SAE International	SURFACE VEHICLE RECOMMENDED PRACTICE	SAE J2624 JUN2013
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Comprehensive Lining Evaluation - Vehicle

RATIONALE

This document is Cancelled without replacement.

- Robust vehicle testing procedures already exist.
- For the aftermarket, available robust dynamometer procedures are utilized. To find and use older vehicles for J2624 vehicle testing is problematic.
- There are few requests for this SAE publication. Additionally, the testing agencies have had no requests to perform this test.

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1. ***Scope***—There is currently no requirement in place for aftermarket brake lining performance. NHTSA has indicated that the automotive aftermarket should take a proactive approach to come up with a standard test definition for lining evaluation. Many aftermarket manufacturers use dynamometer testing to evaluate lining performance, but there is currently not a common recognized method for on-vehicle lining screening. This procedure was created to provide a quick, on-vehicle test method for lining performance evaluation. This procedure is intended for use in passenger cars; multi purpose vehicles and light trucks with a gross vehicle weight less than 4535 kg(10 000 lb).

1.1 **Purpose—**This Recommended Practice is intended to provide the automotive aftermarket brake lining manufacturer with an on-vehicle test procedure for comparison of brake lining performance with Original Equipment or a competitor's performance. Care should be taken to maintain consistency between tests that are being compared. The data provided includes stopping distance performance in three lining conditions: green, burnished and faded. Also, driver pedal feel is quantified so that it can be objectively compared in the three principal lining conditions.

2. ***References***

2.1 **Applicable Publication—**The following publication forms a part of this specification to the extent specified herein.

2.1.1 FEDERAL MOTOR VEHICLE SAFETY STANDARDS—Available from the Superintendent of Documents, U. S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

FMVSS105, October 2000

2.2 **Related Publication—**The following publication is provided for information purposes only and is not a required part of this specification. Unless otherwise indicated, the latest version of SAE publications shall apply.

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

SAE J299—Stopping Distance Test Procedure

3. Equipment

3.1 Data acquisition system capable of recording at least 50 Hz.

3.2 Vehicle speed/distance sensor.

3.3 Pedal force transducer.

3.4 Longitudinal decelerometer.

3.5 Thermocouples in each outer lining (disc) or leading/secondary lining (drum).

3.6 Pedal travel transducer.

3.7 Vehicle weight measurement capability.

3.8 Wind speed indicator.

3.9 (OPTIONAL) Pressure transducer in each brake circuit.

4. Test Preparation

4.1 Brake drums/rotors should be resurfaced to remove any previous lining material transfer and to approximate field service conditions. If new drums or rotors are used they should also be resurfaced. (Optional) New drums and rotors need not be resurfaced if they are the components being tested.

4.2 Front and rear brake linings should be new; if test linings are for only one axle, the other axle should be tested with OE material.

4.3 Wheels and tires should be OE size and type, to ensure that test results obtained most accurately reflect the design-intended vehicle performance.

4.4 **Lightly Loaded Vehicle Weight—**Weigh vehicle to curb weight plus 181 kg (400 lb) in the front passenger area (including driver and instrumentation).

4.5 **Gross Vehicle Weight—**Weigh vehicle to recommended maximum load, including front-to-rear recommended weight distribution.

4.6 Note prior to conducting a single stop, the brakes must be at the correct initial brake temperature (IBT), except the burnish, fade and recovery stops. This is accomplished by any of the following three methods:

a. Letting the brakes exhaust the heat while sitting on the side of the test surface
b. Driving at 30 to 50 km/h to assist the brakes in cooling
c. Forcing air over the brakes with an external source to cool the brakes

5. General Test Conditions

5.1 Testing to be conducted on a smooth, dry surface of either Portland cement or asphalt. The grade must be less than or equal to 1%. If a longitudinal grade exists the testing direction is always to be downhill. Note approximately 14.5 km (9 miles) will be needed for the fade sequence.

5.2 Wind velocity should be less than 19.3 kph (12 mph) for the testing. The wind direction should be either pushing the rear of the vehicle or the side of the vehicle.

5.3 Maximum allowable pedal effort for all brake applies is 667 N (150 lb).

5.4 The vehicle openings (windows, convertible top) must be closed during testing.

5.5 The air conditioning must be turned off during stopping.

5.6 The air temperature must be between 0 °C and 40 °C.

6. Test Procedure

6.1 Static Floor Checks. Conduct the following floor checks to verify data acquisition system function as well as brake system bleed.

