Brake System Road Test Code – Passenger Car and Light-Duty Truck – SAE J843d

SAE Recommended Practice
Editorial Change March 1973

THIS IS A PREPRINT WHICH IS SUBJECT TO REVISIONS AND CORRECTIONS. THE FINAL VERSION WILL APPEAR IN THE 1983 EDITION OF THE SAE HANDBOOK.

SAE The Engineering Resource For Advancing Mobility

PREPRINT

BRAKE SYSTEM ROAD TEST CODE—PASSENGER CAR AND LIGHT-DUTY TRUCK—SAE J843d

SAE Recommended Practice

Report of Brake Committee approved January 1963 and last revised May 1971. Editorial change March 1973.

1. Scope—This SAE Recommended Practice establishes a uniform procedure for the level road test of the brake systems of new light-duty trucks and new multipurpose passenger vehicles[1] up to and including 6000 lb (2700 kg) gvw and all classes of new passenger cars.

2. Purpose—The purpose of the test code is to establish 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.

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 plug type thermocouple in each brake. See Fig. 1.

4.3 Brake Drum (or Rotor) and Hub Assembly—New drums (or rotors) recommended. 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. New linings are recommended on all brakes. Adjust brakes to manufacturer's specifications.

4.5 Vehicle Test Weight—Vehicle manufacturer's recommended axle test loading[2] shall be maintained throughout full test procedure except during the minimum load test (paragraph 5.8).

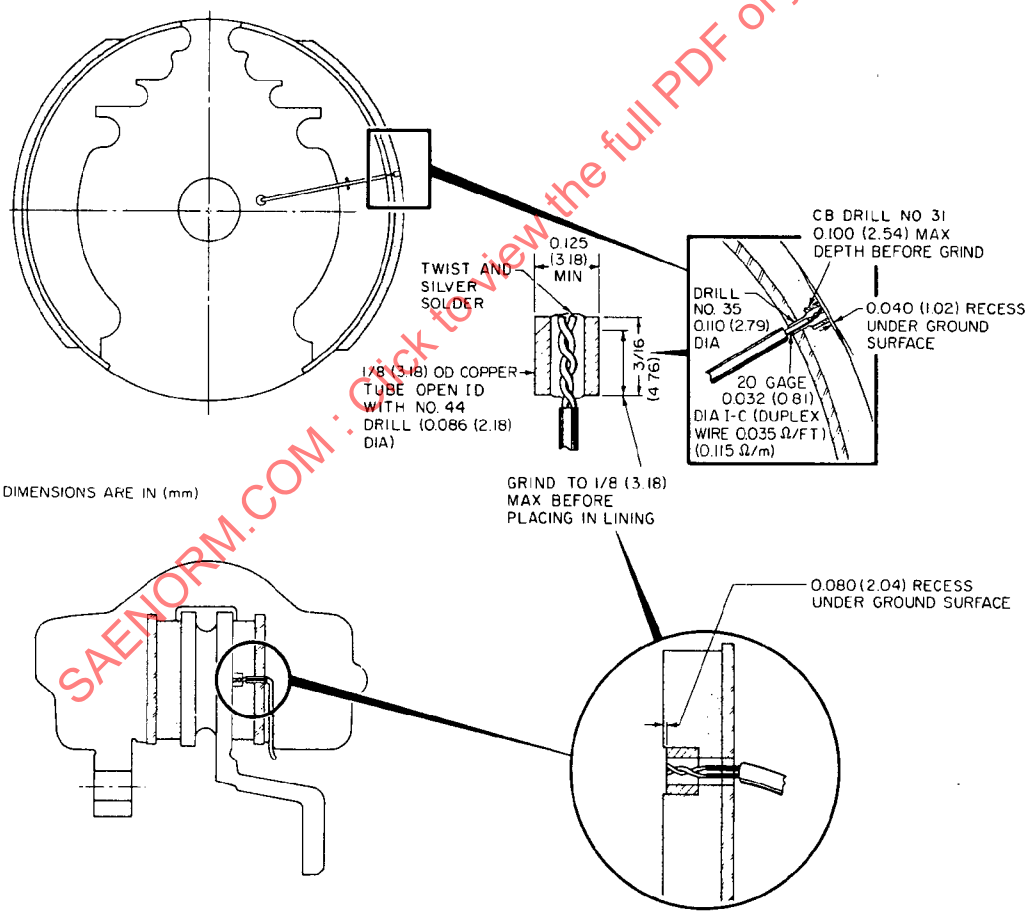


FIG. 1—TYPICAL PLUG THERMOCOUPLE INSTALLATIONS

[1]Multipurpose passenger vehicle means a motor vehicle with power, except a trailer, designed to carry 10 persons or less, which is constructed either on a truck chassis or with special features for occasional off-road operations.

