SOCIETY OF AUTOMOTIVE ENGINEERS, INC. • TWO PENNSYLVANIA PLAZA • NEW YORK, NEW YORK 10001

LAND SEA AIR SPACE

TECHNICAL REPORT J843c

BRAKE SYSTEM ROAD TEST CODE—PASSENGER CAR—SAE J843c

SAE Recommended Practice

Report of Brake Committee approved January 1963 and last revised February 1970.

1. Scope—This SAE Recommended Practice establishes a uniform procedure for the level road test of the brake systems of all classes of passenger cars.

2. Purpose—The purpose of the test code is to establish a uniform test procedure to determine brake system capabilities with regard to:

2.1 Deceleration versus input, as affected by vehicle speed, brake temperature, and usage.

2.2 Brake system integrity.

2.3 Stopping ability during emergency or inoperative power assist conditions.

2.4 Water recovery characteristics.

3. Instrumentation

3.1 Line pressure or pedal force gage.

3.2 Decelerometer (U-tube or equivalent).

3.3 Direct reading temperature instrument.

3.4 Speedometer (calibrated) or Fifth Wheel Pousometer.

3.5 Tire pressure gage.

3.6 Odometer (calibrated).

3.7 Thermometer—ambient (or ambient sensitive thermocouple).

3.8 Stopmeter (fifth wheel, distance only).

3.9 Optional Instrumentation:

Pedal travel gage.

Solenoid stop counter.

Stop watch.

4. Installation Details

4.1 **Friction Material Preparation**—Attach and finish friction material per vehicle manufacturer's specifications.