6.1.1 Perform 3 static applies with a pedal force ramp rate of 135 N/s and a maximum pedal force of 667 N (150 lb), with a full vacuum booster.

6.1.2 Perform 3 static applies with a pedal force ramp rate of 135 N/s and a maximum pedal force of 667 N (150 lb), with the vacuum booster depleted.

6.2 First (Green Brake) Effectiveness at GVW—With the vehicle loaded to GVW, conduct 4 best-effort stops in Neutral from 48.3 km/h (30 mph). IBT ≤65 to 93 °C (150 to 200 °F).

6.3 100-Snub Burnish at GVW—Conduct 100 snubs in gear from 80.5 to 48.3 km/h (50 to 30 mph), with a deceleration ramp-up to 0.5 g in 1.5 s, and hold the decel constant for the remainder of the apply. IBT for the first snub is ≤93 °C (200 °F). Snubs are to be conducted at 1.6 km (1 mile) intervals.

6.4 Second Effectiveness at GVW—With the vehicle loaded to GVW, conduct 3 best-effort stops in Neutral from 96.6 km/h (60 mph), with an IBT ≤65 to 93 °C (150 to 200 °F).

6.5 Third Effectiveness from 96.6 km/h (60 mph) at LLVW—Repeat 6.4, except with the vehicle loaded to LLVW, and with the ABS disabled.

6.6 Baseline, Fade and Recovery at GVW

6.6.1 BASELINE—Conduct 3 stops in gear from 48.3 km/h (30 mph), constant deceleration (3 m/s/s), and pedal force 44.5 to 267 N (10 to 60 lb).

NOTE— Cool brakes between stops (IBT 65 to 93 °C)

6.6.2 FADE—Conduct 10 stops from 96.6 km/h (60 mph). Deceleration is above 4.6 m/s/s (15 ft/s/s) for stops 1 to 5, without exceeding 667 N (150 lb) pedal force, and 1.5 to 4.6 m/s/s (5 to15 ft/s/s) for stops 6 to 10 (4.6 m/s/s (15 ft/s/s) is to be maintained if pedal force is ≥667 N (150 lb)). Interval is 0.64-km (0.4-mile); IBT for stop #1 is 54 to 66 °C (130 to 50 °F). Accelerate immediately to initial speed after each stop. After the 10th stop, accelerate to 48.3 km/h (30 mph) and drive 1.61 km (1 mile), then proceed immediately into recovery stops.

6.6.3 RECOVERY—Conduct 5 stops from 48.3 km/h (30 mph), 3.0 m/s/s (10 ft/s/s) deceleration, at 1.61-km (1-mile) intervals. Stops 104 max pedal force 667 N (150 lb). Stop 5 max pedal force is the average of the 3 maximum pedal force values from the baseline stops plus 89 N (20 lb). Minimum is average max pedal force for 3 baseline stops minus 44.5 N (10 lb) or times 0.6; whichever is lower, but not less than 22 N (5 lb).

6.7 15-snub reburnish at GVW—Repeat 6.3, only with 15 snubs instead of 100.

6.8 Fourth Effectiveness from 96.6 km/h (60 mph) at GVW—Repeat 6.4.

6.9 Parking Brake (Optional)—Parking brake hill hold at GVW on a 20% slope (uphill and downhill) in neutral. Maximum pedal force is 500 N (112 lb) for a foot pedal, and 400 N (90 lb) for a hand lever. 1 application and up to 2 re-applications if necessary.

7. Suggested Report Format

7.1 Stopping Distance Summary—For the shortest valid stop in each section list the stopping distance for both the baseline and test sample results. The shortest valid stop is a stop that meets all of the requirements of Section 5. Table — lists an example of this summary.

TABLE 1A—SAMPLE SUMMARIZED STOPPING DISTANCE TABLE (METRIC)

Test Section	Baseline Performance OE Linings	Test Sample Performance XYZ Linings
First Effectiveness from 48.3 kph at GVW	17 m	60 m
Second Effectiveness from 48.3 kph at GVW	14 m	47 m
Second Effectiveness from 96.6 kph at GVW	64 m	199 m
Third Effectiveness from 96.6 kph at LLVW	50 m	172 m
Fade and Recovery (pedal force requirement)	93 N	116 N
Fourth Effectiveness from 96.6 kph at GVW	55 m	184 m

