POWER STEERING PUMP DIAGNOSIS AND TESTING

FILM REVIEW READY REFERENCE HANDBOOK 3002 and 3003
VOL. 69 S2 L2A

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NATIONAL SERVICE OFFICE
FORD DIVISION

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INTRODUCTION

The techniques described in this handbook will enable the Ford Service Technician to service Ford-design power steering pump problems that come to his attention.

Through careful study of the information contained in this handbook and in your applicable Shop Manuals, you should be able to:

- Diagnose common power steering pump problems.
- Understand and perform critical power steering pump testing and inspection procedures.
- Understand and perform important power steering pump assembly procedures.

This handbook describes the three most basic power steering pump problems, describes the new test equipment, how to conduct pump flow and pressure relief tests, and outlines the major causes of high and low outlet pressure. In addition, charts and specifications for the 1969 Ford-design power steering pump are included.
Each Ford-design power steering pump has an identification tag to identify the assembly for service purposes... The tag is located on the outlet fitting and is fastened by a reservoir retaining nut. Each tag has the date code, service model identification and the manufacturing plant shift code enscribed.

The reservoir is attached to the rear side of the pump housing front plate, and the pump body is encased within the reservoir.

The pump rotor has 8 slippers and springs rotating inside a cam insert.
Internal flow is accomplished by a variable orifice mechanism.

The metering pin travels with the spool valve, decreasing the area of the orifice (opening) at higher speeds to reduce flow to the steering gear.

The relief valve limits pressure at left or right stop positions of the steering wheel. The applicable Shop Manual provides a description of the components of the power steering pump.

Diagnosing a power steering pump complaint requires that you properly quiz the customer to get his description of the problem. Now that Ford dealerships are responsible for servicing power steering pumps, you will have to consider the basic problems behind the improper operation of these pumps and verify the complaint.
THREE BASIC PROBLEMS

There are three basic problems that may require a partial or complete overhaul of the pump. They are:

- external leakage
- pump noise
- insufficient pump pressure

EXTERNAL LEAKAGE

External leakage can be caused by a variety of problems:

FALSE LEAKAGE

Always check for indications of false leakage first. If the reservoir has been overfilled, or the steering wheel has been turned with the engine off, fluid could be forced out of the filler tube and deposited on the outside of the pump.

LEAKAGE AT CAP AND DIPSTICK ASSEMBLY

Leakage can occur at the top of the filler tube if the cap and dipstick assembly is improperly installed, damaged or lost. Replace the dipstick and cap assembly, if required. Always make sure the dipstick and cap assembly is installed securely.

LEAKAGE THROUGH BRAZING

When there's leakage through the brazing at the filler neck or return tube at the reservoir, replace the reservoir.

LEAKAGE BETWEEN RESERVOIR AND HOUSING PLATE

External leakage between the reservoir and housing plate can be caused by the following conditions:
THREE BASIC PROBLEMS

Foreign Material and Damaged Seals

Foreign material, such as metal chips on the reservoir O-ring seal or in the seal area, are likely causes of external leakage. A damaged seal or a seal out of position are other causes. Solve these problems by cleaning the seal area, replacing the seal, and making sure the seal is properly positioned.

Out-of-Round or Oversized Reservoir

There may be a remote possibility that the reservoir is out-of-round or oversized. Once again, replacement of the reservoir is necessary, to correct these conditions.

Damaged Reservoir or Housing Plate

Another reason for leakage at the reservoir O-ring seal is a damaged inside diameter of the reservoir or a damaged outside diameter of the housing plate. There must be no damage to these mating surfaces. If there is, the damaged part must be replaced.

Remember, every time the reservoir is disassembled from the pump, use a new reservoir O-ring seal for assembly.