4.2 **Thermocouples**—Install the desired type of thermocouples in

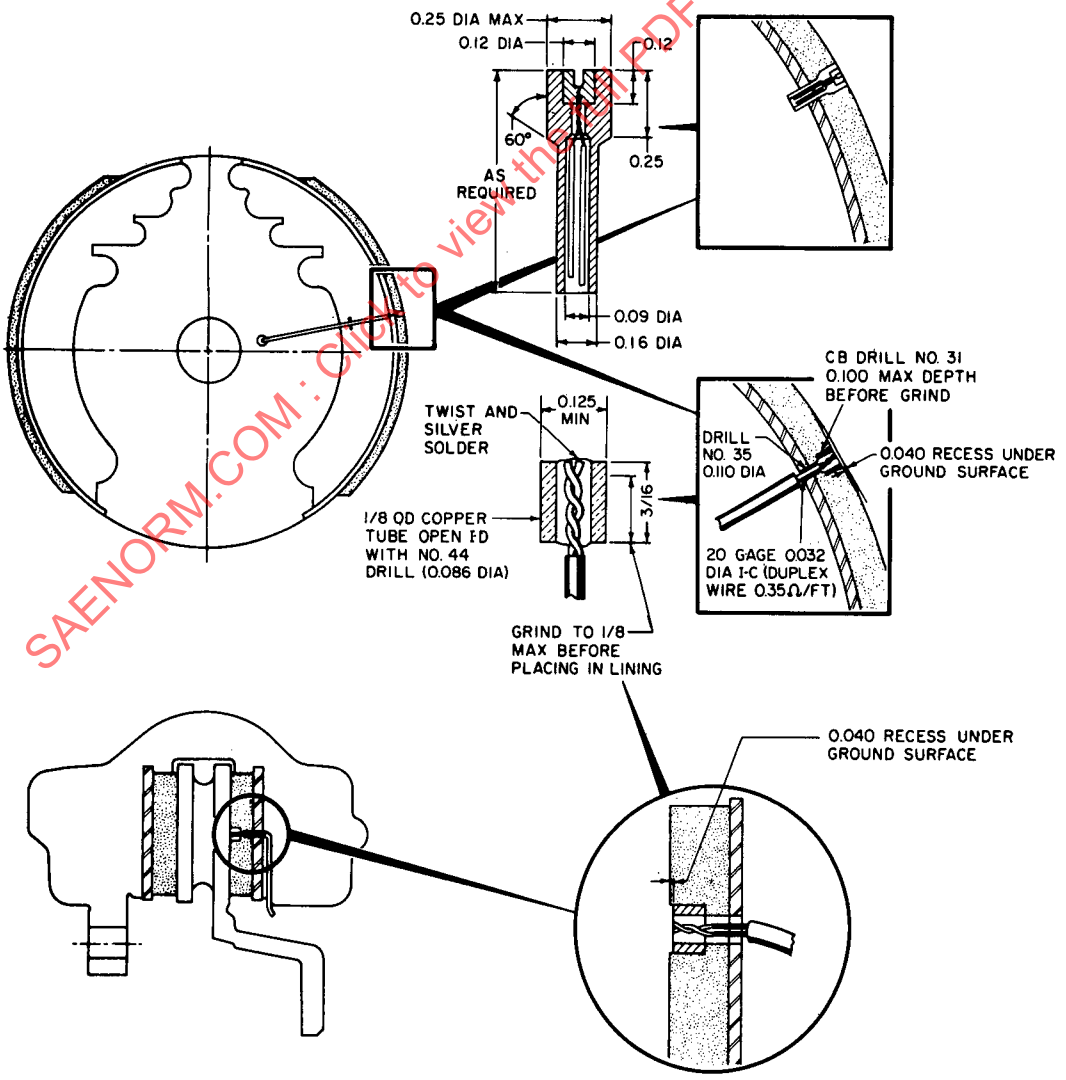

FIG. 1- TYPICAL PLUG THERMOCOUPLE INSTALLATIONS

each brake. Any one of the following installations may be used:

4.2.1 Plug type. See Fig. 1.

4.2.2 Web-rim junction type, welded or otherwise, in intimate contact with the brake shoe near the web-rim junction.

4.2.3 Thermocouple inserted in a hole drilled from the lining edge, approximately one-half the width of the lining in depth and as close to the shoe rim as possible.

All thermocouples shall be located in approximate center of the most heavily loaded shoe, one per brake.

4.3 Brake Drum (or Rotor) and Hub Assembly—New drums (or rotors) recommended for each test. Surface finish, dimensional characteristics, with special emphasis on runout of rubbing surface, shall be in accordance with vehicle manufacturer's specifications.

4.4 Brake Assembly—Brakes shall be prepared in accordance with vehicle manufacturer's specification with special attention to required load characteristics on all brake springs. Adjust brakes to manufacturer's specifications.

4.5 Vehicle Test Weight—Vehicle manufacturer's recommended axle test loading shall be maintained throughout full test procedure except during the minimum load test[1] (paragraph 5.8). The tire pressure should be set per manufacturer's specifications for the vehicle test weight specified.

5. Test Procedure

5.1 Test Notes

5.1.1 Effectiveness, fade, and recovery test stops shall be conducted on a substantially level (not to exceed a ±1% grade), dry, smooth, hard-surfaced roadway of Portland cement concrete (or other surface with equivalent coefficient of surface friction) that is free from loose materials.

5.1.2 During all phases of this procedure, any unusual performance such as wrap-up or noise characteristics are to be noted and recorded. Note any uncontrollable braking action causing the vehicle to pull or swerve out of a 12 ft wide roadway lane.

5.1.3 "Initial brake temperature" is defined as 0.2 mile before stop (average temperature of brakes on hottest axle), brakes off.

5.1.4 If brakes require warming to prescribed temperature, use burnish procedure and shorten interval if necessary.

5.1.5 Because variations in ambient temperature have a significant effect on test results, fade and recovery tests must be conducted within a range of ambient temperature of 40-90 F.

5.1.6 Decelerations used in the various fade, recovery, or warmup procedures refer to values at which the decelerometer is held approximately constant during the stop by varying the input pressure.

