Install the 3/4 N.F. nuts with the remaining 4 Pacbrake washers on the housing holddown studs.

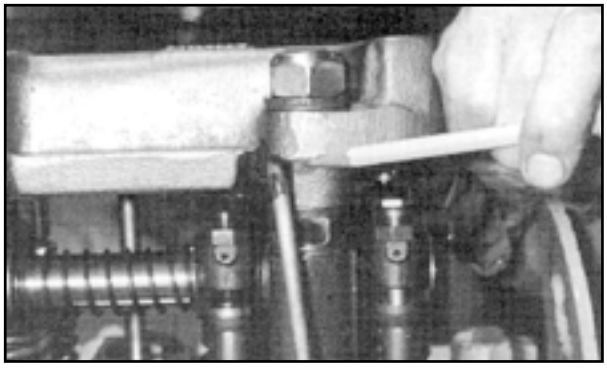
CAUTION: Before torquing, take care that the 7/16 N.F. support bracket nuts and washers are not in contact with the housing. Check once again that the location pin is properly engaged in the groove.



27

From the turbo side of the engine, starting with the left holddown nut, torque both evenly in two steps to 50 lb.ft. (70 N•m). Then to100 lb.ft. (140 N•m).

NOTE: Fuel lines must not come in contact with any part of the engine or engine brake components. Engine damage from fuel contamination could result.



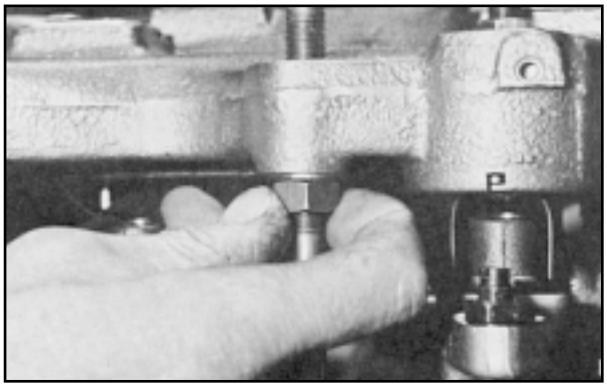
28

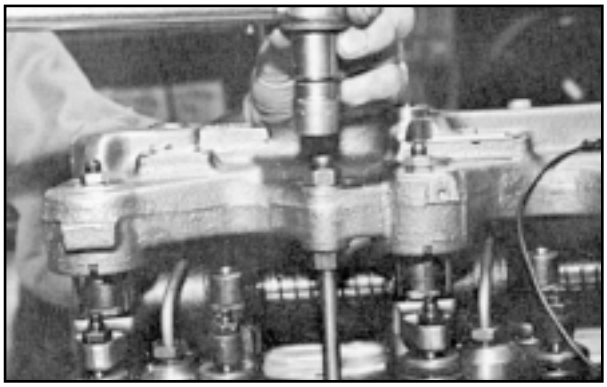
Repeat steps 23 through 27 on rear of engine.

29

Turn the support bracket nuts with the washers up under the housings as tight as possible using fingers only. Install upper washers and nuts and torque to 50 lb.ft. (70 N•m).

CAUTION: The support brackets fix the housing at the height already determined when you torqued the housing at the rocker arm pedestals. It is important that the housing is not forced up or down from this position. Also be aware that the flat washers used on the support bracket studs can momentarily stick to the housing should you remove the engine brake. (These washers could drop into the engine, so exercise care in their removal).

