



Transmission Erosion 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 standard defines detailed procedures and minimum equipment requirements to measure the erosion resistance of a gasket material/assembly to minimize testing variation. Performance requirement will be defined on drawings and material specifications.

1.2 Applicability. This standard applies to transmission gasket applications where high pressure and high velocity fluids are expected, such as valve body/spacer plate gasket. It can be used for material development, and part validation. It is not aimed for product batch releasing control purposes.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ASTM D445

2.2 GM Standards/Specifications.

9986153	9986354	9986396	9986505
9986333	9986368	9986494 (ID)	9986555

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

2.3 Additional References.

- Emerson Electric Company, St. Louis, Missouri (www.emerson.com)
- Mohawk Heaters, Mohawk Heating Company, Incorporated (<http://mohawkheat.com>)
- Rockwell Automation, Incorporated, Milwaukee, Wisconsin (www.rockwellautomation.com)
- Statement of Requirements (SOR)
- Vickers Vane Pumps (available at www.grainger.com)

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 Basic Equipment. Labs performing the erosion test should have the equipment listed in this section.

3.2.1.1 Fixture Temperature Control (FTC) Device. Capable of measuring in room temperature range to 150 °C ± 3 °C accuracy.

3.2.1.2 Fluid Temperature Monitoring Device. Capable of measuring in room temperature to 150 °C ± 3 °C accuracy.

3.2.1.3 Fluid Pressure Monitoring and Measuring Pressure Equipment (Pressure Gauge). Capable of measuring pressure as required per test instructions 1.72 MPa (250 psi) for normal application, up to 6.21 MPa (900 psi) for given applications. Equipment must operate at the required temperatures and be compatible with the test fluid used (designated transmission fluid per 3.3.2). Gauge must not corrode in this test environment.

3.2.1.4 Fluid Velocity Measuring Equipment (Flow Meter). Capable of measuring fluid velocity as required per test instructions. Equipment must operate at the required temperatures and be compatible with the test fluid used. Gauge must not corrode in this test environment.

3.2.1.5 Torque Wrench. Capable of measuring the specified test joint fastening specifications.

3.2.1.6 Shut-off Devices (Mandatory). Provides shutdown of the equipment in the event test assembly exceeds specified fluid temperature and pressure conditions (under or over). Automatic shutdown at low end pressure limit and pressure release at the high end. Made from non-corrosive material(s) that withstand the fluid, temperature and pressure environment of this test.

3.2.2 Fluid Circulation System.

3.2.2.1 Testing Fluid Reservoir. Located external to test fixture with sufficient volume capacity to accommodate fluid heat expansion. The recommended capacity is 24 L (10 gal (U.S.)) or higher. The reservoir is fabricated from nonreactive material to fit the requirements. A high limit thermocouple to monitor reservoir fluid temperature and shut down the system is mandatory. Float level controls with alarm to prevent over fill or over flow are optional.

3.2.2.2 Tube Compression and Flare Fittings. Use brass or other noncorrosive materials to fit diameter of designated tubing.

3.2.2.3 Pump and Heater – ATF Circulation for Erosion Test. A typical pump capacity is 38 L/minute (10 gal/minute (U.S.)), 1.03 MPa to 1.72 MPa (150 psi to 250 psi) pressure range. The equipment is recommended to aim for handling line pressure up to 6.21 MPa (900 psi) (for some transmission applications). Heater output must be capable of reaching specified fluid operating temperature within 15 minutes to 30 minutes from room temperature. The setup must be capable of maintaining test fluid temperature within ± 3 °C in the specified temperature range. Heat must be supplied so that the test fluid is warmed uniformly. Acceptable methods are immersion heaters, external electrical heaters with wall temperature controllers or circulation of externally heated fluid. Chromalox (Emerson Electric, see 2.3) CMXO-550-9H 480 2000 or Mohawk Heater units (see 2.3) have a thermocouple for controlling/monitoring fluid temperature leaving fluid pump.

3.2.2.3.1 A vane pump of either V10 or V20 design is recommended due to the fact that vane pumps are quieter and run longer without problems than gear pumps. The pump should be equipped with Viton seals, as most pumps come with nitrile seals and will not last at the 150 °C temperature. Most vane pumps are designed to run between 1200 rpm and 4000 rpm. Suggestion is to use at least a 3 hp (preferably 5 hp), 3-phase, 460 V to 480 V, electric motor with the appropriately sized motor drive, that allows for adjustment to dial in the rpm to achieve the desired flow rate. The pump should be ordered with threaded inlet and outlet connections to hold up to 150 °C temperatures.

3.2.2.3.2 Recommended equipment that meet the flow rate and line pressure requirements:

- Pump: Vickers P/N F3-V20-1P11S-1C20L (a V20 series, single stage vane pump, see 2.3). This pump flows 41.6 L/minute (11 gal/minute) at 1200 rpm. It has a Viton front shaft seal and counterclockwise shaft rotation when viewed from front of pump.
- Motor: 3 hp to 5 hp, 460 V to 480 V, 3-phase (Any reputable brand would be adequate).
- Drive: PowerFlex 525 AC Drive rated for the electric motor (Rockwell Automation, Incorporated, see 2.3).