5.1.7 Deceleration and line pressure (pedal force) readings shall not be taken below 5 mph.

5.2 Preburnish Check—In order to allow for a general check of instrumentation, brakes, and vehicle function, the following stops are to be run: 10 stops, 30-0 mph, 10 fpsps, 1 mile interval, 40 mph cooling speed in normal driving gear.

Record—Maximum line pressure (pedal force).

NOTE: Assuming instrumentation, brakes, and vehicle are functioning satisfactorily, proceed immediately with First Effectiveness Test.

5.3 First (Preburnish) Effectiveness Test—Initial brake temperature, 200 F before each application.

Stop Speed—30 mph and 60 mph (full stops in neutral).

Increments—Curve to be defined to point of incipient skid by adequate number of points.

Record—Deceleration and line pressure (pedal force) and method of brake application (that is, machine or manual).

When using manual method, full stops to be defined by maximum line pressure (pedal force) and deceleration. Also note, at the appropriate stop, which wheel or wheels skidded.

5.4 Burnish

Stop Speed—40-0 mph.

Stop deceleration—12 fpsps (in normal driving gear).

Stop interval—As required to achieve 250 F "initial brake temperature"[2] or a maximum of 1 mile. NOTE: The 1 mile maximum must be observed even though the initial temperature exceeds 250 F.

Cooling speed—40 mph (moderate acceleration to cooling speed).

Stops required—200. Record line pressure (pedal force) and brake temperature for stops 1, 20, and each succeeding 20th stop.

Optional—Inspect and/or adjust brakes after burnish cycle. Record if either operation is performed.

[1]Normally curb +600 lb for vehicles of four or more passengers.
[2]See Test Notes, Paragraph 5.1.3.

5.5 Emergency Brake System Test—This test can be run separately. It need not necessarily be run after paragraph 5.4. If run separately, brakes are to be burnished per paragraph 5.4.

Initial brake temperature—150 F before each stop.

Procedure—With one-half of system open to the atmosphere, determine the pedal force to cause failure warning system to operate. Determine the pedal force required to provide minimum stopping distance. The maximum pedal force must not exceed 200 lb. Stops are to be made in normal driving gear from 60 mph without leaving a 12 ft lane. Repeat the procedure with only the other half of the system open to the atmosphere.

Record—Pedal force required to actuate failure warning system, maximum pedal force, minimum deceleration, and stopping distance for each failure mode.

5.6 Inoperative Power System Test—This test can be run separately. It need not necessarily be run after paragraph 5.5. If run separately, brakes are to be burnished per paragraph 5.4.

Initial brake temperature—150 F.

Procedure—With primary source of power inoperative and its reserve depleted, determine the pedal force required to provide minimum stopping distance. The maximum pedal force must not exceed 200 lb. Stops are to be made in normal driving gear from 60 mph without leaving a 12 ft lane.

Record—Maximum pedal force, minimum deceleration, and stopping distance.

5.7 Second Effectiveness Test—Repeat paragraph 5.3, except add 80 mph stop speed.

5.8 Minimum Load Test—This test can be run as a separate test. It need not necessarily be run after paragraph 5.7. If run separately, brakes are to be burnished per paragraph 5.4.

If run after paragraph 5.7, a 35 stop reburnish per paragraph 5.4 is required.

Remove weights, and with driver and observer only (or equivalent total weight not to exceed 300 lb including instrumentation) conduct Effectiveness Test.

Initial brake temperature—200 F.

Stop speed—60 mph (full stops in neutral).

Increments—Curve to be defined to point of incipient skid by an adequate number of points.

Record—Deceleration and line pressure (pedal force) and method of brake application (that is, machine or manual). When using manual method, full stops to be defined by maximum line pressure (pedal force) and deceleration. Also note, at the appropriate stop, which wheel or wheels skidded.

5.9 High Speed Stop Test

Conduct at original test weight per paragraph 4.5.

Initial brake temperature—150 F.

Stops required—1.

