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## Overlooked Pressure Hose Seal Causes Power Steering Leaks

### Application:

All Power Steering systems using O-ring seals on fittings.

### Problem:

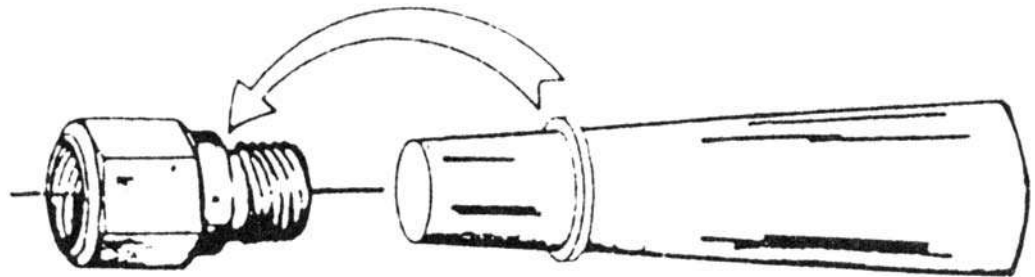
After replacing the Power Steering Pump or steering unit, leaks develop at fittings.

### Cause:

Original O-rings were not replaced, damaged or not properly installed.

### Solution:

Install all supplied O-ring seals as per installation instructions. Be sure to replace the seal inside the pressure hose.



### Installation Tip:

Slide pressure hose fitting back and remove old seal. Soften new seal in warm water, expand over a tapered punch, then transfer to hose as shown.

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## MIS-DIAGNOSED POWER STEERING PUMP NOISE

### Application:

1992-93 CHEVROLET AND GMC TRUCK C/K, S/T MODELS  
1992-93 OLDSMOBILE BRAVADA WITH 4.3L, 5.0L, 5.7L ENGINES  
CARDONE part numbers: 20-661, 7803, 7824, 7828, 7832, 7877, 7901, 7918, 7924, 7931, 7933, 7938, 7943, 7950, 7985, 7987, 7999, 8301, 8703, 8704, 8705, 8713, 8712, 8724, 8749, 8756.

### Problem:

A whine noise emanating at the front of the vehicle that appears to be coming from the power steering pump.

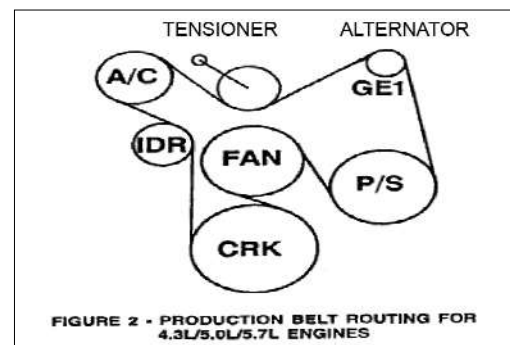
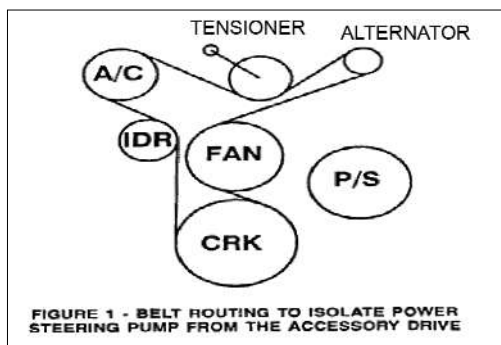
### Cause:

The noise may actually be the result of a failed bearing in the alternator.

### Solution:

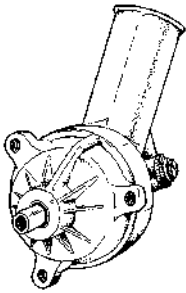
The following procedure can help determine the source of the noise by isolating the power steering pump from the alternator (GM reference bulletin 463201).

1. Isolate the power steering pump from the alternator by installing an accessory drive belt off of a 3.4L equipped 1993 or 1994 Camaro or Firebird. Install the diagnosis belt as shown in FIGURE 1.
2. Run the engine and listen for the noise. Do not drive the vehicle with this belt attached. If the noise is gone, the power steering system is most likely at fault. If the noise remains, proceed to diagnose the remaining elements of the accessory drive including the generator.
3. After the noise is successfully corrected, remove the accessory drive belt used for diagnosis.
4. Install the original accessory drive belt as shown in FIGURE 2.



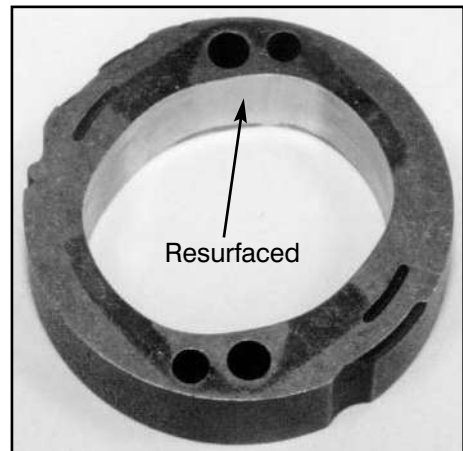
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## Power Steering Pumps



- Control Valves
- Power Cylinders
- Power Steering Pumps
  - Filters
- Rack & Pinion Units
- Steering Gears

**Cam Rings** - In order to prevent low flow, noise, or no pressure, CARDONE resurfaces the cam ring to give it the original, consistent surface. By running your finger around the inside of the cam ring, you will be able to feel the smooth inner surface. Every unit is tested for proper flow and pressure to make sure it meets all OEM specifications. This process ensures a high quality unit that won't come back.



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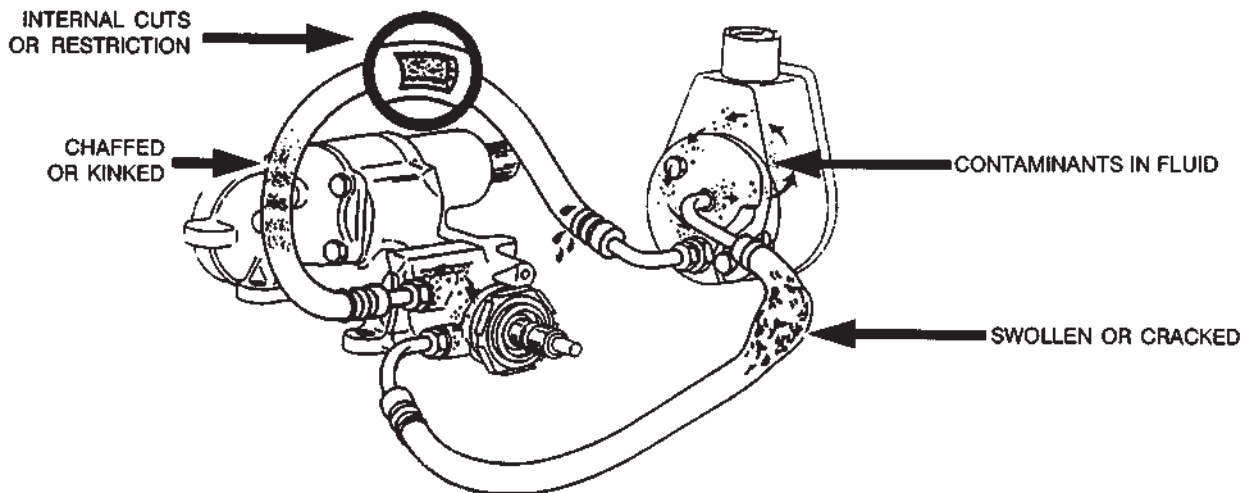
## Power Steering Binding or Lack of Assist After Installation

**Application:** All vehicles with Power Steering.

**Problem:** Binding, poor return ability, leaking, stiff steering, noise or fluid overheating.

**Cause:** Restricted flow of hydraulic fluid. Kinked or damaged line or accumulation of grit and debris, block proper flow of fluid through Power Steering System.

**Solution:** Check hose routing and condition. Make sure all lines are O.E. Specification. Before installing any replacement unit, flush the entire system and replace **ALL** hoses.



**Note:** CONTAMINATED FLUID COULD CAUSE THE SAME SYMPTOMS. ALWAYS FLUSH THE ENTIRE SYSTEM AND INSTALL A POWER STEERING FILTER.

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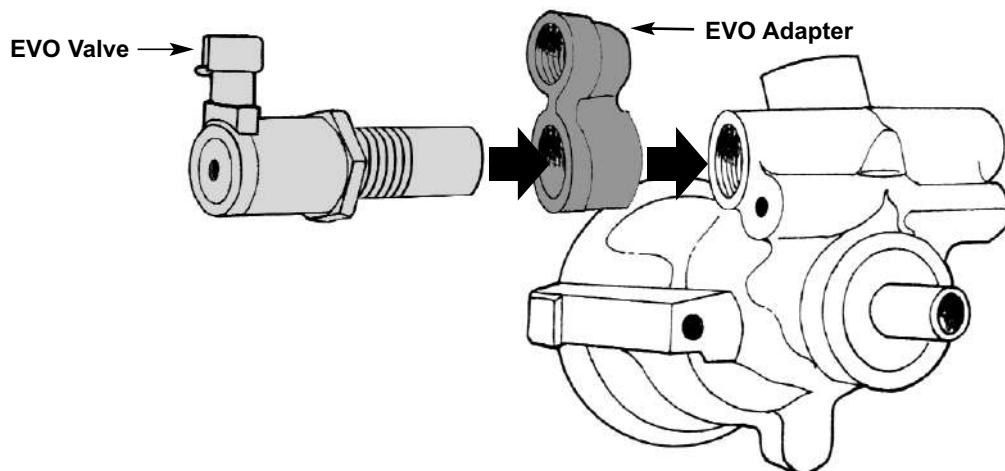
## GM EVO Power Steering Pump Doesn't Have Enough Ports

**Application:** All Saginaw power steering pumps equipped with an Electronic Variable Assist valve (EVO).

**Problem:** CARDONE replacement pump has only one port and no pressure fitting. The original unit has two ports.

**Cause:** The extra port is actually a special adapter that is not supplied with the replacement unit. The adapter and EVO valve must be transferred to the replacement unit.

