SHOP TIPS FROM Autolite Ford

VOL. 5, NO. 10 JUNE, 1967

TROUBLESHOOTING LINKAGE-TYPE POWER STEERING SYSTEMS

Technical parts and service information published by the Autolite-Ford Parts Division and distributed by Ford and Lincoln-Mercury dealers to assist servicemen in Service Stations, Independent Garages and Fleets.

PLUS—PCV VALVE SERVICE AND OTHER TIMELY TOPICS

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TROUBLESHOOTING LINKAGE-TYPE

IN THIS ISSUE

Be sure and file this and future bulletins for ready reference. If you have any suggestions for additional information that you would like to see included in this publication, please write to: Autolite-Ford Parts Division of Ford Motor Company, Ford Products Merchandising Dept., P.O. Box 3000, Livonia, Michigan 48151.

Autolite Ford

VOL. 67 PSM 112 LITHO IN U.S.A.

Fairlane, Falcon, Mustang, Mercury Intermediate, Cougar, and some truck models employ a linkage-type power steering system.

A power cylinder, control valve, pump and reservoir (Fig. 1) comprise the major components, along with linkage, fluid lines and a manual-type steering gear.

An integral-type power steering system is used on later model Ford, Mercury and Lincoln cars. Trouble shooting this type of system will be covered in a subsequent issue of Shop Tips.

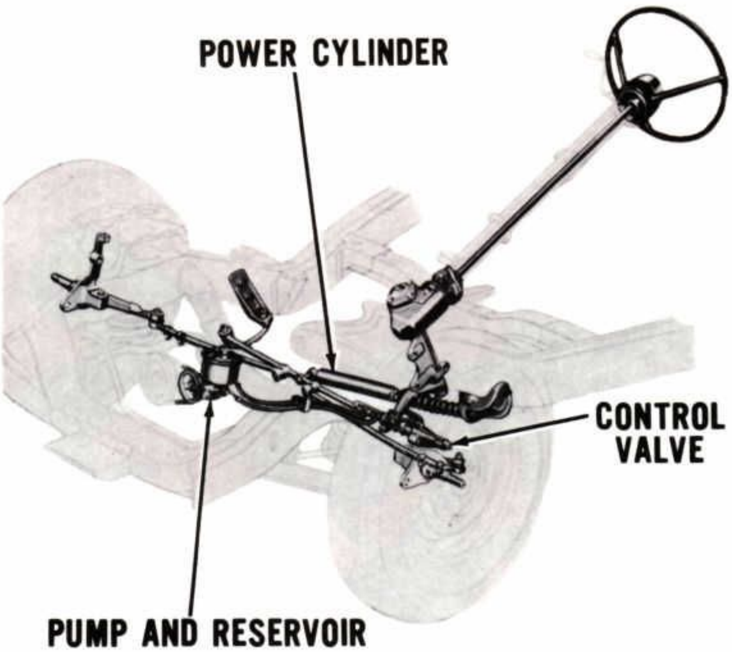


Figure 1—Linkage-Type Power Steering System

The "fixed" end of the power cylinder housing attaches to the steering linkage. The "moveable" piston rod end attaches to frame left side rail. The pump delivers oil under pressure to the control valve. The control valve, in response to right or left turn pitman arm action, directs oil to the appropriate end of the power cylinder, where it exerts the force needed to reduce driver turning effort.

This system is designed to provide long, trouble-free service, with a minimum of periodic maintenance.

Every 6,000 miles the car maintenance schedule calls for checking the reservoir fluid level; checking the drive belt and adjusting if required; and lubricating the steering arm stops. At 36,000 miles the ball stud connecting the pitman arm to the control valve should be lubricated; and on 1964 and prior models, the linkage should be lubricated and the filter replaced in the reservoir.

If any malfunctions such as leaks, inoperative and/or erratic steering occur, a systematic diagnostic procedure should be followed to locate and fully correct the problem. Accurate diagnosis is extremely important since *some* trouble symptoms which APPEAR to be caused by the steering system are also common to suspension, wheel and tire problems. A few preliminary checks will avert unnecessary repairs and save you time and trouble in getting to the heart of the problem.

POWER STEERING SYSTEMS

POWER STEERING PRELIMINARY TESTS

Check Pump Drive Belt

Inspect the pump drive belt for wear, glazing and breaks. If any of these conditions are evident, replace the belt. Be sure and install the specified type of belt. And remember, a drive belt grips on the *sides* of the pulley "V", not the bottom.

Check Drive Belt Tension

Always use a gauge to check drive belt tension (Fig. 2). Checking belt tension by pressing down halfway between two pulleys and measuring the deflection is not always a reliable technique. Drive belts must be neither too loose, nor too tight. Loose belts, of course, cause slipping which can result in less than normal pump output pressure. Equally important, and often overlooked, is the fact that belts which are too *tight* not only will likely fail prematurely, but they cause excessive pulley shaft bearing wear.

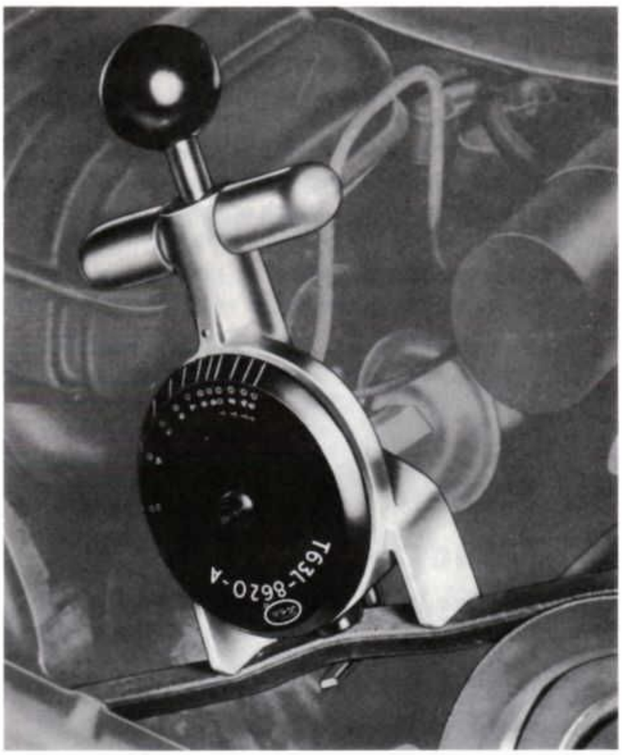


Figure 2--Checking Drive Belt Tension

New belts (run for less than 10 minutes) should be adjusted to obtain a tension of 120-150 pounds. Used belts (run for more than 10 minutes) should be adjusted to obtain a tension of 90-120 pounds.

Caution:

When adjusting the power steering drive belt tension, do not pry against the reservoir. Obtaining belt tension in this manner can damage the reservoir, resulting in leaks. Instead, pry upwards on the ½-inch boss (Fig. 3) with an open end wrench.

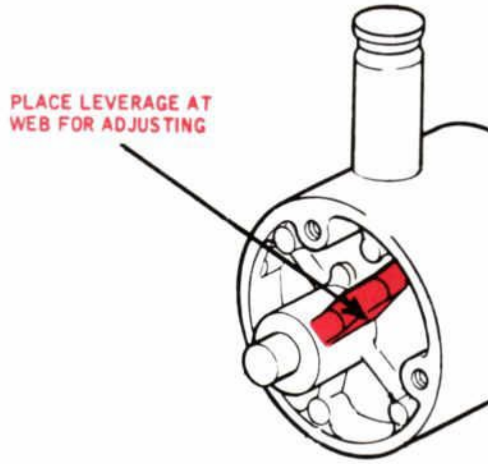


Figure 3—Power Steering Belt Tension Adjustment Lug

Check Fluid Level

Start the engine and run it long enough to bring it to normal operating temperatures. Turn the steering wheel all the way to the left and then to the right several times, to expel any air from the system. DO NOT HOLD THE WHEELS AGAINST THEIR STOPS, as this may cause the oil to become overheated. Shut the engine off, and check the fluid level. The fluid should be to the "F" mark on the dip stick, or to the bottom of the filler neck on pump reservoir with a straight filler tube (Fig. 4). If the fluid is low, add Rotunda automatic transmission fluid, Ford Part No. C1AZ-19582-A, or equivalent. DO NOT OVERFILL THE RESERVOIR.

