



Washer System Test Procedure

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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. This standard defines the testing methodology and requirements for validating both front and rear washer systems to GM requirements. Components for these systems include washer bottle, washer filler tube, filler tube seal, washer pumps, level sensor, washer hoses, check valves, washer nozzles, filter, tube filter and any attaching hardware.

This specification does not cover front windshield wiper components or rear wiper components, unless washer nozzle/hoses are attached to these system components.

This specification does not fulfill any GMW3172 requirements specified in the Subsystem Technical Specification (SSTS). A separate pump only test plan shall be developed with GM validation to meet GMW3172 requirements.

1.2 Applicability. This document is applicable for all car, Multipurpose Passenger Vehicle (MPV), and truck models produced by GM.

The following reservoirs are used:

- Reservoir for windshield washer systems.
- Reservoir for headlamp washer systems.
- Reservoir for windshield washer systems and headlamp washer systems.
- Camera and sensor cleaning systems.

The following pumps are used:

- Devices with one pressure outlet (Mono pump).
- Devices with two pressure outlets (Dual pump).

1.3 Remarks. This document is the GM Worldwide Washer System Testing Standard (see Appendix A, Figure A1 for test flow). The purpose is to establish a common test methodology for washer systems to ensure that a high quality world class system is consistently developed and produced. This is a living document and any suggestions or revisions will be reviewed and/or updated annually by the Windshield Wiper Global Subsystem Leadership Team (GSSLT).

The washer system is used to store and apply a washing agent to the target area on the outside of the windscreen and backlite of vehicles; if used correctly, no washing agent shall escape and no hoses shall become detached from the screen washer.

The washer reservoir, also referred to for convenience as the reservoir, is that part of the washer system which is used to store the washer fluid.

The hose set is the part of the washer system, which serves for the transport of the washing fluid. The hose set shall be designed optimally regarding flow technology. Unless otherwise agreed, components of the hose set are hoses of different lengths, molded parts such as hoses connections, adapters, T-fittings, Y-fittings, elbow joints, valves or other parts. In addition to flexible hoses, rigid pipes or grooved pipes can be used. The assembly including the complete washer system, the connections from the pump to the hose set and the hose set to the nozzles shall all be tested.

Besides these tests, the system together with all components shall comply with the legal requirements of those countries in which employed.

2 References

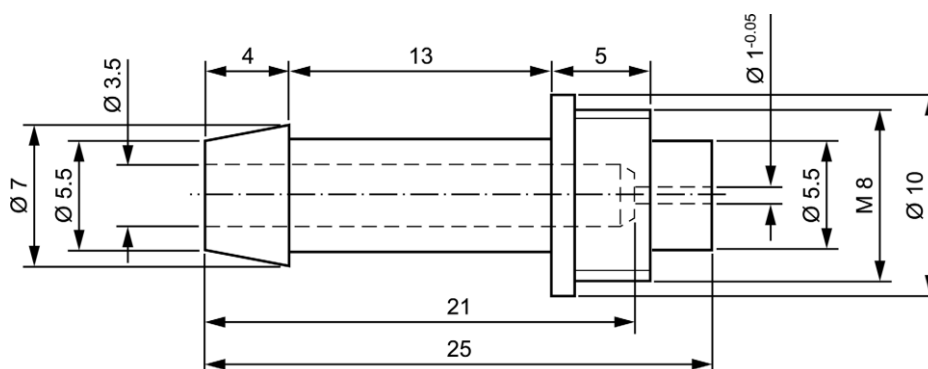
Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

78/318/EEC	CMVSS 104	FMVSS 104	IEC 60068-2-27
ASTM D865	EU 1008/2010	GB 15085-1994	ISO 188

GMW3059	GMW3172	GMW14234	GMW16331
GMW3116	GMW3600	GMW14650	GMW17075

- 5 Phase Template Statement of Requirements (SOR)
- GM Security Guidelines
- GM Subjective Rating Scale for Component Noise
- Applicable Component Technical Specifications (CTS)
- Washer System Subsystem Technical Specification (SSTS)



3.1.2.7 Test hose with 4.0 mm Inner Diameter (ID) for performing test with reproducible measurements. See Appendix C, Figure C1 for hose lengths.