**Solution:** To transfer the valve and adapter, first unscrew the EVO valve. With the valve removed, apply side-to-side turning pressure to the adapter. The adapter should loosen. Slide adapter out of pump housing (see picture of separated components). Thoroughly clean the valve and adapter, then install in reverse order of removal. Be sure supplied piston and spring are installed in replacement unit before assembling adapter.



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## Choose the Best Power Steering Filter for Your Application

**Application:**

All power steering equipped vehicles.

**Problem:**

Premature power steering failure or increased warranty returns.

**Cause:**

Particles were not completely removed during the flushing process or particles from everyday wear of components caused valves to stick and block flow of fluid. Your weapon against contamination is to use one of the in-line filters shown below.

**Solution:**

Fight to keep your steering system clean and prevent premature power steering failure by always installing a new CARDONE Power Steering Filter. There are two part numbers that will fit most applications: 20-0012F for 1/2" hose and 20-0038F for 3/8" hose. Both filters are rated at 200 microns to catch the smallest debris.



20-0012F for 1/2" hose

20-0038F for 3/8" hose

**Note:**

- Always use fluid recommended for your vehicle.
- Be sure to flush the power steering system any time a component is replaced. (Refer to PT 20-0012, 20-0027, 20-0028, 20-0029).
- Carefully inspect all hydraulic hoses and replace any that appear damaged. Also, consider replacing hoses on high mileage vehicles or hoses that are more than 5 years old. (Refer to PT 20-0004, 20-0005, 20-0016).

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## Erratic Steering Assist on GM Variable Effort Steering (VES) Vehicles

### Application:

1997-1998 GM/GMC Sport Utilities (Astro, Express, Safari, Savanna)  
1997-2001 GM/GMC Pickups (Silverado, Sierra)

### Problem:

Steering that unexpectedly twitches or jerks in a turn, at highway speeds, or has no assist.

### Cause:

Vehicles equipped with VES rely on the steering wheel position sensor, the Electronic Variable Orifice (EVO) valve, and a control module (a Suspension Control Module, Body Control Module, ECM or EVO Control Module depending on the application) to control steering assist. Failure of any of these components will affect the steering assist.

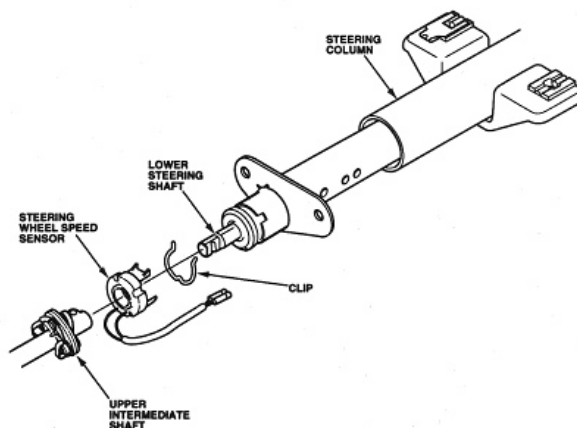
### Solution:

**Sensor Test:** If the steering wheel position sensor is bad, the vehicle ECM, in most cases, will detect this and set a Diagnostic Trouble Code (DTC). If no code is set, temporarily disconnect the sensor then see if erratic assist stops or assist returns. If operation returns to normal, perform tests on the sensor, wiring to ECM and the ECM. Please refer to the vehicle service manual for detailed sensor testing and repair procedures. The graphic below shows the typical sensor location on the steering column.

**EVO Test:** The EVO valve controls the power assist provided by the power steering pump. Even if this component fails, no DTC's are set in the ECM. Please refer to Pro Tech PT 20-0024 for EVO information and test tips.

**ECM:** The ECM (or on some applications, a special EVO module) directly controls the EVO. Failure of the ECM (or the vehicle speed sensor), the steering wheel sensor or the EVO can cause assist problems. Repair or replace as necessary.

Verification of proper function of all these components should be performed before replacing any of these components.



### Note:

Please refer to your vehicle's service manual for specific diagnostic instructions. This ProTech bulletin is supplied as technical information only and is not an authorization for repair.

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## Failure To Transfer Sensor Components Results In Shaft Seal Failure Or Check Engine Light

### Application:

1992-2004 Mazda and Mitsubishi vehicles with sensor-equipped power steering pumps.

### Problem:

The replacement power steering pump front seal has blown out, or the check engine light turns on and code P550 is set.

### Cause:

It may be necessary to transfer the original sensor and its components (shown below) to the replacement pump. If these components are not transferred correctly, shaft seal failure results due to excessive pressure, or if the sensor is defective, code P550 is set.

### Solution:

Figure 1 shows the sensor, spring and rubber-tipped style plunger. Be sure components are installed in the order shown, and the rubber-tipped plunger is installed in the direction shown. Note that the metal-tipped style plunger shown in Figure 2 may be installed in either direction if the metal plunger separates from the brass holder. The third style, Figure 3, is already assembled as one piece. Be sure to thoroughly clean the sensor and its components, and install the sensor using the new supplied O-ring. Refer to the vehicle service manual for correct tightening specs. Replace a damaged or defective sensor (dealer item). If code P550 is set, be sure to verify proper operation of sensor and the ECM before servicing or replacing the power steering pump.

Figure 1. Pressure Sensor Assembly (Rubber-tipped plunger)

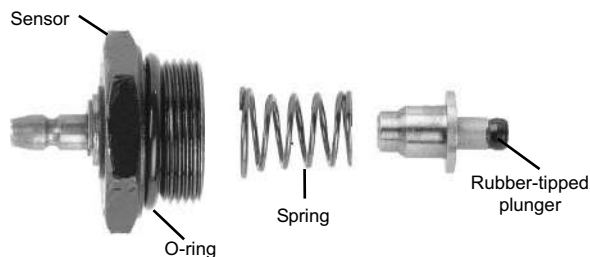


Figure 2. (Steel-tipped plunger)



Figure 3. (One piece)





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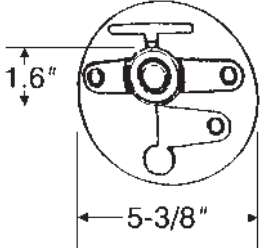
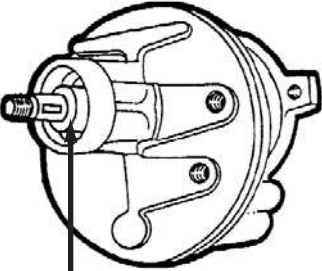
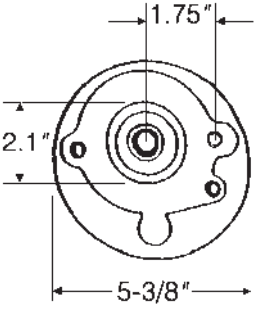
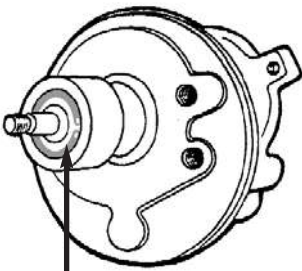
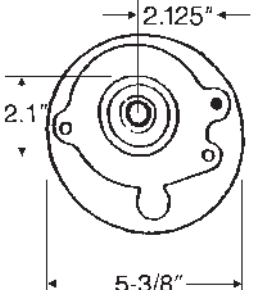
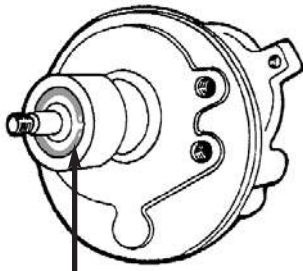


## GM Medium Duty Power Steering Pump ID Guide

**Application:** Chevrolet and GMC 40 to 80 series trucks.

**Problem:** How to identify large Saginaw Pumps.

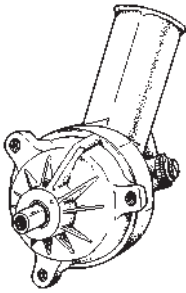
**Solution:** Use guide to identify Power Steering Pumps.

  <p>Bushing Type Bearing (No Snap Ring) <b>20-300</b></p>	  <p>Snap Ring Retained Bearing <b>20-301</b></p>	  <p>Snap Ring Retained Bearing <b>20-302</b></p>
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**Note:** Pump is only available without reservoir.  
**Failure to flush system properly will VOID THE WARRANTY.**

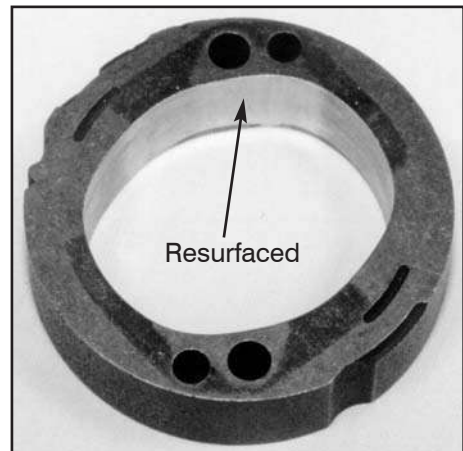
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## In-Line Power Steering Filter — An Ounce of Prevention

**Application:**

All power steering equipped vehicles.

**Problem:**

Premature failure of power steering components.

**Cause:**

Particles not removed during the flushing process or particles from everyday wear of components and hoses cause valves to stick and block fluid flow.

**Solution:**

When replacing any power steering component, always flush the entire system and then install an in-line filter such shown below (part 20-0038F). Be sure to use OE recommended or equivalent fluid, see Pro Tech 20-0027 for more information.



In-Line Filter 20-0038F

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## Power Steering Leak At Pressure Feed Tube Or Union

**Application:** All power steering equipped vehicles using a banjo-style pressure fitting or union.

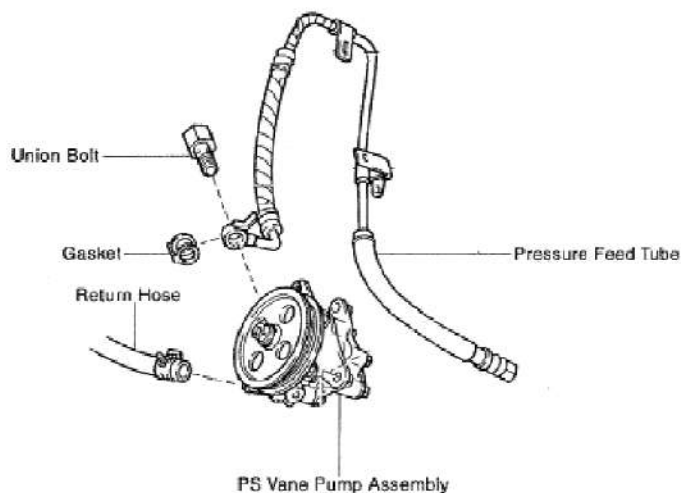
**Problem:** Leaks at pressure tube or fitting union after replacing hose or servicing the power steering pump.