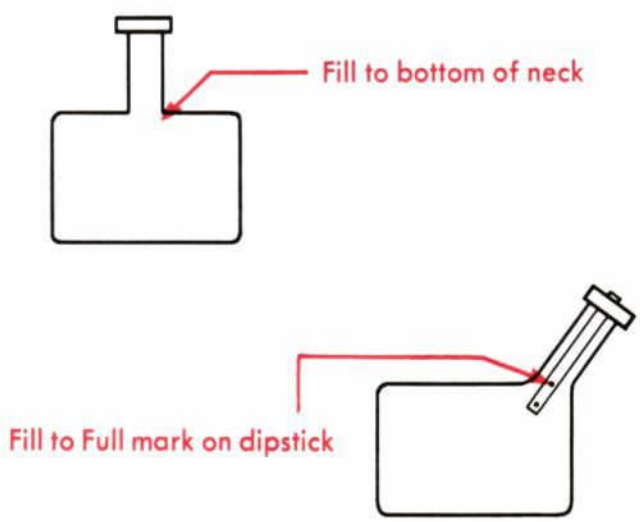


Figure 4—Full Marks—Power Steering Reservoir

TROUBLESHOOTING LINKAGE-TYPE

General Front End Inspection

A general front end inspection is important to help determine if steering problems are caused by power steering components, or by wheels, tires and suspension components.

1. Check for tire wear and specified air pressure in all four tires.
2. Raise the front of the car off the floor. Shake each front wheel, grasping the upper and lower surfaces of the tire, to check the front suspension ball joints and mountings for looseness, wear and damage. Check the brake backing plate mountings. Tighten any loose nuts and bolts. Replace any worn parts.
3. Check the steering gear mounting and all steering linkage connections for looseness. Tighten any loose nuts and bolts. Worn or bent parts should be replaced.
4. Check front wheel bearing adjustment. Replace worn or damaged bearings.
5. Spin each front wheel, and check wheel balance.
6. Jounce each corner of the vehicle to test shock absorber action. If the vehicle doesn't quickly settle in the normal, level position, check the shock absorber and replace as required.

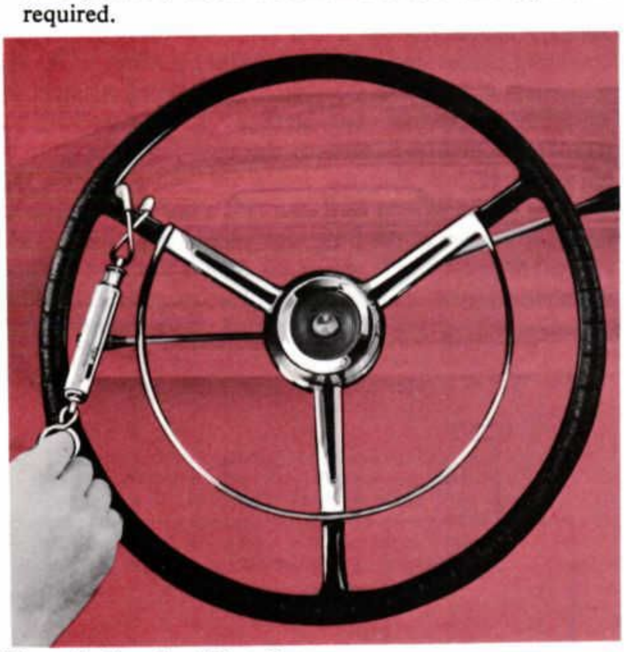


Figure 5—Turning Effort Test

PERFORMANCE TESTS

Turning Effort Test

With the front wheels properly aligned and tire pressure correct, check the effort required to turn the steering wheel.

1. With the car on the dry concrete, set the parking brakes. With the engine warmed up and operating at idle speed, turn the steering wheel to the left and right several times to warm the fluid.
2. Attach a pull scale to the steering wheel (Fig. 5). Check the effort required to turn the wheel at least one complete revolution in both directions. The specified torque should be approximately 4½ pounds and equal in both directions. If the turning effort is excessive, a worm bearing preload and sector mesh load test should be made.

Worm Bearing Preload and Sector Mesh Load Test and Adjustment

1. Remove the fluid from the power steering reservoir with a suction gun. Disconnect the fluid return line from the reservoir. Place the end of the return line in a container and turn the steering wheel in both directions as required to discharge the fluid from the gear.
2. Working from under the car, disconnect the pitman arm from the steering gear. Remove the hub cap from the steering wheel.
3. Turn the steering wheel to either stop. Attach an in-lb torque wrench to the steering wheel attaching nut (Fig. 6). Measure the force required to move approximately 20 degrees away from the stop. If the reading is not within 3-4 in-lbs, loosen the bearing adjuster locknut on the steering gear, and tighten or loosen the adjuster to bring the worm bearing preload within specifications.
4. Locate the mechanical center of the steering gear by rotating the steering wheel all the way from right to left, then back the wheel off exactly ½ the total number of turns.

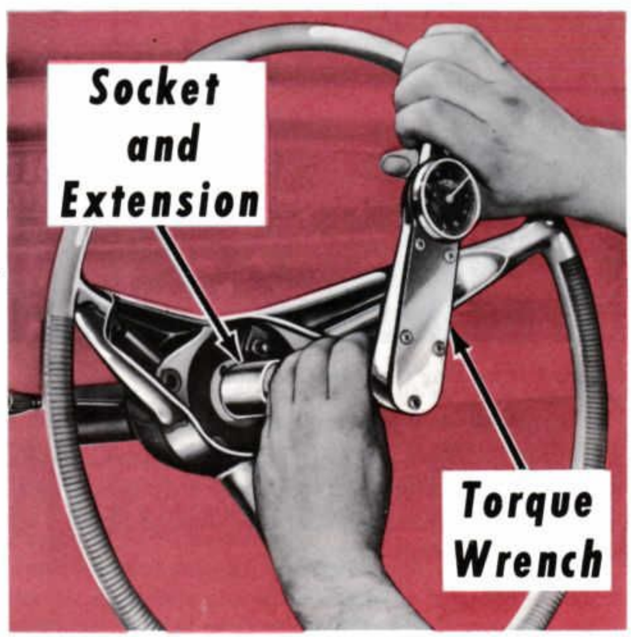


Figure 6—Steering Gear Load Test

5. Rotate the steering wheel at least ¼ turn to the left. Using an in-lb torque wrench, turn the steering wheel through center at a constant pull. Read the torque at the exact mechanical center. Rotate the wheel to the right of center and again take a reading as the wheel is turned through the center position. If two slightly different readings are obtained, the larger should be recorded as the total on-center mesh load.
6. If total overcenter mesh load is not within 8-9 in-lbs, loosen the sector shaft adjuster locknut, and turn the adjuster screw to obtain the proper mesh load. NOTE: 1/16 turn of the adjuster will increase the mesh load approximately 2 in-lb.

   Tighten the adjuster locknut, making sure the adjuster screw does not turn. Recheck the mesh load.

Fluid Pressure Test

A fluid pressure test will show whether the pump or some other unit in the power steering system is causing trouble in the system. If the following steps indicate that the pump is operating properly, then the trouble must be in some other part of the system.

1. Disconnect the pressure line hose from the pump outlet, and install a pressure testing tool between the hose and the pump outlet (Fig. 7). Be sure that the pressure gauge is between the pump and the shut-off valve on the tool.

