

Passenger cars - Service brake road test procedures

1. Scope

This Standard specifies road test procedures for service brakes for passenger cars operated under normal conditions. This Standard does not apply to two-wheeled vehicles.

2. Applicable Publications

The following publications form a part of this Standard to the extent specified herein.

The latest issue of all publications shall apply.

JIS D0210	General Rules of Brake Test Method of Automobiles and Motorcycles
JASO C428	Parking Brake Test Procedure

3. Definitions

The definitions of main terms used in this Standard conform to **2 (Definition of Terms)** of **JIS D0210** and the following.

- a) Initial Brake Temperature** The value read within 15 seconds before the start of brake application. Where specified, the initial brake temperature shall be the highest of the mean values for each wheel measured per axle.

4. Test Conditions

4.1 Vehicle Classification

Test vehicles are classified by nominal maximum speed and conform to the provisions of **JIS D0210**.

Category P1	Over 140km/h
Category P2	111km/h to 140km/h
Category P3	91km/h to 110km/h
Category P4	90km/h and under

4.2 Vehicle Condition

Test vehicles shall conform to **4.1 (Condition of Vehicles)** of **JIS D0210**

4.3 Condition of Brake Parts

Each part of the braking device shall conform to **4.3 (Condition of Brake)** of **JIS D0210**.

4.4 Road Surface and Weather Conditions

Conform to **4.2 (Road Surface and Weather Conditions)** of **JIS D0210**.

4.5 Temperature Measurement

Brake temperature shall be measured as specified in **6 (Temperature Measurement)** of **JIS D0210**.

5. Test Procedures

5.1 Braking Operation

- Braking operation shall be performed with a continuous pedal force not exceeding 500N until the vehicle comes to a complete stop.
- In braking operations with constant braking deceleration, when the designated deceleration cannot be attained after pedal force reaches 500N, braking operation shall be performed with pedal force of 500N.
- Braking shall be initiated when the vehicle is at the center of a 3.5m wide lane, and the posture of the test vehicle shall be controlled so that no part of the vehicle leaves the lane.

5.2 Test Items and Sequence

a) Preburnish check

Initial braking speed	50km/h or less
Initial brake temperature	80°C or less
Braking operation	Braking deceleration of 3.0m/s ² or less

Repetitions	10 or less
Record	Pedal force or line pressure, braking deceleration, and initial brake temperature

Remarks: Proceed to the next test item only after this test is completed with test equipment, brakes and vehicle functioning normally throughout the test.

b) First effectiveness test

Initial braking speeds	50km/h, 100km/h for P1 and P2 vehicles 50km/h, 80km/h for P3 vehicles 50km/h, 65km/h for P4 vehicles
Transmission control position	Neutral
Initial brake temperature	80°C
Braking operation	Constant braking deceleration or constant pedal force (line pressure)
Repetitions	Braking applications shall start with the lowest braking deceleration or pedal force for each initial braking speed, and shall be repeated with increasing degrees until wheel lock occurs, the vehicle exceeds the lane boundaries or pedal force reaches 500N. Brake applications should be repeated at least 6 times at appropriate intervals.
Record	Pedal force or line pressure, braking deceleration, wheel lock condition, and deviation of vehicle from lane boundaries.

Remarks: Initial braking speed should be applied sequentially from the lowest specified condition.

c) Burnish

Initial braking speed	65km/h
Transmission control position	Normal driving position
Braking operation	Braking deceleration of 3.5m/s ²
Cooling speed	65km/h
Braking interval	1,500m or 120°C of the initial brake temperature, whichever is attained earlier. Braking shall commence when the temperature reaches 120°C even if the braking interval does not reach 1,500m.
Repetitions	200
Record	Pedal force or line pressure, and initial brake temperature (every first and 20th repetitions)

d) Second effectiveness test

1) Low temperature effectiveness test

Initial braking speed	50km/h
Transmission control position	Neutral
Initial brake temperature	50°C or less
Braking operation	Constant braking deceleration or constant pedal force (line pressure)
Repetitions	Braking shall start with the lowest braking deceleration or pedal force for each initial braking speed, and shall be repeated with increasing degrees until wheel lock occurs, the vehicle exceeds the boundaries, or pedal force reaches 500N. Brake applications shall be repeated at least 3 times at appropriate intervals.
Record	Pedal force or line pressure, braking deceleration, and initial brake temperature

Remarks: When the initial brake temperature does not reach 50°C, braking operation may be performed successively.

2) Normal temperature effectiveness test Repetition of the first effectiveness test specified in **b)**.

The initial braking speeds, however, shall be as follows.

50, 100, and 130km/h for P1 vehicles

50, 80, and 100km/h for P2 vehicles

50 and 80km/h for P3 vehicles

50 and 65km/h for P4 vehicles

e) First reburnish

Repetition of the burnish specified in **c) Burnish**, except that the number of brake applications shall be reduced to 35 and data shall be recorded for the first, 10th, 25th and 35th repetitions.

f) Light load effectiveness test

Repetition of the first effectiveness test specified in **b) First effectiveness test**. (Not required for vehicles with a capacity of 2 persons or less.)

g) First fade and recovery test

1) Base line check

Initial braking speed	V _{max} 0/-20 km/h Upper limit 100km/h Where, V _{max} : the nominal maximum speed (km/h)
Transmission control position	Neutral
Initial brake temperature	80°C
Braking operation	Constant braking deceleration of 5.0m/s ²
Repetitions	3
Record	Pedal force or line pressure

2) Fade test

Initial braking speed	Upper limit 100km/h Where, 80%V _{max} : value (km/h) equal to nominal max. speed multiplied by 0.8 40%V _{max} : value (km/h) equal to nominal max. speed multiplied by 0.4
$\sqrt{(80\% V_{\max})^2 - (40\% V_{\max})^2}$	
Transmission control position	Normal driving gear
Initial brake temperature	60°C for initial application only
Braking operation	Constant braking deceleration of 3.0m/s ² constant (See g of 6.1 .)
Cooling speed	Equal to initial braking speed
Accelerating condition	Maximum level immediately following completion of braking
Braking interval	640m
Repetitions	10
Record	Pedal force or line pressure, initial brake temperature, time required for fade test, and atmospheric temperature and wind velocity at the beginning of fade test

Remarks: The test shall continue uninterrupted from the initial to the final braking of the fade test.