External Leakage at Outlet Fitting

External leakage may be observed at the area of the outlet fitting. Close inspection may indicate that the fitting is improperly assembled.
External Leakage at Outlet Fitting Nut

Leakage at the outlet fitting may be caused by insufficient torque on the outlet fitting nut. To remedy the condition, torque the nut to specifications. Be sure the specified 47 foot-pound limit is not exceeded!

Damaged Housing-Reservoir Gasket

The gasket between the housing and the reservoir may have been damaged before or during assembly. A damaged gasket must be replaced. This gasket should also be replaced every time the housing and reservoir are disassembled.

Damaged Reservoir and Pump Housing Surfaces at Outlet Fitting

External leakage can be caused by damaged sealing surfaces on the inside of the reservoir and the outside of the pump housing at the outlet fitting gasket. Replace the part(s) with the damaged sealing surface(s).

Shaft Seal Leakage

Leakage at the pump shaft seal area will occur if the shaft seal was not pressed flush with the housing
plate surface, or if the shaft seal lip was damaged prior to assembly.

**Damaged Shaft Seal Counterbore**

Leakage may occur if the bottom of the shaft seal counterbore is excessively rough or damaged. Remedy this by replacing the housing plate and bushing assembly.

**Damage at Rotor Shaft**

Leakage will be caused by damage at the rotor shaft outside diameter, such as helical grooving, or scratches along the axis of the shaft. In these cases, the shaft must be replaced.

**Plugged Shaft Seal Drain-Back Hole**

In rare cases, leakage may be caused by a plugged shaft seal drain-back hole that is not drilled through. The drain-back hole must permit fluid flow back into the reservoir. If the hole is plugged, clean it. The pump
has to be partially disassembled to clean the drain-back hole properly. If the hole is not drilled through, replace the housing plate and bushing assembly.

Also, the drain-back hole in the housing may not be lined up with the hole in the housing plate due to improper assembly. Make sure the holes are properly aligned during assembly.

TO SUMMARIZE, THERE ARE FIVE SHAFT SEAL LEAKAGE PROBLEMS:

- At the seal
- At the shaft
- At the counterbore bottom
- At the drain-back hole
- At the shaft bushing

CAUTION:

Observe one major precaution when working in the shaft seal area. Prevent tool marks and scratches from crossing sealing surfaces or they will provide a "leak path" for the oil.

PUMP NOISE DIAGNOSIS

It is important to know and recognize the different kinds of pump noises so they can be diagnosed.

Swish

"Swish" is a noise created by the flow of excess fluid into the by-pass port of the pump valve housing, with the fluid temperature below 130 degrees.

The shearing effect of the heavier, cool oil is not harmful to pump operation and should diminish at normal operating temperatures.
THREE BASIC PROBLEMS

Whine

“Whine” can be caused by interference of the components in the pumping element. It can also be caused by aerated fluid.

On-Center-Hiss

An “On-Center-Hiss” is caused by fluid flow passing through a damaged outlet fitting or by excessive flow. This term is used because the noise is heard with the flow control valve in an “On-Center” position.

Click

A noise like a “Click” is caused by pump slippers being too long, by broken slipper springs, or by excessive wear of the pumping elements.

Chatter

“Chatter” is caused by chipped corners at the rotor outside diameter or a bent or distorted slipper spring.

NOISE DUE TO AERATED FLUID

The greatest cause of excessive pump noise is air in the fluid. Here are the conditions that produce aerated fluid:

--End--
THREE BASIC PROBLEMS

Low Fluid Level

An extremely low fluid level caused by improper fill or external leakage at any point in the power steering system will produce aerated fluid. Low fluid level should have been discovered during the preliminary diagnostic procedures, as outlined in the applicable Shop Manual.

Broken Reservoir Baffle

A broken reservoir baffle will result in aerated fluid.

Loose, Improperly Torqued Housing-to-Plate Screws

Loose or improperly torqued housing-to-plate screws will cause aerated fluid, and resulting pump noise. Tightening of the screws to the specified torque will eliminate the cause of this problem.