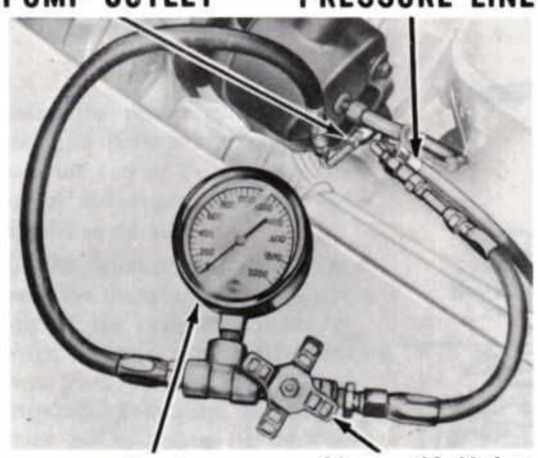


Figure 7—Pressure Test

2. Open the shut-off valve on the testing tool, and operate the engine at idle speed. If the pump normally operates quietly, ignore the louder pump noise when the pressure testing tool is connected to the system. Allow at least two minutes for the fluid to warm up before starting the pressure tests.
3. Turn the front wheels all the way to the right and then to the left, noting the fluid pressure reading on the gauge when each wheel is against its stop.

   Normal pressure is 750-900 psi. Do not hold a wheel against its stop for more than three to five seconds at a time because the fluid may overheat.
4. If the fluid pressure, with a wheel against its stop, is less than 750 psi, turn the wheel off the stop. Slowly close the testing tool shut-off valve, and watch the gauge for an increase in pressure. Do not leave the valve closed for more than three to five seconds.
5. If the fluid pressure, with the shut-off valve fully closed, still shows less than 750 psi, the pump is causing the trouble. If the pressure increases to normal pressure range, the trouble is in either the control valve or the power cylinder.
6. After the fluid pressure test is complete, shut off the engine and remove the pressure testing tool. Make the necessary repairs or replacements to eliminate the trouble in the system.

LEAK TESTS

In any type of hydraulic system, there is always the possibility of leaks developing at connections and seals. Figure 8 illustrates some points where they are most likely to occur. However, because oil tends to run and spread over the surface areas, it is sometimes difficult to locate the *exact* spot when the leak area is covered with dust and dirt. The following procedures will assist in finding and correcting four types of power steering hydraulic leaks.

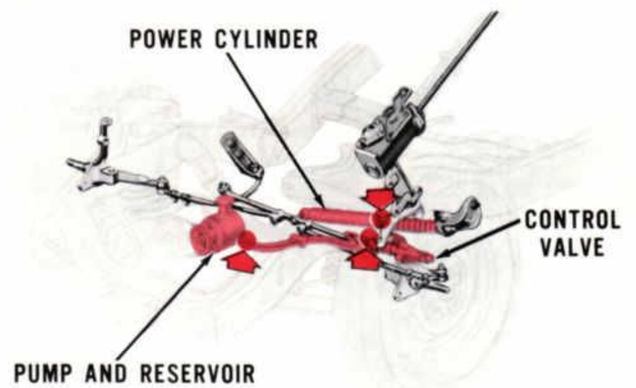


Figure 8—Leakage Check Points

1. Fitting and Tube Seat Leaks

Since most fluid leaks occur at the fittings and connections, these parts should be checked first. Leaks are usually due to loose fittings, damaged fittings, or malformed tube seats.

Recommended Corrective Procedure

1. Clean all oil, dirt or grease from the outside of the control valve, power cylinder, bottom of the pump and all lines and fittings.
2. With the engine running, inspect all these components and connections.
3. Tighten those fittings (refer to Fig. 9 for torque specifications) where leaks appear, using a special 5-flat tube wrench.

   Do not tighten the fittings with a standard open-end wrench. To detect leaks, it may be necessary to pressurize the system by starting the engine and turning the wheels from lock to lock. *Do not hold the steering wheel against the stops for more than five seconds, or the fluid may overheat.*
4. If a properly torqued fitting continues to leak, it will be necessary to inspect the fitting, line flare and tube seat for damage. Tube seats can be removed by using an Easy-Out tool, or by using a bolt of appropriate size as follows:
   1. Tap the hose seats with a tap of suitable size, removing all metal chips from the hole. Heavy grease applied to the top will hold most of the chips.
   2. Place a nut and a flat washer large enough to cover the seat port on a bolt of appropriate size. Then insert the bolt in the tapped hole and turn it to pull the seat out of the port.
   3. Position a new seat in the port, and thread a bolt of the same size into the port and tighten the bolt until the seat bottoms. Do not apply excessive torque, as a distorted tube seat orifice will limit oil flow and cause noise.

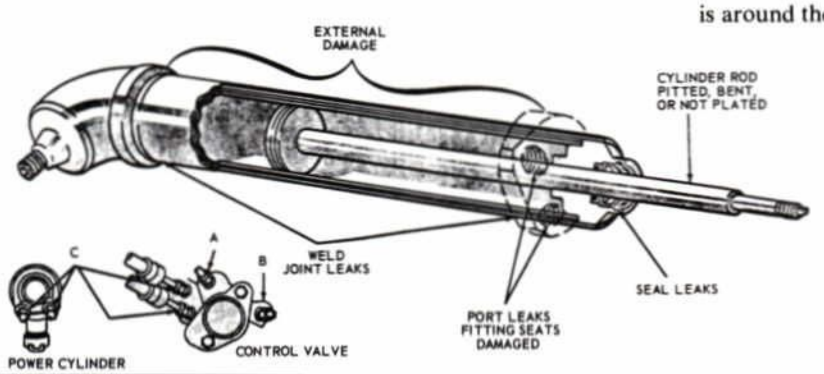
Refer to the following chart for tube seat application:

TUBE SEAT APPLICATION CHART

TUBE SEAT	FORD PART NUMBER
¼"	372895-S
5/16"	373430-S
⅜"	372896-S

2. Power Cylinder Leaks

The most probable location for leaks at the power cylinder is around the piston rod seal (Fig. 9).



TUBE LOCATION	SEATS SIZE	PART NO.	HOSE FITTING TORQUE
A	3/8"	372 896-S	10-20 LB. FT.
B	1/4"	372 895-S	6-9 LB. FT.
C	5/16"	373 430-S	14-18 LB. FT.

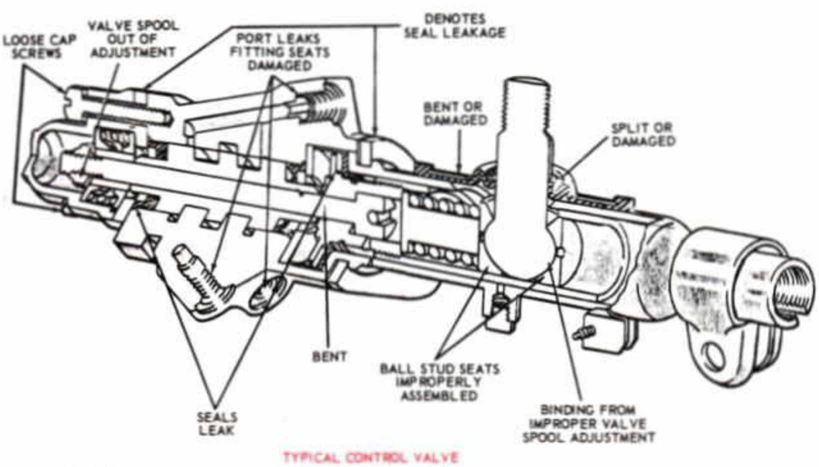


Figure 9—Control Valve and Power Cylinder Diagnosis Guide

Recommended Corrective Procedure

If the leak detection procedure outlined for problem No. 1 discloses leakage through the seal, install power cylinder seal repair kit (Ford Basic Part Number 3A764) as shown in Figure 10. Do not replace the power cylinder assembly unless the piston rod is binding, scored, or has a dull-gray finish instead of a high-luster chrome finish.

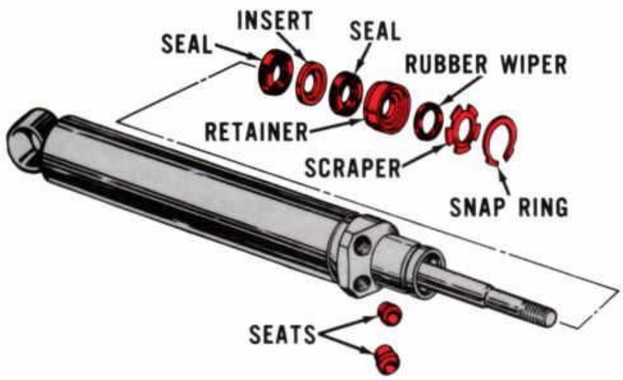


Figure 10–Power Cylinder

Power Cylinder Seal Replacement

The power steering cylinder seal can be replaced with the cylinder in the vehicle, but the operation is more convenient if the work is done at the bench.