3.1.2.8 Apparatus for the holding and mounting of components to be tested.

3.1.2.9 Measuring glasses of suitable version (see Table 1).

Table 1: Measuring Glasses of Suitable Version

Capacity in milliliters (mL)	Scale Division in milliliters (mL)
1000	10
2000	20

Note: Alternative flow meters with a measuring range of 0.2 L to 3.0 L/minimum may also be used.

3.1.2.10 As described in the individual tests, water (tap water) with a color dye added or a mixture of 50% by volume water and 50% by volume isopropanol shall be used as test fluid as required.

The test fluid shall be in sufficient quantity to ensure that the complete hose set is constantly filled with fluid during the test.

3.1.2.11 Pump and Fluid Level Sensors. The reservoirs for the individual tests shall be equipped with the original pumps, fluid level sensors and tank funnel (if intended) as well as the relevant seals.

3.1.3 Test Vehicle/Test Piece.

3.1.3.1 Unless otherwise specified, three samples of components, or systems, shall be tested.

3.1.3.2 All components/systems used in testing shall be within drawing specifications and have supporting data prior to start of test.

3.1.3.3 Washer reservoirs that will be produced with regrind material need to follow regrind test methodology listed in GMW14650.

3.1.3.4 Visual Inspection and Dimensional Test. The washer system, i.e., all individual components, shall not have any visible damage or flaws, which could impair the function or appearance, in the as received condition.

The dimensions and tolerances specified in the component and/or release drawings shall be fulfilled by all parts of the washer system. The washer system shall be designed in such a way that it is protected against contamination, e.g., dirt, chips, etc., which could impair the function, until assembled.

3.1.3.5 Material Test.

3.1.3.6 All materials used for the washer system shall conform to the drawing and material specifications, as well as to releases and definitions of the relevant component specification.

3.1.3.7 The components of the washer system shall be resistant to the fluids used during testing. This also applies to the commercially available cleaning agents and additives employed during normal vehicle operation. The functionality of the system shall not be adversely affected as a result of parts being dissolved in such cleaning agents.

3.1.3.8 The washer system shall be resistant against a solution of:

- By volume 50% water and 50% by volume methanol in a temperature range of -18 °C to +80 °C.

3.1.3.9 Design Requirements. The washer system shall be designed such that when assembled it can apply ≥ 1 L washing fluid (water) as evenly as possible to the surface of the windscreen within one (1) minute.

The washer system shall be designed in such a way that it is protected against contamination, e.g., dirt, chips, etc., which could impair the function, until assembled.

3.1.3.10 Materials which are susceptible to hydrolysis, e.g., acetyl homopolymer or thermoplastic polyester shall not be used.

3.1.3.11 Marking. On a suitable position the GM logo (GMW16331), the date of manufacture (GMW16331), the manufacturers logo, the part number and the standard symbol of material (GMW3116), for plastic parts, as far as applicable, shall be clearly legible and be durably marked.

The marking shall not impair the function of the washer system.

3.1.3.12 Environmental Protection. Restricted and Reportable Substances for Parts to GMW3059.

3.1.4 Test Time. Time is dependent on test being performed.

3.1.5 Test Required Information.

3.1.5.1 GM Validation is to be notified of test failures within 24 h period of occurrence.

3.1.5.2 Supplier to develop five (5) phase document for all test failures.

3.1.5.3 Product Security. Security protocol for the test vehicle must be followed per GM Security Guidelines.

3.1.6 Personnel/Skills. Test technician familiar with test facilities and equipment.

3.2 Preparation.

3.2.1 Nominal fastener torques unless otherwise specified store at 12 h at +23 °C ± 3 °C.

3.2.2 A suggested test flow is in Appendix A, Figure A1 (Test Legs) – Use to reduce the total number of components or subsystems needed for all the required testing for this procedure.

