



TRW900A Diagnostic Testing Procedures

Rev. 2017

INTRODUCTION

CAUTION Do not attempt to diagnose a hydraulic steering related problem without using a Power Steering System Analyzer (PSSA). You will not be able to properly determine the correct information needed to analyze and diagnose the steering system.

A Power Steering System Analyzer (PSSA) is required when completing these hydraulic diagnostic tests. These PSSA test procedures were developed using TRW power steering components. However, the operating principles of the PSSA can be applied to all commercial power steering systems.

These instructions will explain how to properly install the PSSA and direct the technician, step-by-step, through each of the test procedures requiring the use of the PSSA. This will provide the technician with necessary test results for completing Diagnostic Test Form TRW900B and assist the technician in locating the root cause of any hydraulic steering related complaint.

WARNING While performing these tests, TRW advises that you take necessary precautions when working with internal vehicle components and hot hydraulic fluid. Be sure to take special care to protect yourself, and those around you, while performing a diagnostic test.

PRELIMINARY CHECKS

- **Fluid** (Aerated, Burnt, Discolored) - Refer to **SRV-100 Flushing and filling the Steering System**
- **Gear/Pump** (Leaks) - Repair before testing
- **Hoses** (Damaged, Leaks, Wear) - Repair before testing
- **Intermediate Shaft** (Binding, play) - Repair before testing
- **Linkage** (Damage, Wear) - Repair before testing
- **Steering Wheel** (Play) - Perform an on vehicle gear sector shaft adjustment.
- Indicate **Preliminary Checks** inspection results by circling either Y for Yes or N for No.
- Provide additional comments in **Diagnostic Notes** box on page 1.

Installing the Power Steering System Analyzer (PSSA)

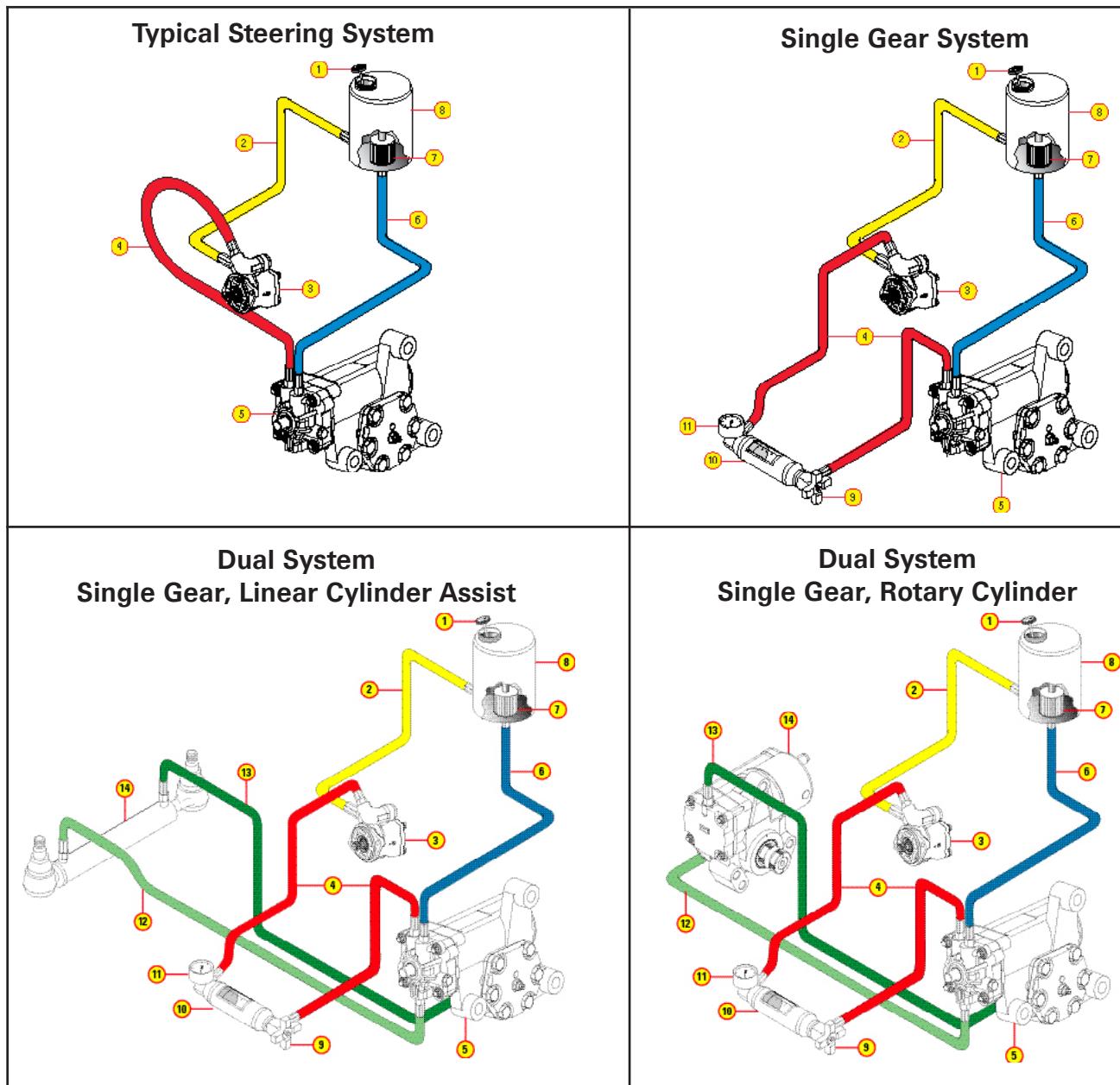
The PSSA is an integrated flow meter, pressure gauge and load valve. The PSSA measures flow and pressure and applies a load to the pump through the steering systems hydraulic pressure line.