[2]For light truck—Manufacturer's gvw rating not to be exceeded.
For passenger car—Normally curb weight + 600 lb (270 kg) for vehicles of four or more passengers.

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, hardsurfaced 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 (3.7 km) wide roadway lane.

5.1.3 "Initial brake temperature" is defined as 0.2 mile (0.3 km) 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 (4.4–32.2 C).

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 (8 km/h).

GENERAL DATA AND SUMMARY SHEET

VEHICLE: MAKE _____ MODEL _____ YEAR _____
ENGINE _____ TRANSMISSION _____ AXLE _____
WEIGHT ____ LB (kg) FRONT WEIGHT - ____ LB (kg) REAR WEIGHT - ____ LB (kg) BALLAST ____ LB (kg) TEST WEIGHT
EMPTY WEIGHT _____ GENERAL DATA _____
TIRE SIZE: FRONT _____ REAR _____ MAKE FRONT _____ REAR _____
MANUFACTURER'S DESIGNATION: FRONT _____ REAR _____

BRAKES: FRONT-SIZE _____ TYPE _____ CYL DIA _____
REAR-SIZE _____ TYPE _____ CYL DIA _____
LINING-FRONT _____ REAR _____
DRUM (ROTOR) TYPE - FRONT _____ REAR _____
MASTER CYL DIA _____ PEDAL RATIO _____ POWER BRAKE: YES ___ NO ___ TYPE _____
TEST INFORMATION: THERMOCOUPLE INSTALLATION METHOD
SPECIAL EQUIPMENT _____
TESTED BY _____ LOCATION _____ DATE _____

TEST PHASE	TEST RESULTS
PREBURNISH CHECK	LB PF
EFFECTIVENESS TESTS 60 MPH (96 km/h) AT ____ FT/S² (m/s²) 60 MPH (96 km/h) AT ____ FT/S² (m/s²) 80 MPH (129 km/h) AT ____ FT/S² (m/s²)	1ST 2ND RD ____ ____ ____ LB (N) PF ____ ____ ____ LB (N) PF ____ ____ ____ LB (N) PF
EMERGENCY BRAKE TEST WARNING SYSTEM ACTUATION 60 MPH (97 km/h) STOPPING DISTANCE	TYPE: POWER MANUAL FRT ____ RR ____ LB (N) PF FRT ____ FT (m) ____ LB (N) PF RR ____ FT (m) ____ LB (N) PF
INOPERATIVE POWER ASSIST SYSTEM TEST 60 MPH (97 km/h) STOPPING DISTANCE	____ FT (m) ____ LB (N) PF
MINIMUM LOAD TEST HIGH SPEED STOP TEST	____ FT/S² (m/s²) ____ LB (N) PF ____ FT/S² (m/s²) ____ LB (N) PF
FIRST FADE AND RECOVERY TEST FADE STOPS 1-4 RECOVERY STOPS 1-5 RECOVERY STOPS 6-12	____, ____, ____, ____ LB (N) ____ FT/S² (m/s²) BY ____ LB (N) ____ LB (N) PF MAX
SECOND FADE AND RECOVERY TEST FADE STOPS 1-8 RECOVERY STOPS 1-5 RECOVERY STOPS 6-12	____, ____, ____, ____, ____, ____, ____, ____ LB (N) PF ____ FT/S² (m/s²) BY ____ LB (N) ____ LB (N) PF MAX
STABILITY DURING EFFECTIVENESS TESTS	CONTROLLABLE BRAKING BELOW ____ FT/S² (m/s²): YES ____ NO ____
FINAL INSPECTION LINING INTEGRITY MECHANICAL INTEGRITY HYDRAULIC INTEGRITY	YES ____ NO ____ YES ____ NO ____ YES ____ NO ____
WATER RECOVERY TEST AVERAGE BASELINE PF RECOVERY STOPS 4-6 RECOVERY STOPS 7-14 RECOVERY STOP 15	AVG BASE ____ LB (N) PF ____ LB (N) PF MAX ____ LB (N) PF MAX ____ LB (N) PF FROM BASE

