



Washer Reservoir Level Sensor Component Specification

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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. The purpose of this test is to evaluate the performance of the washer reservoir level sensor on a component level.

1.2 Applicability. This standard is applicable for all car, Multipurpose Passenger Vehicle (MPV), and truck models produced by GM Worldwide with a level sensor in the washer system reservoir.

1.3 Remarks.

- This document is intended to test performance requirements of a wiper washer reservoir level sensor under environmental conditions.
- This document and any suggestions or revisions will be reviewed and/or updated annually by the Wiper and Wash Systems Global Subsystem Leadership Team (GSSLT).
- This procedure is a component level test. A vehicle level test is required for validation.

2 References

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

2.1 External Standards/Specifications.

CMVSS 104	EU 1008/2010	GB 15085-1994
DIN 40050-9	FMVSS 104	

2.2 GM Standards/Specifications.

GMW3059	GMW3191	GMW16393
GMW3172	GMW3600	

2.3 Additional References.

- Five (5) Phase document.
- Component EMc and ENvironmental Test Database (CEMENT).
- GM Security Guidelines - (<https://gmweb.gm.com/HR/Security/Pages/FutureGuide.aspx>).
- GM1829 Analysis Development Validation Plan and Report (ADVP&R) which is located in the SSTS.
- ISO/IEC standards.
- Program Specific Component Technical Specifications (CTS).
- Program Specific Subsystem Technical Specifications (SSTS).

3 Test Preparation and Evaluation

3.1 Resources.

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.

3.1.3 Facilities. The test facilities shall be accredited to ISO/IEC standards or by the International Laboratory Accreditation Cooperation. However, all measuring variables as specified in this specification shall be determined correctly with respect to its physical definition.

3.1.4 Equipment. Equipment is also listed in 4.3 Performance Requirements.

3.1.4.1 Climate Chamber. A climate chamber as follows.

- A range T_{min} to T_{max} suitable for level sensor test fixture.
- Recirculating air temperature cabinet.
- Test room, suitable for the execution of the test.

- Temperature range: -40 °C to +100 °C.
- Permissible temperature accuracy: ± 3 °C.
- Temperature rate of change shall be ± 1 °C/minute.

3.1.4.2 Holding Fixtures. Required for component level testing. The fixture is required to hold the level sensor in the vehicle position. The fixture shall be approved by the GM Design Engineer (DE) and/or Subsystem Validation Engineer (SVE).

3.1.4.2.1 Testing With Fluid Required. A fixture shall be built to hold the reservoir in vehicle position and capable of fitting into the climate chamber. The fixture may be built to accommodate more than one reservoir to facilitate time requirements.

3.1.4.2.2 Level Sensor Apparatus. A fixture used to create slush point and establish T_{Slush} (see Appendix A).

3.1.5 Test Vehicle/Test Piece. Test samples shall be of production intent design and material for design validation (DV); or, production intent design and materials manufactured with production processes (from the supplier's production line) for product validation (PV). Any changes to the components or material, e.g., design, fit, form, function, properties, manufacturing process, and/or location of manufacture require revalidation. GM shall approve validation methods for product/process changes before the supplier is committed to the change. Refer to GMW3600.

3.1.5.1 Samples. Unless otherwise specified, six (6) samples of components or systems shall be tested. A suggested test flow is in Appendix D, Figure D1.

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

3.1.5.3 Initial Level Sensor Measurements. All test samples shall be tested before each test and documented in Data Sheet B1. Samples shall be tested at 250 V for 2 s. Any level sensors which have a current leakage $> 40 \mu\text{A}$ shall be considered failed. All other requirements in the program specific Subsystem Technical Specification (SSTS) shall be met.

3.1.6 Test Time.

Calendar time:	7 days
Test hours:	148 hours
Coordination hours:	4 hours

3.1.7 Test Required Information. Requirements from the program specific Subsystem Technical Specification (SSTS) or respective specification are necessary in order to execute test methods in this document. Equipment and test sample detail is included in 3.1.4 of this document.

