

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2489

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APR2000

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Submitted for recognition as an American National Standard

SAE No. 2 Friction Test Machine Durability Test

- 1. Scope**—This SAE Recommended Practice is intended as the definition of a standard test, 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 clutches with automotive transmission fluids. It can also be used to conduct durability tests on wet friction systems.

The specific purpose of this document is to define a Durability Test based on a specific power level selected from either the 3600 r/min Stepped Power Test or from the 6000 r/min Stepped Power Test, for the evaluation of wet friction system performance variation as a function of number of cycles. This procedure is intended as a standard procedure for common use by both suppliers and end users.

The only variables selected by the supplier or user of the friction system are:

- a. Friction Material
- b. Fluid
- c. Reaction Plates

These three variables must be clearly identified when reporting the results of this test. If any of the test parameters or system hardware as described in this document are changed, other than the friction material, test fluid, or reaction plates, the data may not be reported as having been obtained using this document.

This procedure is not intended to evaluate the initial coefficient or break-in characteristics. For this information, refer to SAE J2490 SAE No. 2 Friction Test Machine μ PVT Test.

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2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1646—Glossary of Terms—Lubricated Friction Systems
SAE J2487—SAE No. 2 Friction Test Machine 3600 r/min Stepped Power Test
SAE J2488—SAE No. 2 Friction Test Machine 6000 r/min Stepped Power Test
SAE J2490—SAE No. 2 Friction Test Machine μ PVT Test

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

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale PA 15096-0001.

SAE J286—SAE No. 2 Clutch Friction Test Machine Guidelines
SAE J1499—SAE Band Friction Test Machine (SAE) Test Machine Guidelines

2.2.2 FORD MOTOR COMPANY PUBLICATION—Available from Ford Motor Company, FSATF Committee, 35500 Plymouth Road, Box 215, Livonia MI 48150.

Ford MERCON[®] V Specification

2.2.3 GENERAL MOTOR PUBLICATION—Available from GM Research & Development Center, General Motors Corporation, Technology Licensing, 30500 Mound Road, M/C 480-106-160, Warren MI 48090-9055.

GM DEXRON[®]-III Specification, GM6417M

2.2.4 DAIMLER CHRYSLER PUBLICATION—Available from Daimler Chrysler Corporation, Engineering Standards Group, 800 Chrysler Drive East, Auburn Hills MI 48326-2757.

Daimler Chrysler Specification MS9602

3. Test Equipment—As described in SAE J2487 and SAE J2488.

4. Typical Operating Conditions and Test Parameters—As described in SAE J2487 and SAE J2488 depending upon the conditions selected for the Durability Test.

5. General Test Information—As described in the SAE J2487 and SAE J2488.

5.1 Test Description—The Durability Test consists of 200 conditioning cycles, wherein the stop time is stabilized, followed by a specified number of cycles at the desired power level of either the 3600 r/min Stepped Power Test or the 6000 r/min Stepped Power Test. The conditioning cycles are run under the conditions of the first level of the Stepped Power Test selected for the Durability Test. The Durability cycles are accumulated by repeating the 200 dynamic cycles and breakaway cycle of the selected level of the Stepped Power Test.

5.2 End of Level Inspection—Shut down test stand. At the completion of the required dynamic engagements and the breakaway measurement, the housing is opened and the clutch pack carefully removed with special attention to ensure that the plates can be reinstalled in the exact same location and order relative to adjoining plates and fixed locations in the housing. Measurements are made of the friction element thickness as noted in 5.4 of SAE J2487 and J2488. Observations of the conditions of the reaction plates and friction elements and the fluid are recorded. Photographs may be taken to show the condition of the plates and assemblies.

6. Data Acquisition

6.1 Data Acquisition Rate—For digital data acquisition systems, the data is to be recorded at 1000 samples per second per channel using a 15 ms time constant RC filter. (Filtering will slew data. Preferred method is to record all raw data and manipulate later.)

6.2 Coefficient Calculations—Coefficients are calculated for the following dynamic coefficients at every 25th engagement. (Reference SAE J1646)

- a. Midpoint dynamic — $50\% \mu_d$
- b. Endpoint dynamic — $\leq 100 \text{ ms } \mu_{dmax}$ (Based on raw data single point value)

The breakaway coefficients, obtained every 200 dynamic engagements, is defined as:

Breakaway coefficient — $1.0 \mu_{s4.37}$

6.3 Data Averaging and Filtering—Data is to be averaged at the specified location in either the time or speed domain as specified in 6.1 with midpoint coefficient average values calculated using data points ± 80 ms on both sides of the required calculation point. Endpoint coefficient average values are calculated from non-filtered peak torque data measured in the last 100 ms of the engagement. For the 1000 Hz-sampling rate, the averages are based on 161 data points.