Depending on the model of PSSA being used, an arrow showing the direction of the oil flow is displayed. This will assist in verifying the flow meter is properly installed in the system. A load valve, located near the gauge, is used to either restrict or open the flow of oil to the system.

The gauge has a SAE/Metric scale to read the flow of oil in either **GPM** (U.S. gallons per minute) or **LPM** (liters per minute). The system pressure is measured in either **PSI** (U.S. pounds per square inch) or **kg / cm²** (kilograms per centimeter squared).

The PSSA is installed between the power steering pump and the steering gear. Connect the valve end of the power steering system analyzer to the steering gear's pressure port and the other end to the pump's pressure port.

PSSA Installations



Legend

- | | | | |
|------------------|---------------------|--------------------|---------------------|
| 1. Thermometer | 5. Steering Gear | 9. Load Valve | 13. Auxiliary Line |
| 2. Supply Line | 6. Return Line | 10. Flow Meter | 14. Assist Cylinder |
| 3. Pump | 7. Reservoir Filter | 11. Pressure Gauge | (Linear or Rotary) |
| 4. Pressure Line | 8. Reservoir | 12. Auxiliary Line | |

PSSA Procedures

1. Install the power steering system analyzer in the pressure line with load valve fully open. Recheck and adjust the fluid level, if required. Follow the lines and verify they are connected correctly before attempting to perform any tests. Install a temperature gauge in the reservoir and begin the test with the fluid temperature between 180-200° F (82-97° C).

NOTE System temperature can be preheated before testing by adjusting PSSA load valve to 1000 psi and observing the temperature gauge. Once 180° is achieved, open load valve and begin testing. During testing if system reaches over 200°, temperature can be regulated by opening load valve and letting engine idle until temperature drops to 180°.

CAUTION When closing the power steering system analyzer load valve, do so slowly and keep an eye on the pressure gauge. Do not allow the system to exceed 3000 psi or (207 bar) for safety of personnel and to prevent damage to the vehicle.

CAUTION Do not keep the load valve closed for more than 5 seconds at a time because damage to the system may result from excessive heat build-up. If the system temperature exceeds 250° F (121° C), stop the test. This temperature level is considered extreme and steering system performance and life will be seriously affected. Damage to hoses, seals, and other components may result if operated at extreme temperature.

NOTE If, before PSSA testing, the steering system is operating above the recommended temperatures, a heat problem may be the root cause of the complaint.

2. Record pump and gear part numbers. (serial numbers are not required unless directed by call center)
3. Record the Engine Idle RPM and System Temperature.

NOTE Verify engine idle speed per original equipment manufacturers specifications.

Table A: Backpressure and Pump Pressure/Flow Test

4. With the engine speed at **IDLE**, load valve open, measure and record flow - **GPM** and backpressure - **PSI**
5. With the engine speed at **IDLE**, adjust the load valve to show **500 PSI** on the gauge. Measure and record flow - **GPM**. Repeat this step at **1500 PSI**.
6. With engine speed at **IDLE**, close load valve completely, measure and record **PSI**.
7. With the load valve fully open, increase the engine speed to **1500 RPM**, measure and record flow - **GPM** and backpressure - **PSI**
8. With the engine speed at **1500 RPM**, adjust the load valve to display **500 PSI** on the gauge. Measure and record the flow - **GPM**. Repeat this step at **1500 PSI**
9. With engine speed at **1500 RPM**, close load valve completely, measure and record **PSI**.
10. Throughout **Table A** testing, was pump pressure erratic and/or flow instantly return to no load gpm observed in **Table A**? Indicate response in **Erratic?**, circle either Y for Yes or N for No.

NOTE When hydraulic tests and repairs are completed and hoses are reconnected, check the fluid level and bleed the air from the hydraulic system using the procedures outlined in **SRV-100 Flushing and filling the Steering System** found at www.trucksteering.trw.com

Power Steering Pump Flow and Relief Pressure Review

Determine the recommended system flow and pressure for the steering system being used by referring to the Original Equipment Manufacturer's service manual for this application or gear and pump specifications found within the appropriate service manuals at www.trucksteering.trw.com

Compare the flow and relief pressure measured, to gear and pump specifications.

If the maximum system flow and/or pressure recorded is lower than that specified for the pump, the pump may not be developing enough pressure to steer the vehicle.

