

Issued 1972-01
Revised 2006-01

Superseding J286 JAN2005

SAE No. 2 Clutch Friction Test Machine Guidelines**1. Scope**

This SAE Recommended Practice is intended as a guide toward implementation of a standard practice but may be subject to frequent change to keep pace with experience and technical advances. This should be kept in mind when considering its use.

The SAE No. 2 Friction Test Machine is used to evaluate the friction characteristics of automatic transmission plate clutch with automotive transmission fluids. It can also be used to conduct durability tests on wet friction systems.

This document is intended for common use by both suppliers and end users to define minimum test machine requirements to allow objective comparisons of wet friction material system performance.

1.1 Rationale

Added procedure intent to scope.

2. References**2.1 Related Publications**

The following publications are for information purposes only and are not a required part of this specification.

2.1.1 SAE PUBLICATIONS

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1499—SAE Band Friction Test Machine (SAE) Test Machine Guidelines

SAE J1646—Glossary of Terms—Lubricated Friction Systems

SAE Paper 670051—New Fixture for Testing Friction Materials for Automatic Transmission Clutch

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3. Test Equipment

3.1 SAE No. 2 Friction Test Machine with breakaway accessory.

3.2 Flywheels to deliver desired kinetic energy.

3.3 Data Acquisition

At not less than 1000 samples per second and storage system with at least four channels with response as follows:

- a. Torque Channel, Bandwidth, 500 Hz—Accuracy shall be within $\pm 0.5\%$ full range.
- b. Apply Pressure Channel, Bandwidth, 500 Hz—Accuracy shall be within $\pm 0.5\%$ full range.
- c. Speed Channel, Bandwidth, 500 Hz—Accuracy shall be within $\pm 0.1\%$ full range.
- d. Test Fluid Temperature Channel, Bandwidth, 3 Hz—Accuracy shall be within $\pm 1\%$ full range.

3.4 Jacket Heater and/or Cooler

For test fluid temperature control.

3.5 Adapters and Spacers

Splined hub for friction discs, splined retainer for steel separators, pressure plate connected to apply piston and single spacer to provide proper clutch pack clearance; path for fluid flow to be provided from inside diameter to outside diameter of clutch pack through properly oriented holes in splined clutch adapters; flatness of pressure plate and spacers to be within 0.013 mm total indicator reading across the diameter of the plate.

3.6 Apply Piston Seal

- a. Viton®
- b. Teflon®—Recommended for use in high-temperature fluid tests

3.7 Lubrication System Flow Configuration

3.7.1 GRAVITY FLOW

This represents the configuration wherein the head top fitting is connected to the bottom of a vented reservoir located above the head (see Figure 1a).

3.7.2 CENTRIFUGAL FLOW

This represents the configuration wherein discharge from the head is connected to a vented reservoir located above the head and a return line is provided from the bottom of the reservoir to the centerline of the cover. A flow meter may be installed in the line to the cover (see Figure 1b).

3.7.3 EXTERNAL FLOW

This represents the configuration wherein an external pump supplies fluid at a specific flow rate through a line to the centerline of the cover. A flow meter may be installed in the line to the cover (see Figure 1c).