COMMENTS _____

REPORTED BY _____ DATE _____

FIG. 2–GENERAL DATA AND SUMMARY SHEET

5.1.8 On vehicles with manual transmissions, disengage clutch below 10 mph (16 km/h).

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 (48–0 km/h), 10 ft/s² (3 m/s²), 1 mile (1.6 km) interval, 40 mph (64 km/h) 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 (93.3 C) before each application.

Stop speed—30 and 60 mph (48 and 97 km/h) (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 shall be defined by maximum line pressure (pedal force) and minimum deceleration. Also note, at the appropriate stop, which wheel or wheels skidded.

5.4 Burnish

Stop speed—40–0 mph (64–0 km/h).

Stop deceleration—12 ft/s² (3.7 m/s²) (in normal driving gear).

Stop interval—As required to achieve 250 F (121 C) "initial brake temperature"[3] or a maximum of 1 mile (1.6 km). NOTE: The 1 mile (1.6 km) maximum must be observed even though the initial temperature exceeds 250 F (121 C).

[3] See Test Notes, paragraph 5.1.3.

VEHICLE _____
TESTED BY _____
DATE _____

INITIAL EFFECTIVENESS, EMERGENCY BRAKE, AND INOPERATIVE POWER SYSTEM DATA

INPUT CORRELATION
ENGINE IDLING IN NEUTRAL

PEDAL FORCE - PF, LB (N)	LINE PRESSURE - LP PSI (N/m²)

BURNISH
- MPH (64- km/h), 12 FT S² (m/s²) IN GEAR,
- F (121 C) IBT EACH STOP BUT 1 MILE (1.6 km) MAX INTERVAL

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

PREBURNISH CHECK
- MPH (64- km/h) TO FT S² (m/s²) IN GEAR,
1 MILE (1.6 km) INTERVAL

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

EMERGENCY BRAKE SYSTEM
- MPH (km/h) IN GEAR
- F (- C) IBT EACH APPLICATION

MODE	PF TO ACTUATE WARNING SYSTEM

MODE	PF--LP	FT (m)

FIRST (PREBURNISH) EFFECTIVENESS
- F (- C) IBT EACH APPLICATION

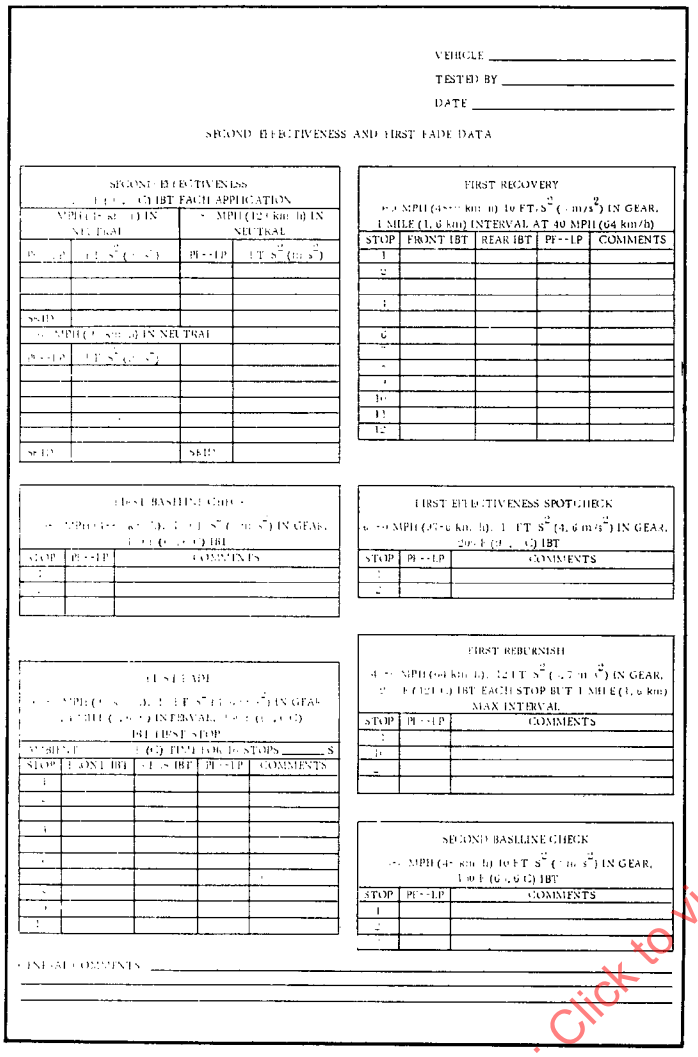
9 MPH (4- km/h) IN NEUTRAL		60 MPH (km/h) IN NEUTRAL	
PF--LP	FT S² (m s²)	PF--LP	FT S² (m s²)
SKID		SKID	