7. Data Reporting

7.1 Data Tables—A data table showing the friction material, spacer plate and fluid along with the system performance at each level in terms of the coefficients given in 6.2 along with the average wear values and calculated E/M ratio are to be included in the test table. An example Table is given in Appendix A.

7.2 Figures—There are two figures required in reporting the results of this test. Examples of the two figures are given in Appendix C.

- a. Figure of the midpoint dynamic coefficient and the cumulative average plate wear versus the level number.
- b. Figure of the E/M ratio and breakaway coefficient versus level number.

If the system does not successfully complete both the 200 dynamic engagement and the breakaway test, there is no data reported for that level. Alternatively, only data for the successful completion of a level are to be reported. Failure is defined as complete destruction of the friction material/system. (Report number of cycles into level at which failure occurred.)

7.3 Optional Data—Instantaneous plots of the 50th and 200th dynamic engagements at each level may be provided. Additionally, comments and photographs on the condition of the plates at the end of each level may also be included. Examples of such optional data are shown in Appendix A.

PREPARED BY THE SUBCOMMITTEE SAE AUTOMATIC TRANSMISSION
FRICTION STANDARDS COMMITTEE

APPENDIX A

Examples of data tables, graphs and photos used in the reporting the results of this test are provided in this appendix. At a minimum the data table and the midpoint coefficient plots must be presented. Optional data such as instantaneous plots and photographs may also be included.

Fric. Matl.: MATERIAL A

F/M: XXXX

Separator: ITEM 5

FRICTION PLATE DURABILITY TEST PROCEDURE: SAE J2489						
Test No.: ZZZZ Friction Material Type: MATERIAL A Friction Material Lot No.: XXXX Separator Plate: ITEM 5 Fluid Type: FLUID B Fluid Lot No.: YYYY						
TOTAL CYCLES	TEST LEVEL	CYCLE	MIDPOINT COEFFICIENT	ENDPOINT / MIDPOINT RATIO	BREAKAWAY COEFFICIENT	CUMULATIVE THICKNESS LOSS [AVG / PLATE] [MM]
50	1	25	0.149	0.998		
200	1	200	0.152	0.984	0.123	0.03
250	2	50	0.140	0.994		
400	2	200	0.134	1.011	0.120	0.20
450	3	50	0.135	1.015		
600	3	200	0.137	1.002	0.120	0.21
650	4	50	0.137	1.008		
800	4	200	0.138	1.005	0.119	0.23
850	5	50	0.134	1.029		
1000	5	200	0.136	1.010	0.121	0.25
1050	6	50	0.136	1.028		
1200	6	200	0.137	1.026	0.124	0.25
1250	7	50	0.139	1.023		
1400	7	200	0.142	1.029	0.125	0.25
1450	8	50	0.143	1.034		
1600	8	200	0.144	1.013	0.129	0.28
1650	9	50	0.141	1.038		
1800	9	200	0.140	1.049	0.126	0.28
1850	10	50	0.141	1.043		
2000	10	200	0.141	1.044	0.130	0.28
2050	11	50	0.142	1.036		
2200	11	200	0.141	1.054	0.129	0.29
2250	12	50	0.141	1.028		
2400	12	200	0.139	1.042	0.129	0.30
2450	13	50	0.138	1.030		
2600	13	200	0.139	1.031	0.128	0.32
2650	14	50	0.139	1.040		
2800	14	200	0.135	1.048	0.129	0.33
2850	15	50				
3000	15	200				