**Cause:** Seal between the hose and fitting has failed due to a dirty or damaged sealing surface, gasket damage or reuse of the old gasket.

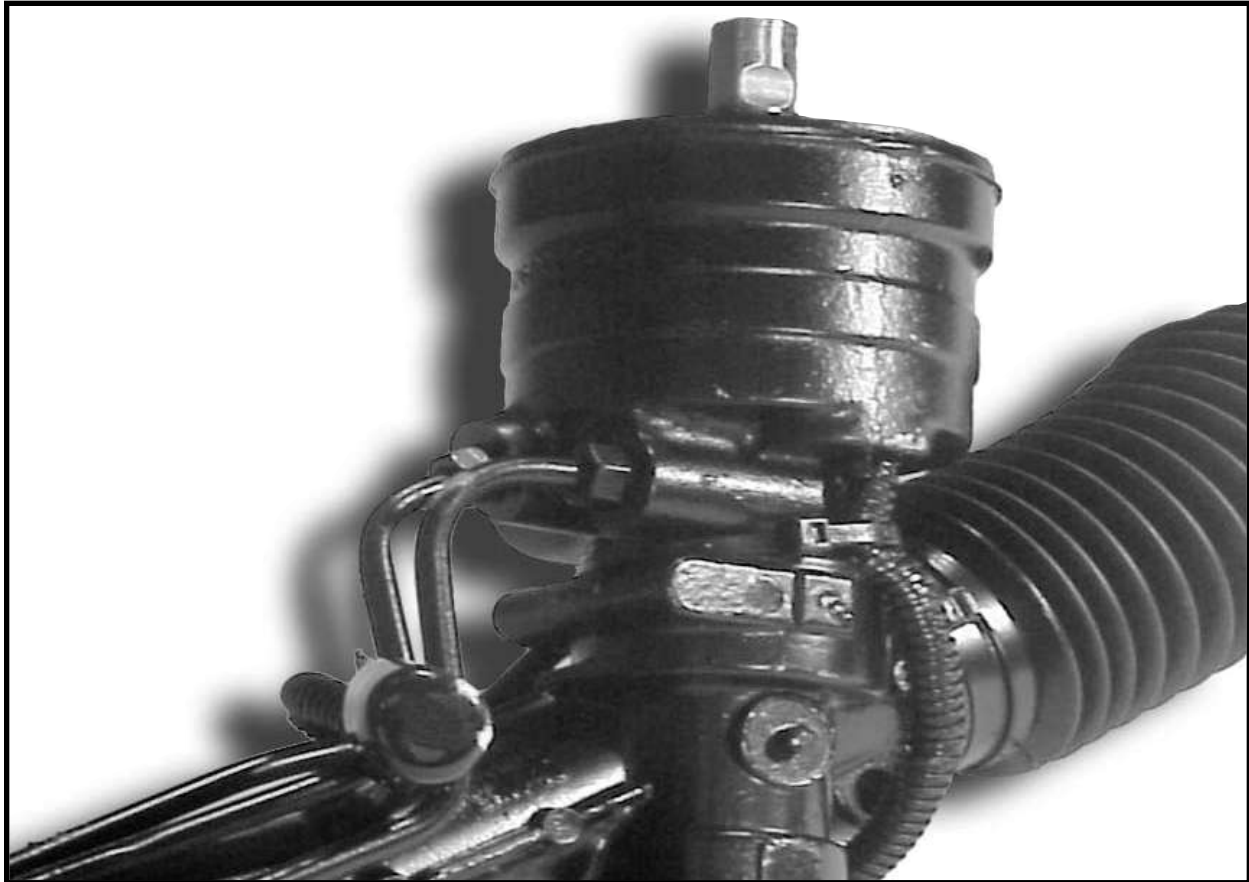
**Solution:**

1. Always use a new gasket at the banjo fitting.
2. Be sure that the sealing surface of the fitting on the pump is clean and that it is not deformed from its original condition. Even a small nick on the sealing surface could cause a leak.
3. Torque the union bolt to the recommended repair torque (typical 52 Nm, 38ft.lbs. – refer to vehicle service manual for specific torque).

**Typical  
Installation**



# As steering systems become more complicated, your choice of parts doesn't have to be.



As OEMs continue introducing technologically advanced parts, you can count on us to remanufacture them. You no longer have to call the new car dealer to capture technology sales because we remanufacture the units using the same quality systems as original equipment manufacturers. The result is units that perform and last just as long as their new counterparts and offer you high profit margins.

Consequently, you can rely on CARDONE's Rack & Pinion units with Magnasteer and EVO. In the future, OEMs will be introducing these variable-ratio racks on more vehicles, and we will be ready to offer them to you. We make it easy: one source for all makes and

all models. So, keep it simple. Keep it reman. **Magnasteer** — Magnasteer is a variable-effort system that uses vehicle speed input and magnets to modify steering assist.

**Electronic Variable Orifice** — EVO is a valve on the rack & pinion that uses a hydraulic circuit system and an electronic controller to create a variable effort steering.

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## Clogged Power Steering Reservoir Filter - Toyota & Lexus

### Application:

Toyota and Lexus vehicles with power steering.

### Problem:

Noise coming from the power steering pump or reduced assist from the power steering system.

### Cause:

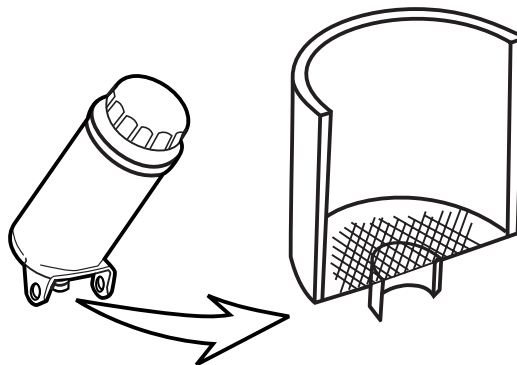
Noise or reduced assist may be caused by restriction in the power steering fluid reservoir. Most Toyota/Lexus-style reservoirs have a filter screen at the bottom. Over a period of time this filter could get clogged causing the restriction of fluid.

### Solution:

Replace any hose that shows signs of cracking or internal deterioration. Thoroughly flush the power steering system; then remove the reservoir for cleaning as follows:

1. Clean the exterior and interior of reservoir with new power steering fluid or suitable solvent.
2. Blow off the filter screen using pressurized air until restriction or clog is removed.
3. Using a flashlight, check to make sure that the filter screen is free of debris. **Note:** Contamination may be an indication of internal breakdown of hoses, which must be replaced before operating the vehicle. Failure to replace bad hoses could damage both the pump and steering unit.
4. Reinstall reservoir, referring to the service manual for tightening specs and bleeding procedures.

Cut-away of a typical reservoir showing internal filter screen



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## Noisy Chrysler Power Steering When Cold

**Application:**

Chrysler, Dodge & Plymouth vehicles with power steering.

**Problem:**

Noise from power steering system at cold ambient temperatures.

**Cause**

Fluid viscosity inadequate at low temperatures.

**Solution:**

Change and flush the fluid, using factory required fluid.

- Step 1. Run engine until it reaches operating temperature.
- Step 2. With the engine turned off, remove a return hose from the cooler or reservoir and drain the system.
- Step 3. With engine still off, slowly turn the steering wheel lock-to-lock a number of times to purge any remaining fluid.
- Step 4. Reinstall the return hose and fill the reservoir to the max cold level using the required power steering fluid.
- Step 5. Purge air from the system using factory recommended method. See PT 20-0002. Refer to Chrysler TSB # 19-03-98

Always refer to your vehicle's service manual for repair procedures and specs.

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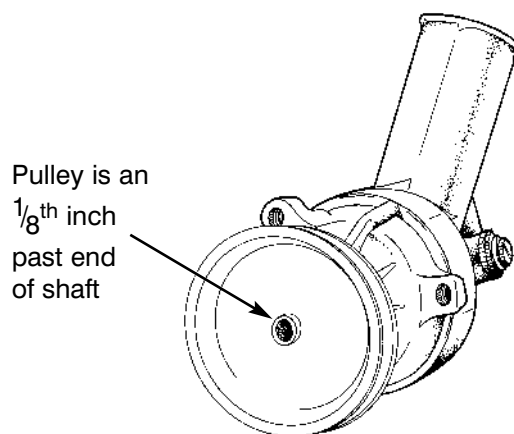
## Ford Power Steering Noise Caused by Pulley Position

**Application:** All vehicles equipped with Ford C2 style pumps (typical unit shown below with aluminum housing and plastic reservoir).

**Problem:** Noisy power steering pump operation not attributed to air in the system.

**Cause:** The belt pulley may not be pressed on the shaft in the proper position. Side loading from the misaligned pulley forces internal parts to rub, causing noisy operation.

**Solution:** Make sure the pulley is pressed on  $\frac{1}{8}$ <sup>th</sup> inch past the end of the shaft as shown below. Proper pulley alignment is critical for all applications. Always replace bent or damaged pulleys.



**Note:** Allow 500 mile break-in for this style pump. Noisy operation can also be the result of air in the system or restricted fluid flow. Refer to Pro-Techs PT 20-0002, PT 20-0003, PT 20-0004 and PT 20-0005.

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## Power Steering Systems — No Bubbles, No Troubles

### Application:

All power steering assisted vehicles.

### Problem:

Noisy pump operation, lack of power assist, fluid spilling from reservoir.