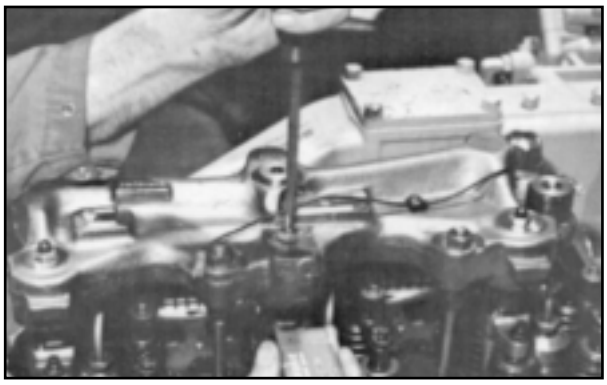




SLAVE PISTON ADJUSTMENT PROCEDURE

30

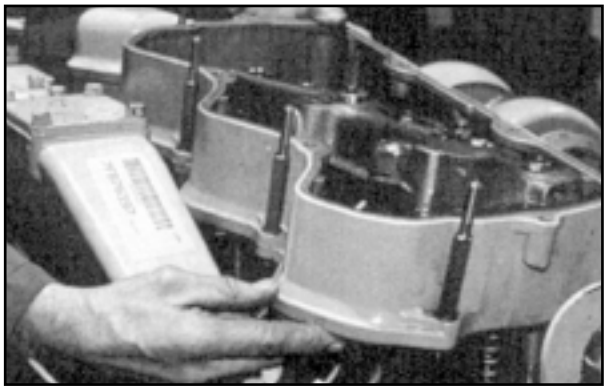
Slave piston adjustment can now be performed at any location that the exhaust crosshead is loose to the touch (has no pressure applied by a rocker arm). Insert a .102 Pacbrake feeler gauge Part #34675 between the slave piston feet and the crosshead. Turn the Paclash adjusting screw down until a slight drag is felt on the feeler gauge and torque the lock-nut to 25 lb.ft. (35 N•m). Re-check the clearance.



31

Install Caterpillar valve cover bases with the four studs and washers (short threaded ends down) on each base located as shown. Use the Caterpillar screws in the other locations.

CAUTION: Ensure proper clearance is obtained between #3 and #6 Pacbrake crossheads and the cover bases. Cover base material may have to be removed.



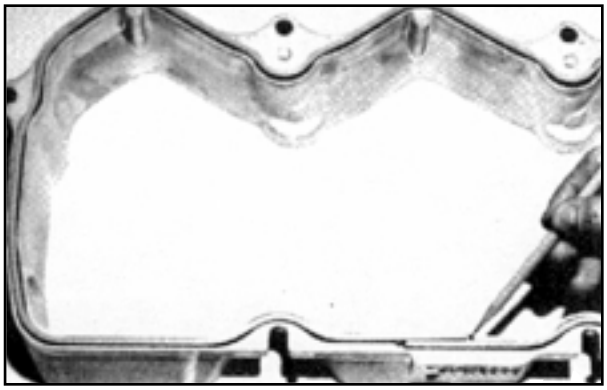
FINAL ASSEMBLY AND ENGINE CHECKS

32

Two types of terminal lead-out bushings are used with the Pacbrake spacer. Both types are installed in the same manner. Apply clean lube oil to the seal ring and tighten until seated.

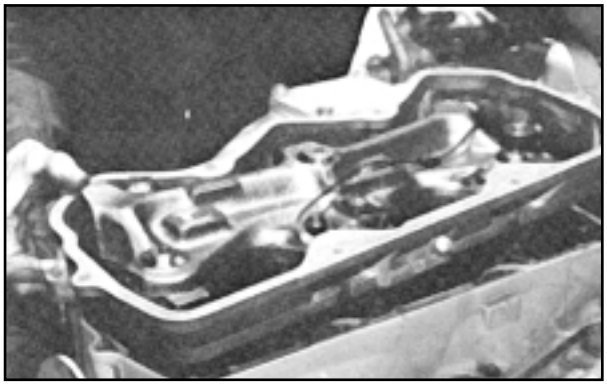
33

Install the Pacbrake gaskets in the spacers, leaving a gap of approximately 1/8" at each end to allow for expansion. Pacbrake gaskets are pre-cut to the approximate length, so that cutting is not necessary.



34

Install the spacers over the base mounting studs.