3) High temperature effectiveness test

Interval from preceding test	Immediately after the fade test perform maximum acceleration test. Start braking operation when the specified initial braking speed is attained.
Initial braking speed	Same as in 1) Base line check
Transmission control position	Neutral
Braking operation	Constant braking deceleration of 5.0m/s ² constant
Repetitions	1
Record	Pedal force or line pressure and initial brake temperature

4) Cooling effectiveness test

Interval from preceding test	1,500m immediately after completion of high temperature effectiveness test, run vehicle at 50km/h and, upon attaining specified braking interval, start braking operation.
Initial braking speed	50km/h

Transmission control position	Normal driving gear
Braking operation	Constant braking deceleration of 3.0m/s ² constant (See g) of 6.1.)
Cooling speed	50km/h
Braking interval	1,500m
Repetitions	4
Record	Pedal force or line pressure and initial brake temperature

5) Recovery test

Interval from preceding test	1,500m immediately following cooling effectiveness test, run vehicle at initial braking speed and, upon attaining specified braking interval, start braking operation.
Initial braking speed	Same as in 1) Base line check
Transmission control position	Neutral
Braking operation	Constant braking deceleration of 5.0m/s ² constant (See g) of 6.1.)
Cooling speed	Equal to initial braking speed
Repetitions	1
Record	Pedal force or line pressure and initial brake temperature

6) Effectiveness spot check (Optional)

Initial braking speed	Same as in 2) Fade test
Transmission control position	Neutral
Initial brake temperature	80°C
Braking operation	Constant braking deceleration of 3.0m/s ² constant (See g) of 6.1.)
Repetitions	2
Record	Pedal force or line pressure

h) Second reburnish

Repetition of **e) First reburnish**.

i) Second fade recovery test

- 1) Base line check** Repetition of **g**), **2) Base line check**. The initial braking speed, however, shall be 50km/h.
- 2) Fade test** Repetition of **g**), **2) Fade test**. The braking deceleration, however, shall be 5.0m/s² constant and the number of repetitions shall be 15.
- 3) High temperature effectiveness test (Optional)** Repetition of **g**), **3) High temperature effectiveness test**.
- 4) Recovery test** Repetition of **g**), **5) Recovery test**. The initial braking speed and cooling speed, however, shall be 50km/h and the number of repetitions shall be 12 or more.
- 5) Effectiveness spot check (Optional)** Repetition of **g**), **6) Effectiveness spot check**. The initial braking speed, however, shall be 5.0m/s² constant.

j) Third reburnish

Repetition of **First reburnish** of **e)**

k) Final effectiveness test

Repetition of **d**), **2) Normal temperature effectiveness test**. The initial braking speed, however, shall be optionally changeable to the following values:

150km/h for vehicles with nominal maximum speeds above 160km/h but less than 170km/h.

160km/h for vehicles with nominal maximum speeds exceeding 170km/h.

l) Fourth reburnish Repetition of **e) First reburnish**. This item may be omitted when not essential.**m) Water recovery test****1) Base line check**

Initial braking speed 50km/h

Transmission control position	Normal driving gear
Initial brake temperature	80°C
Braking operation	Constant braking deceleration of 3.0m/s ² constant (See g) of 6.1.)
Repetitions	3
Record	Pedal force or line pressure

2) Water immersion

The test vehicle shall travel or shuttle back and forth in a trough containing 15cm of water for 2 minutes at an approximately 10km/h with the brake fully released.

2) Recovery test

Interval from the preceding test	Initial braking shall be applied within 1 minute from completion of water immersion.
Initial braking speed	50km/h
Transmission control position	Normal driving gear
Braking operation	Constant braking deceleration of 3.0m/s ² (See g) of 6.1.)
Cooling speed	50km/h
Braking interval	800m or less
Repetitions	15
Record	Pedal force or line pressure

Remarks: Travelling speed shall not exceed 50km/h for the period between completion of water immersion and the start of initial braking. During this period, no braking operation should be performed.

n) Final inspection

Every brake shall be disassembled and inspected, and the results recorded.

5.3 Allowable Modifications of Test Conditions

a) Test braking for the following items shall start when the reading of the calibrated measuring instrument stays within the following range under the specified conditions.

1) Initial braking speed shall be within ± 3 km/h of that specified.

Record the value targeted within this range. Initial braking speed shall not exceed 80% of the vehicle's nominal maximum speed and therefore shall be reduced by increments of 5km/h when required P4 vehicles with low nominal maximum speeds.

2) Initial brake temperature shall be held within $\pm 10^\circ\text{C}$ of that specified. For P3 and P4 and special built vehicles, initial brake temperatures 80°C and 120°C shall be modifiable to 60°C and 80°C respectively.

b) Readings of the calibrated measuring instruments shall be kept within the ranges specified below.

1) Braking deceleration shall be held within $+0.5/0$ m/s² of that specified. Record the value targeted within this range.

2) Cooling speed shall be within ± 3 km/h of that specified. Record the value targeted within this range. Initial braking speed shall not exceed 80% of the vehicle's nominal maximum speed and therefore shall be reduced by increments of 5km/h when required P4 vehicles with low nominal maximum speeds.

c) The braking interval shall be set to a value as close as possible to the specified distance. The braking interval, however, shall be modifiable within the range specified in Table 1 when modification is required. When a particular distance within this range is set as the braking interval, or when the distance involves periodic change, record the value.

Table 1 Allowable Range for Braking Interval

Unit: m

Test Item	Braking Interval (Distance)
Fade Test	640 ± 150
Burnish Cooling Effectiveness Test Cooling Recovery Test (Fade Recovery Test)	1500 ± 300

When P4 vehicles are tested at cooling and initial braking speeds lower than the specified values, the braking interval shall conform to the specified distance interval.

5.4 Unspecified Braking Operations

Any braking operation not specified for the tests shall be avoided. When the brake needs to be heated to the specified temperature, however, the initial braking speed and braking deceleration shall conform to the burnish conditions.

5.5 Modification of Vehicle Classification

Vehicle classification may be modified for vehicles not specified in the vehicle categories.

5.6 Additional Test Items

When the parking brake test (optional) is necessary, a part or all of the test items specified in **JASO C428** may be performed. The test sequence is not specified.

6. Records

6.1 Recording Procedures

The following items shall be monitored, measured and recorded.