### Cause:

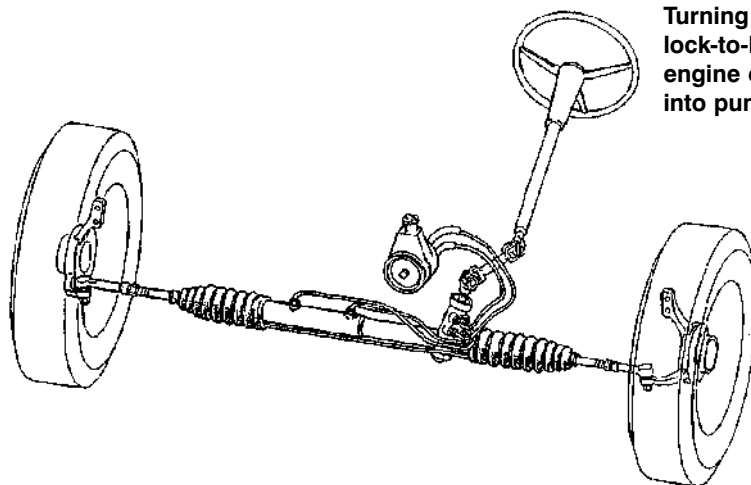
Air may be in the system.

### Solution:

Perform a basic system check looking for hose problems, proper fluid level and fluid condition. Flush entire system if fluid is burnt or contaminated, then bleed the system as described below.

### Bleeding Tips

Check all connections for leaks or other hose problems. Fill fluid level to "cold" mark. Safely lift and support vehicle so front wheels clear ground. With engine off, slowly turn the tires completely to one lock. Wait 5 seconds, then slowly turn wheels completely to opposite lock. Wait 5 seconds then repeat cycle 15-20 times. Regularly check the reservoir for fluid level. Continue until there is no foaming and fluid looks normal.



Turning tires slowly lock-to-lock with the engine off forces air into pump reservoir.

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## Improper Placement of Fitting O-ring Results in No Pressure

### Application:

All vehicles equipped with power steering.

### Problem:

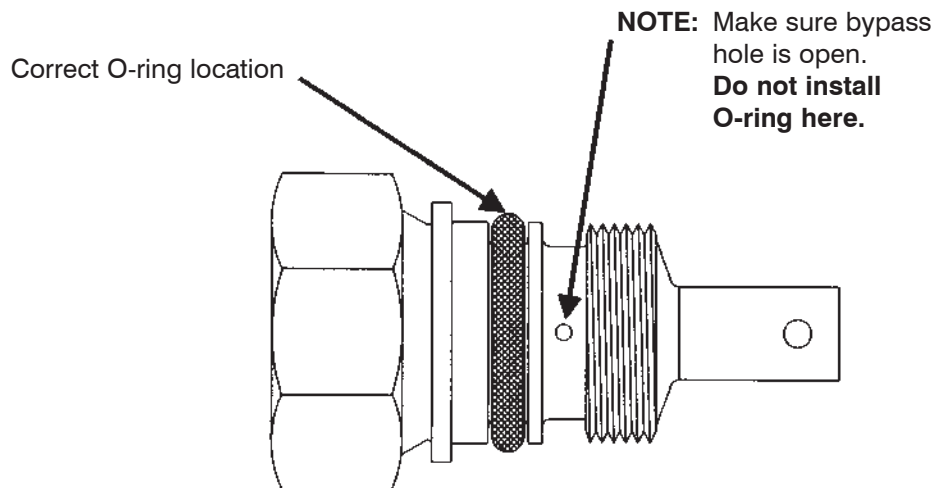
No pressure output from power steering pump after installation of a new O-ring on the power steering pressure fitting.

### Cause:

Incorrect placement of O-ring on the pressure fitting, blocking the flow of fluid from the bypass hole to the flow control valve. This causes a no-pressure condition.

### Solution:

Install the replacement O-ring in the correct position on the fitting. Also make sure piston is moving freely in bore, a stuck piston will cause the same problem.



### Note:

See instruction sheet 93-0347-20.

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## Not All Power Steering Fluids are Created Equal

### Application:

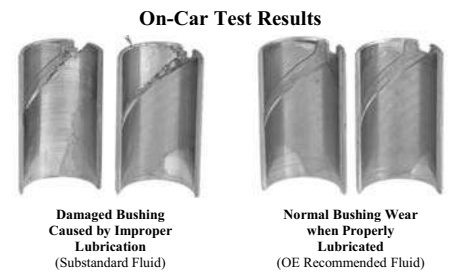
All vehicles equipped with hydraulic steering systems.

### Problem:

The extreme premature failure of the power steering pump. The failure is characterized by noise, shaft seal leak, reservoir boil-over, foaming in the reservoir or unexplained sload (even with an automatic belt tensioner). Please note that failure can occur as quickly as 20-30 minutes after pump installation.

### Cause

Use of substandard power steering fluid that lacks the additives necessary for proper lubrication of the power steering pump; more specifically additives such as viscosity improver, friction modifiers and anti-foaming agents. Use of substandard fluids causes both the fluid and system to overheat, and the pump bushing to breakdown. At this point the pump is no longer capable of holding pressure, resulting in total loss of assist.



### Solution:

Use an OE recommended or equivalent fluid for complete system replacement and top-offs! Refer to the vehicle manual or an OE vehicle information system (Mitchell's, Alldata, etc.) to find the recommended fluid for your application. A fluid that meets OE standard typically has specifics printed on the label (Fig. 1). A general statement claiming the fluid meets OE requirements does not guarantee good fluid quality (Fig. 2). Power steering fluid does not have an API (American Petroleum Institute) certification, and therefore does not have minimum standards associated with its production. The only standards established for power steering fluid come from the OEM.

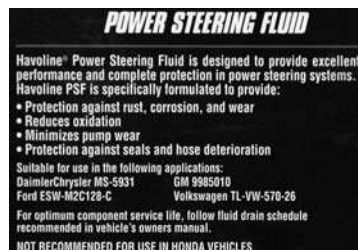


Fig. 1



Fig. 2

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## Old-School Method of Flushing Still the Best

### Application:

All Power Steering equipped vehicles

### Problem:

After replacing power steering components, there is a lack of assist, intermittent assist problems or noisy operation.

### Cause:

System not completely flushed of all debris and contamination.

### Solution:

Time is money – that's why there are so many of the new mechanical flush systems in use today. They are fast, efficient and labor saving. There are, however, still important advantages in flushing the system the old fashioned way, by rotating the pump and turning the steering wheel side-to-side. While mechanical flush systems get the job done, most simply pull the old fluid from the power steering pump reservoir (while sometimes using a cleaning agent) and then replace it with new fluid. The old-school method of cranking the engine to spin the pump while also turning the steering wheel is most effective, because it stirs up debris that needs to be flushed away. For additional information on this flushing method see ProTech PT 20-0012.

No matter what method you use to flush the system, always install an in-line filter and be sure to replace any hydraulic hose that is damaged or shows signs of age or failure. After flushing be sure to replace the fluid with OE approved or equivalent fluid. For hose recommendations see PT 20-0004, 0016. For filter options, refer to PT 20-0003. For information on fluids see PT 20-0027.



In-Line Filter 20-0038F

### Note:

Please refer to your vehicle's service manual for specific diagnostic instructions. This ProTech bulletin is supplied as technical information only and is not an authorization for repair.

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## Don't Let the Power Steering Snake Bite You

**Application:** All vehicles equipped with power steering.

**Problem:** Power steering component failure ( i.e., Rack & Pinion, Gear Box, Pump, Control Valve or Power Cylinder).

**Cause:** Contamination in the steering system.

**Solution:** During installation of the replacement unit carefully inspect the hydraulic hoses. Hoses that appear harmless may have hidden problems. They deteriorate from the inside out, passing contamination throughout the entire system. This results in premature failure of the steering system. ALWAYS FLUSH THE ENTIRE SYSTEM AND REPLACE HOSES TO PREVENT WARRANTY PROBLEMS.



**FAILURE TO REPLACE  
HOSES COULD COME  
BACK TO BITE YOU!**

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## POWER STEERING—DO'S & DON'TS

Listed below are a few basic, but important tips to help ensure a successful installation of a replacement power steering pump.

**DO:** Replace all hoses that show signs of cracking and/or deterioration.

**DON'T:** Use a hammer, press or impact gun when installing pulley on the replacement pump.

### ALWAYS USE A HAND WRENCH.

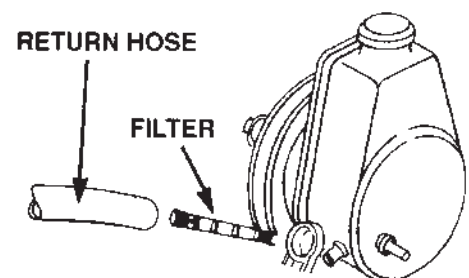
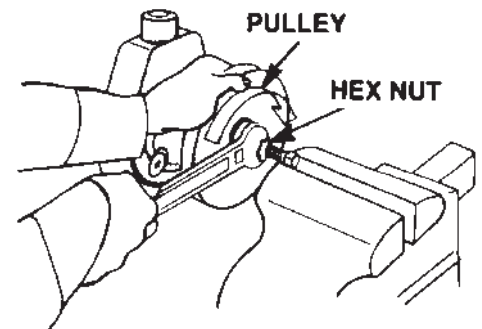
**DON'T:** Assume the system is free of contaminants. Failure to flush will lead to premature pump failure.

**DO:** Torque mounting bolts and hoses to proper specifications. Use a belt tension gauge when installing belt. Refer to vehicle service manual for proper tightening specifications.

