SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

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SAE No. 2 Friction Test Machine Durability Test

RATIONALE

a. Dropped reference to GM, Ford and DC publications as they were deemed not specific to be helpful nor widely available.

b. Made changes in Section 7 data table references. Clarified chart references, removed appendix reference error.

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 standard procedure is intended for common use by both suppliers and end users to allow objective comparisons of wet friction material system performance. 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 μPVT Test.

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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

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 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 μPVT 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, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J286 SAE No. 2 Clutch Friction Test Machine Guidelines

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

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. An example of test parameter reporting is detailed in Appendix B.

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 can skew 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 – $_{\leq 100ms}\mu_{dmax}$ (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 detailing the friction material, spacer plate, test energy level and fluid along with the system performance at each 200 cycle test sequence in terms of the coefficients as described in 6.2 along with the average wear values and calculated E/M ratio are to be included in the report. Example Figure A1 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 A, Figure A2.

a. Figure of the midpoint dynamic coefficient and the cumulative average plate wear versus the test sequence number.

b. Figure of the E/M ratio and breakaway coefficient versus test sequence 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 test sequence 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 test sequence may be provided. Additionally, comments and photographs on the condition of the plates at the end of each test sequence may also be included. Examples of such optional data are shown in Appendix A, Figure A3.

8. NOTES

8.1 Marginal Indicia

The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE 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

Test Speed:
Test Energy Level (constant through test):

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	0.126	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

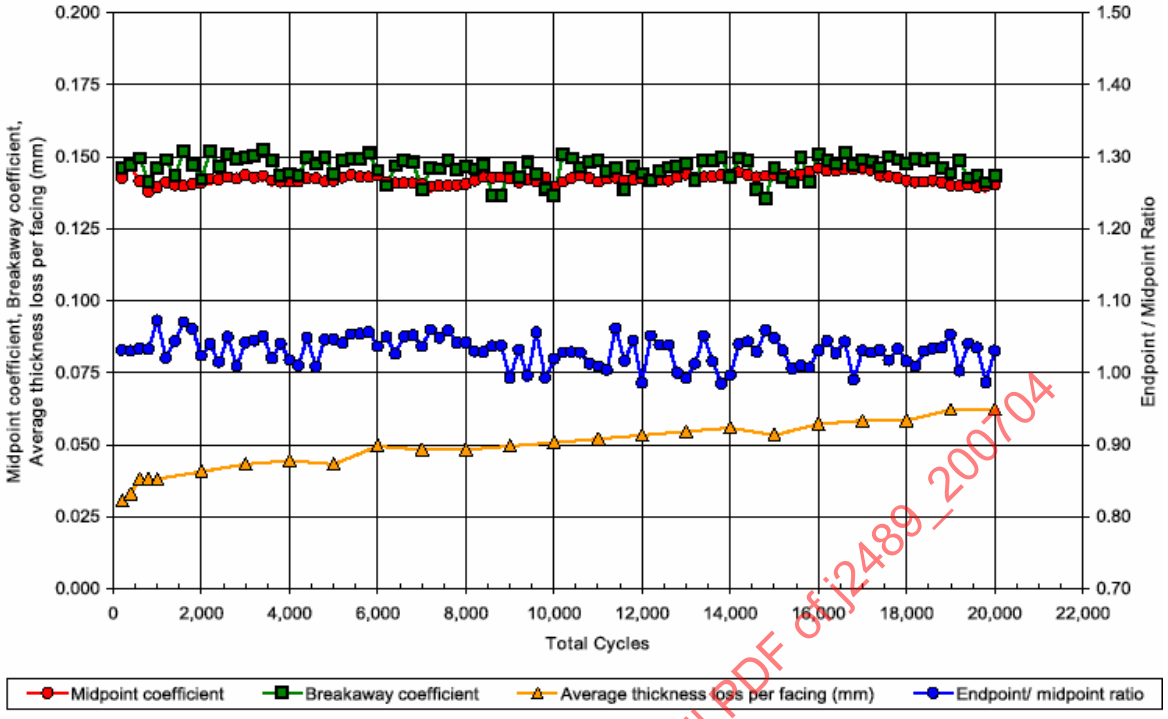

FIGURE A2 - DURABILITY TEST GRAPHS