TABLE 1B—SAMPLE SUMMARIZED STOPPING DISTANCE TABLE

Test Section	Baseline Performance OE Linings	Test Sample Performance XYZ Linings
First Effectiveness from 30 mph at GVW	57 ft	60 ft
Second Effectiveness from 30 mph at GVW	47 ft	47 ft
Second Effectiveness from 60 mph at GVW	210 ft	199 ft
Third Effectiveness from 60 mph at LLVW	165 ft	172 ft
Fade and Recovery (pedal force requirement – Stop 5)	21 lb	26 lb
Fourth Effectiveness from 60 mph at GVW	182 ft	184 ft

7.2 Pedal Feel—The results of the initial portions of select burnish stops are used to generate a table of pedal feel. Pedal feel is quantified in terms of 2 characteristics: responsiveness and firmness. Responsiveness is defined as the relationship between pedal force and deceleration, or pedal travel and deceleration. Firmness is defined as the relationship between pedal force and pedal travel. The following table provides these quantitative pedal feel results for the two tests. The linings are evaluated in the three principle linings states pre-burnished (green), post burnish and post fade. 50 mm of pedal travel or 0.4 g's of deceleration is the reference used to gather pedal feel information. Averaging of 5 stops is done at this pedal location to reduce driver apply variability. The green linings are evaluated on burnish stops 6 to 10. The post burnish is measured at the end of the burnish on stops 96 to 100. The post fade is measured on stops 10 to 15 of the post fade re-burnishes. Table 1 lists the summarized pedal feel information.

TABLE 1—SAMPLE SUMMARIZED PEDAL FEEL TABLE

Lining Condition	Responsiveness (lb/g) Test	Responsiveness (lb/g OE	Responsiveness (in/g) Test	Responsiveness (in/g) OE	Firmness (lb/in) Test	Firmness (lb/in) OE	Test Sample Relative to OE
Green	99	75	7.7	6.6	7.2	8.7	17 to 32% less responsive, 17% firmer
Post-Burnish	73	62	6.9	6.0	7.2	8.7	15 to 17% less responsive, 17% firmer
Post Fade	62	58	7.2	6.4	5.8	7.1	7 to 13% less responsive, 18% less firm

7.3 (Optional) Summarized Section Tabular Data—Optionally the report could contain the following information that would be useful in understanding the demands the brake system of a particular vehicle is placing on the friction material. See Figures 1 and 2.

SECTION: 210--First (Green brake) Effectiveness 48.3 kph at GVW
REFERENCE FMVSS105 STOP DISTANCE REQUIREMENT: **20 m**

Stop #	INITIAL SPEED AT APPLY	ACTUAL MEAS DIST	J299 CORR DIST	MAXIMUM PEDAL FORCE	AVERAGE PEDAL FORCE	MAXIMUM PEDAL TRAVEL	AVERAGE PEDAL TRAVEL	MAXIMUM DECEL	AVERAGE DECEL	DRIVER SUBJECTIVE STOP COMMENT
1	49.8 kph	21.5 m	**20.1 m**	637.2 N	624.6 N	90.6 mm	89.2 mm	0.63 g	**0.57 g**	SMOOTH STABLE AND QUIET
2	48.8 kph	19.9 m	**19.4 m**	664.4 N	634.7 N	93.9 mm	93.1 mm	0.62 g	**0.58 g**	SMOOTH STABLE AND QUIET
3	49.4 kph	19.9 m	**19.0 m**	652.6 N	624.9 N	92.8 mm	92.0 mm	0.58 g	**0.57 g**	SMOOTH STABLE AND QUIET
4	49.2 kph	18.1 m	**17.3 m**	676.3 N	630.5 N	94.1 mm	92.6 mm	0.67 g	**0.60 g**	EXCEEDED MAX PEDAL FORCE

Stop #	INITIAL BOOSTER VACUUM	AVG BOOSTER VACUUM	MAX FRONT PRESS	MAX REAR PRESS	AVG FRONT PRESS	AVG REAR PRESS
1	574 mm•Hg	547 mm•Hg	103 bar	104 bar	102 bar	103 bar
2	641 mm•Hg	572 mm•Hg	107 bar	108 bar	106 bar	106 bar
3	614 mm•Hg	540 mm•Hg	103 bar	104 bar	102 bar	103 bar
4	630 mm•Hg	559 mm•Hg	106 bar	107 bar	105 bar	106 bar