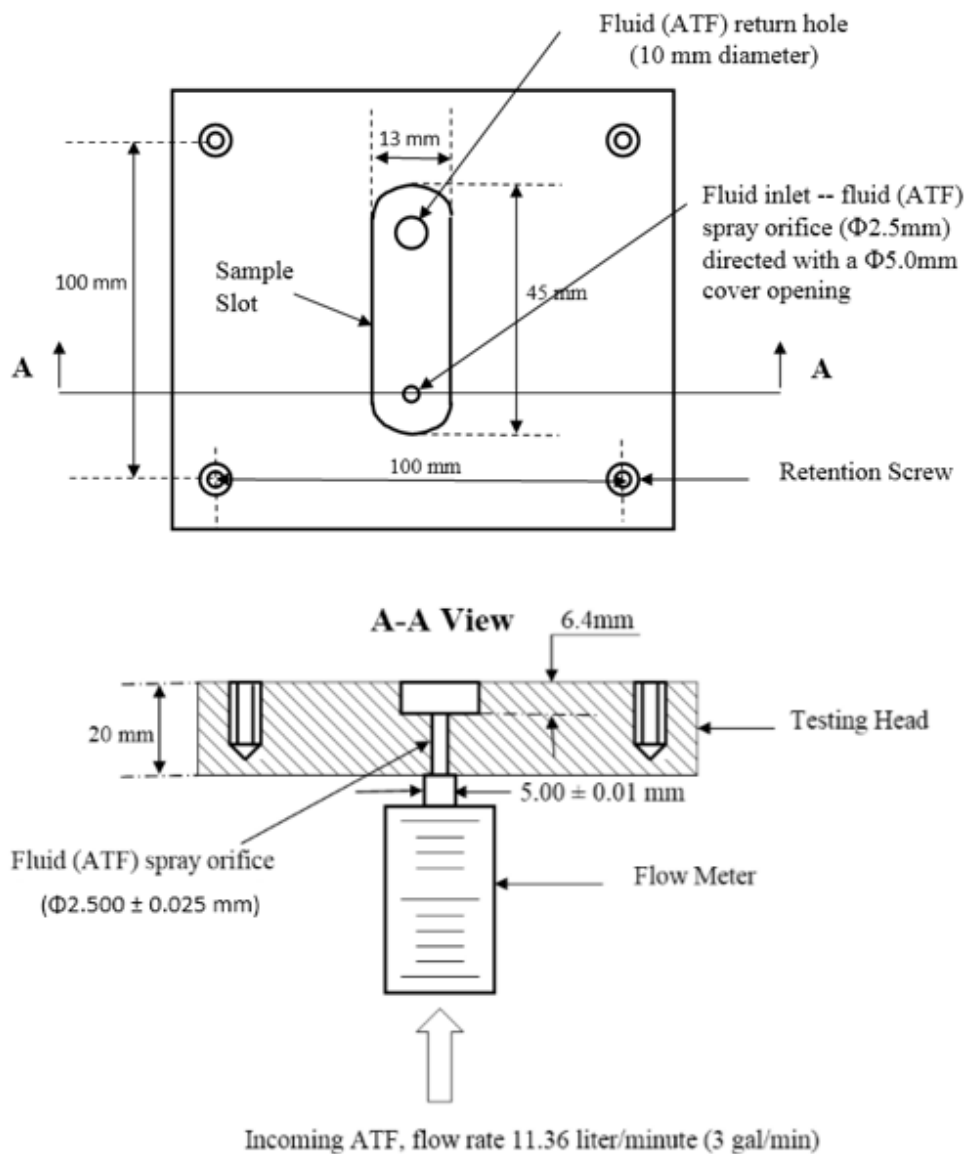
3.2.2.4 Delivery Lines – Supply and Return. Recommended supply lines, 12 mm (0.5 in) inside diameter minimum, braided steel with polytetrafluoroethylene liner. Recommended return line and fixture drain fitting, AN12 (0.75 in) inside diameter minimum. The delivery lines and fittings must be strong enough to handle a minimum of 1.72 MPa (250 psi) transmission line pressure at 150 °C. The supply line should have proper insulations to keep the same fluid temperature as the fluid in reservoir or test fixture.

3.2.2.5 In-line filtration. In-line filtration with 10 μm filter medium is required before fluid being returned back to the fluid reservoir, to prevent sediment from entering into reservoir.

3.2.3 Erosion Rig. Reference Figure 1.

3.2.3.1 The erosion rig should be equipped with heater and temperature control capable of monitoring temperature from room temperature to 150 $^{\circ}\text{C} \pm 3^{\circ}\text{C}$ accuracy.