- a) Any phenomenon indicating abnormal brake performance; noise, vibration, etc. taking place during the test.
- b) Occurrence of any wheel lock during the test including the position of the wheel involved, the conditions in which wheel lock occurs, etc. and the use of the anti-lock device.
- c) Failure of the test vehicle to be kept within the test lane boundaries.
- d) Advance measurement of the correlation between line pressure and pedal force when the line pressure is adopted
- e) For tests with constant braking deceleration; Initial, intermediate (continuous), and final values of pedal force or line pressure and the time they approach the maximum value. Values shall be measured before vehicle speed drops below 10km/h to avoid build up influence on the reading incidental to the period immediately before the stopping moment.
- f) For tests with constant braking pedal force; Initial, intermediate (continuous), and final values of the braking deceleration and the time they approach the maximum value. Values shall be measured before the vehicle speed drops below 10km/h to avoid build up influence on the reading incidental to the period immediately before the stopping moment.
- g) When the average value of braking deceleration does not stay within $\pm 15\%$ that specified where constant application is required the deviated values and the respective values of pedal force or line pressure shall be recorded.
- h) Any modification in specified values including those specified in **5.3 Test Conditions**.
- i) Measurement of the atmospheric temperature and wind velocity is recommended before starting the all tests.
- j) The reading sequence of the initial brake temperature of each wheel shall be the same throughout the tests.

6.2 Recording Forms

- a) Record formats shall be as follows:

- 1) Summary Sheet of Service Brake Data and Road Performance (Passenger Cars); (**Attached Table 1**)

Average braking deceleration and average pedal force entered in this table shall be calculated as in **Attached Fig. 1**. They are replaceable with the mean values of the initial, intermediate, and final braking deceleration and pedal force respectively. The average value of pedal force at average braking deceleration of 6.0m/s^2 in the effectiveness tests shall be calculated as in **Attached Fig. 2**.

2) Summary Graphs of Service Brake Road Performance (Passenger Cars); (Attached Table 2)

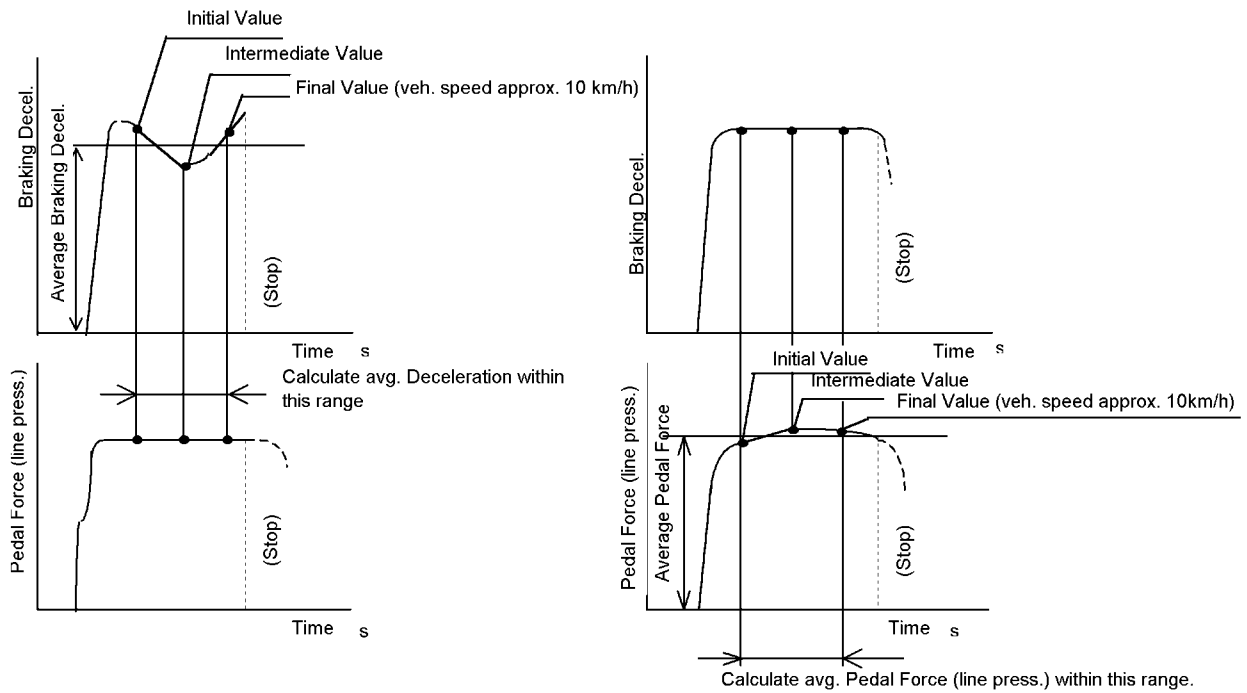
3) Recording format by test item; Attached Tables 3 to 8