INOPERATIVE POWER SYSTEM
- MPH (km/h) IN GEAR
- F (- C) IBT EACH APPLICATION

PF--LP	FT (m)	COMMENTS

GENERAL COMMENTS: _____

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



VEHICLE _____

TESTED BY _____

DATE _____

SECOND EFFECTIVENESS AND FIRST FADE DATA

SECOND EFFECTIVENESS
[illegible] IBT EACH APPLICATION

[illegible] MPH ([illegible] km/h) IN NEUTRAL		[illegible] MPH (129 km/h) IN NEUTRAL	
PF--LP	[illegible] FT/S^2 ([illegible] m/s^2)	PF--LP	[illegible] FT/S^2 ([illegible] m/s^2)
SKID		SKID	
[illegible] MPH ([illegible] km/h) IN NEUTRAL			
PF--LP	[illegible] FT/S^2 ([illegible] m/s^2)		
SKID			

FIRST RECOVERY
[illegible] MPH ([illegible] km/h) TO [illegible] FT/S^2 ([illegible] m/s^2) IN GEAR,
1 MILE (1.6 km) INTERVAL AT 40 MPH (64 km/h)

STOP	FRONT IBT	REAR IBT	PF--LP	COMMENTS
1				
2				
[illegible]				
6				
[illegible]				
10				
11				
12				

FIRST BASELINE CHECK
[illegible] MPH ([illegible] km/h), [illegible] FT/S^2 ([illegible] m/s^2) IN GEAR,
[illegible] F ([illegible] C) IBT

STOP	PF--LP	COMMENTS
[illegible]		
[illegible]		

FIRST EFFECTIVENESS SPOTCHECK
[illegible] MPH ([illegible] km/h), 1 FT/S^2 (3.6 m/s^2) IN GEAR,
200 F (93.3 C) IBT

STOP	PF--LP	COMMENTS
[illegible]		
[illegible]		

FIRST FADE
[illegible] MPH ([illegible] km/h), [illegible] FT/S^2 ([illegible] m/s^2) IN GEAR,
[illegible] MPH ([illegible] km/h) INTERVAL, [illegible] F ([illegible] C)
IBT FIRST STOP

AMBIENT ____ F (C) TIME FOR 15 STOPS ____ S

STOP	FRONT IBT	REAR IBT	PF--LP	COMMENTS
1				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				

FIRST REBURNISH
[illegible] MPH (64 km/h), [illegible] FT/S^2 ([illegible] m/s^2) IN GEAR,
[illegible] F (121 C) IBT EACH STOP BUT 1 MILE (1.6 km)
MAX INTERVAL

