



Hydraulic Steering System Return Hose Pressure Characterization During Steady State Operation

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To measure the hydraulic pressure in the power steering return hose(s) while the fluid temperature is typical for normal vehicle operation and the fluid flow is at a steady state typical of a vehicle at 100 km/h.

1.2 Applicability. This procedure is applicable to all vehicles with a hydraulic power steering system.

1.3 Remarks. This test provides information for the selection of return hose type and the connection style for securing the return hose material to the return hose assembly metal pipes and for durability testing the return hose material connections to the metal pipes.

This test is recommended to be run following GMW16318 since it utilizes the same test equipment and parts.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW16318

2.3 Additional References.

- Lincoln Industrial Corporation, St. Louis, Missouri, www.mityvac.com
- Lovejoy, Incorporated, Downers Grove, Illinois, www.lovejoy-inc.com
- Meggitt Sensing Systems, Irvine, California, www.endevco.com

3 Resources

3.1 Facilities. Approximately 2 m × 2 m minimum bedplate. It is also acceptable to use the same roll around cart specified for use in GMW16318.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment. Reference GMW16318 as equipment needs are identical.

3.2.1. Electric motor.

3.2.1.1 Minimum speed capability of 1750 rpm.

3.2.1.2 Minimum power of the electric motor is 2 hp or 1.5 kW.

3.2.2 Angle stands and associated equipment to constrain the test specimen as described in 4.3.2 and 4.3.7.

3.2.3 Endevco (Meggitt Sensing Systems) Pressure Transducer Model Number 8530B-2KM37 or equivalent. See Appendix A, Figure A1.

3.2.3.1 Pressure capability: 14 MPa (2000 psig).

3.2.3.2 Sampling frequency: 1000 Hz minimum.

3.2.4 Pressure transducer pipe adapter(s). Steel adapters for steel pipe and aluminum adapters for aluminum pipe are required. See Appendix A, Figure A2 for adapter configuration and dimensional specifications for the specified pressure transducer. Equivalent adapters are permissible for different transducers.

3.2.5 Thermocouple.

3.2.6 Signal recorder/data collection device.

3.2.7 Appropriate amp/signal conditioner for the pressure transducer or equivalent.

3.2.8 Motor cart/setup, consisting of the motor and switch to run the power steering pump. See Appendix A, Figures A4 thru A7 for examples.

3.2.8.1 Bracket to secure pump to cart at in-car position. See Appendix A, Figures A8 and A9 for examples.

3.2.9 Handheld Mityvac (Lincoln Industrial Corporation) vacuum pump (tool number J35555) or equivalent and Bleeder Adapter (tool number J43485) or equivalent.

3.2.10 Rubber isolated motor coupling assembly (Lovejoy Jaw Type or equivalent) with specially prepared coupling hub for adaptation to the pump driveshaft. See Appendix A, Figure A4 for photo of typical coupling.

3.3 Test Vehicle/Test Piece. The parts (3.3.1 through 3.3.7) shall be included in the pre-production test kits requested by the validation engineer to support this testing or provided by design engineer.

All test material shall be dimensionally certified prior to receipt to confirm that it is representative of design intent. Reference GMW16318 as test piece needs are identical.

3.3.1 Power steering pump.

3.3.2 Power steering reservoir(s).

3.3.3 Power steering gear assembly.

3.3.4 Power steering hose assemblies.

3.3.5 Power steering cooler if applicable.

3.3.6 Any other component in the power steering circuit.

3.3.7 A sufficient quantity of the production intent power steering fluid.

3.4 Test Time.

Calendar time: 6 days

Test hours: 24 hours

Coordination hours: 40 hours

3.5 Test Required Information. The Design Engineer shall supply:

3.5.1 Layout/math data showing pump to reservoir relative position and pump to steering gear relative position.

3.5.2 Assembly information, such as Master Process Document (MPD) sheets, showing assembly position, sequence, etc.

3.5.3 Hydraulic connections tightening torque.

3.5.4 Hydraulic power steering pump relief pressure.

3.5.5 The minimum pump speed (rpm) at which the pump's flow control valve is actuated and the pump is in flow control mode.

3.5.6 The volume of fluid produced per minute (liters per minute) while in flow control mode.

3.5.7 The material (steel or aluminum) of the power steering hose assemblies' pipes, to which the pressure transducer ports will be attached.

3.6 Personnel/Skills. One laboratory test technician skilled in the setup, tuning, and use of pressure and temperature measurement equipment and controllers. One test engineer for test planning, data preparation, direction, and incident analysis. One validation engineer to request part kits and track the status of parts from Pre-Production Operations (PPO).