**DON'T:** Let a quality job go to the shop unprotected.

**DO:** Use a power steering filter when applicable.

**DO:** Use new fluid recommended for your vehicle.



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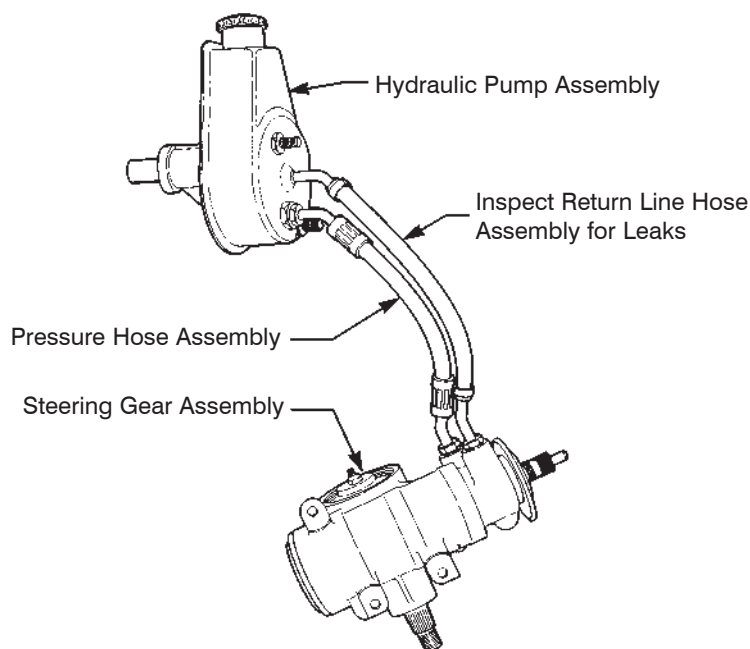


## Defective Power Steering Hoses Allow Air in the System

**Problem:** Power steering fluid foams, causing power steering noise.

**Cause:** The return hose from the reservoir to the power steering gear may be brittle and have cracks, pinholes, or loose clamps. This allows air to enter the fluid. Use the following procedure to diagnose the system:

**Solution:** Run the engine to operating temperature. With engine off, gently pressurize the power steering pump reservoir (do not exceed 8 PSI). Look for a leak on the return hose. Repair or replace as necessary.



**Note:** Rack and pinion system similar.





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## Power Steering Hoses: No Flow, No Go

Power Steering Hoses work in a harsh environment. Operating temperatures range from -30° F to over 300° F, and the pressure hose must handle pressures up to 1,500 PSI. These hoses must absorb pressure surges and pulsations and be flexible enough to expand and contract to help control system noise. Hoses must also be resistant to external wear factors like ozone, grease, oil, road debris, wear from rubbing, and twisting stress from engine torque.

**The Problem:** What you can't see is hurting you.

The operating conditions just described are tough to be sure, but are nothing compared to conditions inside a hose. Small flakes of metal and other impurities from worn parts become suspended in the fluid and eventually deteriorate the hose from the inside. As deterioration advances, larger hose particles flake off, adding more particles into the system. Orifices become blocked, or the flow control valve starts to stick. Eventually, system performance declines, and then component failures begin.

If hoses exposed to these conditions are not replaced before operating a replacement pump or steering unit, then steering system failure is inevitable. The flexing and bending necessary to remove old components will cause hoses that are already broken down internally to completely fail, which often totally blocks flow through to the new parts. So when you suggest a hose change, don't take "no" for an answer!

### Things to Check:

- Check for a soft or spongy hose — a serious sign of wear indicating advanced internal deterioration.
- Check the hose-to-coupling connection for leaks or drips.
- Look for small pinholes or cracks in the hose outer jacket.
- Check hose for brittleness or hardness; this indicates that the hose has lost its ability to absorb pressure surges.
- Check for thickened fluid; this is an indication of internal hose deterioration and contamination.
- If fluid is black, silver or gray, the seals on the spool valve have worn grooves in the rack or gear control valve housing. Rubber and metal particles are circulating throughout the system. In addition to replacing the hoses, the rack or gear should also be replaced.
- Check fluid for burnt smell. This indicates the system has been operating under heavy load and may need a cooler. Flush the system and replace fluid.

Two other components found in many systems that can also be a source of flow restriction are power steering coolers and reservoirs with internal filters. Please refer to ProTech PT 20-0022 and PT 20-0029 for more information.

**Note:** Please refer to your vehicle's service manual for specific diagnostic instructions. This ProTech bulletin is supplied as technical information only and is not an authorization for repair.

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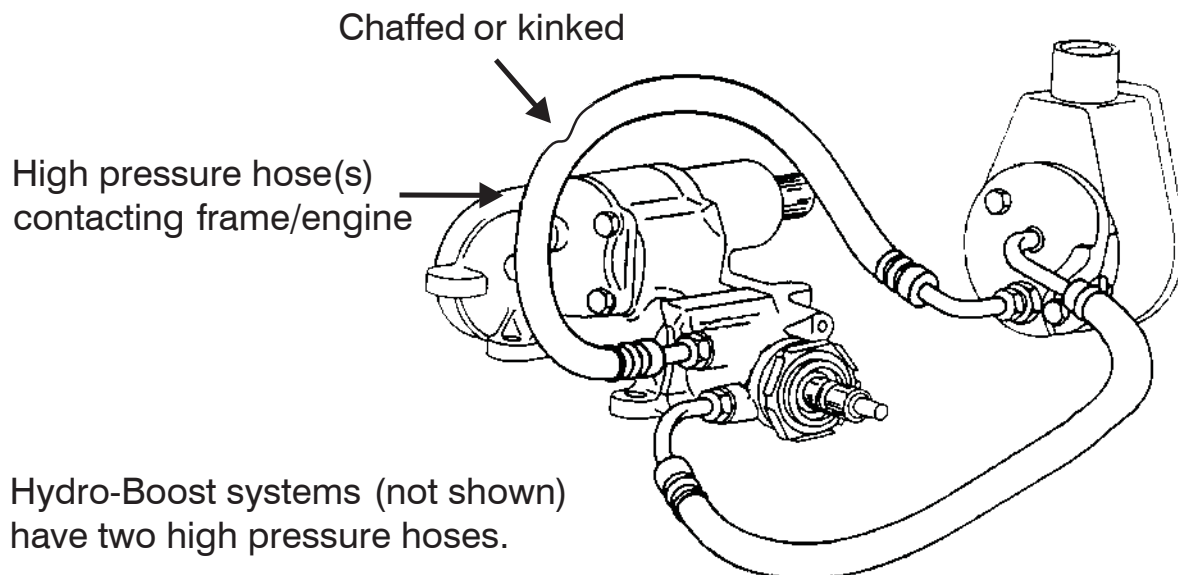
## Relocating Power Steering Hose May Eliminate Vibration

**Application:** All power steering equipped vehicles.

**Problem:** Power steering noise.

**Cause:** Power steering pressure hoses vibrate under high pressure. Hoses may be contacting the body, frame or engine oil pan causing noisy operation.

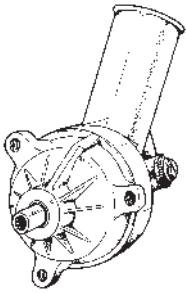
**Solution:** Relocate the power steering hoses. Check for missing hold down clamps or hardware. Replace damaged hoses as necessary.



**Note:** Failure to flush system will **VOID THE WARRANTY.**

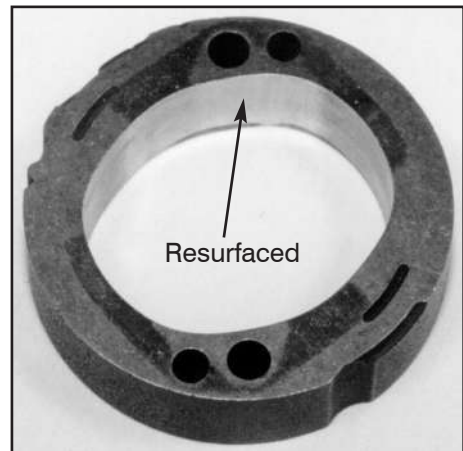
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## Power Steering Pumps



- Control Valves
- Power Cylinders
- Power Steering Pumps
  - Filters
- Rack & Pinion Units
- Steering Gears

**Cam Rings** - In order to prevent low flow, noise, or no pressure, CARDONE resurfaces the cam ring to give it the original, consistent surface. By running your finger around the inside of the cam ring, you will be able to feel the smooth inner surface. Every unit is tested for proper flow and pressure to make sure it meets all OEM specifications. This process ensures a high quality unit that won't come back.



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## POWER STEERING PUMP 20-8002 INSTALLATION TIP

### Application:

Dodge Truck R2500, R3500, 1997-2002 with 5.9L Diesel Engine.

### Problem:

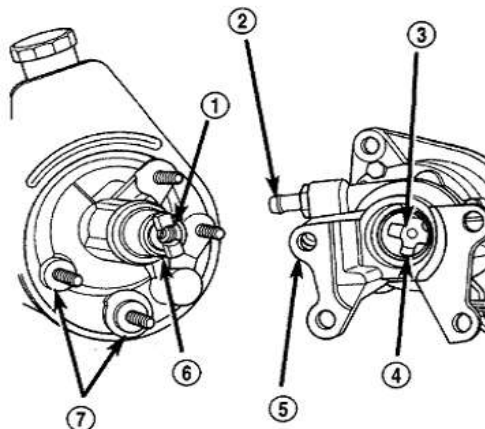
Due to the distinct removal and installation characteristics of the 20-8002, proper care must be used to prevent improper mounting and/or damage to the vacuum pump and its corresponding oil seal. Follow the tips below for removal and installation of this unit. Please refer to your vehicle's service manual for more detailed instructions if needed.

### Removal:

- 1) Use caution when sliding the power steering pump away from the vacuum pump – do not damage the oil seal (arrow #4) in the vacuum pump.
- 2) Remove the two mounting spacers (arrow #7). Do not discard; these must be re-installed.

### Installation:

- 1) Install the two mounting spacers.
- 2) Rotate the steering pump shaft (arrow #1) until the adapter (arrow #6) aligns with the vacuum pump drive (arrow #3). Install the steering pump onto the vacuum pump bracket.  
**CAUTION:** Use care to avoid damaging the oil seal (arrow #4) in the vacuum pump during installation. The steering pump housing and spacers (arrow #7) must mate completely with the mounting bracket (arrow #5).
- 3) Install the vacuum pump bracket to steering pump nuts and tighten to 18-ft. lbs.
- 4) Position **new** gasket on vacuum pump assembly. **NOTE:** Use sealer if necessary to retain the gasket.
- 5) Align and install the pump assembly on the engine. Ensure the steering pump stud is inserted into the block bracket. Tighten the pump-to-engine block attaching bolts to **57-ft. lbs.**
- 6) Install the steering pump to the mounting bracket nut and tighten to **18-ft. lbs.**
- 7) Install the pressure and return hoses to the power steering pump. Tighten the pressure fitting at the pump to **23-ft. lbs.**



- 1) Power Steering Pump Shaft
- 2) Vacuum Fitting
- 3) Vacuum Pump Drive
- 4) Oil Seal
- 5) Mounting Bracket
- 6) Power Steering Pump Shaft Adapter
- 7) Mounting Spacers

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## Prime Power Steering Pump Before Operation — How To

### Application:

All vehicles with Power Steering Pumps.