Table B: Pressure Range (while turning) and Poppet Trip Pressure

NOTE

Table B testing is performed with vehicle wheels on the ground.

1. Increase engine speed to 1500 RPM.
2. Begin to turn the steering wheel to the left. Record **Pressure Range - Left - Minimum**
3. Continue to turn steering wheel to the left until almost the end of travel is reached. **Record Pressure Range - Left Maximum**. Continue turning left, when the end of travel is reached, apply 20 lbs to rim of steering wheel. **Record Poppet Trip Pressure - Left**
4. Begin to turn the steering wheel to the right. **Record Pressure Range - Right - Minimum**
5. Continue to turn steering wheel to the right until almost the end of travel is reached. **Record Pressure Range - Right - Maximum**. Continue turning right, when the end of travel is reached, apply 20 lbs to rim of steering wheel. **Record Poppet Trip Pressure - Right**

NOTE

The end of travel poppet trip pressure should be at least 200 PSI below pump relief test value. If recorded value does not meet this criteria, poppets should be reset, using service procedure **TAS101 On Vehicle Poppet Adjustment** found at www.trucksteering.trw.com or at **TRW YouTube** videos. When complete, recheck the vehicle steering to verify it is operating properly.

Table C: Internal Leakage Test

This section will provide instruction on how to measure internal leakage for both a single gear and dual gear system. Follow the lines to verify that they are hooked up correctly before attempting to perform any tests.

⚠ WARNING

This test can be dangerous if not performed correctly. Keep fingers clear of the axle stops and spacer block during this test. Make sure that the spacer block contacts the axle stop squarely. Contact that is not square could break the axle stops or dangerously throw or eject the spacer block.

NOTE

This test should only be performed if complaint is occurring during testing and after **Pump Test - Table A** and **Poppet Trip Pressure - Table B** results have been verified to be within specifications and repaired, if required.

NOTE

The **Internal Leakage Test** is performed with vehicle wheels on radius plates or wheels elevated with front axle safely supported.

Table C Internal Leakage

To test the steering gear for internal leakage, first the operation of the gear's internal unloading (poppet) valves or relief valve (or both, in some gears) must be prevented. This will allow full pump relief pressure to develop. To prevent operation of the poppets, place an unhardened steel spacer block, between the axle stop and steering knuckle at one wheel. The spacer block must be at least 1 inch up to 1.5 inches thick and long enough to keep your fingers clear. If the steering gear is equipped with a relief valve, remove the relief valve cap, o-ring, and two piece relief valve from the steering gear valve housing. Install the relief valve plug, special tool number J37130, in its place, to prevent operation of the steering gear relief valve.

NOTE A new relief valve o-ring is required when reinstalling the relief valve and valve cap into the gear after this test.

CAUTION When conducting this test, do not hold the steering wheel in the full turn position for longer than 5 to 10 seconds at a time to avoid damaging the pump.

1. Install the PSSA in the pressure line with load valve fully open. Recheck and adjust the fluid level, if required. Install temperature gauge in the reservoir and perform the test with the fluid temperature between 180-200° F (82-97° C).
2. Install spacer block on left axle stop, turn the steering wheel to the left until the axle stop bottoms on the spacer block.
3. Apply 20 pounds of force to the rim of the steering wheel. This will make sure that the steering gear control valve is fully closed. Record the steering gear internal leakage **GPM** and **PSI** from the PSSA in **Table C Primary Gear GPM - PSI - Left**.
4. Install spacer block on right axle stop, turn the steering wheel to the right until the axle stop bottoms on the spacer block. Perform step 3 and record the steering gear internal leakage **GPM** and **PSI** from the PSSA in **Table C Primary Gear GPM - PSI - Right**
5. If internal leakage is greater than 1 gallon per minute (3.8 liters per minute) and there is no assist hydraulic linear or rotary cylinder in the system, repair or replace the gear.

With **Assist Cylinder**: If the internal leakage is greater than 2 gallons per minute (7.6 liters per minute), and there is an auxiliary hydraulic linear or hydraulic rotary cylinder in the system, controlled by the primary gear, isolate the assist cylinder from the system by disconnecting the assist cylinder hydraulic lines at the primary steering gear auxiliary ports. Plug the primary steering gear auxiliary ports with suitable steel or high pressure plugs or caps;

- If a **rotary cylinder** is used in the system, connect the disconnected lines together with a suitable union fitting.
- If a **linear cylinder** is used in the system, plug the disconnected lines and disconnect the cylinder from steering linkage, verifying it will clear the steered axle.

Repeat the **Internal Leakage** test, steps 2, 3, 4 and record results in **Table C With Assist Cylinder** boxes. If the internal leakage is now less than 1 gallon per minute (3.8 liters per minute), repair or replace the assist cylinder. If the internal leakage is now greater than 1 gallon per minute (3.8 liters per minute), repair or replace the primary gear.

NOTE When hydraulic tests and repairs are completed and hoses are reconnected, check the fluid level and bleed the air from the hydraulic system using the procedures outlined in **SRV-100 Flushing and filling the Steering System** found at www.trucksteering.trw.com