3.3 Conditions.

3.3.1 Environmental Conditions. Unless otherwise specified.

- Ambient temperature: 23 °C ± 3 °C.
- Voltage: 13.5 V ± 0.5 V at motor terminals.
- Humidity is to be a minimum of 50 ± 5% for all tests unless otherwise specified.

3.3.2 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.

3.3.2.1 Unless otherwise specified for the individual tests, the tests shall be performed after a minimum storage time of 12 h at +23 °C ± 3 °C without preliminary treatment.

3.3.3 Parts are to be tested in vehicle orientation unless otherwise specified.

3.3.4 As described in the individual tests, water (tap water) or a mixture of 50% water and 50% (by volume) isopropanol/methyl alcohol (50/50 test fluid) shall be used as test fluid.

3.3.5 Pre Test Data. Collect current draw, pressure/volume, and noise requirements specified in vehicle specific washer system SSTs and Appendix B prior to all test unless otherwise specified.

3.4 Instructions. No special instructions.

3.5 Data.

3.5.1 Test Documentation. Include photographs of the test setup and the individual test results.

3.5.1.1 Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM department prior to the start of delivery of production level components or materials. Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release. If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.5.1.2 Record measurements and results as specified by individual procedures in the final test report.

3.5.1.3 Document the test results in a test certificate or report. Test reports shall include all of the following: test equipment serial numbers, calibration information, description of test material (including design revision, lot or batch, options, etc.), test specification date, pertinent setup information, and photographs. The Supplier shall write evaluation reports to document the results of all their validation activities and shall make the test results and evaluation reports available to GM Engineers upon request (see GMW3600). All reports are to be in the English language. Document all test results, parameters and findings.

3.5.1.4 Photos of the test fixture and test sample.

3.5.1.5 The following is also required for ALL test reports (Reference Appendix E, Table E1).

- Procedure number and section numbers on all test reports.
- Requirement being met and SSTs requirement number.
- All test parameters for environment and equipment.
- Any authorized deviations to the plan.

3.6 Safety. This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

3.7.1 Test Results.

3.7.1.1 Test reports with supplier letterhead are to be generated by the responsible supplier and electronically distributed to GM Validation. All Reports are to reference the specified test procedure and any applicable Federal Regulations. All reports are to be in the English Language.

3.7.2 Deviations from this Standard. 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 Requirements and Procedure

4.1 Washer Pump Performance.

4.1.1 Purpose. This test is to ensure that a washer pump design has sufficient fluid pressure/volume at different voltages and temperatures.

4.1.2 Test Equipment. Per 3.1.2.

4.1.3 Test Samples. Quantity of 22 randomly selected pumps, nine (9) wiper washer systems with test nozzles per 3.1.2.6 and two (2) washer bottles.

4.1.4 Test Preparation. None is required.

4.1.5 Test Conditions. The tests shall be performed according to the test sequence (see Applicable Component Technical Specification (CTS)). The prescribed test sequence shall be observed to ensure that comparable results are attained (see Washer System Subsystem Technical Specification (SSTS) and 5 Phase Template Statement of Requirements (SOR)).

4.1.6 Test Procedure. Ambient temperature $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$, install washer pump in reservoir filled with water and connect test hose and test nozzle, set up as shown in Appendix C, Figure C1. Connect the variable power supply. Route test hose back into reservoir, fill pump with fluid and operate pump for continuous 60 s cycle three times. Let pump rest for 60 s between cycles. Record initial pump performance criteria:

- Voltage.
- Amperage.
- Noise Level.
- Volume at test nozzle.
- Pump Pressure.