To correct pump noise caused by aerated fluid, first eliminate the cause of the fluid aeration, then purge the system of air.

ADDITIONAL CAUSES OF NOISE

There are several other causes of excessive pump noise:

- Improper assembly of components such as slippers. For example, the slipper illustrated has been installed backward and the flat is facing in the wrong direction.
THREE BASIC PROBLEMS

- Imperfections on the rotor outside diameter or rotor end surfaces.

- Interference, such as a rotor hitting the cam.

- A cam with a hairline crack on the inner surface.

- Damaged rotor splines.

- Excessively worn or scored pumping elements and pressure plates.
NEW TEST EQUIPMENT

NORMAL WEAR
BRIGHT...UNSCORED

EXCESSIVE WEAR

- A damaged outlet fitting orifice due to an improperly machine-ground chamfer or no chamfer on the inlet side of fitting. The hissing noise that is heard under these conditions is caused by fluid flow rather than interference of moving parts.

NEW TEST EQUIPMENT

Another common problem is insufficient pressure. A pump flow test has been added to the diagnostic procedures, and supplements the pump pressure test. These tests help you to obtain the information needed to determine whether a power steering problem is caused by the power steering pump or to another component, such as the steering gear or control valve.

Before pump flow and pressure are tested, the preliminary checks and adjustments of the complete system must be performed. These are unchanged from previous years. Refer to the applicable Shop Manual for the proper procedures.

Check the:
- complete system for damage or leaks.
- fluid level in the reservoir.
- drive belt tension.
- pulley sizes on engine and pump.
- tire pressures.
- correct vehicle application. Be certain the pump installed is the one specified for the vehicle.

The previously used pump pressure test has now been supplemented by a pump flow test. Since the test procedures are revised, more test equipment is required. The new equipment consists of:

A thermometer to sense fluid temperature while the tests are performed.
An input fitting — stamped “input.” Plus a manual valve.

A by-pass hose and an output fitting stamped “output.”

The new test setup directs fluid flow from the pump through the test tool and back into the pump. The other component parts in the system are bypassed.

The new tool separates and isolates the power steering pump from other power steering system parts and shows the true pump conditions, free from all errors or problems which may be caused by the steering gear or control valve. This is done by the calibrated orifice or outlet in the output fitting of the new tool.
HOW TO CONDUCT A PUMP FLOW TEST

Assemble all the *added* test equipment to the original test equipment.

Connect the inlet hose of the test tool to the pump outlet.

Disconnect the pressure hose from the pump. Then, disconnect the return line from the gear.

Next, connect the return hose from the gear to the return hose of the tool. On some cars, the steering gear is difficult to get at. In these cases, disconnect both hoses at the pump and use a return hose from out-of-stock instead of the return hose already installed in the vehicle.
HOW TO CONDUCT A PUMP FLOW TEST

After the test tool is installed, open both manual valves to the full-open position.

To assist temperature rise, partially close the manual valve in the bypass to create a back pressure. The back pressure must not exceed 350 PSI. When fluid temperature reaches a range of 165 to 175 degrees — with the engine still operating at the specified idle RPM — close the manual valve in the bypass.

Remove the reservoir filler cap and dipstick assembly and insert the test thermometer in the filler neck.

Check the gauge reading. The minimum acceptable pressure reading is 620 PSI. If the pressure reading is below the minimum of 620 PSI, the pump must be repaired. If the pressure reading is at or above 620 PSI, the pump flow is okay, and you can proceed with the pump pressure relief test.

Install a tachometer and operate the engine at the idle speed specified in the applicable Shop Manual until the pump fluid temperature in the reservoir rises to within 165 to 175 degrees.
HOW TO CONDUCT A PUMP PRESSURE RELIEF TEST

Open both manual valves to the full-open position. Once again operate the engine at the specified idle speed until the pump fluid temperature in the reservoir rises to within a range of 165 to 175 degrees.