4 Procedure

4.1 Preparation.

4.1.1 Attach the adapter(s) to the pipe(s) of the hose assemblies.

4.1.1.1 Adapter locations on the return hose assembly shall be as close to the hose to pipe connections as possible. Typical adapter locations are approximately 50 mm from the hose connection to prevent heat damage to hose material during soldering or welding process. Typical adapter location must be in a straight section of pipe. See Appendix A, Figure A3 for typical adapter location(s).

4.1.1.2 Adapter location on the pressure hose assembly shall be anywhere it is convenient to attach it. See Appendix A, Figure A3 for typical adapter location.

4.1.2 After adapters are attached to pipes, drill a hole through the wall of the pipe using the adapters as a drill guide. Maximum drill size shall be same as tap drill for adapter. Blow air through the hose assembly during drilling to prevent chips from accumulating in the pipe. The direction of the blown air should be prioritized based on avoiding blowing the chips through tuning devices such as restrictors or through the shortest distance of return hose length possible.

Note: Pipes must be free of contamination prior to installing transducers and running tests to prevent pump damage.

4.1.3 Install specified pressure transducers in adapters.

4.1.4 Drill hole through reservoir cap sufficiently large to allow thermocouple to pass through into reservoir.

4.1.4.1 Install thermocouple through hole in cap and glue in place.

4.2 Conditions.

4.2.1 Environmental Conditions. Test to be run at typical lab temperature, approximately 20 °C.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions for Test Set Up.

4.3.1 Install steering system to fixtures using nominal torques.

4.3.2 Pump to be mounted to pump cart in vehicle orientation.

4.3.3 Secure steering gear assembly to angle stand assembly.

4.3.4 Pressure and return hose assemblies shall be in approximate vehicle position, taking care not to kink, twist or flatten hoses.

4.3.5 Attach or secure rubber isolated motor coupling to pump shaft.

4.3.6 Set motor speed to the greater of the pump speed defined in 3.5.5 or minimum motor speed. The motor speed must not exceed 3000 rpm.

4.3.7 If there is a remote reservoir, make sure the reservoir is oriented per design intent above the pump.

4.3.8 Fill system with oil and bleed system to remove any air from system using handheld vacuum pump.

4.3.9 Test instrumentation and recording equipment with trial run.

4.4 Instruction for Test Execution.

4.4.1 Start recording equipment and confirm transducer and thermocouple function.

4.4.2 Verify fluid temperature is no colder than room temperature.

4.4.3 Start electric motor.

4.4.4 Collect the following information and record:

- Pump speed
- Pressures
- Fluid Temperature

4.4.5 Allow the fluid temperature to increase until 135 °C is attained.

4.4.6 Stop electric motor immediately upon reaching 135 °C.

4.5 Notes for Test Execution.

4.5.1 Since the cooler is not operating in the normal air flow of the vehicle, the fluid should experience a temperature increase without any further input from the test operator.

4.5.2 If the temperature does not increase, but settles into a steady state of a fluid temperature lower than 135 °C, conduct the steps 4.5.2.1 through 4.5.2.3.

4.5.2.1 Revolve the steering gear input shaft to the steering gear travel stop and hold until the pump has been in pressure relief for approximately 5 s.

4.5.2.2 Release the steering gear input shaft and allow the temperature to stabilize for 5 s to 10 s.

4.5.2.3 If necessary, repeat the pressure relief step and the temperature stabilization step until the fluid reaches 135 °C.

4.5.3 Do not permit fluid temperature to exceed 160 °C.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation.

5.3.1 Calibration Record Sheet, Appendix B, Data Sheet B1.

5.3.2 Test Review and Approval Form, Appendix B, Data Sheet B2.

5.3.3 Photographs of test setup and issue observations.

5.3.4 Test results.

5.3.4.1 Pressure of each channel recorded at the temperatures:

5.3.4.1.1 Twenty (20) °C.

5.3.4.1.2 Eighty (80) °C.

5.3.4.1.3 One hundred and thirty five (135) °C.

5.3.4.2 Pressure vs. Time plot (Time Histories) of all pressure transducers.

5.3.4.3 Temperature vs. Time plot (Time History) of the thermocouple.

5.3.4.4 Pressure vs. Temperature plot of all pressure transducers.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

BLK	Black
Cal.	Calibration
DIA	Diameter
GRN	Green
GSSLT	Global Subsystem Leadership Team
MAX	Maximum
MPD	Master Process Document
No.	Number
PPO	Pre-Production Operations
REF	Reference

Samp. Sample
THD Thread
Veh. Vehicle
WHT White

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW16368

9 Release and Revisions

This standard was originated in April 2010. It was first approved by Chassis Steering Global Subsystem Leadership Team (GSSLT) in May 2010. It was first published in June 2010.

Issue	Publication Date	Description (Organization)
1	JUN 2010	Initial publication.
2	JUL 2015	Revised to current template. (Chassis Steering GSSLT)