4.1.6.1 Set pressure gage to measure peak pressure and route test nozzles in graduated cylinder. Fill system with fluid and run for one minute. Operate pump with 13.5 V for 30 s and record maximum pressure and fluid volume during this time (multiply fluid volume $\times 2$ for one (1) minute flow calculation). Record the Pump Pressure and flow rate.

Note: If pump design is reversing type, repeat the preceding steps with pump operating in opposite direction. Record the Pump Pressure and flow rate.

4.1.6.2 Repeat steps in 4.1.6.1 with 9.0 V and 16.0 V applied to washer pump. Compare initial readings to test results and record any performance issues.

4.1.6.3 Drain all fluid from system and run pump for 60 s $\pm$ 3 s and refill with 50/50 test fluid. Place reservoir in thermal chamber and soak at $-20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 4 h. While at $-20\text{ }^{\circ}\text{C}$ and 13.5 V, repeat steps 4.1.6.1 and 4.1.6.2.

4.1.6.4 Place reservoir in thermal chamber and soak at $65\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 4 h. While at $65\text{ }^{\circ}\text{C}$ and 13.5 V, repeat steps 4.1.6.1 and 4.1.6.2.

4.1.6.5 Repeat 4.1.6.1 with the pump running at 9 V, 10 V, 11 V, 12 V, 13 V, 13.5 V, 14 V, 15 V and 16 V.

4.1.6.6 Compare initial readings to test results and record any performance issues.

4.1.6.7 Perform Design Review Based on Test Results (DRBTR) by disassembling pumps and checking for internal water leaks and potential issues.

4.1.7 Test Requirement. Pump shall meet pressure and volume performance requirements specified in vehicle specific washer system SSTs and Appendix B.

4.2 Washer Pump Dry Operation.

4.2.1 Purpose. This test is to ensure that a front or rear washer pump design is not susceptible to damage when operated without fluid.

4.2.2 Test Equipment. Per 3.1.2.

4.2.3 Test Samples. Same samples as 4.1.3.

4.2.4 Test Preparation. None are required.

4.2.5 Test Conditions. Per 3.3.

4.2.6 Test Procedure. Washer pump is to be installed into a completely empty reservoir.

4.2.6.1 With reservoir and pump inlet empty, operate the pump dry for continuous 60 s. Let pump stabilize for a minimum of 15 minutes.

4.2.6.2 With reservoir and pump inlet empty, operate the pump dry for 20 activations. One activation period is 3 s on and 5 s off.

4.2.6.3 Fill reservoir with 50/50 test fluid and connect test hose and test nozzle, set up as shown in Appendix C, Figure C1. Operate pump for 30 s and record maximum pressure output during this time and the volume retained.

Note: If pump design is a reversing type, repeat steps: 4.2.6.1, 4.2.6.2 and 4.2.6.3 with pump operating in opposite direction.

4.2.6.4 Perform Design Review Based on Test Results (DRBTR) by disassembling pumps and checking for internal water leaks and potential issues.

4.2.7 Test Requirement. Pump shall meet pressure and volume performance at 13.5 V and $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ as specified in washer system SSTs.

4.3 Washer Pump Methanol Resistance.

4.3.1 Purpose. This test is to ensure that a washer pump design is resistant to methanol-type washer fluids.

4.3.2 Test Equipment. Per 3.1.2.

4.3.3 Test Samples. Same samples as 4.1.3.

4.3.4 Test Preparation. None is required.

4.3.5 Test Conditions. Per 3.3.

4.3.5.1 Test Temperature. At $80\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

4.3.6 Test Procedure. Install washer pump in reservoir filled halfway with 50 water/50 isopropanol/methyl alcohol test fluid.

4.3.6.1 Operate washer pump so fluid fills the pump impeller cavity. With pump cavity primed, block pump outlet so fluid remains in impeller cavity.

4.3.6.2 Place reservoir/pumps in thermal chamber and soak at $80\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 8 h.