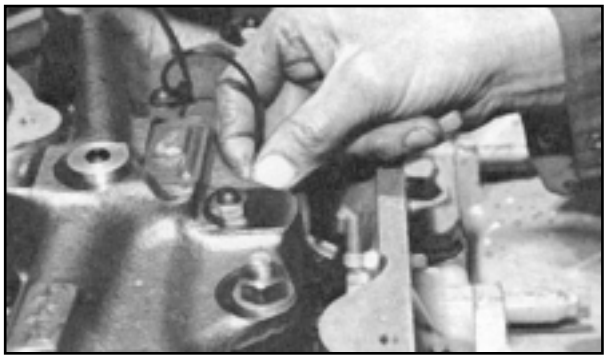
35

Install the Pacbrake serrated nuts and capscrews in the proper locations and tighten evenly to 13 lb.ft. (18 N•m).

36

Install the solenoid wire on the spacer lead-out terminal.

NOTE: We recommend that you double check you installation to this point, then start the engine and idle 5 to 10 minutes.

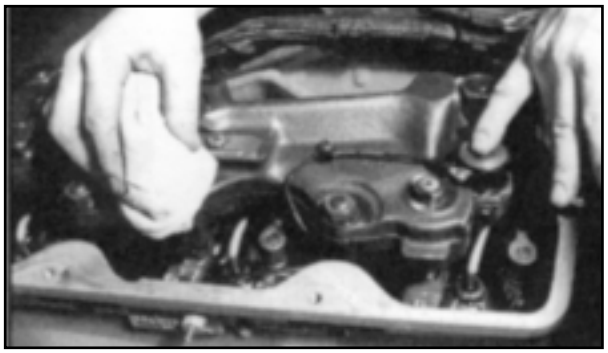


37

With the engine running hold a clean rag over the control valve covers (located on the engine brake housing) to catch oil spray. Depress the solenoid 5 or 6 times to purge the air from the engine brake housings.

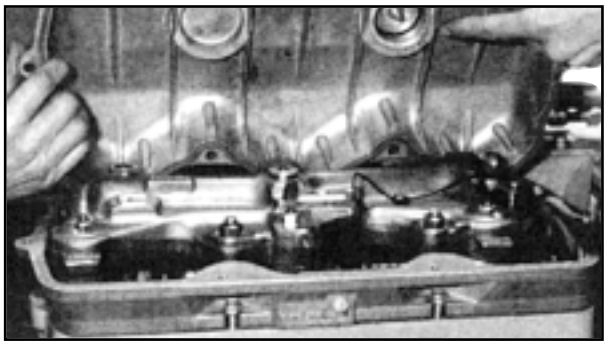
NOTE: With solenoids depressed, slave and master piston movement can also be checked.

A final check for abnormal oil or fuel leaks should be performed.



38

Before installing Caterpillar valve covers, check for interference at oil filler or breather locations. If interference is found, remove cover material (away from the engine) to ensure the necessary clearance.



39

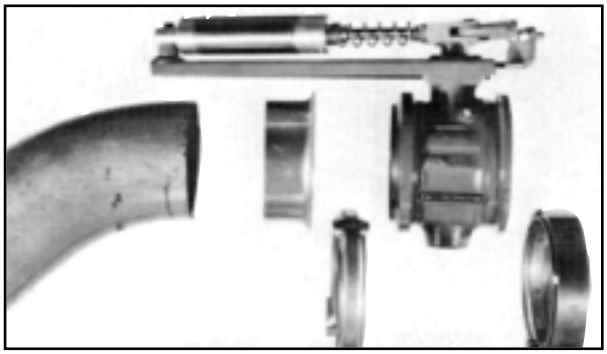
Install valve covers and torque holddown screws to 13 lb.ft. (18 N•m). Relocate breather pipe and install the breather pipe extension hose supplied.

NOTE: Attach the two orange decals supplied with this kit to the valve covers. The information on these decals is important to future servicing of this Pacbrake.

