SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J286 | REV. SEP96

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Superseding J286 NOV83

Submitted for recognition as an American National Standard

(R) 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.

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.

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

2.1.2 FORD MOTOR COMPANY PUBLICATION—Available from Ford Motor Company, Components Engineering Department, 36200 Plymouth Road, Box 14, Livonia, MI 48150.

Ford MERCON® Specification

2.1.3 GENERAL MOTORS PUBLICATION—Available from General Motors Corporation, Powertrain Division, M/C 965, Ecorse and Wiard Roads, Ypsilanti, MI 48198-6918.

GM DEXRON®-III Specification, GM6297M

3. Test Equipment

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

3.2 Flywheels to deliver desired kinetic energy.

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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 ±0.5% full range.
b. Apply Pressure Channel, Bandwidth, 500 Hz—Accuracy shall be within ±0.5% full range.
c. Speed Channel, Bandwidth, 500 Hz—Accuracy shall be within ±0.1% full range.
d. Test Fluid Temperature Channel, Bandwidth, 3 Hz—Accuracy shall be within ±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).

3.8 Aerated Fluid Tests

a. Cylinder of dry compressed air, –59.4 °C dew point, and regulatory controls.
b. Micrometering valve.
c. Flowmeter to measure air flows from 0 to 300 cm^3/min.
d. 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 mm^2.

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 ±0.5%.

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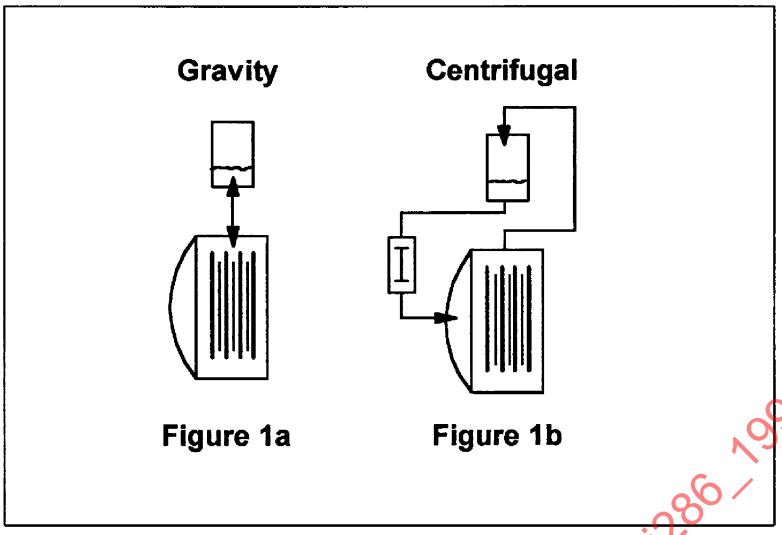

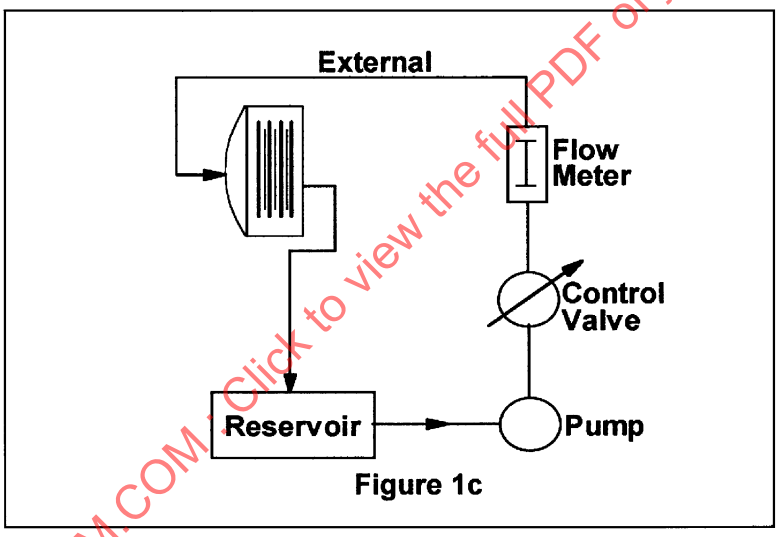

FIGURE 1—FLOW CONFIGURATIONS

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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·m^2.

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).

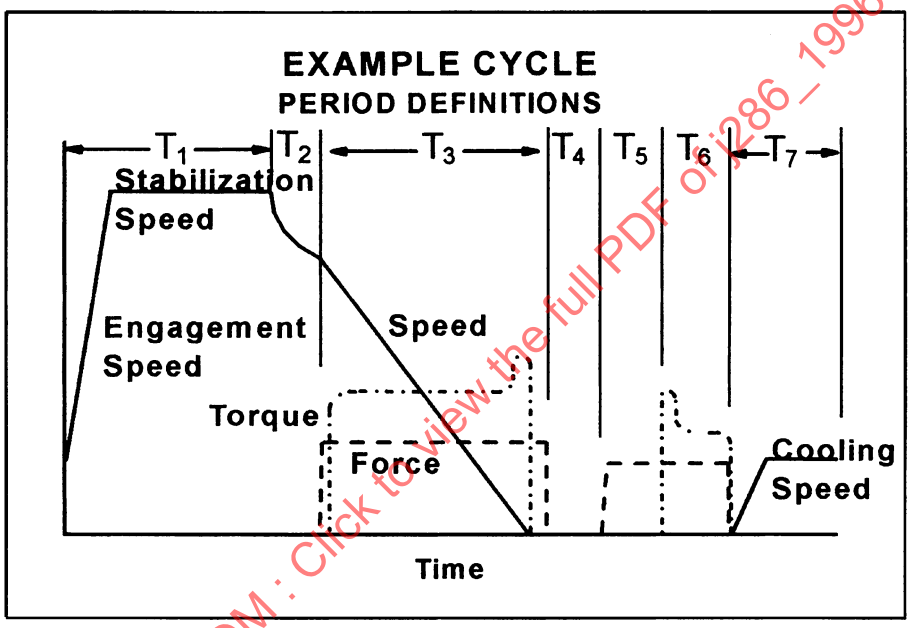

FIGURE 2—EXAMPLE CYCLE

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4.13.1 T_1, 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 T_2, 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 T_3, APPLY PERIOD—Period of time, which includes the dynamic engagement mode, when the drive motor is coasting and force is applied.

4.13.4 T_4, DWELL PERIOD—Period of time when the friction elements are at zero speed and the apply force is released.

4.13.5 T_5, SOAK PERIOD—Period of time when the friction elements are at zero speed and the force is applied.