Close the manual valve at the gauge or output fitting.

Next, close the manual valve in the bypass. Do not keep both manual valves closed for more than 5 seconds at a time. Longer periods will result in an abnormal increase of fluid temperature and cause excessive pump wear.

Now, check the pressure gauge reading and record it. Refer to the specifications in the Film Review (Ready Reference) book, applicable Shop Manual or Specifications Booklet and compare the readings. If the pressure reading is below minimum specifications, the pump needs to be overhauled. If the pressure reading is at or above minimum specifications, the pump is okay. The problem may be in the power steering gear or the power assist control valve.

CAUSES OF LOW OUTLET PRESSURE

A low pressure valve installed in a pump requiring a high pressure valve will result in a low pressure output below specification.

Low pressure output can also be caused by a relief valve ball sticking open or not seated within the valve cover. Other problem conditions can affect pump flow, as well as pump pressure.
Two common sources of low pressure problems are an extremely low fluid level and a loose pump belt. These conditions should have been discovered and corrected during the preliminary checks.

Another condition which may cause low output pressure is a damaged ball or seat in the relief valve.

The same leakage condition, with resulting pressure drop, exists when the sealing surfaces are damaged at the valve cover or at the housing.

If the housing-to-valve and cover assembly seal is improperly assembled, damaged or omitted, oil will leak from the high pressure chamber into the inlet chamber. This will cause insufficient pressure.

Component parts, such as the housing plate, pressure plates, cam insert, retainer end plate, or valve and cover assembly will cause internal leakage and low pressure when they're not flat against the mating surface or the mating surfaces are damaged.

An improperly ground pump housing flange, for instance, provides leak channels on the low side to
CAUSES OF LOW OUTLET PRESSURE

cause aeration, noise, and low pressure with fluid being discharged from the fill tube as system temperature increases. Also, as the temperature increases, so does the noise.

An improperly ground flange is also indicated by an improper seal area on the gasket surface, causing a leak path.

Improper assembly of internal parts, or missing parts such as pressure plate springs, will result in low pressure output.

An improperly ground or out-of-flat pump valve assembly contributes to low pressure.

A plugged sensing orifice in the valve housing can cause a considerable pressure drop.
CAUSES OF LOW OUTLET PRESSURE

A plugged outlet orifice will cause the same condition.

Scored components, such as pressure plates, rotor or cam, can result in flow and pressure below specification.

A chipped or damaged condition of the upper or lower pressure plate at the pressure port areas will also cause low flow and high steering effort due to insufficient pressure.

Interference between the outside diameter of the rotor and the cam surface will cause a clicking noise, improper assist and low system pressure.

An out-of-flat condition of the upper or lower pressure plates will allow a leak path. This can cause low flow and high steering effort due to pressure below specifications.

If a pump is repaired due to wear, broken parts or dirt, it will be necessary to flush the steering system as outlined in the Shop Manual.
Upon completion of repairs and flushing procedures, make sure the pump reservoir is filled with fluid before attempting to operate the engine. Check the fluid level as outlined in the Shop Manual.

The diagnosis, testing and inspection procedures in this handbook and the repair or replacement procedures in your applicable Shop Manuals will enable you to correct any power steering pump problem that comes to your attention — and get a hearty “Well Done!” from your Ford service customers.
### FORD POWER STEERING PUMP IDENTIFICATION AND APPLICATION CHART

<table>
<thead>
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<th>MODEL NUMBER</th>
<th>FALCON, MONTEGO, FAIRLANE, MUSTANG, COUGAR (Except 302, 351 Engines)</th>
<th>FORD, MERCURY, METEOR, THUNDERBIRD WITH XR-50 STEERING GEAR</th>
<th>FORD WITH SAGINAW STEERING GEAR AND TRUCK F-100, F-250 (4 x 2)</th>
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### SERVICE IDENTIFICATION MODEL CHART — POWER STEERING PUMP PULLEYS

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