4) Graphic sheets by test item; Attached Tables 9 to 13

Reference Standards

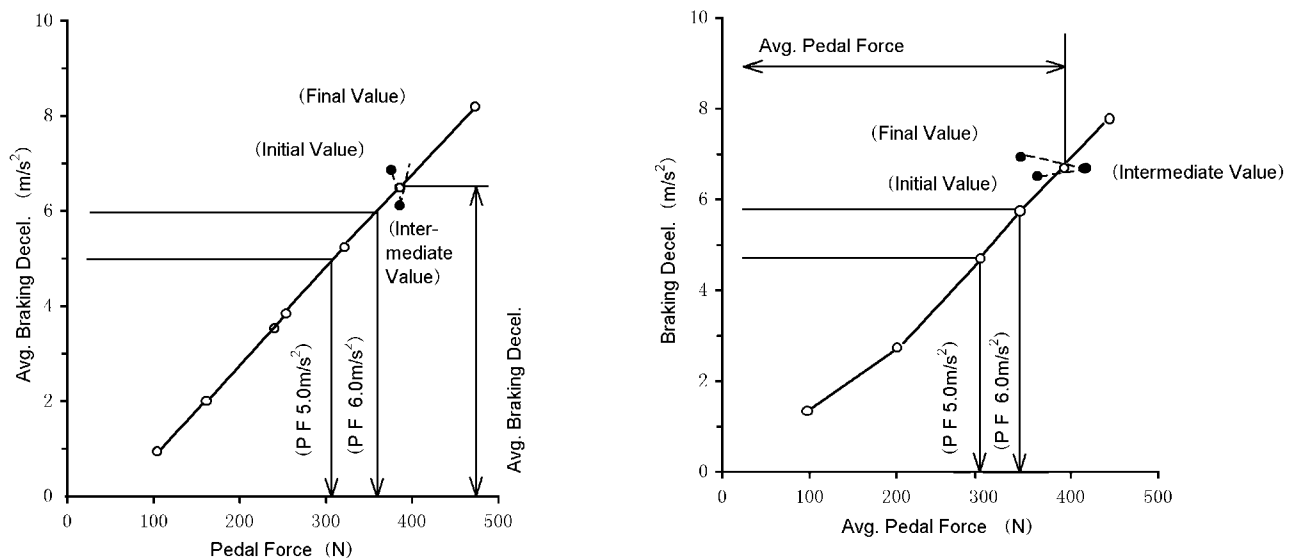
JIS D0106

Road Vehicles - Brake Types, Braking Mechanics and Brake Operation



a) Braking Operation at Constant Pedal Force (line pressure) b) Braking Operation at Constant Braking Deceleration

Attached Fig. 1 Calculation of Average Deceleration and Pedal Force (line pressure)



a) Braking Operation at Constant Pedal Force (line pressure) b) Braking Operation at Constant Braking Deceleration

Attached Fig. 2 Summary of Effectiveness

Attached Table 1 Summary Sheet of Service Brake Data and Road Performance (Passenger Cars)

Reference No. _____
 Test Date _____ Day _____ Month _____ Year _____
 Test Site _____
 Tested by _____

Vehicle Specifications

Car Make _____ Model _____ Chassis No. _____ Year _____
 Eng. model _____ Displacement _____ cm³ Max. speed (nom) _____ km/h Vehicle class _____
 Transmission model T/M _____ T/C _____ Forward _____ steps Reverse _____ steps Final reduction gear _____
 Veh. weight (mass) Nominal load/() empty Front shaft load() kN Rear shaft load() kN Total () kg
 Specified load/() light Front shaft load() kN Rear shaft load() kN Total () kg
 O/all Dimensions L _____ mm W _____ mm H _____ mm Wheelbase _____ mm Suspension system Front _____ Rear _____
 Disc wheel Model _____ Rim size _____ Tire model _____ Size _____ Static load radius _____ m

Brake Specifications

Front Model: Drum Disc Cylinder dia. _____ mm Friction material maker _____
 Size Inner dia. (effect dia.) _____ mm × Outer dia. _____ mm × Thick _____ mm Swept area (both wheels) _____ cm²
 Lining (pad) (Rotate dir.) L _____ mm × W _____ mm × Thick _____ mm Total area (both wheels) _____ cm²
 Rear Model: Drum Disc Cylinder dia. _____ mm Friction material maker _____
 Size Inner dia. (effect dia.) _____ mm × Outside dia. _____ mm × Thick _____ mm Swept area (both wheels) _____ cm²
 Lining (pad) (Rotate dir.) L _____ mm × W _____ mm × Thick _____ mm Total area (both wheels) _____ cm²
 Pedal ratio _____ Master cylinder size _____ Master cylinder model _____
 Servo unit Yes · No Model _____ Warn device Yes · No Operate Pressure _____ MPa
 Pressure control device Yes · No Model _____
 Other brake device _____

Preburnish check Pedal force _____ N at initial braking speed of 50km/h or less and braking deceleration of 3.0m/s² or less.

Effectiveness Test Average pedal force at average braking deceleration of 6.0m/s².

Initial Braking Speed					
Item		km/h	km/h	km/h	km/h
1st Effectiveness		N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²
2nd Effectiveness	Low Temp.	N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²
	Normal Temp.	N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²
Final Effectiveness		N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²
Light Load Effectiveness		N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²	N at 6.0m/s ²

Fade and Recovery Test A Condition of wheel lock in effectiveness test (circle the lock position).

B Indicate whether or not the test vehicle crosses the 3.5m lane margins at an average deceleration of 6m/s².

Initial Braking		km/h				km/h				km/h				km/h				km/h			
Speed	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B			
Item	Wheel	Occurrence	Yes	No	Wheel	Occurrence	Yes	No	Wheel	Occurrence	Yes	No	Wheel	Occurrence	Yes	No	Wheel	Occurrence	Yes	No	
1st	FL RL				FL RL				FL RL				FL RL				FL RL				
Effectiveness	FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			
2nd	FL RL				FL RL				FL RL				FL RL				FL RL				
Effectiveness	FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			
Final	FL RL				FL RL				FL RL				FL RL				FL RL				
Effectiveness	FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			
Light Load	FL RL				FL RL				FL RL				FL RL				FL RL				
Effectiveness	FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			FR RR	m/s ²			

Fade and

Recovery Test

Pedal force denotes the average value

Division	Fade Test										Second Fade					High Temp.		Recovery Test	
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	Max. Temp.	Effec.	1st · 5th	6th on
	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	P.F.	Front	Rear	P.F.	Max. P.F.
1st Fade																			
Recovery																°C	°C		
2nd Fade																			
Recovery																°C	°C		

Water

Recovery Test

Pedal force in base line check _____ N Max. pedal force in 4th to 6th recovery tests _____ N
 Max. average pedal force in 7th to 14th recovery tests _____ N Average pedal force in 15th recovery test and after _____ N

Final Inspection (Describe Condition)

Friction Material _____
 Drum or Disc _____
 Mechanical Elements _____
 Hydraulic Circuit _____

Comments

Prepared by _____

Attached Table 2 Summary Graph of Service Brake Road Performance (Passenger cars)

Vehicle Category	Car Name	Model	Vehicle weight at nominal load (empty vehicle)	Front: kN	Rear: kN	Total: kgf
			at determined load (light load)	Front: kN	Rear: kN	Total: kgf
Alleviation of initial brake temperature condition	Applied/ Not applied					

Figure 1 displays a 5x5 grid of plots showing Braking Decel. m/s^2 (Y-axis) versus Pedal Force (N) (X-axis). The plots are organized into five columns, each representing a different effectiveness test or temperature condition. The rows represent different temperatures: 80°C, 60°C, 40°C, 20°C, and 0°C. The columns are labeled as follows:

- Effectiveness Test (First Effectiveness)
- Initial Brake Temp. 80°C 60°C (Second/ Low Temp. Effectiveness)
- (Second/ Normal Temp. Effectiveness)
- (Light Load Effectiveness)
- (Final Effectiveness)

The plots show that braking deceleration generally increases with pedal force and decreases with increasing temperature. The effectiveness of the brake system is highest at 0°C and lowest at 80°C.