Stop #	INITIAL LF TEMP	INITIAL RF TEMP	INITIAL LR TEMP	INITIAL RR TEMP	MAX LF TEMP	MAX RF TEMP	MAX LR TEMP	MAX RR TEMP
1	64 °C	63 °C	56 °C	57 °C	92 °C	93 °C	83 °C	77 °C
2	79 °C	78 °C	71 °C	68 °C	108 °C	107 °C	99 °C	89 °C
3	88 °C	89 °C	81 °C	76 °C	116 °C	117 °C	110 °C	97 °C
4	92 °C	94 °C	83 °C	78 °C	119 °C	122 °C	111 °C	99 °C

SECTION ID: 210--First (Green Brake) Effectiveness 30 mph at GVW
REFERENCE FMVSS105 STOP DISTANCE REQUIREMENT: **65 ft**

Stop #	INITIAL SPEED AT APPLY	ACTUAL MEAS DIST	J299 CORR DIST	MAXIMUM PEDAL FORCE	AVERAGE PEDAL FORCE	MAXIMUM PEDAL TRAVEL	AVERAGE PEDAL TRAVEL	MAXIMUM DECEL	AVERAGE DECEL	DRIVER SUBJECTIVE STOP COMMENT
1	30.9 mph	70.5 ft	**66.5 ft**	143.3 lb	140.4 lb	3.6 in	3.5 in	0.63 g	**0.57 g**	SMOOTH STABLE AND QUIET
2	30.3 mph	65.3 ft	**64.0 ft**	149.4 lb	142.7 lb	3.7 in	3.7 in	0.62 g	**0.58 g**	SMOOTH STABLE AND QUIET
3	30.7 mph	65.3 ft	**62.4 ft**	146.7 lb	140.5 lb	3.7 in	3.6 in	0.58 g	**0.57 g**	SMOOTH STABLE AND QUIET
4	30.6 mph	59.2 ft	**56.9 ft**	152.0 lb	141.7 lb	3.7 in	3.6 in	0.67 g	**0.60 g**	EXCEEDED MAX PEDAL FORCE

Stop #	INITIAL BOOSTER VACUUM	AVG BOOSTER VACUUM	MAX FRONT PRESS	MAX REAR PRESS	AVG FRONT PRESS	AVG REAR PRESS
1	22.6 in•Hg	21.5 in•Hg	1499 psi	1507 psi	1484 psi	1492 psi
2	25.2 in•Hg	22.5 in•Hg	1551 psi	1562 psi	1532 psi	1541 psi
3	24.2 in•Hg	21.2 in•Hg	1494 psi	1505 psi	1482 psi	1490 psi
4	24.8 in•Hg	22.0 in•Hg	1542 psi	1559 psi	1524 psi	1531 psi

Stop #	INITIAL LF TEMP	INITIAL RF TEMP	INITIAL LR TEMP	INITIAL RR TEMP	MAX LF TEMP	MAX RF TEMP	MAX LR TEMP	MAX RR TEMP
1	147 °F	146 °F	132 °F	134 °F	198 °F	200 °F	182 °F	170 °F
2	175 °F	172 °F	160 °F	154 °F	227 °F	225 °F	211 °F	192 °F
3	190 °F	192 °F	178 °F	168 °F	241 °F	243 °F	230 °F	207 °F
4	197 °F	201 °F	182 °F	172 °F	246 °F	252 °F	232 °F	211 °F

FIGURE 1—TABULAR DATA SAMPLE FORMAT FOR “BEST EFFORT” STOPS

OE Test Results (reference)

OE FRONT LINING: ABEX 6083 EE
OE REAR LINING: ABEX 6083 EE

Stop #	INITIAL SPEED AT APPLY	ACTUAL MEAS DIST	J299 CORR DIST	MAXIMUM PEDAL FORCE	AVERAGE PEDAL FORCE	MAXIMUM PEDAL TRAVEL	AVERAGE PEDAL TRAVEL	MAXIMUM DECEL	AVERAGE DECEL	DRIVER SUBJECTIVE STOP COMMENT
1	50.9 kph	19.9 m	**17.9 m**	669.0 N	636.7 N	92.4 mm	90.8 mm	0.68 g	**0.67 g**	SMOOTH STABLE AND QUIET
2	48.6 kph	17.6 m	**17.3 m**	653.8 N	643.2 N	94.8 mm	93.7 mm	0.67 g	**0.65 g**	SMOOTH STABLE AND QUIET
3	48.2 kph	18.6 m	**18.6 m**	668.4 N	645.3 N	93.8 mm	93.0 mm	0.63 g	**0.62 g**	SMOOTH STABLE AND QUIET
4	49.4 kph	18.3 m	**17.5 m**	642.2 N	598.2 N	93.7 mm	92.1 mm	0.67 g	**0.64 g**	SMOOTH STABLE AND QUIET