3.1.8 Personnel/Skills. The test facility shall have sufficient personnel having the necessary education, training, technical knowledge, and experience for performing the required tests.

3.2 Preparation. Preparation steps are also listed in 4.3 Performance Requirements.

This test procedure has been developed to reflect customer usage for markets which have developed road systems (more stable road systems and lesser amounts of unpaved and rough roads). Other regional or local requirements may necessitate additional test options. For further information, consult regional Engineering Center.

Visually examine each test specimen before testing and/or conditioning. The test specimens shall not exhibit any evidence of deterioration, cracks and/or other deformities that could affect performance, function and/or appearance. A control sample shall be retained. Photographs and/or video recordings of the samples being tested shall be taken.

3.3 Conditions. All conditions specified shall be targeted toward the specified value with any given tolerance ($\pm$) used to compensate for variation. During testing, conditions specified shall not be readjusted within the tolerance unless it is to maintain the particular test condition within the specified tolerance. If such an adjustment is made, it shall be approved by the applicable GM engineer prior to the start of any testing. Unless otherwise specified perform the tests in the as-received condition without any special preconditioning.

3.3.1 Environmental Conditions. Symbol definitions and specifications required for test methods contained in this procedure are listed in Table 1. Actual requirement values for the symbols shall be obtained from the Subsystem Technical Specification (SSTS) or the respective specification and recorded on Data Sheet B1.

Table 1: Temperature and Voltage Parameters and Tolerances

Parameter/Symbol	Default Specification	Tolerance
Minimum Temperature (T_{min})	-30 °C	Specification ± 3 °C
Maximum Temperature (T_{max})	+85 °C	Specification ± 3 °C
Repaint and Storage Temperature (T_{RPS})	-	Specification + 3 °C
Cold Storage Temperature (T_{CS})	-	Specification + 3 °C
Ambient temperature (T_{amb})	+23 °C	Specification ± 3 °C
Test Time	-	Specification $\pm 0.5\%$
Room Ambient Relative Humidity (RH)	50%	Specification $\pm 5\%$
Chamber Relative Humidity	-	Specification $\pm 5\%$
Pulse Width Modulation (PWM) Voltage	-	Specification + 0.25 V
Nominal Voltage (V_{nom}) at motor terminals	-	Specification ± 0.25 V
Force (Loading)	-	Specification $\pm 5\%$
Distance (excluding dimensional check)	-	Specification $\pm 5\%$

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. Refer to Table 1 for more test conditions.

3.3.3 Test Verification. To verify the level sensor is functioning properly before, during or after a certain test events, use the following.

- Set up test stand or fixture with a reservoir or similar container. The reservoir or similar container (to be approved by the GM SVE and/or DE) shall have a valve installed at the bottom to adjust the fluid level inside the reservoir or container.
- Mark the reservoir or container at 25 mm below and 25 mm above the level sensor access location (check the program specific SSTs to ensure the level sensor will actuate at 25 mm. If not, adjust the lines up and down to accommodate a program specific level sensor).
- Mount the level sensor into the washer reservoir or similar container.
- Fill the reservoir or similar to the 25 mm line below the level sensor access location.
- Confirm the level sensor reads "Low Level" and document conditions in test report
- Fill the reservoir or container to the 25 mm line above the level sensor access location.
- Confirm the level sensor reads "FULL" and document conditions in test report.
- Open the valve in the bottom to allow the fluid to drain out of the reservoir. CLOSE VALVE WHEN FLUID REACHES THE 25 mm LINE BELOW THE LEVEL SENSOR ACCESS LOCATION.
- Confirm the level sensor reads "Low Level" and document conditions in test report.
- Remove level sensor from reservoir or container and continue with next test step.

3.4 Instructions. Instructions are listed in 4.3 Performance Requirements.

3.5 Data.

3.5.1 Calculations. Not applicable.

3.5.2 Interpretation of Results. Not applicable.

3.5.3 Test Documentation. All test results shall be documented in the Data Sheet B1. The supplier is required to update the Analysis Development Validation Plan and Report (ADVP&R) (GM1829) and provide updates to the GM SVE and DE. Design Review Based on Test Results (DRBTR) results are to be documented.