EXHAUST RESTRICTER INSTALLATION

40

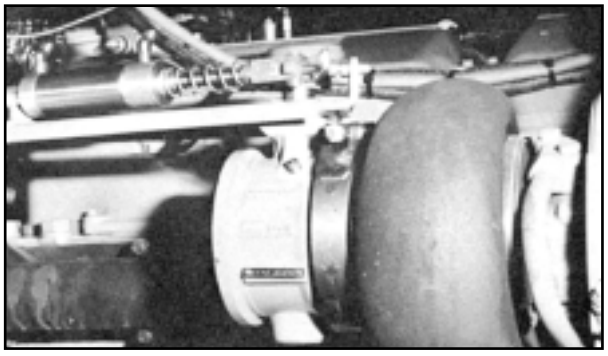
This kit contains an exhaust restricter which mounts in the upright position directly to the turbo. (No more than a 45 degree rotation from vertical in either direction is allowed). In some instances a lack of room may require repositioning of the cylinder and cylinder mounting bracket 90°. If this should become necessary please consult factory for the proper alignment procedures. The restricter can also be mounted downstream from the turbo, but will require a special adapter ring PT # C11752 and minor exhaust modification.



NOTE: All connections between the exhaust restricter and the engine must be leak free, ie. No flex pipe or clamps other than "V" clamps. To ensure maximum efficiency, all exhaust connections, ie. turbo to manifold and manifold to head, must be inspected.

41

Mount the restricter to the turbo with the special "V" clamp provided. The adapter included in the kit is for shortening the exhaust pipe if required. Maintain adequate flex pipe to allow for slight misalignment and to prevent stressing of restricter, turbo, or exhaust manifold. Use the original turbo clamp to connect the exhaust pipe to the non pressure side of the restricter.

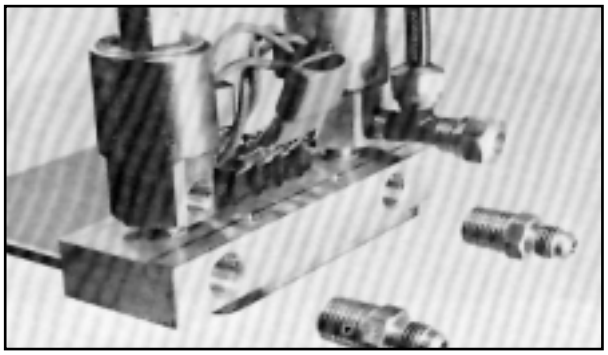


IMPORTANT: Torque "V" clamps to 15 lb.ft. (21 N•m), tap clamp lightly and retorque. Clamps MUST be retorqued after road test to ensure the proper sealing.

CONTROL SYSTEM INSTALLATION

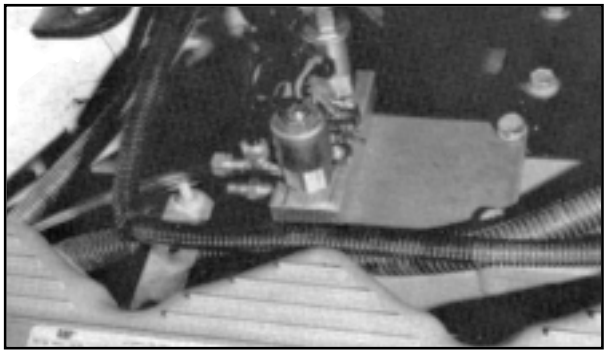
42

Attach two 1/8 NPT x #4 straight fittings to the ports in the aluminum block below each solenoid. Attach the mounting bracket to the solenoid block with two 5/16 x 3/4" capscrews provided.