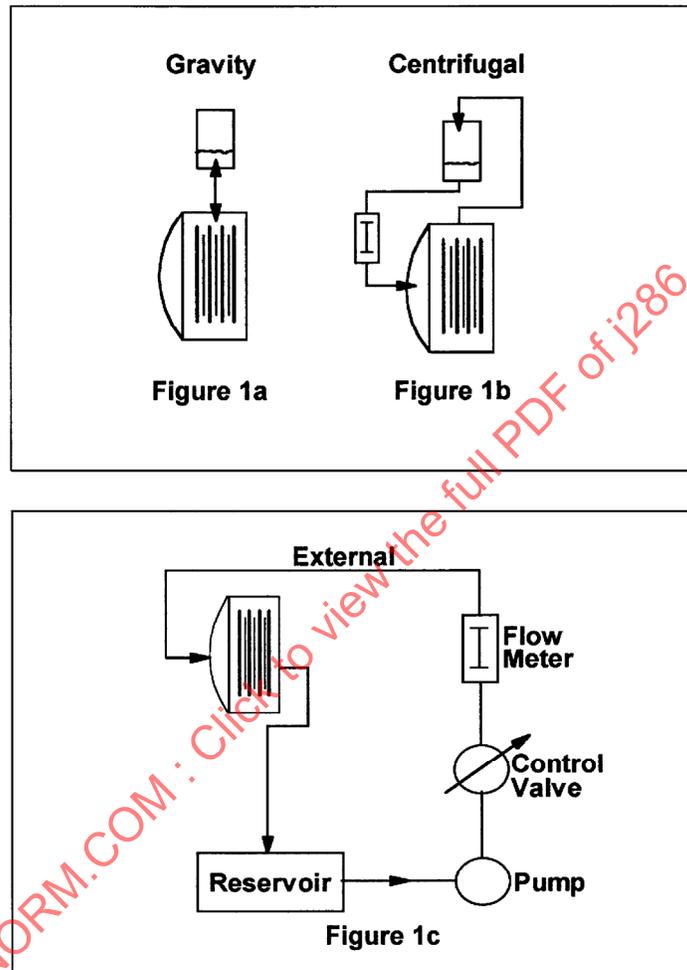


FIGURE 1—FLOW CONFIGURATIONS

3.8 Aerated Fluid Tests

- Cylinder of dry compressed air, -59.4°C dew point, and regulatory controls.
- Micrometering valve.
- Flowmeter to measure air flows from 0 to $300\text{ cm}^3/\text{min}$.
- Air leakage may occur from the piston air chamber between the lip seal and the housing into the circulating test oil. Where this condition is detrimental to test parameters, a special Teflon[®]/Viton[®] seal in a specially designed piston must be used.

4. Typical Operating Conditions and Test Parameters

4.1 Piston Area

15 110 mm².

4.2 Piston Available Travel

4.57 mm.

4.3 Piston Apply Pressure

250 to 1000 kPa as required to produce unit loading; tolerance on desired pressure $\pm 0.5\%$.

4.4 Plate Apply Pressure Rise Rate

2.000 to 3.000 mPa/s.

4.5 Piston Release Pressure

30 to 100 kPa (to be 0 during apply cycle).

4.6 Total Inertia Range

0.1 to 1.5 kg·m².

4.7 Dynamic Engagement Speed

1000 to 10 000 r/min.

4.8 Kinetic Energy

8 to 90 kJ.

4.9 Breakaway Speed

0 to 4.5 r/min.

4.10 Test Fluid Quantity

0.6 to 0.9 L maximum gravity feed or variable quantity for flow-through.

4.11 Test Fluid Temperature

- a. Coefficient Test—50 to 150 °C ± 3 °C
- b. Aeration Life Test—140 °C ± 3 °C
- c. Special Tests—as required

4.12 Clutch Running Clearance

Minimum 0.13 mm per friction surface.

4.13 Cycle Time

A series of events repeated during friction-system testing. Periods in a cycle may include a fluid temperature stabilization period, a coast period to the desired engagement speed, apply period, and cooling period. When breakaway friction measurements are made, a cycle may include dwell, soak, and breakaway periods (see Figure 2).

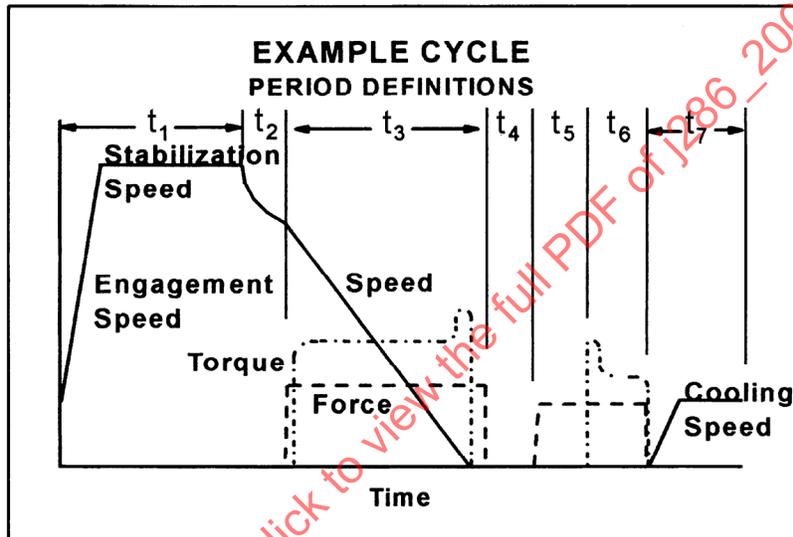


FIGURE 2—EXAMPLE CYCLE

4.13.1 t₁, STABILIZATION PERIOD

Period of time following the cooling period when the clutch is released and rotating at the stabilization speed. The stabilization period is completed when all conditions of speed and temperature have reached equilibrium or steady-state conditions (there are no transients present). The stabilization speed must be greater than or equal to the engagement speed.

4.13.2 t₂, COAST PERIOD

Period of time when the drive motor is off and the apply force is released and, because of drag, the rotational speed coasts down to the desired engagement speed.

4.13.3 t₃, APPLY PERIOD

Period of time, which includes the dynamic engagement mode, when the drive motor is coasting and force is applied.