



Solenoid Retainer Clip Pressure Cycle and Load Frame Test

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 test provides a means of validating solenoid retainers to ensure they meet functional and durability requirements (cycle life).

1.2 Applicability. This test is recommended for all solenoid retainers.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- CTS.
- Statement of Requirements (SOR).

3 Resources

3.1 Facilities.

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.

3.2.1 MTS load frame and/or hydraulic pressure cycle test stand will be required to conduct testing.

3.3 Test Vehicle/Test Piece. Testing fixtures will be required to hold the article in place. It is recommended to use a production intent valve body as a fixture to recreate actual conditions (draft angles, retainer support geometry, etc.) Part modification may also be required to ensure access to the solenoid tip or to route the necessary fluid pressure to the solenoid ports. A sample test fixture is shown in Figure A1 of Appendix A.

3.3.1 If machined from solid fixtures are used it is critical that the draft angles and geometry are representative of the intended valve body interface.

3.4 Test Time. Test time will be a result of number of cycles and cycle rate. The number of cycles should be provided by Design Release Engineer (DRE) and represent the number of cycles the solenoid will see in the application (Product Usage, Measurement, and Application (PUMA) Data), number of samples to be tested, and the reliability required.

3.4.1 Once cycle rate is determined, a pressure trace should be reviewed to ensure that the specified pressures (force on retainer) are being met.

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3.4.2 Pressure traces should be reviewed at some interval to ensure consistent pressures are applied.

3.4.3 Cycle counts shall be consistent with solenoid durability requirements specified in solenoid Statement of Requirements (SOR) and/or solenoid Component Technical Specifications (CTS).

3.4.3.1 In addition to the number of cycles determined in 3.4.3 for normal operating conditions, a specified number of cycles should be conducted at "failure mode" type loading conditions (i.e., blow-off pressure or stuck actuator feed limit pressure). Number of cycles and condition shall be specified by DRE.

3.5 Test Required Information. For load frame testing, determine the maximum applicable force in Newtons (N). Force can be calculated based on Control Pressure, Supply Pressure, and the solenoid geometries that these pressures act against.

3.5.1 If hydraulic testing is conducted, determine the maximum pressure that acts on the respective solenoid ports and apply consistent to solenoid operation.

3.5.2 Whenever possible, use production intent parts for all testing to obtain representative interfaces and production representative results.

3.5.3 Pre-test and post-test inspection should be performed to have a true A/B comparison. Inspections should include draft angles, bore diameters, solenoid diameters, retainer geometry/sizing, etc. Inspection requirements should be reviewed and agreed upon by DRE.

3.5.4 Analysis: When possible conduct a Finite Element Analysis (FEA) to help identify areas of concern.

3.5.5 Test frequency should be < 5 Hz. Consult with DRE/Tech Specialist.

3.5.6 Test temperature shall be provided by DRE.

3.5.7 Testing hydraulically vs. load frame should be determined based on part availability, timing and test stand availability.

3.5.7.1 Hydraulic testing is preferred since it is most representative of the solenoid application and may additionally provide information on O-ring seal performance and any solenoid/bore interface issues.

3.5.7.2 Load frame testing can be done faster if timing concerns or many different retainer configurations are being evaluated. Hydraulic testing may still be required per DRE direction.

3.6 Personnel/Skills. Lab personnel must be qualified to set up and program all applicable testing equipment.

4 Procedure

4.1 Preparation.

4.1.1 Fixture Design. A fixture can be designed for testing or a production intent valve body and solenoid can be modified for testing. **Caution:** Any reuse of fixture/valve body/solenoid could impact test results. Reuse of these parts for multiple retainer test should be avoided.

4.1.1.1 For Load frame testing, the fixture must be designed/modified to allow sufficient clearance for an extension rod from the load frame.

4.1.1.2 If a modified valve body will be used as a test fixture for hydraulic testing, a plate will need to be designed allowing supplied pressure to act on the ports of the solenoid.

4.1.1.2.1 There are two variations of solenoid porting configuration that should be taken into account. One where supply pressure acts on the solenoid tip, and one where control pressure acts on the tip. Figures A2 and A3 of Appendix A illustrate these variations.

4.1.2. If solenoid will need to be energized for hydraulic testing, a constant flow or oil bath of transmission fluid should be provided to cool the solenoid. **Note:** It is acceptable to block solenoid ports (internal to the device) and supply individual solenoid ports with test stand fluid to achieve desired pressures and retainer forces if energizing the solenoid is not practical.

4.1.3. Any machined parts must meet all dimensional specifications of production intent parts.

4.2 Conditions.

4.2.1 Environmental Conditions. Environmental conditions will be application dependent and shall be specified by DRE.

4.2.1.1 Load Frame. Test conditions will be run at ambient temperature. Test fixture will require periodic lubrication using production intent transmission fluid.

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