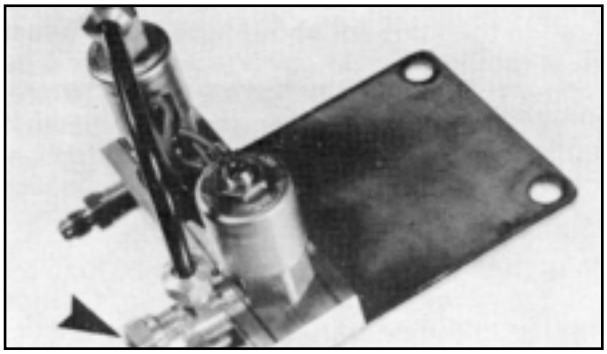
43

Bolt the assembly to the manifold location as shown, alternatively it may be fire wall mounted.



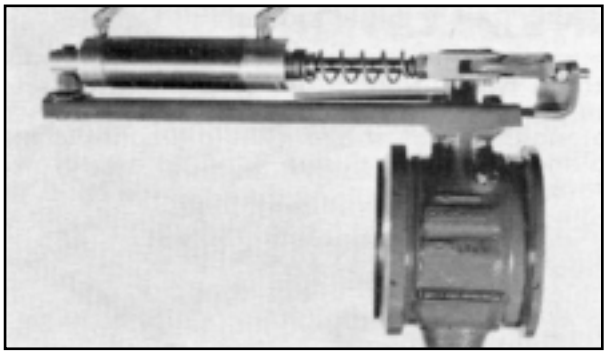
44

Source reservoir air from the dry tank. Using the fittings and nylon tubing provided, plumb this air to the solenoid tee fitting on the block assembly, as shown here.



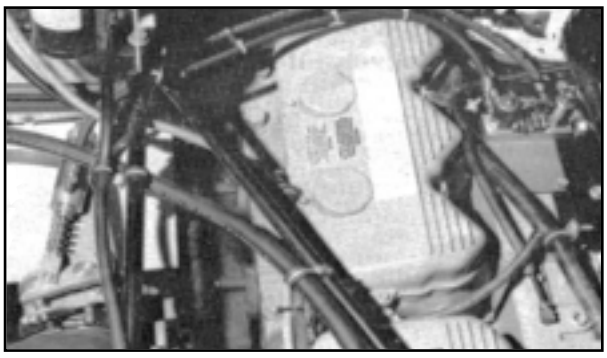
45

Attach two 45˚ 1/8 NPT x #4 fittings to the air cylinder ports on the exhaust restricter.



46

Connect the two wire braid hose assemblies to the air cylinder on the restricter, and route to the fittings on the solenoid block and attach.



NOTE: One hose is slightly longer for ease of installation. (See schematic to determine the correct hose plumbing, ie. which cylinder fitting to which solenoid fitting.

47

Electrical wiring varies with each 3406 electrical system. Engines can have mechanical, PEEC II, PEEC III systems and each type requires a different wiring group.

The P-37 kit is packaged as a basic kit without most wiring and switch components. Please order P-37 kits as follows:

	basic kit		electrical group
(1) Mechanical	P34719	Plus	P34720
(2) PEEC II	P34719	Plus	P34721
(3) PEEC III	P34719	Plus	P34722

Refer to the schematics for the correct installation of the electrical groups.

FINAL ADJUSTMENTS AND TESTS

48

With the engine off and the engine brake circuit energized, a minimum of 11.3 volts must be obtained - measure at both of the engine brake lead-out terminals.

This voltage is important for proper solenoid actuation. Low voltage could result in limited oil supply with the brake housings causing a weak brake.

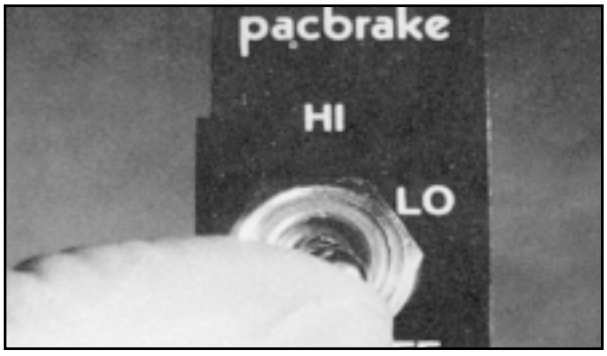
49

The testing of the warm-up system can now be done. (1) Start engine. (2) Turn on warm-up switch, toggle will light. (3) Increase engine RPM to 1000, exhaust restricter is applied and engine is in warm-up mode.