Required Documentation. The following is also required for ALL test reports.

- 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.
- Test setup and the individual test results shall be photographed.
- Completed and signed GM1829, ADVP&R.

3.5.3.1 Evaluation Reports. The supplier shall write evaluation reports to document the results of all validation activities and shall make the test results and evaluation reports available to GM engineers upon request. See GMW3600. All test reports are to be in English and available 2 weeks after test completion.

3.6 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.

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. All results shall be documented on Data Sheet B1.

3.7.1.1 Notification. GM Validation Engineer is to be notified of test failures within a 24 h period of occurrence.

3.7.1.2 Five (5) Phase Requirements. The supplier shall use a Five (5) Phase document for all test failures. The Five (5) Phase document shall be submitted within 48 h.

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

4 Requirements and Procedure

4.1 General. Not applicable.

4.1.1 Observance of Specification. Not applicable.

4.1.2 Installation Position. See performance requirements in 4.3.

4.3 Performance Requirements.

4.3.1 GMW16393, Washer System Test Procedure Evaluation.

Purpose	To ensure that the level sensor when integrated into the wash system performs per the program specific SSTS.
Equipment	See GMW16393 for specific equipment required.
Samples	Six (6) samples are required.
Conditions	See GMW16393 for specific conditions.
Preparation	Follow the specific procedures as described in GMW16393.
Procedure	Follow the specific procedures as described in GMW16393. The following tests shall be performed in accordance of GMW16393 by the reservoir source supplier or the Tier 1 Supplier. • Grommet Leak/Seal Testing. • Vibration Testing. ○ Mechanical Shock. ○ Vehicle Collision.
Acceptance Criteria	See program specific SSTS for requirements.

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4.3.2 Hot and Cold Temperature Storage.**4.3.2.1 Hot Storage.**

Purpose	Verify that if the level sensor is stored in a location which has high ambient temperatures, it will not have any lasting effect on the level sensor's performance.
Equipment	• Environmental chamber capable of: • A range T_{min} to T_{max} suitable for the level sensor test fixture. • Recirculating air temperature cabinet. • Test room, suitable for the execution of the test. • Temperature range: -40 °C to +95 °C. • Permissible temperature accuracy: $\pm 3\text{ °C} \pm 1\text{ °C/minute}$.
Samples	Six (6) samples.
Conditions	Part orientation shall represent shipping package orientation, if known. See program specific SSTs for conditions.
Preparation	Prior to test, the Test Engineer is to evaluate the level sensor under the following conditions: V_{nom}, V_{max} and V_{min}. Ensure the level sensor is working correctly. Document environmental conditions and observation. Visually examine each test specimen before testing and/or conditioning. The test specimens shall not exhibit any evidence of deterioration, cracks and/or other deformities that could affect performance, function and/or appearance. A control sample shall be retained. Photographs and/or video recordings of the samples being tested shall be taken.
Procedure	- Place the six (6) samples in the chamber in vehicle orientation. The level sensor shall not be powered. - Set the chamber temperature to +100 °C with air circulation. Dwell for 100 h inside of the chamber from the time steady state of the chamber is reached. - After exposure, remove the level sensors from the chamber and dwell at ambient $+23\text{ °C} \pm 3\text{ °C}$ for 4 h or until steady state is reached. - Install parts on test fixture or in a washer reservoir and operate to verify test requirements.
Acceptance Criteria	- The level sensor shall function properly before and after test per requirements in the program specific SSTs. - The subsystem/component shall not show any damage, such as cracks, hardenings or deformations, which could impair its function at any point during the test. - The grommet shall not leak. - The level sensor shall not leak. - Current draw shall be within the design specification.

4.3.2.2 Cold Storage.

Purpose	Verify that if the level sensor is stored in a location which has low ambient temperatures, it will not have any lasting effect on the level sensor's performance.
Equipment	- Environmental chamber capable of the following. • A range T_{min} to T_{max} suitable for the level sensor test fixture. • Recirculating air temperature cabinet. • Test room, suitable for the execution of the test. • Temperature range: -40 °C to +100 °C.