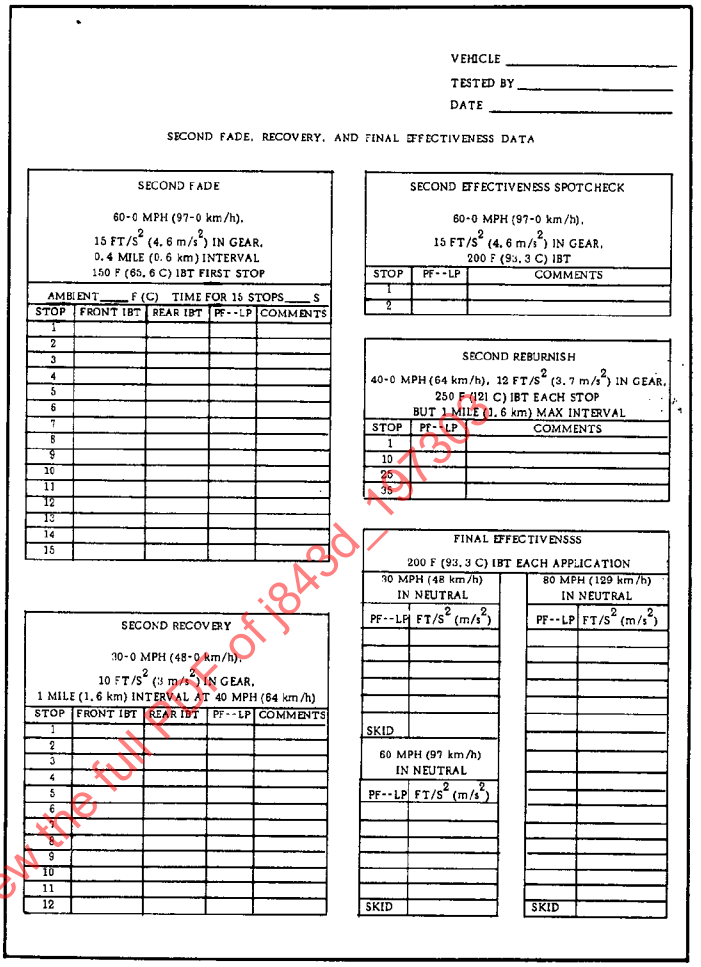
STOP	PF--LP	COMMENTS
[illegible]		
[illegible]		
[illegible]		

SECOND BASELINE CHECK
[illegible] MPH ([illegible] km/h) TO [illegible] FT/S^2 ([illegible] m/s^2) IN GEAR,
[illegible] F ([illegible] C) IBT

STOP	PF--LP	COMMENTS
1		
[illegible]		
[illegible]		

FINAL COMMENTS _____

FIG. 4—SECOND EFFECTIVENESS AND FIRST FADE DATA SHEET



VEHICLE _____

TESTED BY _____

DATE _____

SECOND FADE, RECOVERY, AND FINAL EFFECTIVENESS DATA

SECOND FADE

60-0 MPH (97-0 km/h),
15 FT/S^2 (4.6 m/s^2) IN GEAR,
0.4 MILE (0.6 km) INTERVAL
150 F (65.6 C) IBT FIRST STOP

AMBIENT ____ F (C) TIME FOR 15 STOPS ____ S

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

SECOND RECOVERY

30-0 MPH (48-0 km/h),
10 FT/S^2 (3 m/s^2) IN GEAR,
1 MILE (1.6 km) INTERVAL AT 40 MPH (64 km/h)