Operation of the warm-up system should always be done as stated above and engine RPM should not exceed 1000 RPM.

50

Prior to road test a check of the electrical system should be performed as follows. To test retarding modes, select low position on the high, low, off switch. The exhaust restricter portion should activate, and the truck should still idle. To activate the engine brake, increase RPM to governed RPM and release the throttle. As engine RPM falls to idle, engine will stall.



FINAL ADJUSTMENTS AND TESTS

51

The exhaust restricter back pressure has been preset and does not require further adjustment. A road test should be done to check the operation of the Pacbrake in both “HI” and “LOW” retarding positions. Recheck the torque on all “V” clamps. Torque should be 15 lb.ft. (21 N•m). In the event a road test must be done to make a backpressure setting, proceed as follows.

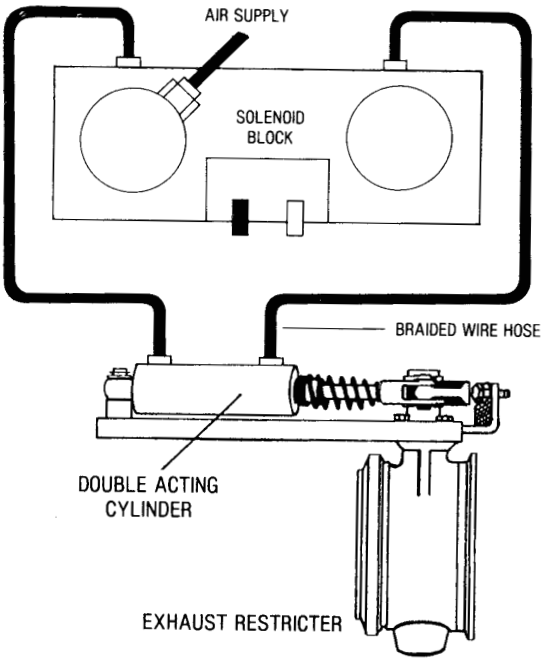
Preparation - The gauge used must be a dampened (liquid filled) type to accurately read the pressure. This gauge kit, part #C10600, can be purchased through Pacbrake's Distribution System. It contains the gauge and all hose and fittings to perform back pressure tests. Remove the 1/8 N.P.T. plug located in the exhaust restricter. Connect the hose with the gauge into this fitting and route into the truck cab to be read during road testing.

Testing - Road testing must provide long durations of 2100 RPM to properly adjust the 50-55 PSI back pressure setting. Do not consider the split-second peak pressure but read the pressure that it settles at. This setting must be done by adjusting the stop screw located on the restricter unit. It is crucial to the operation of this braking system that a minimum of 50 PSI back pressure has been obtained during this test but not exceeding 55 PSI.

IMPORTANT: When setting exhaust restricter backpressure, actuating arm must make contact with adjusting screw stop bolt, to avoid butterfly to wall contact.