Brake Specifications		Front type	Reference No.		
Line pressure (MPa)	Cylinder Diameter		Test Date	Day	Month Year
	Friction Material Maker				
	Rear Type		Tested by		
	Cylinder Diameter		Car Name/Model		
	Friction Material Maker				
	Master Cylinder Size				
	Master Cylinder Model				
	Pedal Ratio		Warning device Yes/No		
	Servo Unit	Yes/No	Model		
	Pressure Control Unit	Yes/ No	Model		
Other Braking Device					

Fade Recovery Test

Initial Brake Temp. (°C)

Line Pressure (MPa)

Pedal Force (N)

Base Line Check Fade Test High-temp. Eff. Test Cooling Eff. Test Recovery Test Eff. Spot Check

Repetitions (1st Fade Recovery)

Fade Space

Initial Brake Temp. (°C)

Line Pressure (MPa)

Pedal Force (N)

Base Line Check Fade Test High-temp. Eff. Test Recovery Test Eff. Spot Check

Repetitions (2nd Fade Recovery)

Figure 1 is a line graph titled "Water Recovery Test (Base Line Check) (Recovery Test)". The Y-axis is labeled "Pedal Force (N) Line Pressure (MPa)" and the X-axis is labeled "Repetitions". The graph is divided into two main sections: "Base Line Check" and "Recovery Test". The "Base Line Check" section shows a sharp drop in pressure during a "2-min. Water Immersion" period, followed by a recovery period. The "Recovery Test" section shows a similar pattern but with a higher recovery level.

Comments
Final inspection Condition of Friction Material
Condition of Drum/Disc
Condition of Mechanical Elements
Condition of Hydraulic Pressure Circuit

The graph illustrates the relationship between Pedal Force (N) and Line Pressure (MPa) and the number of Repetitions during a brake burnishing process. The process is divided into several phases: Preburnish Check, Burnish, 1st Reburnish, 2nd Reburnish, 3rd Reburnish, and 4th Reburnish. The graph shows a series of vertical lines representing the force and pressure at different repetition intervals. The force and pressure increase significantly during the burnish and reburnish phases, reaching a plateau around 120°C.

Phases and Repetitions:

- Preburnish Check:** 1 to 10 repetitions.
- Burnish:** 1 to 100 repetitions.
- 1st Reburnish:** 1 to 20 repetitions.
- 2nd Reburnish:** 1 to 20 repetitions.
- 3rd Reburnish:** 1 to 20 repetitions.
- 4th Reburnish:** 1 to 20 repetitions.

Temperature and Force/Pressure:

- Initial Brake Temp. 80°C 120°C:** The temperature increases from 80°C to 120°C during the burnish and reburnish phases.
- Force and Pressure:** The force and pressure increase significantly during the burnish and reburnish phases, reaching a plateau around 120°C.

Attached Table 3

Reference No. _____
 Test Date D: _____ M: _____ Y: _____
 Test Site _____
 Tested by _____
 Car Name/Model _____

Input Correlation	
Transmission Control Position Neutral Idling Condition of Engine	
Pedal Force N	Line Pressure MPa

First Effectiveness Test			
Initial Brake Temperature °C		Neutral	
Initial Braking Speed km/h		Initial Braking Speed km/h	
P or L	Braking Deceleration	P or L	Braking Deceleration
Wheel lock		Wheel lock	

Preburnish Check				
Repetitions	F.W. *	R.W. *	P or L	Braking Decel.
	IBT	IBT		
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

* IBT: Initial Brake Temperature

Burnish				
-0km/h		m/s ² Normal Driving Gear		
Braking Interval				
Repetitions	F.W. *	R.W. *	P or L	Remarks
IBT	IBT			
1				
20				
40				
60				
80				
100				
120				
140				
160				
180				
200				

Comments

Attached Table 4

Reference No. _____
 Test Dat D: M: Y: _____
 Test Site _____
 Tested By _____
 Car Name/Model _____

Second Effectiveness (Low-temp.)					
					Neutral
Initial Braking Speed			km/h		
P or L	Braking Deceleration	F. W. IBT *	R. W. IBT *	Remarks	

-0km/h m/s² First Reburnish		Normal Driving Gear	
Braking Interval			
Repetitions	F. W. IBT *	R. W. IBT *	P or L
1			
10			
25			
35			

[illegible]

Light Load Effectiveness Test							
Initial Brake Temp.				°C Neutral			
Initial Braking Speed km/h				Initial Braking Speed km/h			
P or L		Braking Deceleration		P or L		Braking Deceleration	
Wheel lock				Wheel lock			

First Base Line Check -0km/h m/s² Initial Brake Temp. °C		
Repetitions	P or L	Remarks
1		
2		
3		

* IBT: Initial Brake Temperature

Comments

Attached Table 5

Reference No. _____

Test Date

D:

M:

Y:

Test Site _____

Tested by _____

Car Name/Model _____

First Fade Test				
-0km/h		m/s ²		Normal Driving Gear
Braking Interval		1st Initial Brake Temp. 60°C		
Atmospheric temp °C		W V	m/s Rqrd. Time: fade test S	
Repetitions	F. W. IBT *	R. W. IBT *	P or L	Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

First Recovery Test				
-0km/h		m/s ²		Neutral
Braking Interval				
Repetitions	F. W. IBT *	R. W. IBT *	P or L	Remarks
1				

First Effectiveness Spot Check			
-0km/h		m/s ²	
		Neutral	
Initial Brake Temperature		°C	
Repetitions	P or L	Remarks	
1			
2			

First High Temp. Effectiveness Test				
-0km/h		m/s ²		Neutral
Repetitions	F. W. IBT *	R. W. IBT *	P or L	Remarks
1				

Second Reburnish				
-0km/h		m/s ²		Normal Driving Gear
Braking Interval				
Repetitions	F. W. IBT *	R. W. IBT *	P or L	Remarks
1				
10				
25				
35				

Cooling Effectiveness Test				
-0km/h		m/s ²		Normal Driving Gear
Repetitions	F. W. IBT *	R. W. IBT *	P or L	Remarks
1				
2				
3				
4				

Second Base Line Check			
-0km/h		m/s ²	
		Neutral	
Initial Brake Temperature		°C	
Repetitions	P or L	Remarks	
1			
2			
3			