Removal

1. Clamp the power cylinder in a vise, and remove the snap ring from the end of the cylinder. Be careful not distort or crack the cylinder in the vise.
2. Pull the piston rod out all the way to remove the scraper, bushing and seals. If the seals cannot be removed in this manner, remove them from the cylinder with a sharp pick. Take care, when using a pick, not to damage the shaft or seal seat.

Installation

When replacing the power cylinder seals, install all of the parts supplied in the repair kit for the cylinder being repaired.

1. Coat the new seals with silicone lubricant (Ford Part Number C0AZ-19553-A) and place the parts on the piston rod, which has been coated with the same grease.
2. Push the rod in all the way, and install the parts in the cylinder with a deep socket slightly smaller than the cylinder opening.

3. Control Valve Leaks

Leaks in the control valve usually involve the spool valve seals (Fig. 9).

Recommended Corrective Procedure

If the leak detection procedure outlined for problem No. 1 discloses leaks somewhere other than the tube seats, such as leakage at the actuator end or between the end cap and the valve body (Fig. 9), replace all the seals using a control valve seal repair kit (Ford Basic Part Number 3A650). Use all the parts in the kit (Fig. 11), and be sure they are properly installed. When assembling the new seals in the valve, an application of silicone grease to the internal parts will help to provide a better seal against future leakage. Apply grease to the centering spring area, especially on the cap and spacer mating surfaces. Coat the threads of the cap retaining bolts with grease. The rubber boot seals, the actuator assembly, and the metal cup seals in the control valve should also be coated with silicone grease.

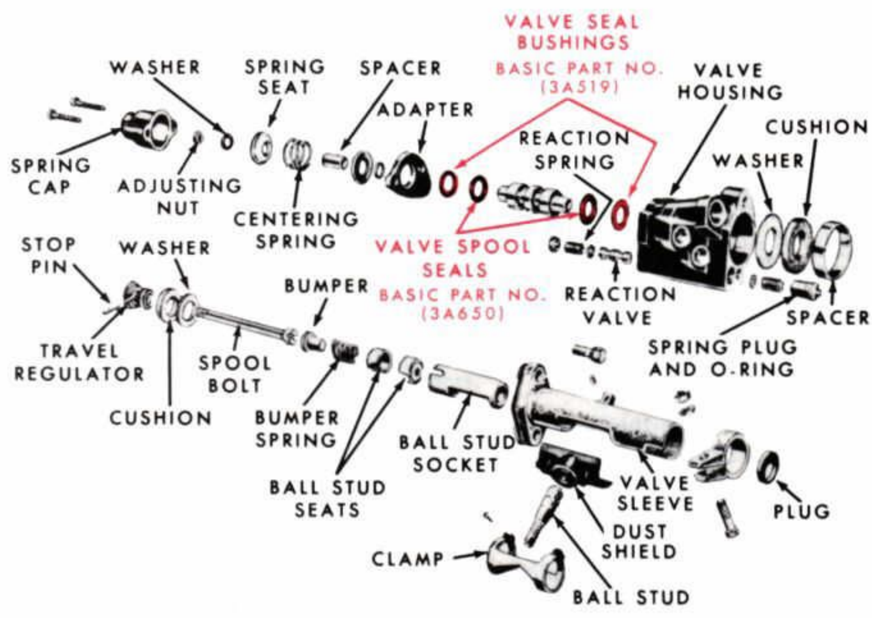


Figure 11–Control Valve–Exploded View

TROUBLESHOOTING LINKAGE-TYPE

NOTE: Over-heating is indicated if disassembly of the valve reveals melted plastic seal containers (Fig. 11). Valves exhibiting this condition can be rebuilt using new retainers (Ford Basic Part Number 3A519) in addition to the 3A650 seal kit. However, the following additional checks are recommended to preclude recurrence.

A. Check hose routing for kinks.
B. Perform system pressure test to possibly isolate the point of restriction.
C. Based on results of the pressure test, inspect the component connections, hose tube flares and hose I.D. for internal restrictions.
D. Check to see the system has the correct amount of fluid and there are no leaking connections.

Figure 12—Disconnecting Control Valve from Pitman Arm

CONTROL VALVE

Removal

1. Disconnect the pressure lines, leading from the power cylinder to the control valve, at the valve. Allow the lines to drain into a container.
2. Disconnect the lines, leading from the power steering pump to the control valve, at the valve. Allow the lines to drain into a container. Remove the clamp that secures the lines to the valve.
3. Remove the bolts that secure the control valve to the steering arm-to-idler arm rod.
4. Remove the cotter pin and the castellated nut that secures the control valve to the pitman arm; then remove the control valve from the pitman arm using tool 3290-C (Fig. 12).
5. Inspect the tube fittings and the seats in the valve for nicks, burrs or damage. Replace the seats in the valve or the tubes, as required.

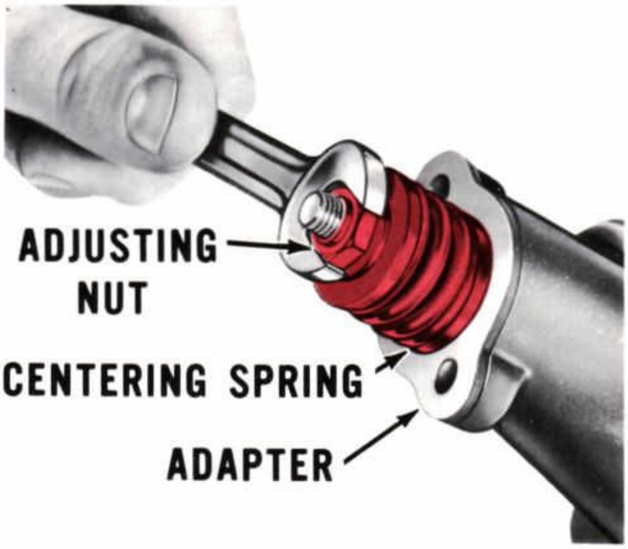


Figure 13—Adjusting Centering Spring

Control Valve Adjustments

Figure 13 shows the centering spring adjustment for a linkage-type power steering unit. A need for this adjustment is indicated when a check of steering effort shows more effort is required to turn the steering wheel in one direction than is needed to turn it in the opposite direction, or if power assist is lost in one direction only. With the cover removed as shown, turn the nut clockwise until it bottoms lightly, and back it off ¼ turn. Check the valve spool for freedom of movement by moving the ball stud backward-and-forward along the sleeve. The movement should be approximately 1/16 inch.

Installation

1. Place the stud in a straight-vertical position. Measure from the center of the stud parallel to the bolt mounting surface to the center of the first bolt hole. The distance should be within the specified limits (4¼"-4⅜") as shown in Figure 14. If not within these limits, adjust the length as required.
2. Secure the control valve stud to the pitman arm with the castellated nut and a cotter pin.
3. Secure the end of the control valve to the steering arm-to-idler arm rod.
4. Connect the pressure line and the oil return line to their respective fittings on the valve. Install the line retaining clamp around the valve.
5. Connect the two lines from the power cylinder to their respective fittings on the valve.
6. Fill the reservoir to the correct level.

FILL FORD POWER STEERING RESERVOIRS WITH ROTUNDA AUTOMATIC TRANSMISSION FLUID (FORD PART NO. C1AZ-19582-A) OR EQUIVALENT.

7. Start the engine and turn the steering wheel to each end of its travel several times to cycle the system. Stop the engine.
8. Check the fluid and fill to the required level.
9. Start the engine and check for leaks.

4. Pump Leaks

Internal leakage may occur at the seals, or the pump body. External leakage points are the shaft seal at the front of the pump and the pump housing seals.