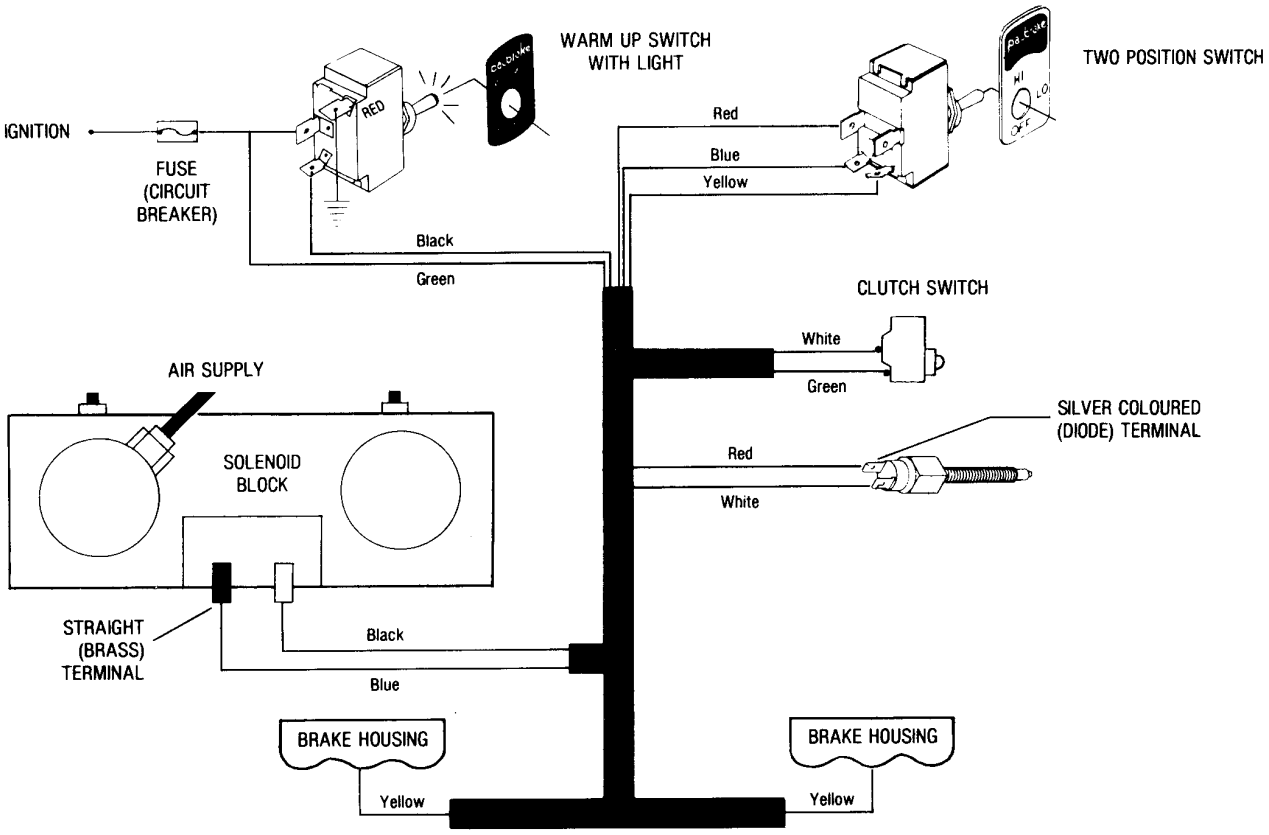
When proper setting is completed, remove the gauge kit and reinstall the plug. Recheck the torque of all “V” clamps. Torque should be 15 lbs.ft. (21 N•m).

PLUMBING SCHEMATIC (ALL MODELS)