Stop speed—As achieved by maximum obtainable accceleration for 1 mile from zero speed but not to exceed 100 mph.

Stop deceleration—15 fpsps in normal driving gear or maximum attainable at 200 lb pedal force.

Record—Maximum line pressure (pedal force) and deceleration (if 15 fpsps cannot be held).

5.10 First Reburnish—Repeat paragraph 5.4, except 35 stops required. Record line pressure (pedal force) and brake temperature for stops 1, 10, 25, and 35.

5.11 First Fade and Recovery Test

5.11.1 BASELINE CHECK STOPS

Initial brake temperature—150 F before each stop.

Stops required—3.

Stop speed—30-0 mph.

Stop deceleration—10 fpsps (in normal driving gear).

Record—Maximum line pressure (pedal force).

5.11.2 FADE

Initial brake temperature—150 F before first stop.

Stops required—10.

Stop speed—60-0 mph.

Stop deceleration—15 fpsps (in normal driving gear) or maximum obtainable at 200 lb pedal force (or equivalent line pressure).

Stop interval—0.4 mile.

Cooling speed—60 mph.

Acceleration to cooling speed—Immediate to maximum.

Record—Maximum line pressure (pedal force) and deceleration (if 15 fpsps cannot be held). Initial brake temperature before every stop, all brakes. Ambient air temperature at beginning of run. Total elapsed time from end of the first fade stop to end of the last fade stop—to

maintain a check on driver consistency and car performance.

NOTE: Drive 1 mile at 40 mph after last fade stop and make first recovery stop.

5.11.3 RECOVERY

Stops required—12 minimum.

Stop speed—30-0 mph.

Stop deceleration—10 fpsps (in normal driving gear), or maximum obtainable at 200 lb pedal force (or equivalent line pressure).

Stop interval—1 mile.

Cooling speed—40 mph.

Rate of acceleration to cooling speed—Moderate.

Record—Maximum line pressure (pedal force) and deceleration (if 10 fpsps cannot be held). Initial brake temperatures before every stop, all brakes.

5.12 First Effectiveness Spot Check

Initial brake temperature—200 F before each stop.

Stops required—2.

Stop speed—60-0 mph.

Stop deceleration—15 fpsps (in normal driving gear).

Record—Maximum line pressure (pedal force).

5.13 Second Reburnish—Repeat paragraph 5.10.

5.14 Second Fade and Recovery Test—Repeat paragraph 5.11, except 15 fade stops required.

5.15 Second Effectiveness Spot Check—Repeat paragraph 5.12.

5.16 Third Reburnish—Repeat paragraph 5.10.

5.17 Final Effectiveness Test—Repeat paragraph 5.7.

5.18 Final Inspection—Disassemble all brakes, inspect, and record all pertinent observations.

5.19 Water Recovery Test—This test can be run separately. It need not necessarily be run after paragraph 5.18. If run separately, brakes are to be burnished per paragraph 5.4.

5.19.1 BASELINE CHECK STOPS

Initial brake temperature—150 F before each stop.

Stops required—3.

Stop speed—25-0 mph.

Stop deceleration—8 fpsps (in normal driving gear).

Record—Maximum line pressure (pedal force) for each stop.

5.19.2 WETTING OF BRAKES

Wetting time—2 minutes minimum.

Wetting procedure—With the brakes fully released, wet all brakes thoroughly by slowly driving through a trough of suitable depth or equivalent method. Start recovery stops not more than 1 minute after wetting brakes. Dot not exceed 25 mph prior to recovery stops.

5.19.3 WATER RECOVERY STOPS

Stop speed—25-0 mph.

Speed between stops—25 mph.

Stop deceleration—8 fpsps (in normal driving gear) or maximum obtainable at 200 lb pedal force (or equivalent line pressure).

Stop interval—0.5 mile.

Stops required—15.

Record—Maximum line pressure (pedal force) for each stop and deceleration (if 8 fpsps cannot be held).