3.2.3.2 Fluid (suggested to be the same as testing fluid) will be pumped into the rig before the test and drained after the test. No control on pump speed is needed as long as it can deliver the required amount of fluid, a level to cover the top of the test fixture.



Note: Φ = Diameter, ATF = Automatic Transmission Fluid.

Figure 1: Erosion Rig (Top and Side Views)

3.2.3.3 Erosion rig fluid reservoir should be at least three (3) times the volume needed for the erosion rig, made from nonreactive material to fit the requirements, with an easy access lid. A high limit thermocouple to monitor reservoir fluid temperature and shutdown the system is mandatory. Float level controls with alarm to prevent over fill or over flow are optional.

3.2.3.4 Testing fixture should be easily installed and or disconnected with erosion rig using quick disconnects.

3.2.4 Erosion Test Testing Fixture. The test fixture is composed of two (2) thick SAE1010/1008 steel plates. A sample slot is cut on the bottom platen that has a thickness of 20 mm ($\frac{3}{4}$ in) with dimensions shown in Figure 1, along with four (4) retention screws, 100 mm apart on four (4) corners. The depth of the sample slot should be designed as such that the distance between the spray orifice and test specimen is 6.4 mm ($\frac{1}{4}$ in). The top platen is flat, servicing as the secure plate, with a thickness ≥ 13 mm ($\frac{1}{2}$ in), which must be strong enough to handle the testing pressure (> 1.72 MPa (250 psi) and up to 6.21 MPa (900 psi) line pressure for some applications) and thick enough to prevent any flexural deformation during test. The bolts (M6 or larger) should be strong enough that the test specimen does not have any movement in the direction perpendicular to the fluid flow direction. The testing surfaces of both platens should have a $0.8 \mu\text{m}$ surface roughness (Ra) finish.

Place the testing specimen in the fixtures with the gasket facing the incoming fluid direction. The test specimen is secured by bolting to the top secure platen. Align specimen with the erosion testing area facing the inlet of the fluid. The test fixtures (1 unit to 3 units) are installed inside the erosion rig with easy access lid, ideally with an observation window (see Figure 6).

3.3 Test Vehicle/Test Piece.

3.3.1 Test Specimen. Testing specimens should be prepared from production gasket material or at least production intent product (paper gasket or Rubber Coated Metal (RCM)), representing the transmission applications. Close attention should be paid to the area of testing (oval-shaped area shown in Figure 2). No defect should be present.

3.3.1.1 "Loose" Non-bonded gaskets, Rectangular Testing Specimen Prepared from Sheet (Paper or RCM). Die cut three (3) rectangular testing specimens with dimensions of 90 mm $\times$ 30 mm ($3\frac{1}{2}$ in $\times$ $1\frac{1}{8}$ in) against the grain direction. Punch a hole with 10 mm diameter in the center of one (1) end (30 mm from the end), 15 mm from the edge of each sample (see Figure 2) for fluid returning purpose.

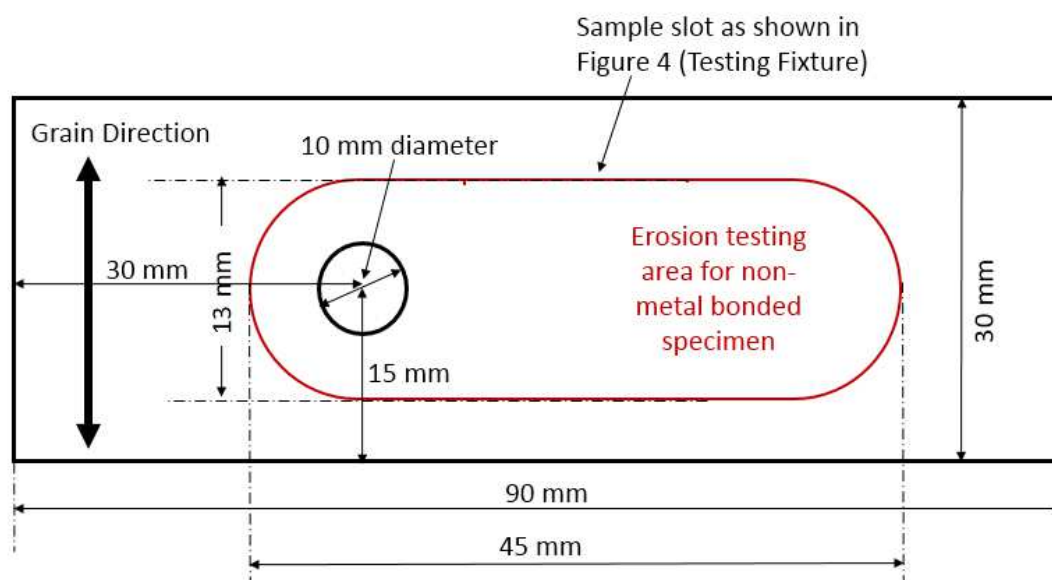


Figure 2: Rectangular Test Specimen Die Cutting from Sheet