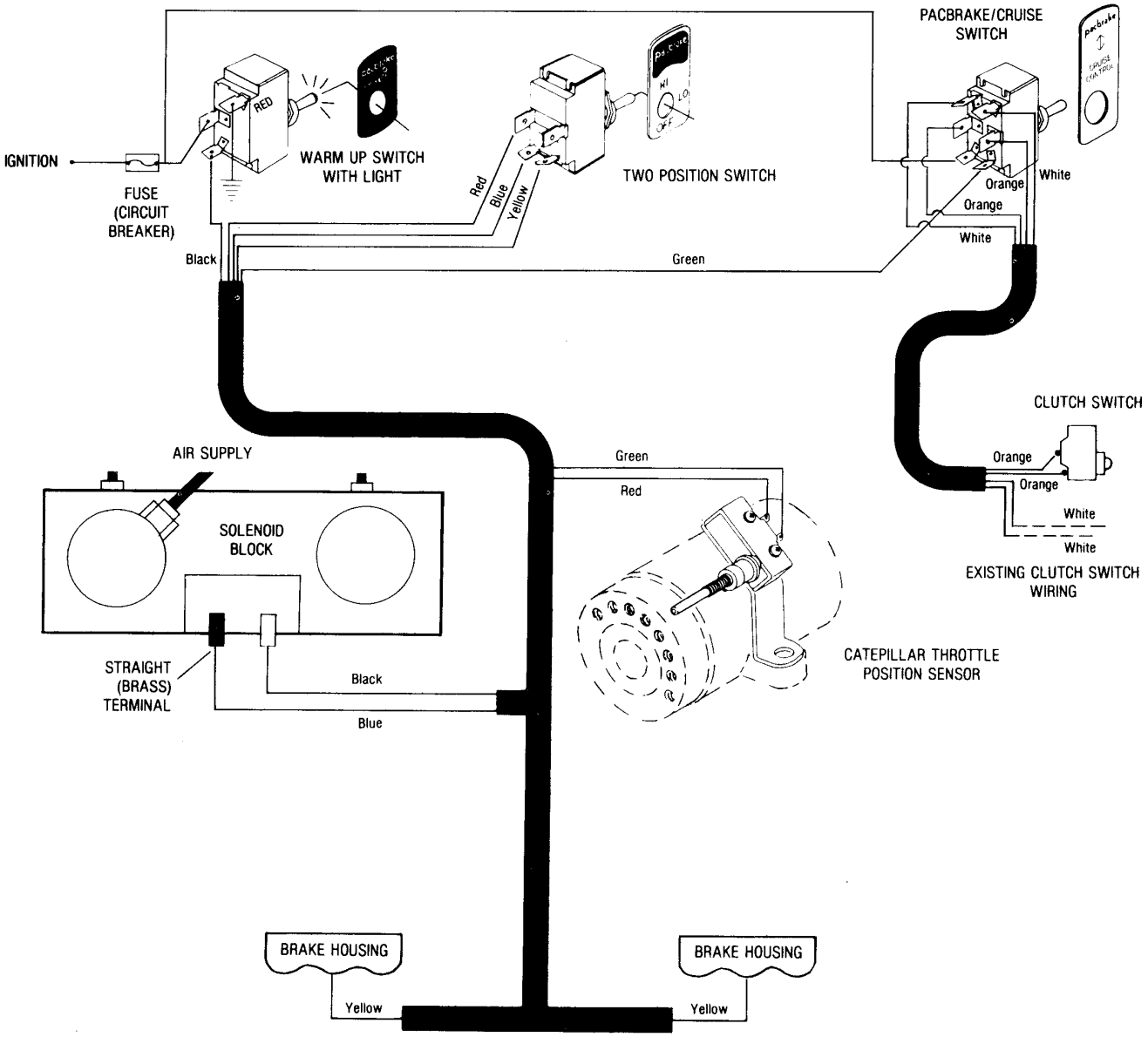


WIRING SCHEMATIC MECHANICAL GROUP 34720

(Harness P828-CT included)



WIRING SCHEMATIC
PEEC III GROUP P34721
(Harness P829-CT included)



PEEC SWITCH INSTALLATION INSTRUCTIONS

1. Install the Pacbrake switch and bracket assembly in the location shown, using the exisiting mounting bolt.
2. Select the appropriate threaded hole in the face of Caterpillars position sensor and with the spacer and two shake-proof washers mount the actuating arm.
3. With the sensor in the idle position set the actuating arm so it has the switch in the closed “clicked” position and lock the 1/4 - 20 capscrew. Torque to 125 lb.in. (14.2 N•m). Operate the throttle to insure the switch is being actuated each time the throttle returns to the idle position and insure no interference exists between the idle and full throttle.

WIRING SCHEMATIC
PEEC III GROUP P34722
(Harness P830-CT included)