5.14 Third Measurement—Obtain complete lining and drum or rotor measurements, minimizing the disturbance of dust accumulation.

5.15 Water Recovery Test

5.15.1 Check Stops (dry brakes)—Make three stops from 20 mph (32 km/h) at a constant 10 ft/s² (3 m/s²). Record initial and final pedal force or application pressures for each stop. All brakes must be 150 F (65.6 C) initial temperature, or less, prior to these stops.

5.15.2 Wet brakes thoroughly for 2 min. Brakes must be released during wetting.

5.15.3 Start recovery stops not more than 1 min after wetting brakes.

5.15.4 Make 15 stops from 20 mph (32 km/h) at ¼ mile (0.4 km) intervals and at a constant 10 ft/s² (3 m/s²). Record both initial and final application pressures or pedal forces for each stop. If 10 ft/s² (3 m/s²) cannot be attained, record deceleration and application pressures or pedal force.

6. Report Forms

General Data Sheet, Fig. 2.

Performance Summary Sheet No. 2, Fig. 3.

Wear Summary Sheet, Fig. 4.

Preparation and Measurement Data for Drum Brakes Summary Sheet, Fig. 5.

Preparation and Measurement Data for Disc Brakes Summary Sheet, Fig. 6.

Preburnish Check Summary Sheet, Fig. 7.

Effectiveness Test Summary Sheet, Fig. 8.

Burnish Summary Sheet, Fig. 9.

Emergency System Effectiveness Summary Sheet, Fig. 10.

Brake Effectiveness Distribution for Vehicle in Combination, Fig. 11.

Fade Test Summary Sheet, Fig. 12.

Recovery Test Summary Sheet, Fig. 13.

Operational Test (Routine), Fig. 14.

Water Recovery Test Summary Sheet, Fig. 15.

BRAKE SYSTEM RATING TEST CODE—COMMERCIAL VEHICLES—SAE J880 MAR85

SAE Recommended Practice

Report of the Brake Committee, approved November 1963, complete revised February 1980, editorial change May 1980, reaffirmed without change March 1985.

1. Purpose—The purpose of this code is to provide a method for determining a brake system rating for new commercial highway vehicles, based on the energy absorption and dissipation capacity of the brake system as established by a repeated test procedure. For performance requirements, refer to SAE J257 (May, 1972).

ed.

2. Scope—This code is intended for vehicles with brake systems having typical service pressure ranges 0–1800 psi (0–12.4 MPa) hydraulic or 0–120 psi (0–830 kPa) air and is not directly applicable to vehicles with other systems.

2.1 The code provides test procedures and instructions for:

2.1.1 Instrumentation and equipment.

2.1.2 Vehicle preparation.

2.1.3 Determining brake system energy absorption capacity.

2.1.4 Calculation of brake rating.

2.2 The code includes provision for those single unit, combination, and special vehicles which cannot be loaded to the manufacturer's gross vehicle weight rating, or cannot be accelerated in the time interval required, or cannot attain the specified 50 mph (80.5 km/h) speed.

2.3 Methods for measuring energy absorption capacity, other than described herein, may be equally valid.

3. Instrumentation and Equipment—Each vehicle to be checked must be equipped with:

3.1 A *U* tube decelerometer or equivalent.

3.2 A fifth wheel speed indicator or calibrated speedometer or tachometer.

3.3 A detonator and 50 ft (15.2 m) tape or equivalent to measure stopping distance.

3.4 A calibrated line pressure gage.

3.5 A stop watch or timing device.

3.6 A brake thermocouple selector switch and a 0–1000°F (−18–540°C) direct reading pyrometer. Brake temperature measurement equipment and thermocouple installation to conform to SAE J843d (March, 1973), except the plug type thermocouple shall be recessed 0.040 ± 0.005 in (1.02 ± 0.13 mm).

ed.

3.7 Provision for reservoir pressure control to limit service line pressure to maximum permitted.

3.8 Shutoff valve to permit cutoff of front and/or rear brakes if brake balance (Section 6) or individual axle brake rating (paragraph 8.3) tests are to be run.

