



Wear Testing Procedure for Plastic Materials against Metal Mating Surfaces under Dry Condition

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 procedure covers the determination of Pressure times Velocity (PV) limit for plastic materials in sliding contact with a stationary steel washer under dry testing condition, by performing the wear test at various PV steps until the plastic specimen fails.

1.2 Applicability. This test procedure is aimed to provide a standard testing procedure for comparing PV capability under non-externally lubricated condition of plastic materials used for dynamic sealing and thrust washer applications. Due to the significant impact of part design and application environment, this test is not intended to replace any part/component functional tests. Test data generated using this method, however, do provide valuable material selection guidelines for transmission thrust washer and dynamic seal applications. It has been a very powerful tool for material screening and the test results have been used for part design and Finite Element Analysis (FEA).

This Test Procedure is not intended for quality control purpose. Unless otherwise specified, the test is required once for initial material approval only or material recertification is needed due to changes (ingredients, source of ingredients, or process) to the approved compound.

1.3 Remarks. English units are still the most popularly accepted units for Tribology in USA. Wear test conditions are usually defined with English units, such as 50 000 psi ft/minute for PV and 50 ft/minute for rotating speed. Therefore, both English units and metric units are used in this procedure for easy reference.

2 References

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

2.1 External Standards/Specifications.

ASTM D3702

2.2 GM Standards/Specifications.

GMW3221

3 Resources

3.1 Facilities. The test is available from Lewis Research, Inc. at 33712 Wescoats Road, Unit #1, Lewes, DE 19958. GM suppliers and independent labs are encouraged to develop internal testing capability with formal approval from the responsible GM Global Propulsion Systems (GPS) Materials Engineer.

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.

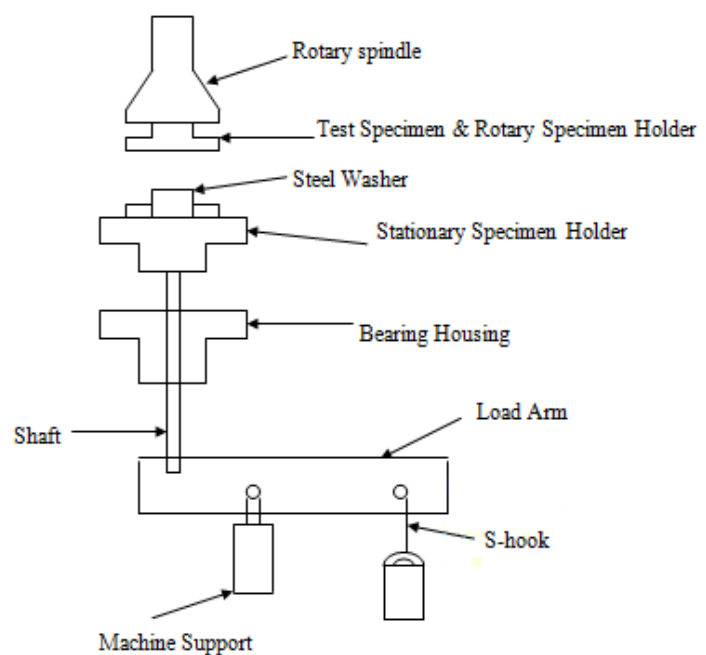
3.2 Equipment.

3.2.1 Tribological tester. Tribological tester equivalent to the Tribometer shown in Figure 1 shall be used. Dead weights are attached to a load arm by an S-hook, and act through a 5:1 lever arm to load the stationary (lower) washer axially upward against a rotating (upper) test specimen. The lever arm shall be balanced to compensate for the weight of the stationary washer. Optional controlled automatic loading systems are available to replace applications of dead weight.

The rotary spindle is driven by a variable speed direct current (DC) motor, controlled by a 10-turn potentiometer, acting through step pulleys. Typical spindle speed range is (10 rpm to 5000 rpm). An elapsed time indicator with reset feature to indicate motor running time is included. The friction force is measured using a calibrated force transducer or collected using a load cell and data acquisition system. The temperature is measured near the interface on the washer.

Optional features include an apparatus for the application, control, and readout of various test environment conditions; and devices to accommodate alternative test sample configurations.