	• Permissible temperature accuracy: $\pm 3\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C/minute}$.
	b. A fixture may be required to hold components in shipping position.
Samples	Six (6) samples.
Conditions	Part orientation shall represent shipping package orientation if known.
Preparation	Prior to test, the Test Engineer is to evaluate the level sensor under the following conditions: V_{nom} , V_{max} and V_{min} . Ensure the level sensor is working correctly. Document environmental conditions and observations.
Procedure	- Place (6) level sensor samples in an environmental chamber and set temperature to $-30\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. Maintain temperature for 100 h. - After exposure, remove the level sensors from the chamber and dwell at ambient for 4 h or until steady state is reached. - Install parts on test fixture or in a washer reservoir and operate to verify test requirements.
Acceptance Criteria	- The level sensor shall function properly before and after test per requirements in the program specific SSTS. - The subsystem/component shall not show any damage, such as cracks, hardenings or deformations, which could impair its function at any point during the test. - The grommet shall not leak. - The level sensor shall not leak. - Current draw shall be within the design specification.

4.3.3 Operating Temperature Range.

4.3.3.1 Thermal Cycling.

Purpose	Verify that the level sensor shall operate and function properly for the temperature range of $-30\text{ }^{\circ}\text{C}$ to $95\text{ }^{\circ}\text{C}$.
Equipment	Fixture Pump.
Samples	Six (6) samples.
Conditions	See program specific SSTS for conditions.
Preparation	Visually examine each test specimen before testing and/or conditioning. The test specimens shall not exhibit any evidence of deterioration, cracks and/or other deformities that could affect performance, function and/or appearance. A control sample shall be retained. Photographs and/or video recordings of the samples being tested shall be taken.
	Install the level sensor in the fixture and place into the climate chamber. Ensure that the level sensor is working properly by checking the output.
Procedure	See Figure 1 profile. - After confirmation that the level sensor is properly functioning and the fixture is set up properly, set the temperature in the chamber to $38\text{ }^{\circ}\text{C}$ with 95% RH. - Hold at $38\text{ }^{\circ}\text{C}$ for 66 h. - After the 66 h, reduce the temperature to T_{min} (default is $-30\text{ }^{\circ}\text{C}$). - Hold at this temperature for 4 h. - After the 4 h, increase the temperature to T_{max} (default is $95\text{ }^{\circ}\text{C}$). - Hold at this temperature for 20 h. - After the 20 h, reduce the temperature to T_{min} (default is $-30\text{ }^{\circ}\text{C}$). - Hold at this temperature for 4 h. - Set the temperature in the chamber to $38\text{ }^{\circ}\text{C}$ with 95% RH.

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- j. Hold at this temperature for 44 h.
- k. After the 44 h, reduce the temperature to T_{min} (default is -30 °C).
- l. Hold at this temperature for 4 h.
- m. After the 4 h, increase the temperature up to T_{max} (default is 95 °C).
- n. Hold at this temperature for 20 h.
- o. After the 20 h, reduce the temperature to T_{min} (default is -30 °C).
- p. Hold at this temperature for 4 h.
- q. Place the level sensors in a reservoir and subject to three (3) freeze thaw cycles consisting of:
 - 1. 8 h at T_{min} (default is -30 °C) then
 - 2. 4 h at T_{amb} (default is 23 °C) or until the system thaws.
- r. If the level sensor does not function properly, stop the test.
- s. Test results are to be documented in Data Sheet B1.

Acceptance Criteria

The level sensors must meet the dielectric breakdown, millivolt drop and insulation test requirements.

Note: Level sensor or grommets pushing out during the freeze/thaw cycles or failure of the level sensors to meet post-test requirements shall be deemed a failure. If test fails due to level sensor push-out on a fixture, retest the level sensor in a production washer reservoir to confirm if there is a concern.

Note: The change in temperature shall be at the discretion of the GM SVE or Test Engineer.