4. Vehicle Information and Data

4.1 Vehicle Information Sheet (Fig. 1) to be filled in prior to starting test.

4.2 Brake Rating Test Data Sheet (Fig. 2) for use during the tests. It should be noted that the maximum individual brake temperatures are not to be used as criteria for brake rating. The measurement of brake temperatures as an index of brake condition during the test is necessary to provide test control and aid in analyzing test results.

4.3 Work Sheet—Correction Factors (Fig. 3) to be filled out and used as required per paragraph 8.2.

5. Vehicle Condition—To rate the brake system properly, the vehicle should:

5.1 Be loaded to GVWR except as provided for in paragraph 8.3. The weight must be distributed as closely as possible to load each axle to its rated load GAWR. The center of gravity should be kept as low as possible. This can be accomplished by the proper selection of chassis, wheelbase, and type of weight used.

5.2 Be equipped with the largest production engine available for the chassis being tested.

Note: If sufficient engine horsepower is not available to obtain some evidence of brake fade, then vehicle weight or deceleration rate correction must be made in accordance with paragraph 8.2.

5.3 Have new or relatively new tires inflated to the cold pressures specified for maximum tire load rating.

5.4 Have sufficient brake balance to obtain not less than 12 ft/s²

SAE TITLE*VOL*4 ** 8357340 0047726 1

VEHICLE INFORMATION SHEET

Test No. _____ Required BRHP (Watts) _____ Test BRHP (Watts) _____
Test Facility and Location _____
Vehicle Make and Model _____
Estimated Center of Gravity of Body and Test Load Above Ground _____
Weight Distribution: Front Axle _____ Rear Axle(s) _____ Total _____
Trailer Axle(s) _____
Gross Total _____
Special Conditions Which Might Affect Brake Performance _____
_____
Are Backing Plates or Dustshields Installed? Front _____ Rear _____ Trailer _____

Tire Size: Front _____ Measured Static Rolling Radius: Front _____
Rear _____ Rear _____
Trailer _____ Trailer _____

Type of Wheels: Front _____ Rear _____ Trailer _____
(Cast Steel Spoke, Steel Disc, Alum., Disc, etc.)

Type of Rim: Front _____ Rear _____ Trailer _____
(Flat Base, Drop Center, etc.)

Brake Drum:	Weight	Type	Make	Part No.
Front				
Rear-Forward				
Rear-Brake				
Trailer				

Brakes:	Size	Make	Type	Lining	Assy. No.
Front					
Rear-Forward					
Rear-Rear					
Trailer					

Actuation Details: (Fill Out per Headings for Either Hydraulic or Air Brakes)

If Hydraulic:	Vacuum Booster or Air Chamber Type and Size	Pedal Ratio and Usable Travel	Master Cylinder Dia and Stroke	Wheel Cylinder Dia(s)

If Air:	Air Chamber Type and Size	Slack Adj. Length or Wedge Angle	Cam Radius	Cam Rotation (With or Opp. Drum)
Front				
Rear-Forward				
Rear-Rear				
Trailer				

	Front	Rear-Forward	Rear-Rear	Trailer
Adjustment: (Automatic)				
(Manual)				
Actuator Stroke at 80 psi (552 kPa) (L/R)				

FIG. 1—VEHICLE INFORMATION SHEET

BRAKE RATING TEST DATA SHEET

Test No. _____ Data Sheet No. _____ of _____ Date _____

No. of Snubs _____ BRHP (Watts) _____ Passed _____ Did not Pass _____

NOTE: Starting Temperature (Hottest Brake) Must be 150–200°F (66–93°C) for Conditioning, Cold Stop(s), Drift Time, Rating Test, and Cooled Stop

Drift Time, s: (1) _____ (2) _____ (3) _____

Cold Stop(s) 20 mph (32.2 km/h)	Start Temp. °F (°C)	Max. Line Pressure psig (MPa)	Max. Decel. ft/s² (m/s²)	Stop Dist. ft (m)	Wheels Locked or Cycled	Pedal or Actuator Stroke, in (m)					
						L/F	R/F	LR-F	RR-F	LR-R	RR-R
First											
(Second)											
(Third)											

Rating Test Initial Speed, mph (km/h) _____ Final Speed, mph (km/h) _____ Cycle Time, s _____