### Problem:

Power Steering Pump failure due to initial startup with a dry pump.

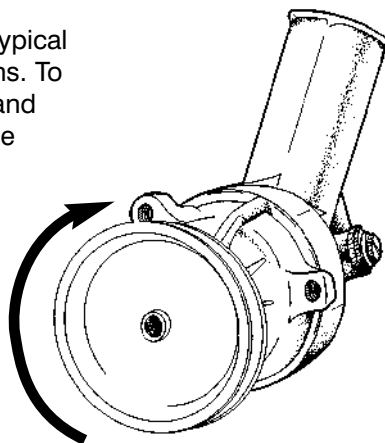
### Cause:

After final factory testing, power steering fluid is drained from the pump. If after installation the pump is run dry, it will fail.

### Solution:

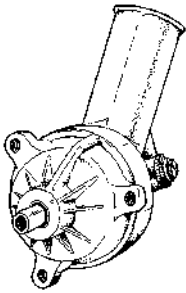
Hand-prime the pump before starting (especially if the pump has a remote reservoir). Before running the pump be sure to fill reservoir to operating level (please refer to our other ProTechs that describe proper flushing and hose maintenance). Hand-turn pulley in correct direction until fluid pumps from the pressure port. Refill reservoir as necessary, complete installation and bleed system per vehicle manufacturer instructions.

Rotation shown is typical for most applications. To prime the pump, hand turn the pulley in the proper direction for your vehicle.



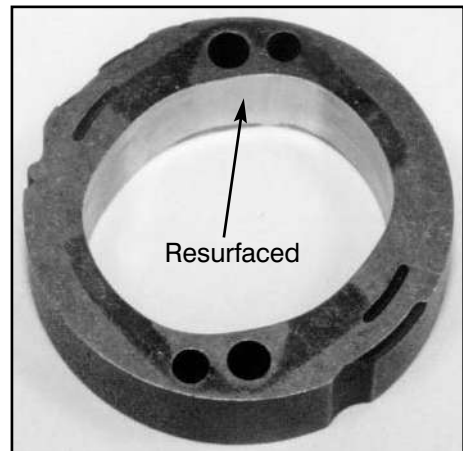
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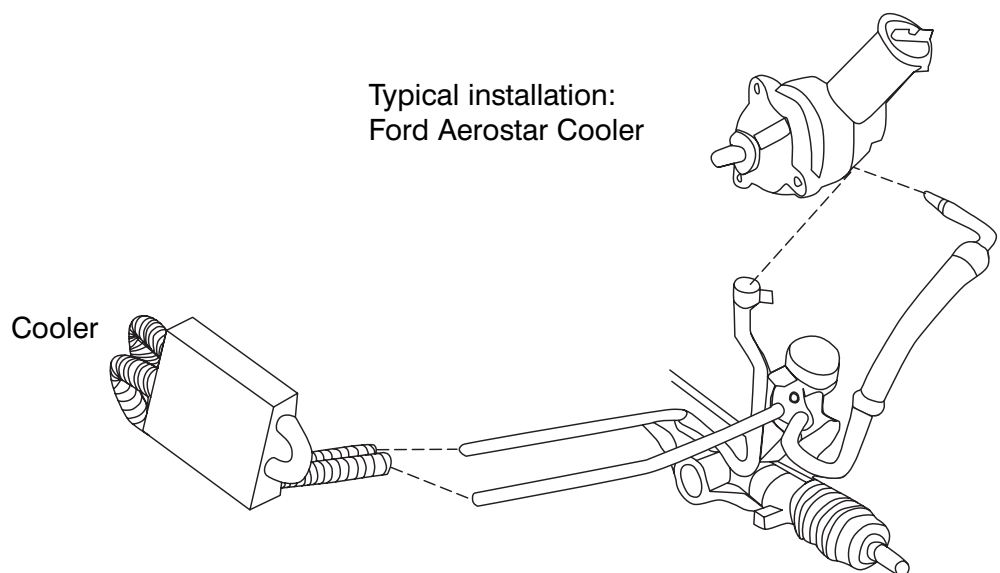
## Silent Killer: Clogged Power Steering Cooler

**Application:** Power Steering equipped vehicles with an oil cooler, especially Ford Aerostar.

**Problem:** Premature Power Steering failure, noisy operation, intermittent assist or premature failure.

**Cause:** Restricted flow through a failed cooler or accumulation of debris and contamination in the cooler.

**Solution:** Temporarily connect return lines together to bypass cooler. Test vehicle. If noise or assist problem is eliminated replace cooler (Ford Aerostar, see Ford technical service bulletin TSB 96-7-19). Be sure to inspect all hoses, including the remote reservoir hose, if so equipped. Also check the pump flow control valve and steering unit spool valve for debris. If debris is found eliminate cause (see ProTech PT 20-0004 and PT 20-0005). Flush the entire system (see PT 20-0012). Check in-line filters that may be blocked, change as necessary (see PT 20-0021).



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## ProTech Bulletin Summary: Power Steering Pumps

Before replacing any power steering component, the cause of original unit failure must be determined and corrected. Installing a replacement unit without correcting the problem will lead to early failure. Always refer to the vehicle service manual for specific installation procedures and specifications. The ProTech bulletins listed below cover topics that should be done BEFORE, DURING and AFTER installation of the replacement unit.

### Before Installation:

- 20-0011, 0019, 0024 EVO: What is EVO? Replacement pump is missing a port.
- 20-0016 Importance of replacing older hydraulic hoses
- 20-0017 GM Medium duty ID guide
- 20-0026 Cold weather problem for some Chrysler vehicles

### During Installation:

- 20-0001 Use the correct tools to install the pulley
- 20-0005 Prevent a problem - replace old hoses
- 20-0006 Incorrect pulley position causes noisy Ford operation
- 20-0007, 0021 Never reuse hydraulic hose or pressure fitting O-rings
- 20-0008 Flushing must be done
- 20-0010 Relocating hoses may eliminate noisy operation
- 20-0012 Preferred flushing procedure
- 20-0013 Temporary pump plugs not removed cause reservoir leaks
- 20-0020 Hand priming pump helps avoid air bound system
- 20-0022 Ford Aerostar cooler can cause lack of assist problems
- 20-0023 Mis-routed belts may cause noisy operation
- 20-0025 Dodge R series diesel installation tip
- 20-0027 Use only correct OE approved fluid; do not use "top-off" products
- 21-0001 Toyota and Lexus vehicles no assist; do not over look reservoir internal filter

### After Installation:

- 20-0002 Devac tool assists system bleeding
- 20-0003 In-line filter protects and prolongs components
- 20-0015 No assist: Pressure fitting O-ring may be in wrong location
- 21-0002 Leaks caused by old defective O-rings and improper tightening of fittings
- 21-0003 Mazda and Mitsubishi seal failure or check engine light caused by improper transfer of sensor components

CARDONE Technical Service develops ProTech bulletins that are intended to help the installer avoid common installation and service errors. The information presented is derived from our own experience and product knowledge gained from product analysis and research. Applying these tips will ensure the best possible performance and service life of the replacement unit.

Please note that these bulletins are provided for your technical information only and are not authorization for repair.



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## ProTech Bulletin Summary: Rack and Pinion, Steering Gear, Control Valve and Power Cylinder

Before replacing any power steering component, the cause of original unit failure must be determined and corrected. Installing a replacement unit without correcting the problem will lead to early failure. Always refer to the vehicle service manual for specific installation procedures and specifications. The ProTech bulletins listed below cover topics that should be done BEFORE, DURING or AFTER installation of the replacement unit. They assist with part selection, describe typical problems and solutions, and provide installation help and service advice.

### Before Installation:

- 20-0016 Consider replacing older hydraulic hoses
- 22-0005 Ford ID guide
- 22-0008 1996-1998 GM applications, CARDONE upgrade overcomes bearing problem
- 27-0002 GM gearbox ID guide
- 27-0005 27-7565 and 27-7569 difference ID guide

### During Installation:

- 20-0007 O-ring line and fitting seals must be replaced
- 20-0008 Flushing must be done
- 20-0010 Relocating hose may eliminate noisy operation
- 20-0012 Preferred flushing procedure
- 20-0014 Prevent steering column air bag coil damage
- 20-0027 Use correct OE approved fluid, do not use "top-off" products
- 22-0001 No thread sealing tape on fittings, check for damaged hoses, other problems, and flushing tip
- 22-0003 Loosening boot clamps to prevent boot damage during alignment
- 22-0004 Common causes of port thread damage
- 22-0006 Center Take Off (CTO): prevent damage to rack – use only original mounting hardware
- 22-0007 Ford rack hydraulic ports identical size - which is pressure, which is return ID guide
- 22-0009 Chrysler van shudder problem
- 22-0010 Ford rack units may have a pressure port check valve - where does it install
- 26-0001 Jaguar installation tip for 26-1916
- 26-0002 Toyota leaking fittings: causes and solutions
- 27-0001 Chrysler 1962-1972 troubleshooting tips
- 28-0001 Power cylinder and control valve lines easily crossed

### After Installation:

- 20-0004 Defective old hoses and improper flushing allow contamination to prevent proper operation
- 20-0005 Prevent problems - replace old hoses
- 20-0021 Two different in-line filters fight contamination
- 27-0003 Dodge truck side-to-side movement: TSB alert
- 27-0006 Popping, crunch noise on certain GM steering gears
- 27-0007 Binding on turns
- 27-0008 Test installed unit under pressure to avoid false loose evaluation

CARDONE Technical Service develops ProTech bulletins that are intended to help the installer avoid common installation and service errors. The information presented is derived from our own experience, and product knowledge gained from component analysis and research. Following these tips will ensure the best possible performance and service life of the replacement unit.

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## Remote Power Steering Pump Reservoirs: Problems and Installation Tips

### Application:

Power steering equipped vehicles with a remote mounted pump reservoir.