Fluid Type: FLUID B

Test: ZZZZ

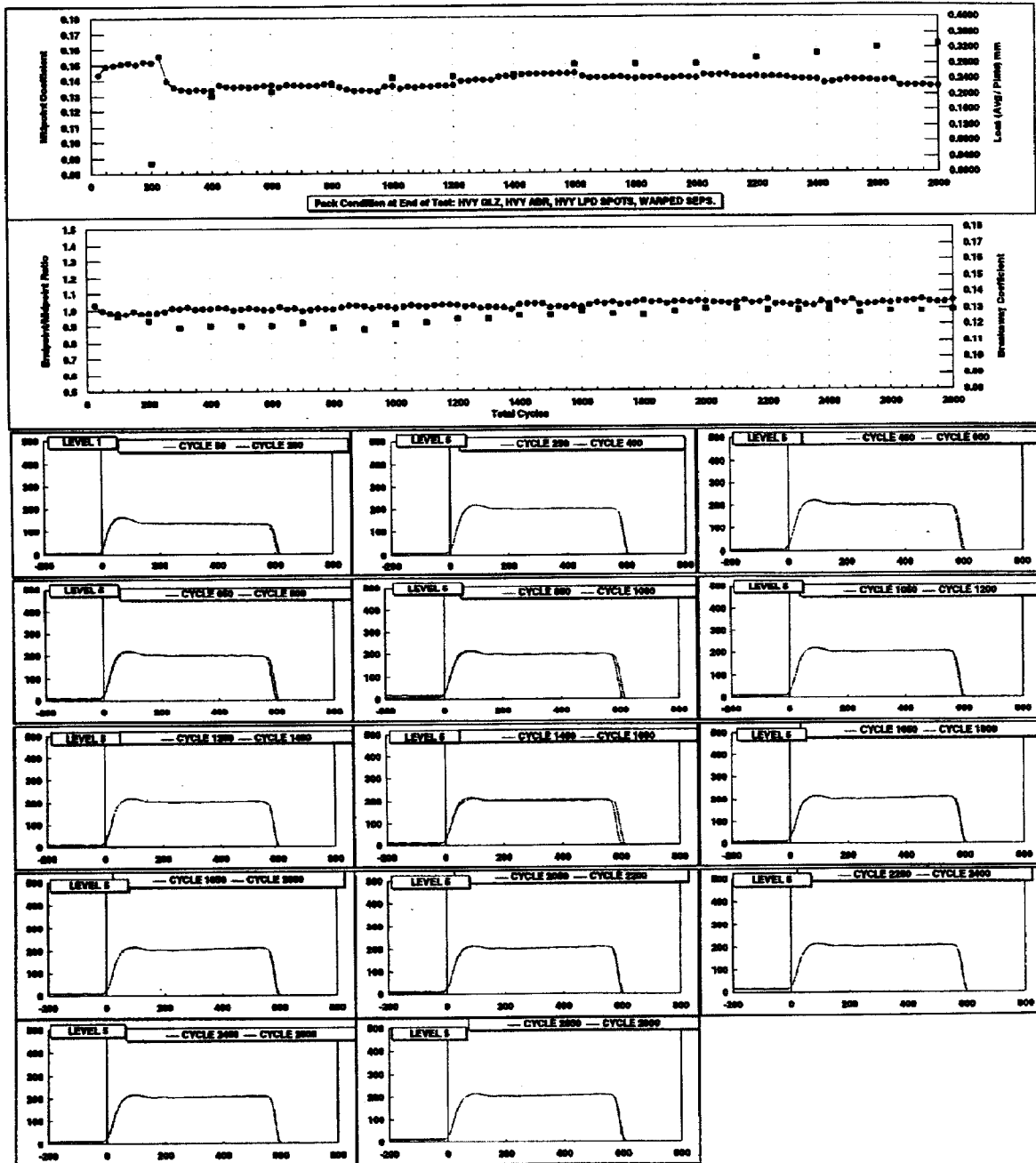
Proc: Durability SAE 2489

FIGURE A1—DURABILITY TEST DATA CHART

Fric. Matl.: MATERIAL A

F/M: XXXX

Separator: ITEM 5



Fluid Type: FLUID B

Test: ZZZZ

Proc: Durability SAE 2489

FIGURE A2—DURABILITY TEST GRAPHS

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Rationale—Not applicable

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—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 clutches with automotive transmission fluids. It can also be used to conduct durability tests on wet friction systems, as shown in SAE J2489.

Reference Section

SAE J286—SAE No. 2 Clutch Friction Test Machine Guidelines

SAE J1646—Glossary of Terms—Lubricated Friction Systems

SAE Paper 870051—New Fixture for Testing Friction Materials for Automatic Transmission Clutch

SAE J2487—SAE No. 2 Friction Test Machine 3600 r/min Stepped Power Test

SAE J2489—SAE No. 2 Friction Test Machine Durability Test

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Developed by the SAE Automatic Transmission Friction Standards Committee