Deceleration, ft/s² (m/s²): Initial _____ Minimum Limit _____

Snub	Brake Apply Time	Press. psig (MPa)	Decel. ft/s² (m/s²)	Temperature, °F (°C)						Snub	Brake Apply Time	Press. psig (MPa)	Decel. ft/s² (m/s²)	Temperature, °F (°C)					
1										16									
2										17									
3										18									
4										19									
5										20									
6										21									
7										22									
8										23									
9										24									
10										25									
11										26									
12										27									
13										28									
14										29									
15										30									

Hot Stop(s) 20 mph (32.2 km/h)	Start Temp. °F (°C)	Max. Line Pressure psig (MPa)	Max. Decel. ft/s² (m/s²)	Stop Dist. ft (m)	Wheels Locked or Cycled	Pedal or Actuator Stroke, in (m)					
						L/F	R/F	LR-F	RR-F	LR-F	RR-R

Stability: Cold Stop _____ Rating Test _____ Hot Stop _____ Cooled Stop _____

—Satisfactory (S) or Unsatisfactory (U)—

Remarks (All Deviations from the Standard or Special Procedures, Including Burnish, Must be Noted.) _____

Test Summary	(S)	(U)
Cold Stop		
Rating Test		
Hot Stop		
Stability		
Final Inspect.		

Time _____ m Ambient Temp. _____ °F (°C) Road Condition _____

Location _____

Driver _____ Data Recorder _____

FIG. 2—BRAKE RATING TEST DATA SHEET

SAE TITLE*VOL*4 ** 8357340 0047728 5

WORK SHEET--CORRECTION FACTORS
FOR LOADS OTHER THAN THE RATED CAPACITY OF THE AXLE(S) OR VEHICLE(S)

Vehicle: Truck _____ Tractor _____ Full Trailer _____ Semi-Trailer _____

Make _____ Model _____

Calculated by _____ Date _____

Velocity Correction (for Burnish and Rating Test)

Y = _____ Braking Percentage on the Test Axle(s) or Vehicle(s) (From Brake Balance Test).

V_1 = _____ Standard Velocity from Which Retardation Starts When Operated at GVWR, mph (km/h).

V_2 = _____ Standard Velocity at Which Brakes are Released, mph (km/h).

W = _____ GVWR of the Vehicle on Test (Trucks, Tractors, and Full Trailers), lb (kg).

W_1 = _____ Rated Load of the Test Axle(s) (Semi-Trailers), lb (kg).

W_2 = _____ Total Weight being Retarded by the Brakes on the Test Axle(s), lb (kg).

V_3 Corrected Test Velocity Trucks, Tractors, and Full Trailers

$$= \sqrt{\frac{Y}{100} \times \left(V_1^2 - V_2^2\right) \times \frac{W}{W_2} + V_2^2} = \_\_\_\_\_ \text{mph (km/h)}$$

V_3 Corrected Test Velocity Semi-Trailers

$$= \sqrt{\left(V_1^2 - V_2^2\right) \times \frac{W_1}{W_2} + V_2^2} = \_\_\_\_\_ \text{mph (km/h)}$$

Deceleration Correction (for Burnish and Rating Test)

d = Standard Deceleration = 10 Burnish | 12 9 Rating | ft/s^2 (m/s^2)

d_1 Corrected Deceleration Trucks, Tractors, and Full Trailers

$$= \frac{Y}{100} \times \frac{(V_1 \times d)}{V_3} \times \frac{W}{W_2}$$ = _____ ft/s^2 (m/s^2)

d_1 Corrected Deceleration Semi-Trailers

$$= \frac{(V_1 \times d)}{V_3} \times \frac{W_1}{W_2}$$ = _____ ft/s^2 (m/s^2)

Standard Stopping Distance Correction

		Cold ft (m)	Hot ft (m)
S	Maximum Standard Stopping Distance =		
S_1	Corrected Maximum Standard Stopping Distance--Trucks, Tractors, and Full Trailers $= \frac{100}{Y} \times \frac{W_2}{W} \times S$ =	ft (m)	ft (m)
S_1	Corrected Maximum Standard Stopping Distance--Semi-Trailers $= \frac{W_2}{W_1} \times S$ =	ft (m)	ft (m)

FIG. 3—WORK SHEET—CORRECTION FACTORS (FOR LOADS) OTHER THAN RATED CAPACITY OF AXLE(S) OR VEHICLE(S)

(3.7 m/s²) steady state deceleration without locking any wheel or causing any wheel slip brake control system to cycle. (Brakes are to be adjusted to manufacturer's specifications.)