4.3.6.3 Allow the pump to stabilize at ambient temperature for 1 h.

4.3.6.4 Fill reservoir with 50/50 test fluid and connect test hose and test nozzle, set up as shown in Appendix C, Figure C1. Operate pump for 30 s and record maximum pressure output during this time.

Note: If pump design is reversing type, repeat the preceding steps with pump operating in opposite direction.

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4.3.7 Test Requirement. Pump shall meet pressure and volume performance at 13.5 V and $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ as specified in washer system SSTs.

4.4 Washer Pump Internal Seal Performance.

4.4.1 Purpose. This test is to verify washer pump impeller cavity is properly sealed.

4.4.2 Test Equipment. Per 3.1.2.

4.4.2.1 Test hose, 2.0 m length, 4.0 mm Inner Diameter (ID).

4.4.2.2 Plug for washer pump inlet.

4.4.3 Test Samples. Same samples as 4.1.3.

4.4.4 Test Preparation. Per 3.2.

4.4.5 Test Conditions. Per 3.3.

4.4.6 Test Procedure. Connect test hose to washer pump outlet and start to fill hose with water. While water is draining from pump inlet, quickly plug the inlet so no air is trapped in pump impeller cavity.

4.4.6.1 Fill entire test hose with water and route hose upward. Fixture pump and hose in this condition per Figure 2.

Note: For reversing washer pumps, test must be repeated so both pump outlets are tested individually.

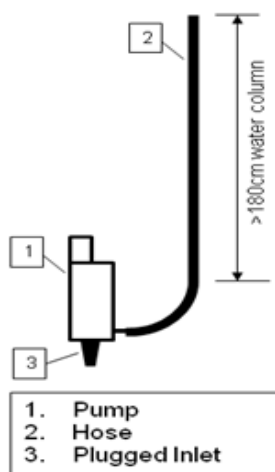


Figure 2: Pump Leak Check

4.4.6.2 Maintain water column for at least 72 h at $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

4.4.6.3 Water-Tightness of Pump. A test setup shall be used which includes a hose (diameter $\approx 4.0\text{ mm}$) to enable the production of a water column of 2 m from the output nozzle of the pump. The intake nozzle of the pump shall be suitably sealed after ventilating the pump.

- After test duration of $72\text{ h} \pm 0.5\text{ h}$, a reduction in the water column height of 5 mm maximum is permissible.
- There shall be no water in the pump motor housing.
- This test shall also be performed for the backlite washer outlet. Both outlets shall be tested analogously.

Note: For reversing washer pumps, steps 4.4.6 thru 4.4.6.2 must be repeated so both pump outlets are tested individually.

4.4.6.4 Drain hose and remove hose and plug from pumps.

4.4.6.5 Perform Design Review Based on Test Results (DRBTR) by disassembling pumps and checking for internal water leaks and potential issues.

4.4.7 Test Requirements. Water height shall not change by more than 5.0 mm.

4.4.7.1 There shall be no internal leaks into pump housing area that retains electric motor.

4.4.7.2 There shall be no external leaks.

4.5 Washer Pump Durability/Reliability.

4.5.1 Purpose. This test is to verify a washer pump system will meet specified performance requirements during a vehicle's lifetime with component reliability of 99% Reliability at 50% Confidence level (R99C50) at one life. One life is defined in the program SSTs.

4.5.2 Test Equipment. Per 3.1.2.

4.5.2.1 Test reservoir capable of holding multiple pump samples for testing.

4.5.2.2 Test hoses with single test nozzle on each.

4.5.2.3 Cycle counter/encoder.

4.5.2.4 Oscilloscope.

4.5.3 Test Samples. Quantity of 12 pumps.

4.5.4 Test Preparation. See 3.2.

4.5.4.1 Reliability requirement can be met through either success or failure testing. Review with GM Validation Engineer and get agreement on which method will be used before start of test.