Recommended Corrective Procedure

If any leaks develop at the pump, do not disassemble to replace the defective parts. Instead, replace the pump.

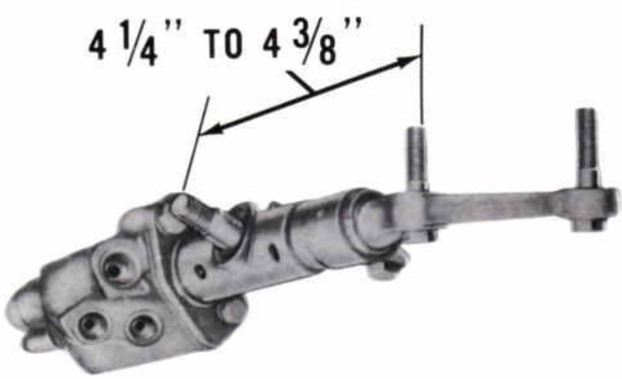


Figure 14—Control Valve Length Adjustment

INOPERATIVE AND/OR ERRATIC STEERING

A number of conditions may cause inoperative and/or erratic steering; not all of them in the power steering system. Here are three power steering malfunctions, and the recommended corrective procedure.

1. Damaged Front Suspension or Steering Linkage

Visually inspect the front suspension and steering linkage (especially the control valve and power cylinder) for signs of external damage (Fig. 9).

Recommended Corrective Procedure

Replacement of damaged components is essential since this condition may be imposing a bind on the piston rod, actuator or internal valving, which will render the steering system inoperative or erratic.

NOTE: Damage to these components may occur if care is not exercised when positioning the hoist adapters on two (2) post hoists, prior to lifting the vehicle.

2. Bound (Bent) Control Valve Actuator

This is often caused by incorrect removal of the control valve stud from the pitman arm.

Recommended Corrective Procedure

Ford tool 3290-C must be used as shown in Figure 12 to prevent damage to the actuator assembly.

3. Bound Control Valve Actuator and Ball Stud

This condition can be caused by an improper spool valve adjustment.

Recommended Corrective Procedure

After removing the valve centering spring cap, tighten the adjusting nut to 90-100 inch pounds (8 ft. lbs.), then back the nut off ¼ turn. Since the spool bolt will tend to rotate when backing the nut off, be sure the nut actually makes ¼ turn (90°) on the threads of the bolt.

NOTE: The design of the valve permits limited rotation of the spool bolt. Complete freedom of rotation indicates improper valve assembly.

The above recommendations are primarily concerned with control valve and power cylinder problems. There are conditions where other components directly affect steering operation, or cause leakage. These conditions will require extending the diagnosis to the entire system and performing the necessary repairs. The following diagnosis chart indicates many of these troubles, plus the cause, and the remedy for each problem.

TROUBLESHOOTING LINKAGE-TYPE POWER STEERING SYSTEMS

POWER STEERING DIAGNOSIS CHART

TROUBLE	CAUSE	REMEDY
(1) Sticky feeling, off center or poor recovery.	(a) Steering wheel bind at steering column.	(a) Check and adjust steering column clearance at steering wheel.
	(b) Steering gear shaft bind in column.	(b) Check and align steering column tube at Firewall (Flex Coupling) or align Gear Housing at Frame (solid shaft), if necessary.
	(c) Excessive gear, mesh preload.	(c) Check and adjust sector shaft preload.
	(d) Interference of pitman arm and valve sleeve at ball stud connection.	(d) Replace pitman arm dust-shield and/or ball stud.
	(e) Interference of ball stud in "T" slot of valve sleeve.	(e) Check valve position and install indexing pin. If condition still exists, remove and discard pin. Set valve rotation in central position and tighten clamp bolt.
	(f) Ball stud adjustment too tight.	(f) Readjust.
	(g) Adjustment of valve spool nut too tight.	(g) Readjust.
	(h) Binding valve spool. **NOTE:** If adjustments (f) and (g) do not correct trouble, check for burrs, dirt or other foreign matter.	(h) Clean and remove burrs with crocus cloth using extreme care not to round off sharp edges. Replace valve spool and housing.
	(i) Excessive breakaway friction of cylinder rod seal.	(i) Replace seal and scraper.
	(j) Steering linkage bind.	(j) Eliminate bind.
	(k) Damaged valve sleeve housing.	(k) Replace sleeve housing.
	(l) Bent cylinder rod.	(l) Replace cylinder.
	(m) Loose cylinder mounting bracket.	(m) Tighten cylinder mtg. bracket attaching bolts and/or replace RIV nuts in side rail.
(2) Excessive free play or lost motion in steering.	(a) Improper sector shaft or mesh preload.	(a) Readjust gear preload.
	(b) Improper valve sleeve ball stud adjustment.	(b) Correct valve sleeve stud adjustment.
	(c) Improper valve adjustment. (Spool nut too loose)	(c) Correct valve spool bolt nut adjustment. Replace defective adjustment parts.
	(d) Excessive play in steering linkage.	(d) Check and correct.
	(e) Excessive negative caster.	(e) Correct front end alignment.
	(f) Defective valve center spring.	(f) Replace spring.
	NOTE: A defective valve center spring is one that is broken or is loose when spool bolt nut is properly adjusted and before end cap is installed.	
(3) Loss of power assist.	(a) Inoperative pump.	(a) Replace pump.
	(b) Damaged lines.	(b) Replace lines.
	(c) Internal parts of power cylinder broken or damaged.	(c) Replace cylinder.
	(d) Extreme maladjustment of valve spool bolt nut.	(d) Adjust valve spool bolt nut. Replace parts necessary.
	(e) Inoperative or loose by-pass check valve.	(e) Replace check valve or reinstall.
(4) Loss of power—one direction.	(a) Maladjustment of valve spool bolt nut in valve.	(a) Adjust valve spool bolt nut.
	(b) Broken reaction limiting spring.	(b) Replace spring.
(5) Oil Leaks.	(a) Loose or damaged hose connection or tube seats.	(a) Tighten or replace hoses. Replace tube seats.
	(b) Leaking valve seals.	(b) Replace seals.
	(c) Leaking cylinder seals.	(c) Replace seals and scraper.
(6) Hard steering.	(a) Low pump output.	(a) (1) Improper belt tension. (2) Inoperative pump. (3) Low pump fluid level.
	(b) Improper gear mesh preload.	(b) Correct adjustment.
	(c) Sticky valve spool.	(c) Free up valve spool.
	(d) Excessive valve leakage.	(d) Replace valve seals.
	(e) Excessive cylinder leakage.	(e) Replace cylinder seals.
	(f) Linkage bind.	(f) Eliminate linkage bind.
	(g) Lack of lubrication.	(g) Lubricate.
	(h) Improper valve spool adjustment.	(h) Adjust valve spool.
	(i) Improper ball stud adjustment.	(i) Adjust ball stud.
(7) Chatter.	(a) Loose cylinder mounting bracket.	(a) Tighten all cylinder mounting nuts to bottom nuts on shoulders.

PCV VALVE SERVICE... A WARRANTY REQUIREMENT

WARRANTY SERVICE REQUIREMENTS

The introduction of Ford Motor Company new models for 1967, and the accompanying 5 year/50,000 mile warranty for new cars and light trucks, brought about some significant changes in service requirements. Most significant were a number of *Minimum Maintenance Services* which must be performed at specified intervals and verified by the serviceman. Cleaning the positive crankcase ventilation system and replacing the PCV valve every 12,000 miles is one of the minimum maintenance services (Fig. 1) required to keep the warranty in effect.

MINIMUM MAINTENANCE SERVICES

ITEM	INTERVAL
Clean emission system hoses, tubes, (oil separator if so equipped), fittings, carburetor spacer and replace emission control valve, and replace thermactor air pump filter if so equipped.	Every 12 months or 12,000 miles

Figure 1—PCV Valve Service—A Warranty Requirement

IMPORTANCE OF PCV SERVICE

The minimum maintenance services includes the PCV system because it is just as important in helping to achieve and maintain the total performance designed into every Ford as services like changing the oil and filter, chassis lubrication, and carburetor air cleaner maintenance. A clean PCV system and a properly operating valve provides:

- More efficient crankcase ventilation . . . resulting in less engine sludge.
- Cleaner engine compartment . . . as a result of eliminating oil vapor emission.
- Increased bearing and engine life . . . as a result of decreased engine contaminants.
- Better gas mileage because blow-by fumes are recycled into the combustion chamber, instead of being wasted.