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

SECOND EFFECTIVENESS SPOTCHECK

60-0 MPH (97-0 km/h),
15 FT/S^2 (4.6 m/s^2) IN GEAR,
200 F (93.3 C) IBT

STOP	PF--LP	COMMENTS
1		
2		

SECOND REBURNISH

40-0 MPH (64 km/h), 12 FT/S^2 (3.7 m/s^2) IN GEAR,
250 F (121 C) IBT EACH STOP
BUT 1 MILE (1.6 km) MAX INTERVAL

STOP	PF--LP	COMMENTS
1		
10		
25		
35		

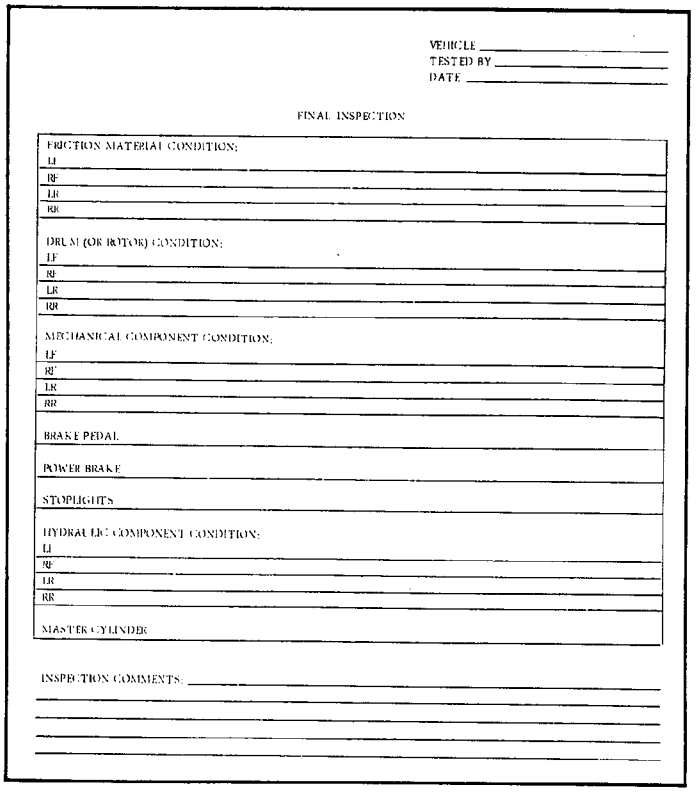
FINAL EFFECTIVENSSS

200 F (93.3 C) IBT EACH APPLICATION

30 MPH (48 km/h) IN NEUTRAL		80 MPH (129 km/h) IN NEUTRAL	
PF--LP	FT/S^2 (m/s^2)	PF--LP	FT/S^2 (m/s^2)
SKID		SKID	

60 MPH (97 km/h) IN NEUTRAL	
PF--LP	FT/S^2 (m/s^2)
SKID	

FIG. 5—SECOND FADE, RECOVERY AND FINAL EFFECTIVENESS 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. 6—FINAL INSPECTION DATA SHEET

Cooling speed—40 mph (64 km/h) (moderate acceleration to cooling speed).

Stops required—200.

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

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 (65.6 C) 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 (890 N). Steps are to be made in normal driving gear from 60 mph (97 km8h) without leaving a 12 ft (3.7 m) 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 Assist 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 (65.6 C).

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 (890 N). Stops are to be made in normal driving gear from 60 mph (97 km/h) without leaving a 12 ft (3.7 m) lane.

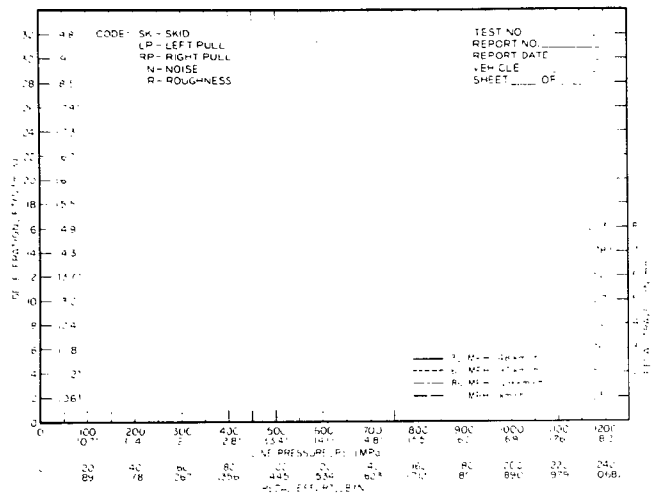


FIG. 7—SAMPLE OF LAYOUT OF EFFECTIVENESS TEST GRAPH COORDINATES

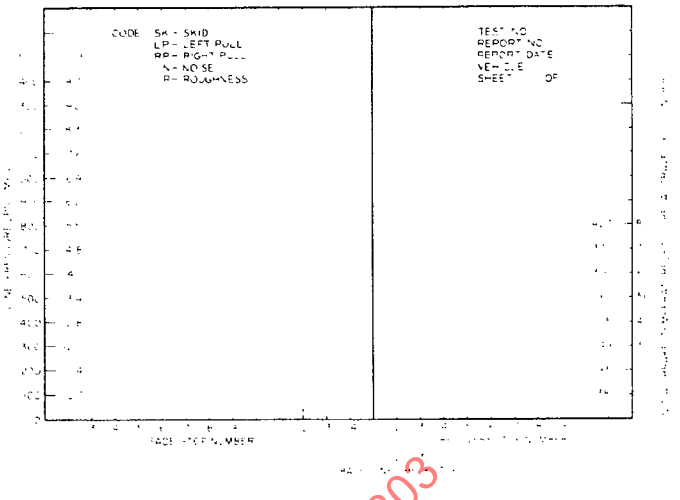


FIG. 8—SAMPLE OF LAYOUT OF FADE AND RECOVERY TEST GRAPH COORDINATES

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

5.7 Second Effectiveness Test—Repeat paragraph 5.3, except add 80 mph stop speed or maximum vehicle speed as achieved by maximum acceleration for 1 mile (1.6 km) from zero speed if 80 mph (129 km/h) is not attainable. Record stop speed attained.