5.5 All vehicles are to be equipped with unmodified brake actuation systems (pressure proportioning valves, metering valves, and wheel slip brake control systems are to be functional as installed in production vehicle) except for test equipment specified in paragraphs 3.7 and 3.8.

5.6 Be equipped with new unburnished production linings which shall then be burnished as follows:

5.6.1 FOR VEHICLES 10 000 lb (4500 kg) GVWR AND UNDER—Make 200 brake applications at 40–20 mph (64.4–32.2 km/h) at 10 ft/s² (3.1 m/s²) except the 10th snub and every 10th snub thereafter (10th, 20th, 30th, etc.) shall be from 50–15 mph (80.5–24.1 km/h) at 12 ft/s² (3.7m/s²). All snubs shall be made at 1 mile (1.6 km) intervals (transmission in neutral or clutch disengaged). The vehicle shall be driven at 40 mph (64.4 km/h) between brake applications. Directly following the 200th application, make 10 applications from 50–15 mph (80.5–24.1 km/h) at 12 ft/s² (3.7m/s²) at 2 min intervals.

5.6.2 FOR VEHICLES OVER 10 000 lb (4500 kg) GVWR—Make brake applications (transmission in neutral or clutch disengaged) in accordance with Table 1. When, during any series, the hottest brake reaches 500°F (260°C), continue at that snub condition for an accumulated total 500 burnish snubs, except that a higher or lower energy snub condition shall be followed when necessary to maintain a temperature of 500 ±50°F (260 ± 10°C). If, after series 6, the 500°F (260°C) brake temperature is not reached, continue at this series until an accumulated total of 500 burnish snubs is performed. Record temperature immediately following each snub.

Use velocity and deceleration corrections when required for axle-by-axle or vehicle-by-vehicle tests of combinations. Drive as nearly as possible at the uncorrected indicated velocity between snubs, drifting to the proper corrected velocity before each snub.

6. Brake Balance Test—This test is optional, and must be run prior to the start of the rating procedure when axle-by-axle or vehicle-by-vehicle ratings are to be combined in accordance with paragraph 8.3. In addition, this procedure may be used optionally to provide useful information concerning the distribution of total braking effort among axles and/or vehicles. Such information can be of great use in adjusting brake inputs to achieve a desired proportioning of braking effectiveness among the axle and/or vehicle; but, no changes in the brakes or actuation system may be made at this point to improve brake balance unless new linings are installed and burnished before going to the rating procedure (Section 7). The Brake System Torque Balance Test Code—Commercial Vehicles—SAE J225 (January, 1971) is to be followed to determine brake balance.

7. Rating Procedure

7.1 General

7.1.1 It is recommended that brakes be re-adjusted to the manufacturer's specifications after burnish.

7.1.2 A series of three rating tests must be run before a rating can be established. The first two tests are run at reduced energy input levels to condition the lining material and to familiarize the driver and observer with the test procedure prior to the qualifying test(s).

7.1.3 Starting temperature (hottest brake) must be 150–200°F (66–93°C) for conditioning prior to drift time, cold stop(s), rating tests, and cooled stop. It is recommended that the depth of the thermocouple recess be maintained at 0.040 ± 0.005 in (1.02 ± 0.13 mm) prior to each test.

7.1.4 All brake applications in the following Test Sequence shall be made with the transmission in neutral or the clutch disengaged.

7.1.5 Record all data on Brake Rating Test Data Sheet (Fig. 2).

7.2 Test Sequence

7.2.1 TEMPERATURE CONDITIONING—Whenever temperature conditioning of the vehicle is required (for example; prior to the first test of the day), it shall consist of a series of snubs from 50–15 mph (80.5–24.1 km/h) at 12 ft/s² (3.7 m/s²) at 2 mile (3.2 km) intervals (using corrected velocities and decelerations where applicable) until the 150–200°F (66–93°C) temperature range for hottest brake is attained.

7.2.2 DRIFT TIME—The drift time shall be determined immediately following temperature conditioning (at 150–200°F (66–93°C) hottest brake). The average drift time is determined by letting the vehicle coast (transmission in neutral) from 50 mph (80.5 km/h), or as corrected, to 15 mph (24.1 km/h). This value must be obtained in the same direction or directions with respect to the wind encountered during the test.