However, a dirty or plugged system or a malfunctioning PCV valve may cause:

- Rough engine idle due to excessive air flowing into the intake manifold because of a stuck valve.
- Fumes to escape from the oil filler cap because of a dirty system, resulting in contaminated crankcase oil, rusting and corrosion of engine parts.
- Oil to be forced out of the dipstick because of a plugged system.

It should be obvious that although PCV service is *required* only on 1967 models, it is equally important on 1966 and earlier models where PCV service is a *recommended* maintenance item. Every service technician should make an extra effort to inform his customers of the importance of PCV service in maintaining high engine efficiency. The valves are relatively inexpensive and it takes only a few minutes to thoroughly clean all the tubes and fittings.

"OPEN" AND "CLOSED" PCV SYSTEMS

Two general types of positive crankcase ventilation systems are used on Ford vehicles; "Open" and "Closed" PCV. Functionally, they are the same in that both recycle "blow-by" gases which pass the piston rings, as well as condensation vapors and crankcase fumes, back into the intake manifold where they combine with the carburetor air-fuel mixture and are burned in the combustion chamber. Essentially, the "open" and "closed" PCV systems differ only in the way ventilation air enters the system; from which each system derives its name.

Ventilation air for the "open" system enters through the oil filler cap, which contains a filter to clean the air, flows from the valve cover down into the crankcase, and then is metered through a spring loaded ventilation (regulator) valve into hoses which route the fumes into the air-fuel mixture at the carburetor spacer plate.

Ventilation air for the "closed" system (Fig. 2) enters through the carburetor air cleaner, where it's cleaned by the air filter or a special screen-type secondary filter, and then routed to the valve cover, down through the crankcase and back to the carburetor much like the "open" system. The "closed" system can be identified by the oil filler cap which is sealed to the atmosphere. As previously mentioned, the oil filler cap of the "open" system is vented to the atmosphere.

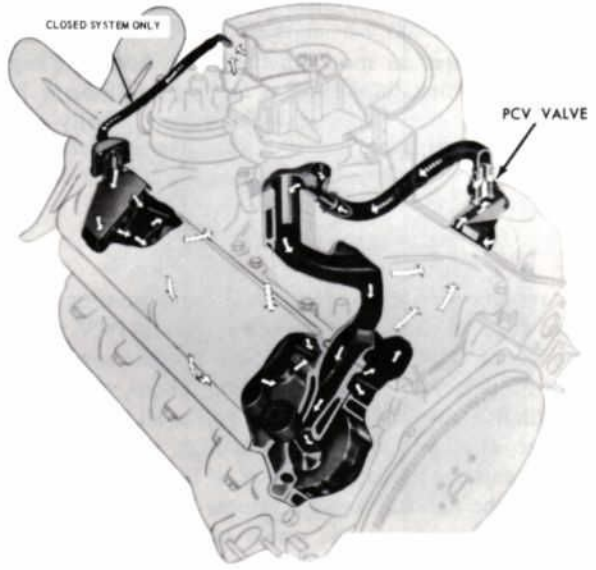


Figure 2—Typcial PCV System

PCV VALVE

Both "open" and "closed" PCV systems use a ventilator (regulator) valve, except some early 1963 6-cylinder engines (Fig. 3). On engines without valves, the air enters openings in the oil filler cap which face into the air flow. The air circulates through the crankcase and is forced through an oil separator located either at the front of the engine, or the rear as shown in Figure 3. Manifold vacuum and crankcase pressure maintain a positive flow of fumes through the air cleaner and into the carburetor. A PCV valve is unnecessary because the fumes enter at the air cleaner and thus do not affect the air-fuel mixture ratio.

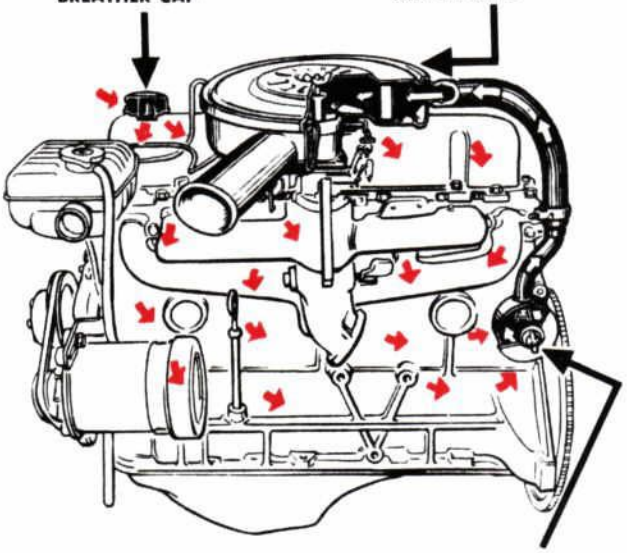


Figure 3—Typical PCV System Without A Valve

Crankcase fumes on most other engines, however, beginning with the first PCV systems for 1961 California built vehicles only, enter below the carburetor, usually at the carburetor spacer plate, and thus affect the air-fuel mixture ratio. A PCV valve is used to regulate the amount of fumes emitted to the air-fuel mixture.

HOW THE PCV VALVE WORKS

PCV systems do not rely on vehicle movements as did the earlier road draft tube system, but rather PCV systems make use of engine vacuum which is present any time the engine is operating. This assures a continuous, positive flow of ventilation air through the crankcase at all engine speeds. However, at engine idle vacuum is high, while ventilation requirements are low. Furthermore, at idle the air-fuel mixture is on the rich side and the volume low. Without a PCV valve, high vacuum at idle would cause a voluminous air flow, thereby diluting the air-fuel mixture and adversely affecting engine performance.

PCV VALVE AT IDLE OR LOW-SPEED OPERATION

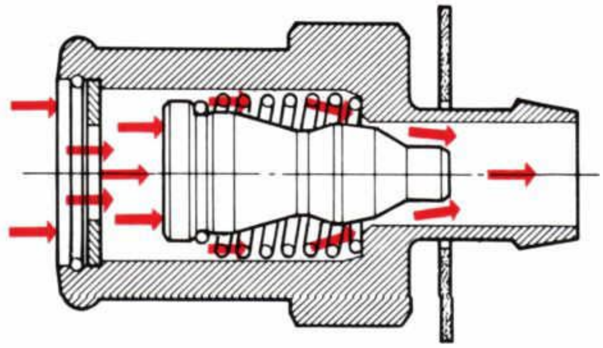


Figure 4—Idling or Low-Speed Operation

At high vacuum, the jiggle-pin valve moves forward overcoming the spring tension and meters a small flow of crankcase fumes.

PCV VALVE AT HIGHER-SPEED OPERATION

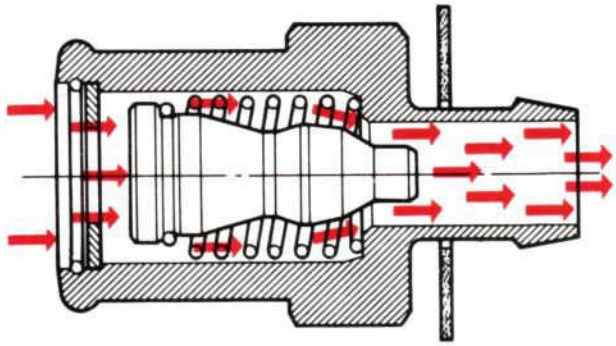


Figure 5—Higher Speed Operation

At higher speeds the vacuum is lower, so the spring moves the jiggle-pin away from the orifice to permit a greater flow of crankcase fumes. More fumes are present in the crankcase due to increased "blow-by" past the piston rings at the wide throttle openings. Also, at higher engine speeds the volume of air-fuel mixture is great enough to tolerate a greater volume of crankcase fumes without adversely affecting engine performance.