### Problem:

Replacement power steering pump produces no pressure, pump is noisy, or fluid over-flows after shutdown.

### Cause:

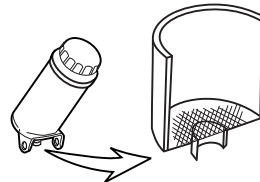
Possible restricted flow out of reservoir or an air-bound system due to a restriction in the system.

### Solution:

Service the remote reservoir and fill the pump and reservoir as follows:

1. Drain all fluid from the remote reservoir and remove it for inspection.
2. Flush and check reservoir for damage.
3. Many reservoirs have a filter or strainer in the bottom that can become blocked with debris or contamination. Test the flow through that filter by pouring some fluid into the reservoir. Look for fluid to freely flow from the reservoir outlet. Flush or replace reservoir as needed to obtain proper flow.
4. Before reinstalling the reservoir, inspect the feed hose between the reservoir and the pump for damage or restriction. This hose often passes near the exhaust manifold and can become soft enough to collapse under the draw of the pump. Replace the hose if there is any indication of damage or doubt of its condition.
5. Install the reservoir, connecting the feed hose to the remote reservoir, but do not connect it to the pump yet. Place the open end of the hose in a catch can, fill reservoir with fluid and allow fluid to flow from the hose until no air is present.
6. Now connect the hose to the pump and complete the installation and bleeding as per the vehicle service manual and any supplied instructions.
7. Be sure to inspect and replace other hoses as needed in the power steering system. For more information see ProTech PT 20-0005 and PT 20-0016. The installation of an external filter to protect the system is highly recommended (PT 20-0021), and it is very important to use OE approved or equivalent fluid (PT 20-0027).

Cut-away of a typical reservoir showing internal filter screen



### Note:

Please refer to your vehicle's service manual for specific diagnostic instructions. This ProTech bulletin is supplied as technical information only and is not an authorization for repair.

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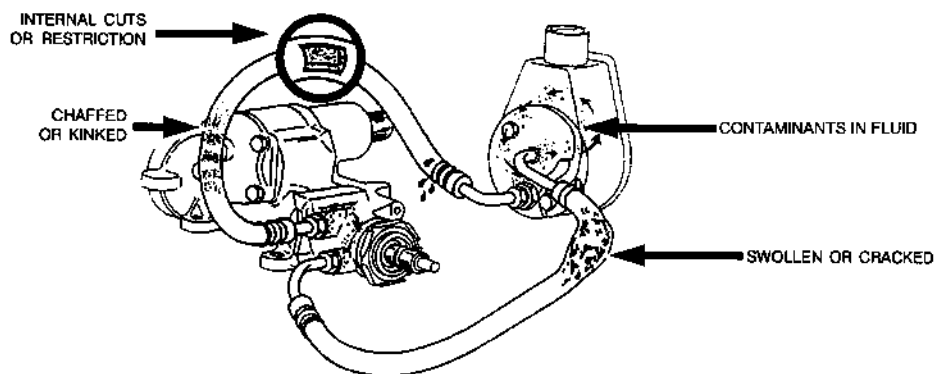
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## Royal Flush - Simple Power Steering Contamination Test

Prior to replacing any power steering system component, the power steering system must be flushed before operation. Flushing removes old hydraulic fluid and contaminants in the power steering system that will cause accelerated wear or improper operation of the replacement unit. Follow the steps below to properly flush the system.

- 1) Remove pressure and return lines from pump. Flush pump reservoir, return and pressure lines by pouring new fluid through components until fluid runs clear. Be sure to only use fluid recommended for your vehicle.
- 2) Reconnect pressure line to pump and steering component. Reconnect return line only to steering component.
- 3) Place return line from power steering unit into a drain pan. Cap return port on reservoir to prevent leakage.
- 4) Fill power steering pump reservoir with NEW fluid recommended for your vehicle.
- 5) Disable the engine so it will not start when cranked. Refer to vehicle service manual for correct procedure.
- 6) Crank engine and continue to replenish fluid until fluid coming from return line has no air bubbles. NEVER LET THE POWER STEERING PUMP RUN DRY! Note: Do not crank engine for more than a few seconds at a time or starter will overheat.
- 7) Install an in-line power steering filter in return line to increase the life of the power steering components. Connect the return line to the power steering pump, making sure all lines are properly torqued. Overtightening hydraulic lines will strip the threads. Failure to install a filter or properly torque fittings will VOID WARRANTY.
- 8) Be sure fluid in pump reservoir is at proper operating level.
- 9) Start the engine and turn the steering wheel from side to side 2 to 4 times to bleed the system.
- 10) Refill reservoir to proper level if necessary.
- 11) Check for smooth assist, excessive noise, connections for leakage and system for proper operation.



### Note:

CARDONE recommends replacing flexible power steering lines that are more than 4 years old.

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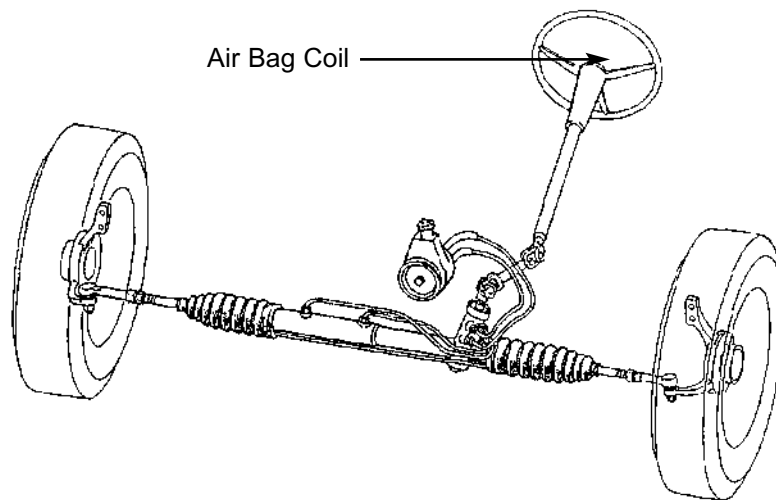
## Excessive Rotation of Steering Causes Air Bag Coil Damage

**Application:** All vehicles equipped with steering column air bags.

**Problem:** Steering column air bag inoperative after steering gear replacement.

**Cause:** Excessive steering wheel rotation during installation of steering gear, resulting in a broken air bag coil.

**Solution:** The steering wheel **must** be held in the center position prior to removal of intermediate steering shaft (use appropriate tool). This will prevent excessive rotation of the steering column and failure of the air bag coil.



**Note:** Consult a shop manual for more specific manufacturers' service procedures and specifications.

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## Ten Steps to Trouble-shoot Power Steering Pumps

What are the things that must be done to ensure successful diagnosis, installation and testing of a replacement power steering pump? The following ten questions outline the most common causes of failure, trouble-shooting suggestions, diagnostic tips, and proven installation procedures and practices.

- 1. Question:** What is the problem now?  
**Answer:** If the original problem continues after replacement pump installation, the pump most likely is not the original cause of the problem.
- 2. Question:** What was the original problem? Was the root cause of failure corrected?  
**Answer:** Was fluid contaminated, did the pump run dry, or was the wrong fluid used? Inspect hoses for damage or internal restriction. Check for damaged pulleys, incorrect belt tension or a defective belt tensioner. If pump is electronically controlled, is the EVO valve faulty, and is the controller working properly?
- 3. Question:** Were modifications made to the steering system or a change in tire size?  
**Answer:** Replacement pumps are OEM replacements intended for unmodified, standard use applications. They are not suited for off-road use, lift kits, over-sized tires or similar modifications and will void unit warranty if so used.
- 4. Question:** Were all steering suspension components operating freely?  
**Answer:** Check all mechanical steering components for proper function. Do not overlook steering wheel shaft and coupler.
- 5. Question:** Were the hoses and/or filter replaced per the manufacturer's specific service intervals?  
**Answer:** The single most common cause of failure of the original and replacement units is defective hoses followed by contamination. If hoses are more than 5 years old and haven't been changed, you have an impending problem.
- 6. Question:** Was the old fluid inspected for signs of overheating or contamination?  
**Answer:** Burnt-smelling fluid indicates the pump was working under heavy load, possibly due to restricted hoses or modified suspension or tires. Dark or black fluid usually is an indication of metal in the system or deteriorated hoses.
- 7. Question:** Was OE-certified fluid used to replace the old fluid?  
**Answer:** Never use fluid intended for "topping off". Use only OE approved power steering fluid.
- 8. Question:** Was the system properly flushed; was a filter installed?  
**Answer:** When any power steering component is changed (pump, steering unit, hoses), the old fluid must be completely flushed out and replaced. Adding a filter helps protect the replacement unit, especially if hoses are not changed, or if flushing is done incorrectly.
- 9. Question:** If pump is a remote reservoir type, was the reservoir screen checked for blockage? What is the condition of the hose between the reservoir and the pump?  
**Answer:** Most imports have some type of screen or filter in the bottom of the upper reservoir that must be flushed. The feed hose between the upper reservoir and the pump often collapse or get pinched.
- 10. Question:** Did you follow any special OE bleed procedures?  
**Answer:** Always refer to the vehicle service manual for specific installation instruction that might include a bleeding procedure. ProTech, "PT20-0012 Royal Flush", can be used for most vehicles.

**Note:** Please refer to your vehicle's service manual for specific diagnostic instructions. This ProTech bulletin is supplied as technical information only and is not an authorization for repair.

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## EVO — Electronic Variable Orifice: What is it?