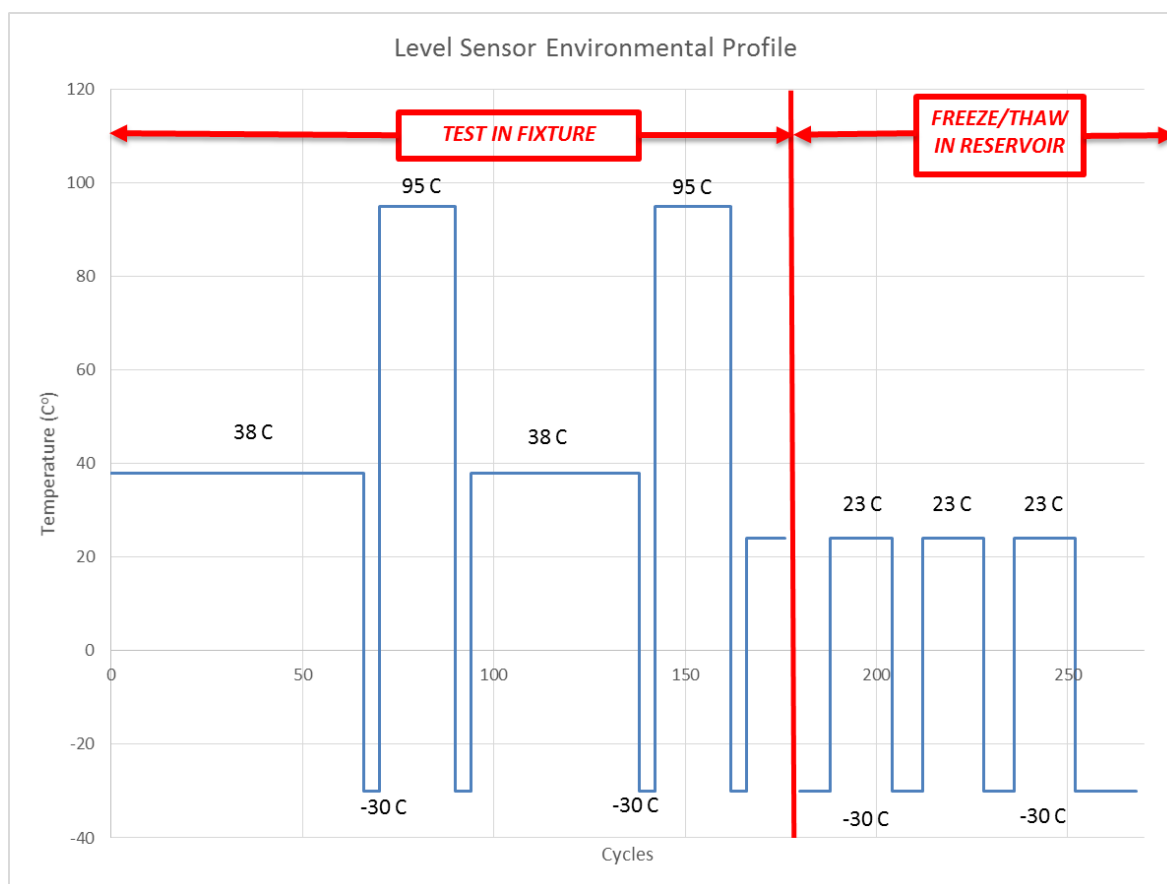


Figure 1: Level Sensor Environmental Profile

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4.3.3.2 Washer System Low Temperature Exposure.