SERVICE

The PCV valve should be REPLACED, and the rest of the system (hoses, tubes, fittings, carburetor spacer plate, etc.) cleaned in a low-volatility, petroleum-base solvent every 12,000 miles. The special screen-type filter located in the air cleaner of some "closed" PCV systems should also be cleaned every 12,000 miles. Also perform the minimum maintenance services for related components: Replace the carburetor air filter of "closed" PCV systems every 12,000 miles, and clean the oil filler breather cap filter of "Open" PCV systems every 6,000 miles. Some engines also use a crimp pack or maze screen oil separator (Figures 3, 6 and 7), which also must be cleaned, every 12,000 miles. All parts may be dried with compressed air, except the filters. Shake them dry, as compressed air may damage them. If there is any doubt about the cleaning capacity of a filter, replace it.

NOTE: Under extremely abnormal driving conditions, the PCV system may have to be cleaned, and the PCV valve replaced before the normal 12,000 mile interval.

CRANKCASE VENTILATION OIL SEPARATOR USAGE CHART

ENGINE	MODEL YEAR	TYPE OF * OIL SEPARATOR	FIGURE
Serviceable Type			
223, 240 6-Cyl.	1963	Crimp Pack	3
220, 260 8-Cyl.	1962-65	Crimp Pack	6
289 8-Cyl.	1963	Crimp Pack	6
289 4/B Spec.	1963-67	Crimp Pack	6
406 4/B & 6/B	1962-63	Crimp Pack	6
427 4/B & 8/B	1963-67	Crimp Pack	6
430 & 462	1961-67	Crimp Pack	6
Non-Serviceable Except When Intake Manifold Is Removed			
352 & 390	1961-65	Maze Screen	7

*FoMoCo Basic Part Number—6A631

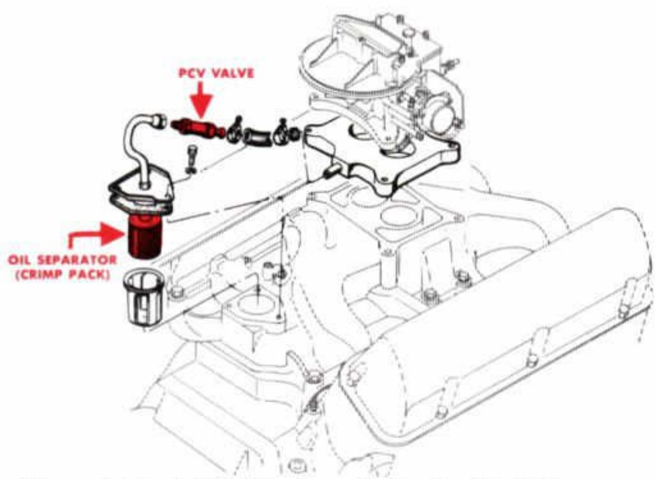


Figure 6—Typical V-8 Engine with Serviceable Oil Separator

PCV VALVE LOCATIONS

The PCV valve is located on the top, rear rocker arm cover on all 6-cylinder engines (Fig. 8); behind the carburetor on most V-8 engines with an oil separator (Figs. 6 & 7); and in the right, rear rocker arm cover of all other V-8 engines (Fig. 9), except the 430 & 462 Lincoln engines, where it's located in a tube at the right, rear of the engine.

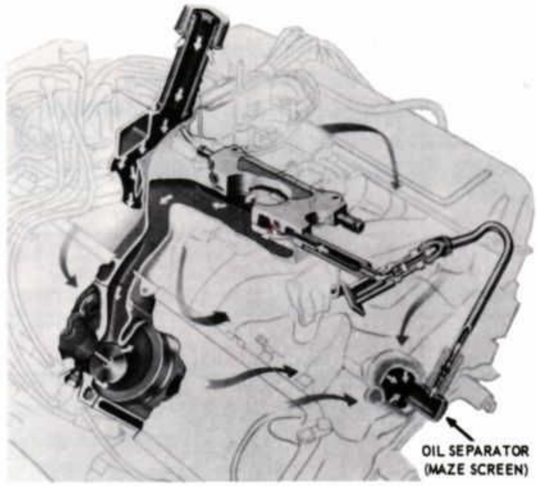


Figure 7—Typical V-8 Engine with Non-Serviceable Oil Separator

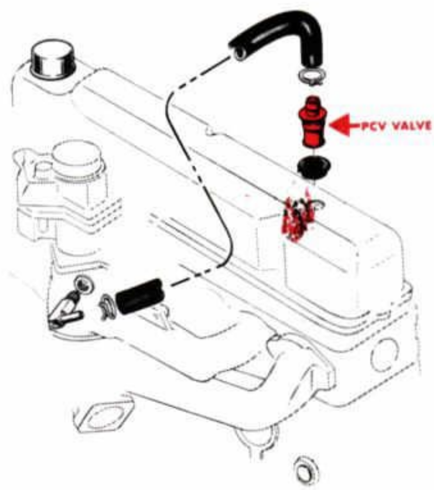


Figure 8—PCV Valve Location—6-Cylinder Engines

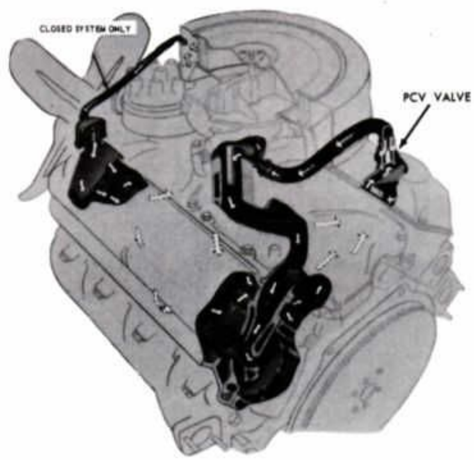


Figure 9—PCV Valve Location—Most 8-Cylinder Engines

PCV VALVE SERVICE... A WARRANTY REQUIREMENT

AUTOLITE PCV VALVES

The following chart lists the Autolite PCV valves used on Ford Motor Company vehicles. See your Ford or Lincoln-Mercury Dealer for other make applications. Autolite PCV valves feature these outstanding advantages:

- 100% inspected for flow characteristics.
- Plunger slides against orifice during operation providing an automatic self-cleaning action . . . designed to help prevent sludge build-up and clogging between service periods.
- Spring is designed to brush lightly against the orifice inner diameter to help prevent build-up of sludge or flow restriction.
- Close tolerance machining of plunger and orifice provide optimum valve performance and efficiency.

AUTOLITE PCV VALVE USAGE—FORD MOTOR COMPANY CARS

(See Your Ford or Lincoln-Mercury Dealer for Other Make Applications)

YEAR	ENGINE	AUTOLITE PCV VALVE NO. *
	BRONCO	
1966-67	170 6-Cyl.	EV-5
1966-67	289 8-Cyl.	EV-8
	COUGAR	
1967	289, 390 8-Cyl.	EV-8
	FAIRLANE	
1965-67	289 8-Cyl.	EV-8
1966-67	390 8-Cyl.	EV-8
1963-67	170, 200 6-Cyl.	EV-5
1964	260, 289 8-Cyl.	EV-2
1962-63	221, 260 8-Cyl.	EV-4
1962	170 6-Cyl.	EV-13
	FALCON	
1963-67	144, 170, 200 6-Cyl.	EV-5
1965-67	289 8-Cyl.	EV-8
1964	260 8-Cyl.	EV-2
1963	260 8-Cyl.	EV-4
1961-62	144, 170 6-Cyl.	EV-13
1960	144 6-Cyl.	EV-7
	FORD	
1965-67	240 6-Cyl.	EV-5
1965-67	289, 352 8-Cyl.	EV-8
1966-67	390, 428 8-Cyl.	EV-8
1966-67	427 8-Cyl.	EV-1
1965	390 8-Cyl.	EV-8
1964	289 8-Cyl.	EV-2
1963-65	427 8-Cyl.	EV-1
1963-64	223 6-Cyl.	EV-5
1962-64	352, 390 8-Cyl.	EV-1
1963	260, 289 8-Cyl.	EV-4
1962-63	406 8-Cyl.	EV-1
1961-62	223 6-Cyl.	EV-4
1961-62	292 8-Cyl.	EV-1
1961	390 8-Cyl.	EV-23[1]
1961	390 8-Cyl.	EV-1[2]
1961	352 8-Cyl.	EV-1
1955-60	All 6 & 8 Cyl.	EV-16
	LINCOLN	
1958-67	All	EV-1
1956-57	368 8-Cyl.	EV-19