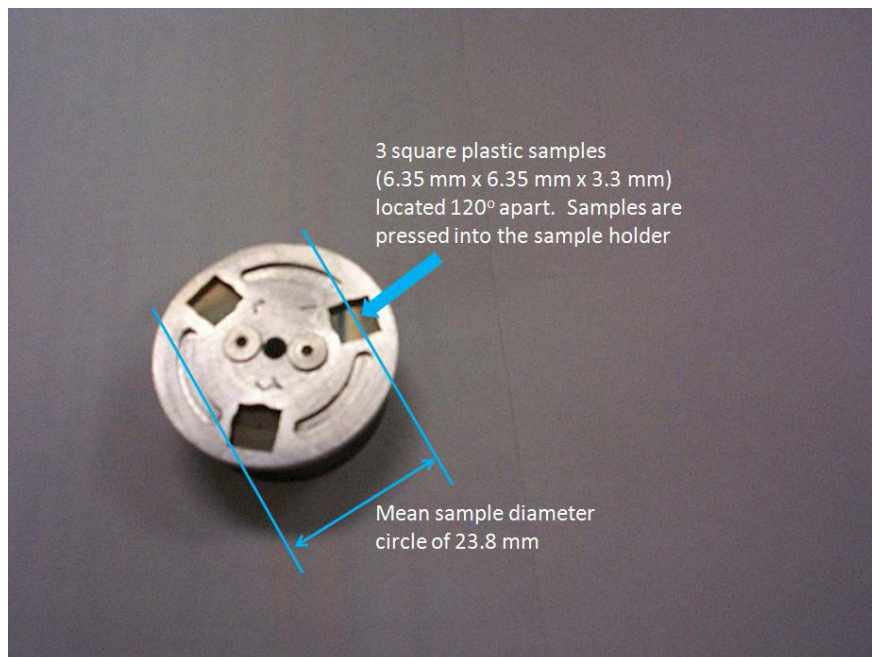
Figure 1: Tribometer



3.3 Test Vehicle/Test Piece.

3.3.1 Specimen (Rotating Component). Three (3) 6.40 mm × 6.60 mm × 3.3 mm (height may vary from material to material) square sample pins are pressed into the sample holder. The sample holder is a circular plate with three (3) blank square holes located 120 degrees apart as shown in Figure 2 (Lewis Research PN94062). The distance between the center of the square and the center of the plate is 11.9 mm. The dimensions of the holes are 6.35 mm × 6.35 mm × 1.30 mm. The total contact area of the samples is 123 mm². The sample pins shall extend above the holding plate at least 2 mm at the start of the test.

Figure 2: Specimens and Fixture - Rotating Component



3.3.2 Mating Surface (Stationary Component). Metallic washer with dimensions meeting requirements of the steel washer defined in ASTM D3702.

3.3.2.1 Standard Washer. Standard ASTM D3702 washer with AISI C-1018 carbon steel washer that is finished to $0.41 \mu\text{m} \pm 0.05 \mu\text{m}$. Ra shall be used unless otherwise specified.

3.3.2.2 Washer Representative to Transmission Application. Material and surface finish as specified by the transmission application may be used to replace the standard steel washer in the test. With surface finish for seal mating component is $1.0 \mu\text{m}$ to $1.3 \mu\text{m}$ Ra. Material varies from high pressure aluminum die cast (such as 380, 390) to low carbon steel (such as 1008, 1010).

3.4 Test Time.

Calendar time: 8 days
 Test time: 60 hours
 Coordination time: 2 hours

3.5 Test Required Information. Test machine shall be placed on a stable surface preventing vibration during test.

3.6 Personnel/Skills. Only trained and qualified personnel shall perform the test.

4 Procedure

4.1 Preparation. Anything that is not detailed in this standard, such as sample cleaning and conditioning, machine calibration requirement, etc., should refer to ASTM D3702 - Standard test method for wear rate and coefficient of friction of materials in self-lubricated rubbing contact using a thrust washer test machine.

The test is run under dry conditions without any external lubrication. A thermocouple is placed on the side of the counter surface, in the hole specified per ASTM D3702. During break-in, the temperature and coefficient of friction are recorded manually several times during each step. During test steps, a computer shall be used to record readings at 15 s intervals.

Linear velocity (m/s) is converted from rpm using the mean diameter of sample circle (23.8 mm) as shown in Figure 2.