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 curb weight plus 300 lb (140 kg) maximum, conduct Effectiveness Test.

Initial brake temperature—200 F (93.3 C).

Stop speed—60 mph (97 km/h) (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 minimum deceleration. Also note, at the appropriate stop, which wheel or wheels skidded.

5.9 High Speed Stop Test—This test can be run as a separate test. It need not necessarily be run after paragraph 5.8. If run separately, brakes are to be burnished per paragraph 5.4.

Conduct at original test weight per paragraph 4.5.

Initial brake temperature—150 F (65.6 C).

Stops required—1.

Stop speed—As achieved by maximum obtainable acceleration for 1 mile (1.6 km) from zero speed but not to exceed 100 mph (161 km/h).

Stop deceleration—15 ft/s^2 (4.6 m/s^2) in normal driving gear or maximum attainable at 200 lb (890 N) pedal force.

Record—Stop speed, maximum line pressure (pedal force), and deceleration (if 15 ft/s^2 (4.6 m/s^2) cannot be held).

5.10 First Reburnish—Repeat paragraph 5.4, except 35 stops required.

5.11 First Fade and Recovery Test

5.11.1 Baseline Check Stops

Initial brake temperature—150 F (65.6 C) before each stop.

Stops required—3.

Stop speed—30–0 mph (48–0 km/h).

Stop deceleration—10 ft/s^2 (3 m/s^2) (in normal driving gear).

Record—Maximum line pressure (pedal force).

5.11.2 Fade

Initial brake temperature—150 F (65.6 C) before first stop.

Stops required—10.

Stop speed—60–0 mph (97–0 km/h).

Stop deceleration—15 ft/s^2 (4.6 m/s^2) (in normal driving gear) or maximum obtainable at 200 lb (890 N) pedal force (or equivalent line pressure).

Stop interval—0.4 mile (0.6 km).

Cooling speed—60 mph (97 km/h).

Acceleration to cooling speed—Immediate to maximum.

Record—Maximum line pressure (pedal force) and deceleration (if 15 ft/s^2 (4.6 m/s^2) 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 (1.6 km) at 40 mph (64 km/h) after last fade stop and make first recovery stop.

5.11.3 Recovery

Stops required—12 minimum.

Stop speed—30–0 mph (48–0 km/h).

Stop deceleration—10 ft/s^2 (3 m/s^2) (in normal driving gear), or maximum obtainable at 200 lb (890 N) pedal force (or equivalent line pressure).

Stop interval—1 mile (1.6 km).

Cooling speed—40 mph (64 km/h).

Rate of acceleration to cooling speed—Moderate.

Record—Maximum line pressure (pedal force) and deceleration (if 10 ft/s^2 (3 m/s^2) cannot be held). Initial brake temperatures before every stop, all brakes.

5.12 First Effectiveness Spot Check

Initial brake temperature—200 F (93.3 C) before each stop.

Stops required—2.

Stop speed—60–0 mph (97–0 km/h).

Stop deceleration—15 ft/s^2 (4.6 m/s^2) (in normal driving gear).

5.13 Second Reburnish—Repeat paragraph 5.4, except 35 stops required.

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 5.13.

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 (65.6 C) before each stop.

Stops required—3.

Stop speed—25–0 mph (40–0 km/h).

Stop deceleration—8 ft/s^2 (2.4 m/s^2) (in normal driving gear).

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

5.19.2 Wetting of Brakes

Wetting time—2 min 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 min after wetting brakes. Do not exceed 25 mph (40 km/h) prior to recovery stops.

5.19.3 Water Recovery Stops

Stop speed—25–0 mph (40–0 km/h).

Speed between stops—25 mph (40 km/h).

Stop deceleration—8 ft/s^2 (2.4 m/s^2) (in normal driving gear) or max-