Stop #	INITIAL BOOSTER VACUUM	AVG BOOSTER VACUUM	MAX FRONT PRESS	MAX REAR PRESS	AVG FRONT PRESS	AVG REAR PRESS
1	644 mm•Hg	572 mm•Hg	106 bar	107 bar	104 bar	105 bar
2	683 mm•Hg	572 mm•Hg	105 bar	106 bar	105 bar	106 bar
3	602 mm•Hg	553 mm•Hg	104 bar	104 bar	103 bar	103 bar
4	604 mm•Hg	576 mm•Hg	105 bar	106 bar	103 bar	103 bar

Stop #	INITIAL LF TEMP	INITIAL RF TEMP	INITIAL LR TEMP	INITIAL RR TEMP	MAX LF TEMP	MAX RF TEMP	MAX LR TEMP	MAX RR TEMP
1	62 °C	51 °C	42 °C	43 °C	81 °C	80 °C	63 °C	63 °C
2	96 °C	85 °C	76 °C	74 °C	114 °C	112 °C	96 °C	93 °C
3	97 °C	84 °C	74 °C	69 °C	116 °C	112 °C	94 °C	89 °C
4	86 °C	75 °C	65 °C	62 °C	105 °C	104 °C	86 °C	83 °C

OE Test Results (reference)

OE FRONT LINING: ABEX 6083 EE
OE REAR LINING: ABEX 6083 EE

Stop #	INITIAL SPEED AT APPLY	ACTUAL MEAS DIST	J299 CORR DIST	MAXIMUM PEDAL FORCE	AVERAGE PEDAL FORCE	MAXIMUM PEDAL TRAVEL	AVERAGE PEDAL TRAVEL	MAXIMUM DECEL	AVERAGE DECEL	DRIVER SUBJECTIVE STOP COMMENT
1	31.6 mph	65.4 ft	**58.9 ft**	150.4 lb	143.1 lb	3.6 in	3.6 in	0.68 g	**0.67 g**	SMOOTH STABLE AND QUIET
2	30.2 mph	57.8 ft	**57.0 ft**	147.0 lb	144.6 lb	3.7 in	3.7 in	0.67 g	**0.65 g**	SMOOTH STABLE AND QUIET
3	30.0 mph	61.1 ft	**61.3 ft**	150.3 lb	145.1 lb	3.7 in	3.7 in	0.63 g	**0.62 g**	SMOOTH STABLE AND QUIET
4	30.7 mph	60.2 ft	**57.5 ft**	144.4 lb	134.5 lb	3.7 in	3.6 in	0.67 g	**0.64 g**	SMOOTH STABLE AND QUIET

Stop #	INITIAL BOOSTER VACUUM	AVG BOOSTER VACUUM	MAX FRONT PRESS	MAX REAR PRESS	AVG FRONT PRESS	AVG REAR PRESS
1	25.3 in•Hg	22.5 in•Hg	1540 psi	1551 psi	1515 psi	1526 psi
2	26.9 in•Hg	22.5 in•Hg	1529 psi	1542 psi	1521 psi	1532 psi
3	23.7 in•Hg	21.8 in•Hg	1503 psi	1514 psi	1487 psi	1497 psi
4	23.8 in•Hg	22.7 in•Hg	1520 psi	1532 psi	1488 psi	1498 psi

Stop #	INITIAL LF TEMP	INITIAL RF TEMP	INITIAL LR TEMP	INITIAL RR TEMP	MAX LF TEMP	MAX RF TEMP	MAX LR TEMP	MAX RR TEMP
1	143 °F	124 °F	108 °F	109 °F	177 °F	176 °F	146 °F	145 °F
2	205 °F	185 °F	169 °F	165 °F	238 °F	233 °F	205 °F	200 °F
3	207 °F	184 °F	165 °F	156 °F	241 °F	234 °F	201 °F	192 °F
4	187 °F	167 °F	149 °F	144 °F	221 °F	219 °F	187 °F	182 °F

FIGURE 2—TABULAR DATA SAMPLE FORMAT FOR “BEST EFFORT” STOPS USING OE MATERIAL FOR COMPARISON

7.4 (Optional) Graphical In-Stop Time History of the Shortest Valid Stop—Optionally the report could contain the following information that would be useful in understanding the demands the brake system of a particular vehicle is placing on the friction material. See Figure 3.