6. Report Forms and Graph Sheets

6.1 General Data and Summary Sheet, Fig. 2.

6.2 Initial Effectiveness, Emergency Brake, and Inoperative Power System Data Sheet, Fig. 3.

6.3 Second Effectiveness, Minimum Load, High Speed Stop, and First Fade Data Sheet, Fig. 4.

6.4 Second Fade and Recovery Data Sheet, Fig. 5.

6.5 Final Effectiveness and Water Recovery Data Sheet, Fig. 6.

6.6 Final Inspection Data Sheet, Fig. 7.

6.7 Sample of Layout of Effectiveness Test Graph Coordinates, Fig. 8.

6.8 Sample of Layout of Fade and Recovery Test Graph Coordinates, Fig. 9.

VEHICLE: MAKE _____ MODEL _____ YEAR _____
ENGINE _____ TRANSMISSION _____ AXLE _____
TEST WEIGHT, LB ____ + ____ BALLAST, DISTRIBUTION _____ LB FRONT _____ LB REAR
GENERAL DATA _____
BRAKES: FRONT SIZE _____ TYPE _____ W/CYL DIA _____
REAR SIZE _____ TYPE _____ W/CYL DIA _____
LININGS-FRONT _____ REAR _____
DRUM/ROTOR TYPE-FRONT _____ REAR _____
MASTER CYL DIA ____ PEDAL RATIO ____ POWER BRAKE: YES ____ NO ____ TYPE _____
TEST INFORMATION: SPECIAL EQUIPMENT _____
TESTED BY _____ LOCATION _____ DATE _____

TEST PHASE	REQUIREMENTS	TEST RESULTS	PASS	FAIL
PREBURNISH CHECK	10-55 LB PF	____ LB PF		
EFFECTIVENESS TESTS		1ST 2ND 3RD		
30 MPH AT 20 FPSPS	15-100 LB PF	____ ____ ____ LB PF		
60 MPH AT 20 FPSPS	15-120 LB PF	____ ____ ____ LB PF		
80 MPH AT 20 FPSPS	20-150 LB PF	____ ____ ____ LB PF		
EMERGENCY BRAKE TEST		TYPE: POWER MANUAL		
WARNING SYSTEM ACTUATION	30 (PWR) 50 (MAN) LB PF MAX	FRONT ____ REAR ____ LB PF		
60 MPH STOPPING DISTANCE	600 FT AND 200 LB PF MAX	FRONT ____ FT ____ LB PF		
		REAR ____ FT ____ LB PF		
INOPERATIVE POWER SYSTEM TEST				
60 MPH STOPPING DISTANCE	600 FT AND 200 LB PF	____ FT ____ LB PF		
MINIMUM LOAD TEST	18 FPSPS AND 120 LB PF	____ FPSPS ____ LB PF		
HIGH SPEED STOP TEST	15 FPSPS AND 200 LB PF	____ FPSPS ____ LB PF		
1ST FADE AND RECOVERY				
FADE STOPS 1-4	120, 147, 173, 200 LB PF	____, ____, ____, ____ LB PF		
RECOVERY STOPS 1-5	5 FPSPS BY 200 LB PF	____ FPSPS BY ____ LB PF		
RECOVERY STOPS 6-12	10 FPSPS, 150 LB PF MAX	____ FPSPS ____ LB PF MAX		
2ND FADE AND RECOVERY				
FADE STOPS 1-8	120, 132, 143, 155, 166, 177, 189, 200 LB PF	____, ____, ____, ____, ____, ____, ____, ____ LB PF		
RECOVERY STOPS 1-5	5 FPSPS BY 200 LB PF	FPSPS BY LB PF		
RECOVERY STOPS 6-12	10 FPSPS, 150 LB PF MAX	FPSPS LB PF MAX		
STABILITY DURING EFFECTIVENESS TESTS	REMAIN IN 12 FT LANE BELOW 20 FPSPS	CONTROLLED BRAKING: YES ____ NO ____		
FINAL INSPECTION				
LINING INTEGRITY	INTACT AND NO CRACKS	YES ____ NO ____		
MECHANICAL INTEGRITY	INTACT AND FUNCTIONAL	YES ____ NO ____		
HYDRAULIC INTEGRITY	LEAK FREE	YES ____ NO ____		
WATER RECOVERY TEST				
AVERAGE BASELINE PF		AVG BASELINE PF ____		
RECOVERY STOPS 4-6	8 FPSPS, 200 LB PF MAX	____ FPSPS ____ LB PF MAX		
RECOVERY STOPS 7-14	8 FPSPS, 100 LB PF MAX	____ FPSPS ____ LB PF MAX		
RECOVERY STOP 15	BASELINE PF ± 20 LB	____ LB PF FROM BASELINE		