### Application:

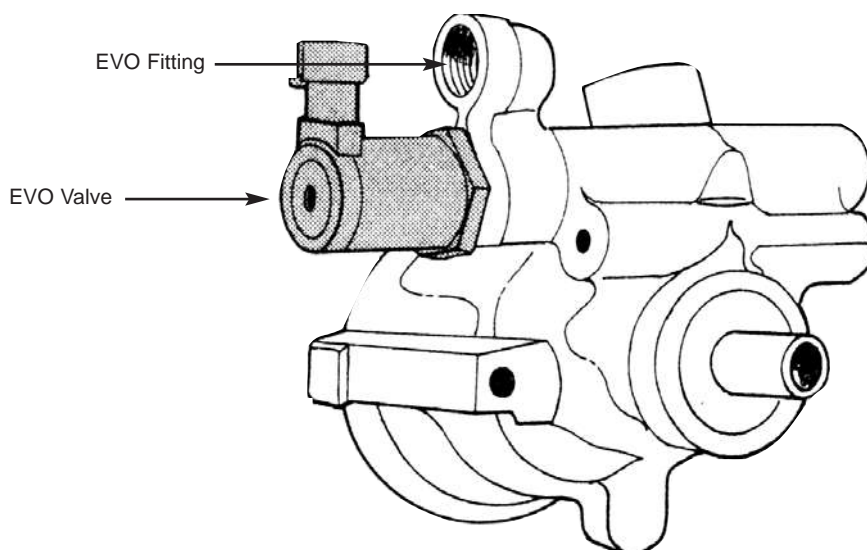
All vehicles equipped with speed proportional steering systems.

### Problem:

Understanding E.V.O. systems.

### Solution:

E.V.O. stands for Electronically Variable Orifice. This component is controlled by an electronic control module that reduces fluid pressure from the power steering pump to the steering gear at highway speeds. Improved high speed handling and road feel is the result.

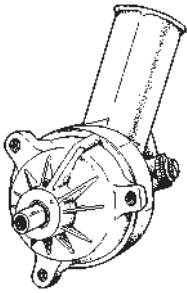


### Note:

Replacement pumps may require the transfer of the E.V.O. fitting and valve to the replacement unit.

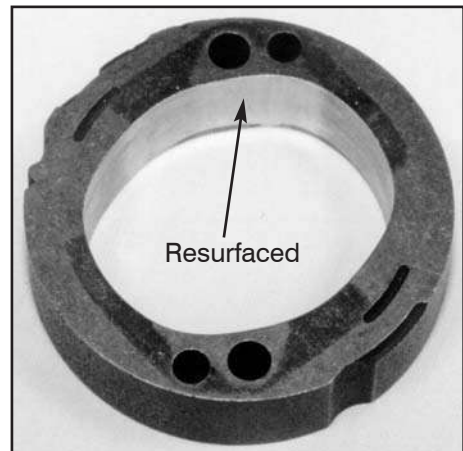
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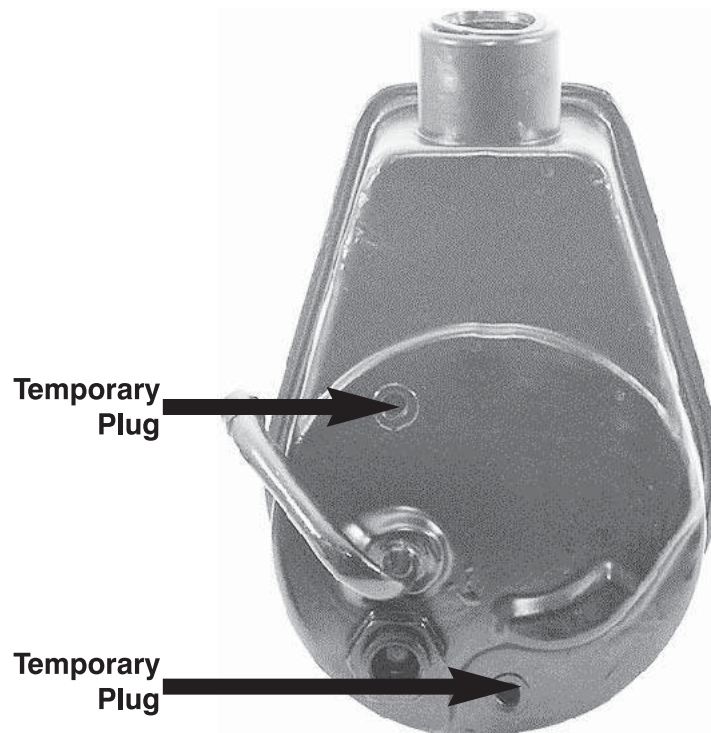
## Overlooked Temporary Plugs Cause Leaks on Some GM Pumps

**Application:** All Saginaw Power Steering Pumps with reservoir.

**Problem:** Unit leaks from plugs in reservoir after installation.

**Cause:** Temporary cap plugs not replaced by mounting bolts.

**Solution:** For most applications these holes will be closed by the mounting bolts or studs. Holes not used for mounting should be plugged using the following sized bolts. For Standard thread pumps bolt size is  $\frac{3}{8}$  x 16, for metric threads use 10m x 1.5m. Bolt length is  $\frac{1}{2}$  inch.





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## What is Variable Assisted Power Steering, What is EVO?

### What is EVO?

EVO means Electronic Variable Orifice. The EVO valve is a key component in variable assist systems. While vehicle manufacturer terminology may differ, a typical system works like this: At speeds below 40 MPH, the Electronic Variable Orifice valve (EVO) is completely open, allowing full hydraulic flow from the power steering pump through the steering unit for maximum power assist. Above that speed, a control module commands the EVO to partially close, restricting hydraulic flow. The reduced assist improves road feel while providing greater directional stability.

### Problem:

A properly functioning system requires proper operation of the EVO valve (see below), control module and vehicle speed sensor. A malfunction in the EVO valve can result in loss of regulated assist or even complete loss of power assist. However, this problem often is mistakenly perceived to be a defective power steering pump or steering gear.



Pump-mounted  
Ford EVO  
valve



Pump-mounted GM  
EVO valve and  
adapter

### Diagnostic Tip:

A scan tool should be used to determine if any variable effort system Diagnostic Trouble Codes (DTC) have been set. However, if the EVO has a mechanical or electrical failure or if foreign debris is trapped within the EVO orifices, a DTC may not be produced.

### Test Tip:

Many EVO valves fail because the solenoid coil opens or develops an electrical short. This coil can be tested for continuity using a volt/ohm meter. Typical resistance is 10-15 ohms (refer to your vehicle's service manual for specific specs). An open or shorted coil indicates that the EVO is defective. DO NOT attempt to test the operation of the valve by applying direct battery voltage to the solenoid; the coil may draw too much current, causing it to fail. Even if the solenoid coil resistance is within range, the valve itself may malfunction due to debris or contamination. Simply shaking the EVO valve will allow the valve inside to move and rattle. If no rattle is heard, this indicates contamination or debris inside. In most cases, flushing is ineffective. Finally, remember that the ECM directly controls a pulse-width modulated signal to the valve. If the valve tests properly, it is possible that the ECM, vehicle speed sensor or related sensors are not working correctly. Sometimes simply disconnecting the connector from the ECM will restore unregulated assist.

Refer to the vehicle manufacturers' service manual for specific test procedures prior to changing any power system component.

### Note:

CARDONE Power Steering Pump numbers ending with "V1" or "V2" (i.e. 20-8747V1) are supplied with the EVO valve. Rack and Pinions ending with "E" are supplied with rack-mounted EVO valve.

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## Devac Tool for Hard-to-Bleed Ford Power Steering Systems

### Application:

All power steering equipped vehicles (especially Ford)

### Problem:

Whine or moan noise from power steering pump

### Cause:

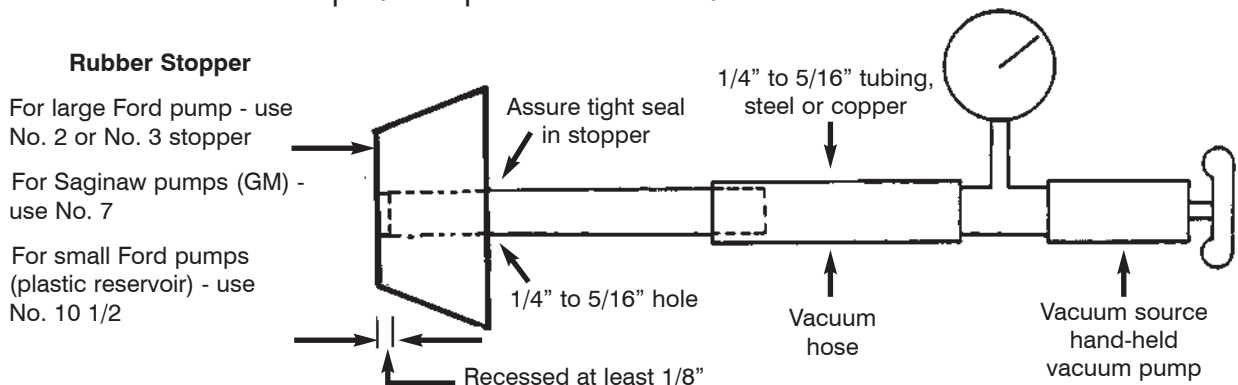
Air trapped in the power steering system

### Solution:

The tool shown below can be used to remove entrapped air.

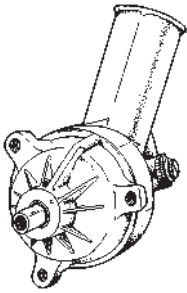
**CAUTION: UNDER NO CIRCUMSTANCES SHOULD ENGINE VACUUM BE UTILIZED.**

1. Check and fill the pump reservoir.
2. Insert the rubber stopper of the air evacuator assembly tightly into the pump reservoir fill neck. Do not allow fluid to contact pump—it will destroy pump.
3. Apply 15 inches Hg. vacuum to pump reservoir with engine idling. Cycle the steering wheel from lock-to-lock every 30 seconds for approximately five minutes. Do not hold steering wheel on stops while cycling. Maintain adequate vacuum with source as the air purges.
4. Release vacuum and remove vacuum equipment. Add additional fluid if necessary and reinstall dipstick.
5. Restart engine, cycle steering wheel and check for oil leaks at all connections. In severe cases of aeration, it may be necessary to repeat this procedure several times.



# Made by O.E. Remanufactured Best by **CARDONE**<sup>®</sup>

## Power Steering Pumps



- Control Valves
- Power Cylinders
- Power Steering Pumps
  - Filters
- Rack & Pinion Units
- Steering Gears

**Cam Rings** - In order to prevent low flow, noise, or no pressure, CARDONE resurfaces the cam ring to give it the original, consistent surface. By running your finger around the inside of the cam ring, you will be able to feel the smooth inner surface. Every unit is tested for proper flow and pressure to make sure it meets all OEM specifications. This process ensures a high quality unit that won't come back.