4.5.4.1.1 Reliability Success Test. Recommended for Post Validation (PV) testing – three (3) samples can be used. Table 2 provides direction for required test duration with three samples. Repeat durability test profile, replacing blades and/or structure as specified, until life cycles have been run without failure. See test requirements for definition of failure.

Note: A Beta slope of 1.5 shall be used as a default and for new suppliers or new designs. The value can be increased based on the following:

- Experienced supplier.
- Similar designed systems with historical data (carryover motor, carryover linkage, etc.)
- AND** Approval by the Subsystem Validation Engineer (SVE) and Designing Engineer (DE) for the program. Supplier shall notify SVE and DE of the Beta slope used and whether success or failure test method will be used prior to start of any testing.

Table 2: Reliability 99% with Confidence 50% ^{Note 1}

R99C50 Chart Using Beta = 1.5	
Sample Size	Number of Life Cycles
6	5.09
12	3.21
R99C50 Chart Using Beta = 2.0	
Sample Size	Number of Life Cycles
6	3.39
12	2.40
R99C50 Chart Using Beta = 3.0	
Sample Size	Number of Life Cycles
6	2.26
12	1.79

Note 1: For reference only.

4.5.4.1.2 Failure Test. Recommended for Design Validation (DV) testing. A minimum of six (6) samples shall be used. Repeat durability test profile, replacing blades and/or structure as specified, until a failure defined in Test Requirements is detected. Analyze the resulting failure data using a Weibull probability plot to estimate the reliability. The estimate shall be R99C50 or better at one life. Deviations to this must have approval by the GM SVE and DE for the program.

4.5.5 Test Conditions. See specific procedure.

4.5.6 Test Procedure. Prior to test, subjectively evaluate the washer pump noise (including but not limited to whine, growl, clicks, clunks, etc.) per GM Subjective Rating Scale for Component Noise (see Appendix B, Table B1) under the following conditions: V_{NOM} , low and high speed, wet glass.

Mount washer pumps in testing reservoir and attach test hoses to each pump outlet. Route these hoses and test nozzle back into test reservoir. See Figure 3.

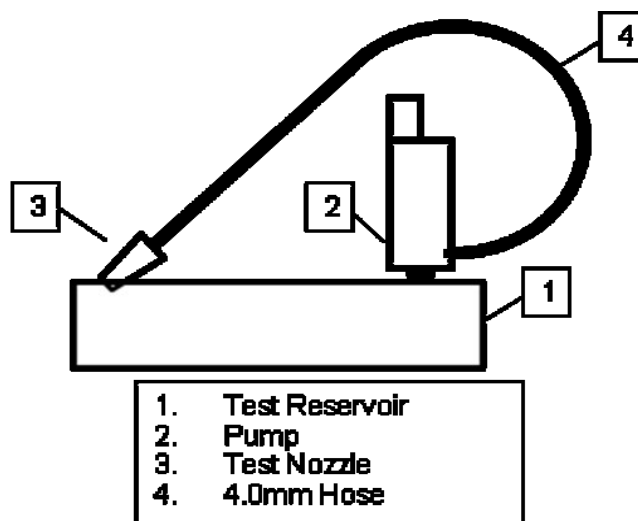


Figure 3: Pump Durability Test Setup

Note: If reversing pump type, route additional test hose from opposing pump outlet back into test reservoir.

4.5.6.1 Fill test reservoir with 50/50 test fluid.

4.5.6.2 Prior to test, operate washer pump and subjectively evaluate pump noise (including but not limited to whine, growl, clicks, clunks, etc.,) per GM Subjective Rating Scale for Component Noise (see Appendix B, Table B1) under the following conditions: 13.5 V, 15 s operation.

4.5.6.3 Connect pressure gage in line with test nozzle and route test nozzle into graduated cylinder. Activate washer pump for 15 s while recording peak fluid pressure and measuring fluid volume after 15 s.

4.5.6.4 Conduct durability/reliability test using washer pump durability test profile in Figure 4. Verification of pump operation must be done at least twice a day.