COMMENTS: _____

REPORTED BY: _____ DATE: _____

FIG. 2—GENERAL DATA AND SUMMARY SHEET

VEHICLE _____
TESTED BY _____
DATE _____

INPUT CORRELATION
ENGINE IDLING IN NEUTRAL

PEDAL FORCE-PF	LINE PRESSURE-LP

BURNISH
40-0 MPH, 12 FPSPS IN GEAR
250 F IBT EACH STOP, 1 MILE INTERVAL MAX

STOP	PF-LP	IBT	COMMENTS
1			
20			
40			
60			
80			
100			
120			
140			
160			
180			
200			

PREBURNISH CHECK
30-0 MPH, 10 FPSPS IN GEAR, 1 MILE INTERVAL

STOP	PF-LP	COMMENTS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

EMERGENCY BRAKE SYSTEM
60-0 MPH IN GEAR
150 F IBT EACH APPLICATION

MODE	PF TO ACTUATE WARNING SYSTEM

MODE	PF-LP	FEET

1ST (PREBURNISH) EFFECTIVENESS
200 F IBT EACH APPLICATION

30 MPH IN NEUTRAL		60 MPH IN NEUTRAL	
PF-LP	FPSPS	PF-LP	FPSPS
SKID		SKID	

INOPERATIVE POWER SYSTEM
60-0 MPH IN GEAR
150 F IBT EACH APPLICATION

PF-LP	FEET	COMMENTS

GENERAL COMMENTS: _____

FIG. 3—INITIAL EFFECTIVENESS, EMERGENCY BRAKE, AND INOPERATIVE POWER SYSTEM DATA SHEET

VEHICLE _____
TESTED BY _____
DATE _____

2ND EFFECTIVENESS SPOTCHECK
60-0 MPH, 15 FPSPS IN GEAR, 200 F IBT

STOP	PF-LP	COMMENTS
1		
2		

WATER RECOVERY BASELINE CHECK
25-0 MPH, 8 FPSPS IN GEAR, 150 F IBT

STOP	PF-LP	COMMENTS
1		
2		
3		

3RD REBURNISH
40-0 MPH, 12 FPSPS IN GEAR
250 F IBT EACH STOP, 1 MILE INTERVAL MAX

STOP	PF-LP	IBT	COMMENTS
1			
10			
25			
35			

BRAKE WETTING
WETTING METHOD: _____
IF TROUGH: LENGTH _____ DEPTH _____
WETTING TIME _____ SEC (120 SEC MIN)