7.2.3 COLD STOP—Make three stops from 20 mph (32.2 km/h) at sufficient deceleration to meet the cold stop distance requirement. The maximum service line pressure used shall not exceed 108 psi (750 kPa) for vehicles with air brakes or 1800 psi (12.4 MPa) for vehicles with hydraulic brakes.

7.2.4 RATING TESTS—For rating purposes, a test series of three to five rating tests are permitted on a specific set of linings. For the first test, select from the first column of Table 2 the number of snubs for the GVWR rating of the vehicle being tested. Snubs should be made in accordance with the brake apply time shown in Table 3, thus continually compensating for fractions of seconds.

Continue with the second and subsequent tests of the series, increasing the severity (number of snubs listed in Table 2) as required for brake rating. Rating tests 1 and 2 are to be completed without regard to limiting criteria. Test 3 may be used for rating. A fourth and fifth rating test may be run as an option as shown in Table 4, provided the number of snubs is repeated; or, increased or decreased an increment of one from the preceding test.

The rating shall be calculated on the basis of the last ten on which the limiting criteria is not exceeded. For determining brake rating power beyond the formula requirement, an additional test series of five rating tests may be conducted on a new set of linings by starting the first rating tests at a greater number of snubs than was used to start the compliance rating test series.

To start the rating test, bring the vehicle to 15 mph (24.1 km/h). Start the stop watch and accelerate vehicle to 50 mph (80.5 km/h) or to the corrected velocity as quickly as possible. Make the predetermined number of snubs to 15 mph (24.1 km/h) at the proper time cycle attempting to maintain 12 ft/s² (3.7 m/s²) or the corrected deceleration by varying the input pressure up to a maximum of 90 psi (620 kPa) service line air pressure or 1500 psi (10.3 MPa) hydraulic pressure on any snub.

7.2.5 HOT STOP—Immediately following the final snub of the rating test, accelerate to 20 mph (32.2 km/h) and make a stop at sufficient deceleration to meet the hot stop distance requirement. The maximum service line pressure used shall not exceed 108 psi (750 kPa) for vehicles with air brakes or 1800 psi (12.4 MPa) for vehicles with hydraulic brakes.

7.2.6 COOLED STOP—Cool the brakes to 200°F (93°C) maximum (hottest brake) and make a stop from 20 mph (32.2 km/h) without locking any wheel or cycling any wheel slip brake control system at a deceleration of 9–12 ft/s² (2.7–3.7 m/s²) to determine final brake stability.

7.2.7 FINAL INSPECTION—Remove drums and visually inspect brakes for functional and structural integrity.

7.3 Rating Requirements—In order to complete the rating test satisfactorily, the vehicle brake system must comply with the following:

7.3.1 Cold stop of no more than:

(a) 25 ft (7.6 m) if single-unit vehicle 10 000 lb (4500 kg) GVWR or less.

TABLE 1

Series	Snubs	Snub Conditions, at 1 mile (1.6 km) Intervals at 10 ft/s² (3 cm/s²) (or Maximum Possible Less than 10)	
		mph	km/h
1	175	40–20	64.4–32.2
2	25	45–20	72.4–32.2
3	25	50–20	80.5–32.2
4	25	55–20	88.5–32.2
5	25	60–20	96.6–32.2
6	25	65–20	104.6–32.2

TABLE 2—NUMBER OF SNUBS FOR RATING TEST

GVWR				Number of Snubs		
Minimum		Maximum				
lb	kg	lb	kg	1st Test	2nd Test	3rd Test
4850	2200	5230	2372	17	19	22
5231	2373	5700	2586	17	19	21
5701	2586	6200	2812	16	18	20
6201	2813	6820	3094	15	17	19
6821	3094	7580	3438	15	16	18
7581	3439	8500	3856	15	16	17
8501	3856	9700	4400	14	15	16
9701	4400	11 300	5126	13	14	15
11 301	5126	13 500	6124	12	13	14
13 501	6124	15 500	7031	11	12	13
15 501	7031	20 200	9163	10	11	12
20 201	9163	29 000	13 154	9	10	11
29 001	13 155	52 000	23 687	8	9	10