* IBT: Initial Brake Temperature

Comments _____

Attached Table 6

Reference No. _____

Test Date D: _____ M: _____ Y: _____

Test Site _____

Tested by _____

Car Name/Model _____

Second Fade Test					
_____ -0km/h		_____ m/s ²		Normal Driving Gear	
Braking Interval _____		1st Initial Brake Temp. 60°C			
Atmospheric temp _____ °C		W V _____ m/s		Rqrd. Time: fade test _____ s	
Repetitions	F. W. IBT *	R. W. IBT *	P or L		Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Second Recovery Test					
_____ -0km/h		_____ m/s ²		Neutral	
Braking Interval _____		Cooling Speed 50km/h			
Repetitions	F. W. IBT *	R. W. IBT *	P or L		Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Second High Temperature Effectiveness Test		
_____ -0km/h		Neutral
_____ m/s ²		
Repetitions	P or L	Remarks
1		

* IBT: Initial Brake Temperature

Second Effectiveness Spot Check		
_____ -0km/h		_____ m/s ²
Initial Brake Temperature _____		Neutral
_____ °C		
Repetitions	P or L	Remarks
1		
2		

Comments _____

Third Reburnish					
_____ -0km/h		_____ m/s ²		Normal Driving Gear	
Braking interval _____					
Repetitions	F. W. IBT *	R. W. IBT *	P or L		Remarks
1					
10					
25					
35					

Attached Table 7

Reference No. _____

Test Date D: M: Y:

Test Site

Tested by _____

Car Name/Model _____

Final Effectiveness Test									
Initial Brake Temp.				°C		Neutral			
Initial Braking Speed km/h					Initial Braking Speed km/h				
P or L		Braking Deceleration			P or L		Braking Deceleration		
Wheel lock					Wheel lock				
Initial Braking Speed km/h					Initial Braking Speed km/h				
P or L		Braking Deceleration			P or L		Braking Deceleration		
Wheel lock					Wheel lock				

Water Recovery Test Base Line Check -0km/h m. Normal Driving Gear Initial Brake Temp. 80°C			
Repetitions	P or L		Remarks
1			
2			
3			

Water Immersion	
Immersion Methods	
Water Trough Size	Length m Depth cm
Immersion Time	s (120 s)

Recovery Test

-0km/h

m/s²

Normal Driving Gear

Braking Interval

m

Repetitions		P or L		Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Fourth Reburnish					
	~0km/h		m/s ² Normal Driving Gear		
Braking Interval					
Repetitions	F. W. IBT*	R. W. IBT*	P or L		Remarks
1					
10					
25					
35					

* IBT:Initial Brake Temperature

Comments

Attached Table 8

Reference No. _____

Test Date D: M: Y: _____

Test Site _____

Tested by _____

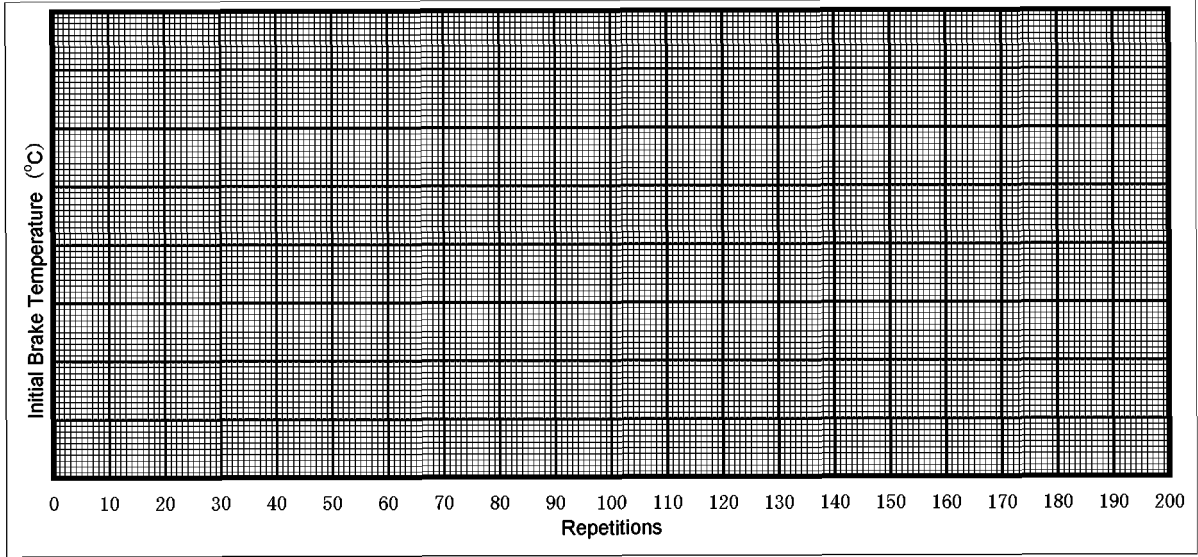
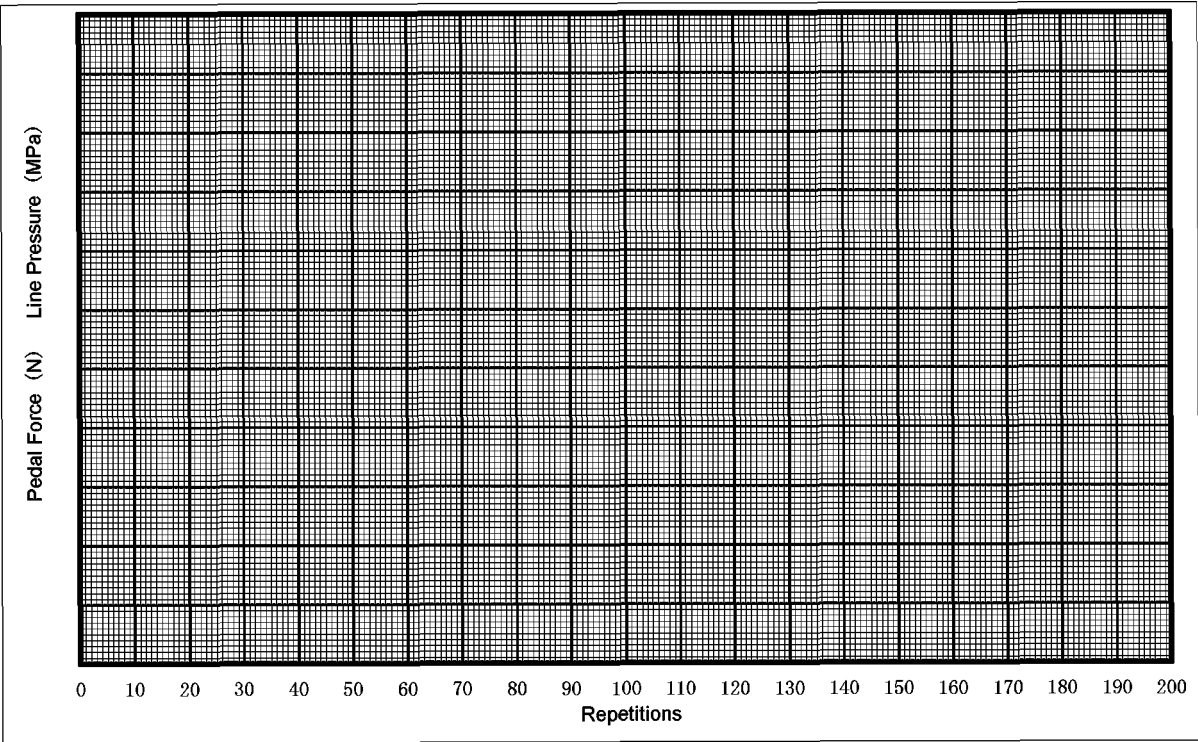
Car Name/Model _____