[1] With Cast Iron Manifold
[2] With Aluminum Manifold

YEAR	ENGINE	AUTOLITE PCV VALVE NO. *
	MERCURY	
1966-67	390, 410, 428 8-Cyl.	EV-8
1965	390 8-Cyl.	EV-8
1965	427 8-Cyl.	EV-1
1963-64	390, 427 8-Cyl.	EV-1
1962-63	406 8-Cyl.	EV-1
1962	390 8-Cyl.	EV-1
1961-62	292, 352 8-Cyl.	EV-1
1961-62	223 6-Cyl.	EV-4
1961	390 8-Cyl.	EV-23
1956-60	312 8-Cyl.	EV-16
1958-60	383, 430 8-Cyl.	EV-1
1957	368 8-Cyl.	EV-19
1955	292 8-Cyl.	EV-16
	MERCURY INTERMEDIATE	
	Comet	
1966-67	390 8-Cyl.	EV-8
1965-67	289 8-Cyl.	EV-8
1964-67	170, 200 6-Cyl.	EV-5
1964	260, 289 8-Cyl.	EV-2
1963	260 8-Cyl.	EV-4
1963	144, 170 6-Cyl.	EV-5
1961-62	144, 170 6-Cyl.	EV-13
1960	144 6-Cyl.	EV-7
	Meteor	
1962-63	221, 260 8-Cyl.	EV-4
1962-63	170, 200 6-Cyl.	EV-5
	MUSTANG	
1965-67	289 8-Cyl.	EV-8
1965-67	170, 200 6-Cyl.	EV-5
1965	260 8-Cyl.	EV-2
	THUNDERBIRD	
1966-67	390, 428 8-Cyl.	EV-8
1965	390 8-Cyl.	EV-8
1962-64	352, 390 8-Cyl.	EV-1
1961	390 8-Cyl.	EV-23[1]
1961	390 8-Cyl.	EV-1[2]
1955-60	All	EV-16

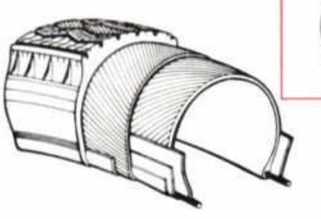
[1]—With Cast Iron Manifolds
[2]—With Aluminum Manifolds

*FoMoCo Basic Part Number—6A666

RADIAL-PLY TIRES . . . Available NOW As Factory Installed Option on Fords, Falcons, Mustangs and Mercurys, Comets, Cougars

Once again, Ford sets the pace . . . by being the *first* American manufacturer to offer Radial-Ply Tires, probably the biggest development in tires since the tubeless . . . as factory installed optional equipment. While other manufacturers are still in the planning stage, Ford, Falcon, Mustang, Mercury, Comet and Cougar buyers can have Radial-Ply Tires installed right at the factory, in either blackwalls or whitewalls.

To distinguish Radial-Ply Tires from other types of tires, the section width is rated in *millimeters* instead of inches. In other words, a 7.35 x 14 tire is designated as a 185 R x 14. The "R" stands for radial, and the 185 comes from the fact that one inch equals 25.4 millimeters. The following application chart gives tire sizes in inches and the equivalent tire size in millimeters.



Cornering with cross-bias. (Note the tread that has left the road)

Conventional cross-bias construction. Cords in adjacent plies run at opposite angles to each other for symmetry.

Directly below the tread are rigid "belts" which go clear around the tire, to reinforce the tread and resist twisting under cornering loads. Note the superior cornering or tracking ability of Radial-Ply Tires as shown in the illustrations. In addition to increased stability, the "belts" offer increased puncture resistance. These "belts" are largely unaffected by side wall movement. Because the side wall and tread move—or work—for the most part independently from each other, there is less friction. Less friction naturally means less heat, so the tires run cooler. Cool operation, combined with increased puncture resistance and greater stability with less squirming of the tread on the road results in longer tire life and improved tread wear.

RADIAL-PLY TIRE APPLICATION CHART

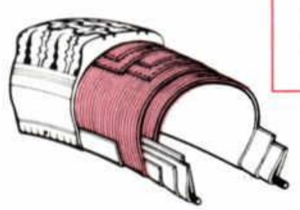
TIRE SIZE	AVAILABLE ON THESE MODELS
7.35 x 14 (185R x 14)	Falcon, Comet, Mustang, Cougar
8.15 x 15 (205R x 15)	Ford, Mercury
8.45 x 15 (215R x 15)	Ford, Mercury

Although Radial-Ply Tires may not run as quietly as conventional tires, many motorists prefer them because of these outstanding advantages:

- Over 50% improved tread life
- Better ride at turnpike speeds
- Greater resistance to punctures, road hazards and curb impacts
- Better traction on wet pavement
- Improved cornering ability

RADIAL-PLY TIRE CONSTRUCTION

Radial-Ply Tires afford these outstanding features because of their unique construction. The cords, or plies, run "straight across" the tire from bead to bead. Conventional tires of cross-bias construction have adjacent layers, or plies, running diagonally in a crisscross pattern at opposite angles to each other for symmetry. The "straight across" ply design makes the Radial-PlyTire more flexible in the side wall and capable of absorbing a great deal more road shock.



Cornering with radial.

Radial-ply construction. In this design, the tread breaker plies are of crisscross construction.

INFLATION PRESSURE

Radial-Ply Tires require the same inflation pressure as conventional bias-construction tires. (NOTE: High Performance Mustang & Cougar require 28 psi front and rear instead of the 24 psi for conventional tires.) Because of their design, however, they have a definite low pressure or semi-flat appearance, when compared to conventional tires. Customers who want to add air should be advised that the semi-flat appearance is a characteristic of Radial-Ply Tires.

As a rule of thumb, Radial-Ply Tires that look fully inflated, when compared to conventional tires, are undoubtedly *overinflated*. Radial-Ply Tires that look a little soft are probably about right.

DEALER IMPRINT

YOUR SOURCE FOR GENUINE FORD AND AUTOLITE ORIGINAL EQUIPMENT PARTS

TECHNICAL SERVICE BRIEFS

DRUM STORAGE—MOTOR OIL

Storing drums of motor oil in outside areas is a widespread and common practice. However, since the drums are exposed to the elements, certain hazards are present if the drums are placed in an *unprotected* and *upright* position. Water or moisture collects on the top of the drum and will be sucked into the drum by changes in temperature; thereby contaminating the oil.

No matter how tightly the bungs (threaded caps) are closed, it is impossible to prevent moisture from being drawn into the drum. The drum and contents warm up during the day and overnight cooling causes contracting, which draws the moisture through the threaded caps.

If outside storage is necessary for drummed oil, one of the following procedures should be followed to avoid water contamination:

1. Place drums on sides.
2. Cover drums, to prevent collection of water or moisture, if placed in upright position.
3. Tilt drums to prevent collection of water or moisture particularly in the threaded cap area.

SPARK PLUG GAP REVISION

(All 1967 Models with 390 GT Engines)

The spark plug gap specification for the subject vehicles has been changed from 0.028″-0.032″ to 0.034 inch. The new spark plug gap smooths out engine roughness at idle and part throttle engine speeds.

HEADLIGHT BULB BREAKAGE

(All 1966-1967 Ford and Fairlane)

Excessive pressure at the headlight indexing lugs may cause bulbs to break. To relieve stresses and provide maximum bulb durability, tape is applied to the headlight ball ring indexing notches at the factory.

If a headlight bulb must be replaced, in service, inspect to see if the tape is in place. If not, two pieces of friction tape should be applied to the headlight ball ring indexing notches (there are three notches) as shown in the illustration.