Purpose	Evaluate level sensor in the washer system design during cold/low temperature exposure according to FMVSS 104, CMVSS 104, GB 15085-1994 and Commission Regulation European Union (EU) EU 1008/2010.
Equipment	Per 3.1.4.
Samples	Use the same samples per 3.1.5.1.
Conditions	See specific procedure.
Preparation	Three (3) additional reservoirs of the same design are to be placed in the test fixture and filled with water. The fixture with washer reservoir is to be placed in chamber at $-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ before actual test to learn how long it takes to freeze the entire fluid mass, including core. The time to freeze shall be determined by the following. • One sample shall be removed from chamber at 4 h and cut open immediately after being removed. • One sample shall be removed from chamber at 4.5 h and cut open immediately after being removed. • One sample shall be removed from chamber at 5 h and cut open immediately after being removed.
Procedure	a. Mount design intent level sensor onto holding fixture so that components are in their relative vehicle position on the level sensor fixture, including the height. b. At $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, fill reservoir with water and operate pump until system is completely primed. c. Set climate chamber at $-30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and soak system 8 h until all fluid, including core, is frozen. This will take a minimum of 4 h but actual time will be based on pre-test preparation (4.3.3.2). d. After cold temperature soak, set climate chamber at $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 4 h or until system thaws completely. e. Repeat freeze/thaw condition from 4.3.3.2 Procedure c and d for a total of six (6) times. f. After last thaw cycle, wait an additional 4 h before activating washer pump for at least 5 s and checking for leaks (nozzles remained plugged). Verify that the level sensor is working properly. g. Perform Design Review Based on Test Results (DRBTR) by disassembling level sensor and checking for internal water leaks and potential issues.
Acceptance Criteria	a. The level sensor shall function properly during (when not frozen) and after test per requirements in the program specific SSTs. b. The grommet shall not leak. c. The level sensor shall not leak.

4.3.3.3 Washer System High Temperature Exposure.

Purpose	Evaluate level sensor in the washer system design during hot/high temperature exposure according to FMVSS 104, CMVSS 104, GB 15085-1994 and Commission Regulation European Union (EU) EU 1008/2010.
Equipment	Per 3.1.4.
Samples	Same samples from 3.1.5.1.
Conditions	See specific procedure.
Preparation	• Visually examine each test specimen before testing and/or conditioning.

	• The test specimens shall not exhibit any evidence of deterioration, cracks and/or other deformities that could affect performance, function and/or appearance. • A control sample shall be retained. • Photographs and/or video recordings of the samples being tested shall be taken. • Photographs of the test setup and fixture shall also be taken.
Procedure	a. Mount design intent level sensor onto holding fixture and reservoir so that components are in their relative vehicle position, including height. Place fixture into climate chamber. b. At $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, fill the fixture reservoir with water and operate fixture pump. c. Set climate chamber at $85\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ and soak for 8 h. d. After hot temperature soak, set climate chamber at $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for at least 4 h to let system stabilize. e. Activate fixture pump for at least 5 s. Verify that the level sensor is working properly.
Acceptance Criteria	a. The level sensor shall function properly during and after test per requirements in the program specific SSTs. b. The grommet shall not leak. c. The level sensor shall not leak.

4.3.4 Switch Operation.

Purpose	This test ensures that the switch shall function properly in four (4) types of solvents.
Equipment	Washer Reservoir.
Samples	Three (3) level sensors.
Conditions	Solvents to be used are as follows. • 100% Water. • 50:50 solution of methyl alcohol (use Isopropanol or Ethanol in place of Methyl Alcohol for specific regional requirements) and water. • 100% commercial washer fluid. • 100% methyl alcohol. Component Installation. • The level sensor shall be mounted in a reservoir in vehicle position and attitude.
Preparation	Set up test fixture in the appropriate environment. Visually examine each test specimen before testing and/or conditioning. The test specimens shall not exhibit any evidence of deterioration, cracks and/or other deformities that could affect performance, function and/or appearance. A control sample shall be retained. Photographs and/or video recordings of the samples being tested shall be taken. Each level sensor shall be cycled five (5) times within 5 minutes to condition them before the start of test.
Procedure	a. The reservoir shall be filled with the preceding washer solvents. b. Allow the level sensor to be exposed to each chemical for 24 h. c. After exposure, evaluate the level sensor for function. d. After function test, inspect the level sensor for defects. Note: An ON-OFF-ON or OFF-ON-OFF sequence of operation shall not be permitted.
Acceptance Criteria	a. The level sensors shall operate properly in all four types of solvents.