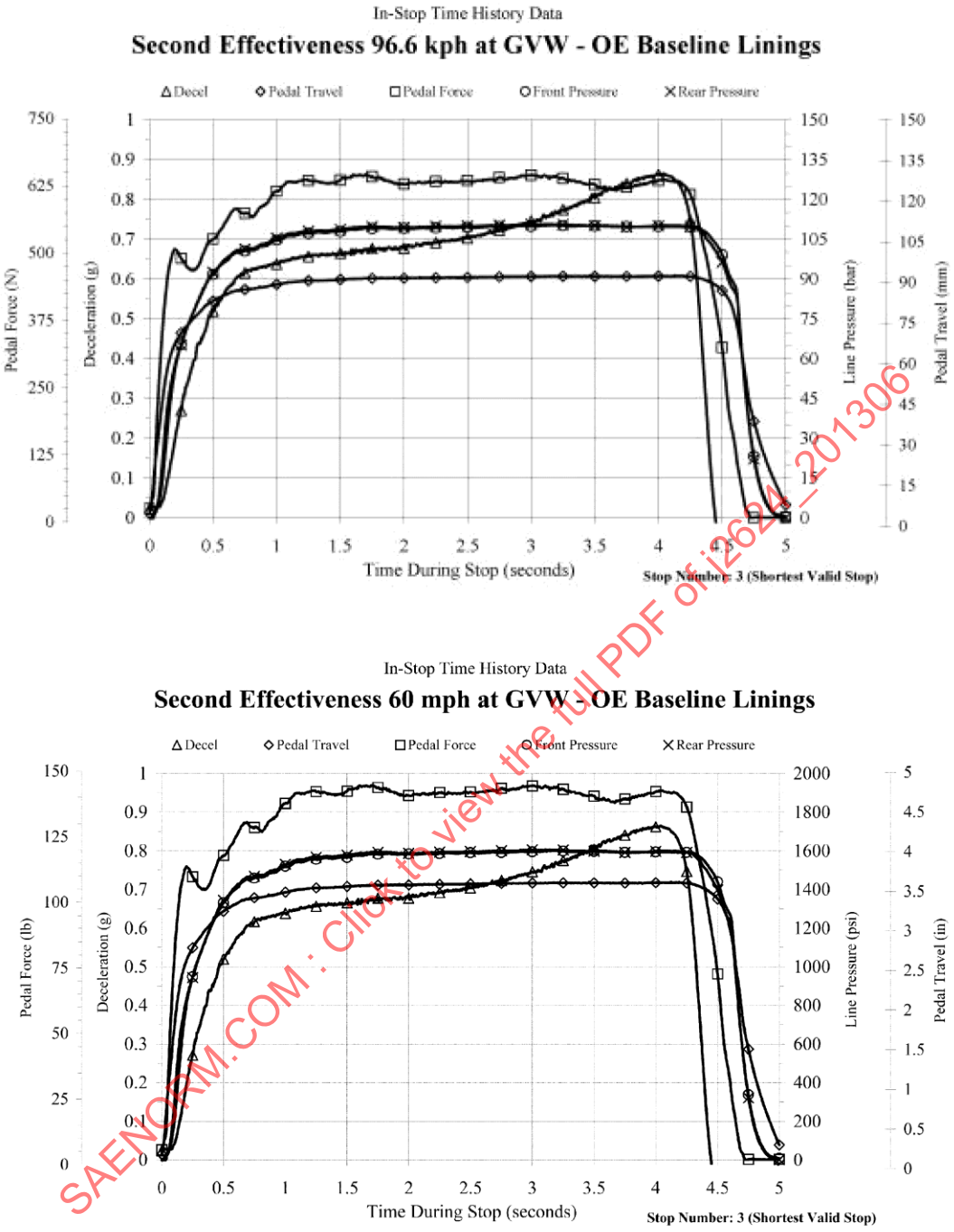

FIGURE 3—SAMPLE SUMMARIZED IN-STOP GRAPHICAL DATA

7.5 (Optional) Graphical Stop Summary During the Fade Sequence—Optionally the report could contain the following information that would be useful in understanding the demands the brake system of a particular vehicle is placing on the friction material. See Figure 4.