FINAL EFFECTIVENESS
200 F IBT EACH APPLICATION

30 MPH IN NEUTRAL		80 MPH IN NEUTRAL	
PF-LP	FPSPS	PF-LP	FPSPS
SKID			
60 MPH IN NEUTRAL			
PF-LP	FPSPS		
SKID		SKID	

WATER RECOVERY
25 MPH MAX AND 60 SEC MAX INTERVAL
AFTER WETTING
25-0 MPH, 8 FPSPS IN GEAR, 0.5 MILE INTERVAL

STOP	PF-LP	COMMENTS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

GENERAL COMMENTS: _____

FIG. 4—SECOND EFFECTIVENESS, MINIMUM LOAD, HIGH SPEED STOP, AND FIRST FADE DATA SHEET

VEHICLE _____
TESTED BY _____
DATE _____

2ND EFFECTIVENESS SPOTCHECK
60-0 MPH, 15 FPSPS IN GEAR, 200 F IBT

STOP	PF-LP	COMMENTS
1		
2		

WATER RECOVERY BASELINE CHECK
25-0 MPH, 8 FPSPS IN GEAR, 150 F IBT

STOP	PF-LP	COMMENTS
1		
2		
3		

3RD REBURNISH
40-0 MPH, 12 FPSPS IN GEAR
250 F IBT EACH STOP, 1 MILE INTERVAL MAX

STOP	PF-LP	IBT	COMMENTS
1			
10			
25			
35			

BRAKE WETTING
WETTING METHOD: _____
IF TROUGH: LENGTH _____ DEPTH _____
WETTING TIME _____ SEC (120 SEC MIN)

FINAL EFFECTIVENESS
200 F IBT EACH APPLICATION

30 MPH IN NEUTRAL		80 MPH IN NEUTRAL	
PF-LP	FPSPS	PF-LP	FPSPS
SKID			
60 MPH IN NEUTRAL			
PF-LP	FPSPS		
SKID		SKID	

WATER RECOVERY
25 MPH MAX AND 60 SEC MAX INTERVAL
AFTER WETTING
25-0 MPH, 8 FPSPS IN GEAR, 0.5 MILE INTERVAL

STOP	PF-LP	COMMENTS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

GENERAL COMMENTS: _____

FIG. 6—FINAL EFFECTIVENESS AND WATER RECOVERY DATA SHEET

VEHICLE _____
TESTED BY _____
DATE _____

1ST RECOVERY
30-0 MPH, 10 FPSPS IN GEAR
1 MILE INTERVAL AT 40 MPH

STOP	PF-LP	IBT-F	IBT-R	COMMENTS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

2ND FADE
60-0 MPH, 15 FPSPS IN GEAR
0.4 MILE INTERVAL, 150 F IBT 1ST STOP

AMBIENT ___ F TIME FOR 15 STOPS ___ SEC

STOP	PF-LP	IBT-F	IBT-R	COMMENTS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1ST EFFECTIVENESS SPOTCHECK
60-0 MPH, 15 FPSPS IN GEAR, 200 F IBT

STOP	PF-LP	COMMENTS
1		
2		

2ND REBURNISH
40-0 MPH, 12 FPSPS IN GEAR
250 F IBT EACH STOP, 1 MILE INTERVAL MAX

STOP	PF-LP	IBT	COMMENTS
1			
10			
25			
35			

2ND RECOVERY
30-0 MPH, 10 FPSPS IN GEAR
1 MILE INTERVAL AT 40 MPH

STOP	PF-LP	IBT-F	IBT-R	COMMENTS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

2ND BASELINE CHECK
30-0 MPH, 10 FPSPS IN GEAR, 150 F IBT

STOP	PF-LP	COMMENTS
1		
2		
3		

GENERAL COMMENTS: _____

FIG. 5—SECOND FADE AND RECOVERY DATA SHEET

VEHICLE _____
TESTED BY _____
DATE _____

FINAL INSPECTION

FRICTION MATERIAL CONDITION:
LF
RF
LR
RR

DRUM (OR ROTOR) CONDITION:
LF
RF
LR
RR

MECHANICAL COMPONENT CONDITION:
LF
RF
LR
RR

BRAKE PEDAL

POWER BRAKE

STOPLIGHTS

HYDRAULIC COMPONENT CONDITION:
LF
RF
LR
RR

MASTER CYLINDER

INSPECTION COMMENTS: _____

FIG. 7—FINAL INSPECTION DATA SHEET