Final Inspection (Describe Conditions)	
Friction Material	
Front Wheel, Right	
Front Wheel, Left	
Rear Wheel, Right	
Rear Wheel, Left	
Drum or Disc	
Front Wheel, Right	
Front Wheel, Left	
Rear Wheel, Right	
Rear Wheel, Left	
Mechanical Elements	
Front Wheel, Right	
Front Wheel, Left	
Rear Wheel, Right	
Rear Wheel, Left	
Brake Pedal	
Auxiliary Pressure Unit	
Brake Lamp	
Hydraulic Pressure Circuit	
Front Wheel, Right	
Front Wheel, Left	
Rear Wheel, Right	
Rear Wheel, Left	
Master Cylinder	

Comments

Attached Table 9

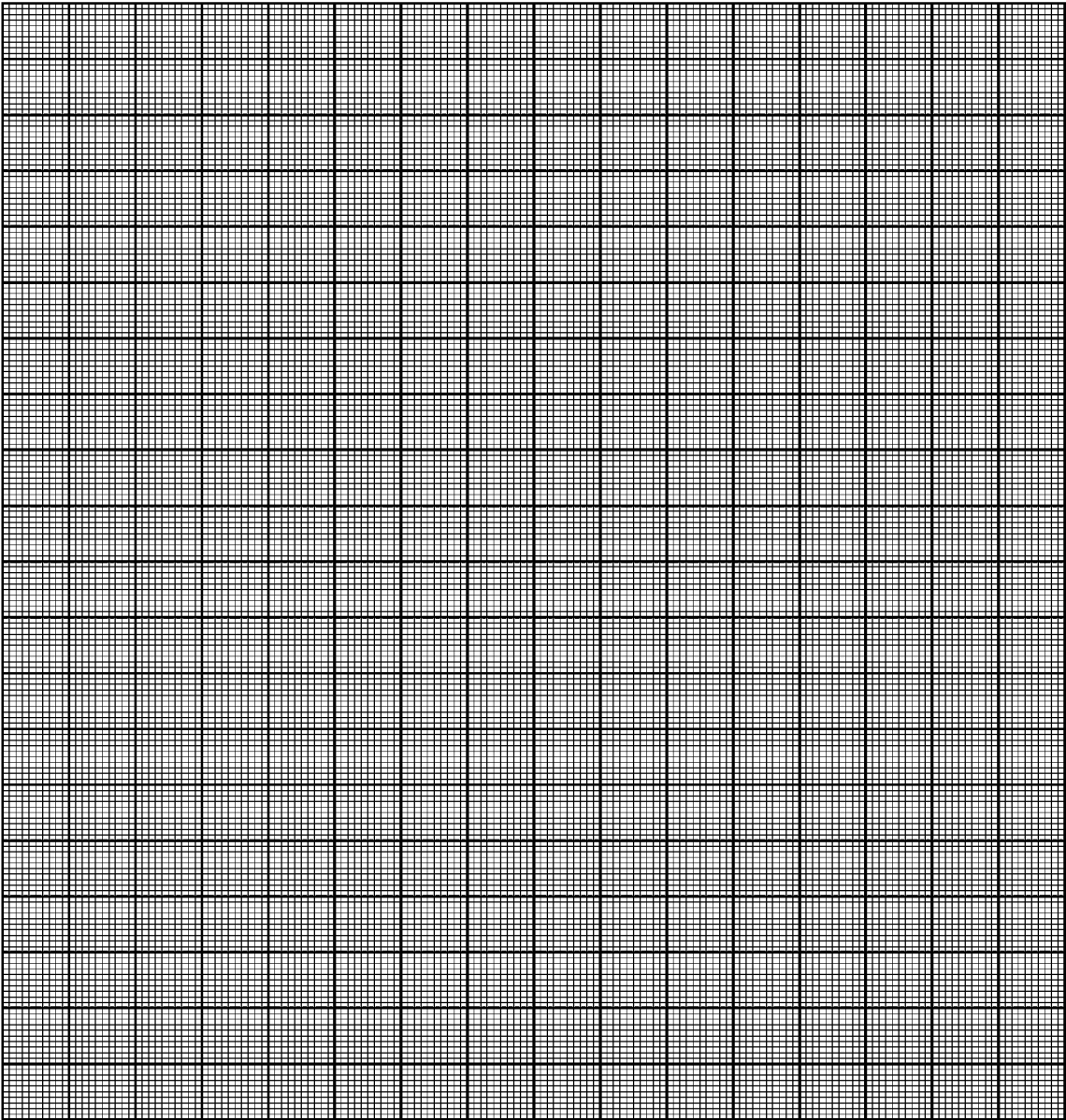
Test Item <u>Burnish/() Reburnish</u>	Test Date	<u> </u> D:	<u> </u> M:	<u> </u> Y:	Reference No. <u> </u>		
	Weather	<u> </u>			Starting Time	<u> </u> hour	<u> </u> min.
	Wind Velocity	<u> </u> m/s			Atmospheric Temp.	<u> </u> °C	
	Car Name/Model	<u> </u>			Driver	<u> </u>	
					Measured by	<u> </u>	



Attached Table 10

Test Item		Effectiveness Test	Test Date	D:	M:	Y:	Reference No.		
	Input Correlation Test		Weather				Starting Time	hour	min
Car Name/Model			Wind Velocity				Atmospheric Temp.	°C	
			Driver				Measured by		

Braking Deceleration (m/sec²) Line Pressure (MPa)



Pedal Force (N)

Attached Table 11

Test Item	First Fade Recovery Test	Test Date	D: _____ M: _____ Y: _____	Reference No.	_____
		Test Site	_____	Starting Time	_____ hour _____ min.
		Wind Velocity	_____	Atmospheric Temp.	_____ °C
Car Name/Model	_____	Driver	_____	Measured by	_____

Time Required for Fade Test _____ min. _____ sec. Fade Braking Interval _____

Initial Brake Temp. (°C)		Pedal Force (N)		Line Pressure (MPa)	
Base 1		Base 1		Base 1	
Base 2		Base 2		Base 2	
Base 3		Base 3		Base 3	
Fade 1		Fade 1		Fade 1	
Fade 2		Fade 2		Fade 2	
Fade 3		Fade 3		Fade 3	
Fade 4		Fade 4		Fade 4	
Fade 5		Fade 5		Fade 5	
Fade 6		Fade 6		Fade 6	
Fade 7		Fade 7		Fade 7	
Fade 8		Fade 8		Fade 8	
Fade 9		Fade 9		Fade 9	
Fade 10		Fade 10		Fade 10	
High Temp. Eff.		High Temp. Eff.		High Temp. Eff.	
Cooling Eff. Test 1		Cooling Eff. Test 1		Cooling Eff. Test 1	
Cooling Eff. Test 2		Cooling Eff. Test 2		Cooling Eff. Test 2	
Cooling Eff. Test 3		Cooling Eff. Test 3		Cooling Eff. Test 3	
Cooling Eff. Test 4		Cooling Eff. Test 4		Cooling Eff. Test 4	
Recovery 1		Recovery 1		Recovery 1	
Eff. Spot Check 1		Eff. Spot Check 1		Eff. Spot Check 1	
Eff. Spot Check 2		Eff. Spot Check 2		Eff. Spot Check 2	

Base line (times) _____ Fade (times) _____ Recovery (times) _____ Eff. Spot Check (times) _____
 (_____ km/h _____ m/s²) (_____ km/h _____ m/s²) (_____ km/h _____ m/s²) (_____ km/h _____ m/s²)

Test Date D: M: Y:

Time required for Fade Test _____ min. _____ sec. Fade Braking Interval _____

Pedal Force (N)	Line Pressure (MPa)
Base 1	
Base 2	
Base 3	
Fade 1	
Fade 2	
Fade 3	
Fade 4	
Fade 5	
Fade 6	
Fade 7	
Fade 8	
Fade 9	
Fade 10	
Fade 11	
Fade 12	
Fade 13	
Fade 14	
Fade 15	
High Temp. Eff.	
Recovery 1	
Recovery 2	
Recovery 3	
Recovery 4	
Recovery 5	
Recovery 6	
Recovery 7	
Recovery 8	
Recovery 9	
Recovery 10	
Recovery 11	
Recovery 12	
Eff. Spot Check 1	
Eff. Spot Check 2	

Eff. Spot Check (times)
(_____ km/h _____ m/s²)

Attached Table 13

Test Item	Water Recovery Test	Test Date	D: _____	M: _____	Y: _____	Reference No.	_____
		Weather	_____			Starting Time	_____ hour _____ min.
		Wind Velocity	_____ m/s			Atmospheric temp.	_____ °C
Car Name/Model	_____	Driver	_____			Measures by	_____

Base Line Initial Brake Temperature _____ °C

	Pedal Force (N)	Line Pressure (MPa)
Base 1		
Base 2		
Base 3		
Recovery 1		
Recovery 2		
Recovery 3		
Recovery 4		
Recovery 5		
Recovery 6		
Recovery 7		
Recovery 8		
Recovery 9		
Recovery 10		
Recovery 11		
Recovery 12		
Recovery 13		
Recovery 14		
Recovery 15		

Reference Table 1 Test Items and Test Sequence of JASO C402 (Service Brake Road Test Procedure - Passenger Car)

() denotes the allowable limits of condition

No.	Test Condition Test Item	Initial Braking Speed (±3)km/h	Transmission Control Position	Initial Brake Temperature (±10)°C	Brake Decel. (+0.5~0) m/s ²	Cooling Speed (±3)km/h	Accel. Condition	Braking Interval m	Repetitions	Pedal Force or Line Pressure N MPa	Remarks
a	Preburnish Check	50 or less		80 or less Recorded	3.0 or less Recorded				10 or less	Recorded	
b	1st Effectiveness Test	P1 50 100 - P2 P3 80 - P4 65	Neutral	80 * 120 * See Remarks. Recorded	1.0~ immediately before locked Recorded	—	—	—	6 or above	500N or less Recorded	Braking Opn. At constant pedal force (line pressure) or constant braking decel. Record any wheel lock or overrun of 3.5m lane margin.
c	Burnish	65	Drive Gear	120 * See Remarks. Recorded	3.5	65	—	1500(±300)	200	Recorded	If brake temp. cools down to 120°C *within the braking interval of 1,500m, immediately begin braking opn. Record 1st and every 20th.
d	1) Low Temp. Eff. Test 2) Normal Temp. Eff. Test	P1~P4 50 100 130 P2 80 100 P3 P4 65	Neutral	50 or less Recorded	Recorded	—	—	—	3 or above	Recorded	
e	1st Reburnish	Same as c) Burnish. The repetitions, however, shall be changed.							35	—	Record at 1st, 10th, 25th, and 35th
f	Light Load Eff. Test	Same as b) 1st Eff. Test.									
g	1st Fade and Recovery	1) Base Line Check P1~P4 $V_{max}^{20} \leq 100$ P1 P2 $\sqrt{(80\%V_{max})^2}$ P3 $\sqrt{-(40\%V_{max})^2}$ P4 ≤ 100 2) Fade Test 3) High Temp. Eff. Test 4) Cooling Eff. Test 5) Recovery Test 6) Eff. Spot Check (optional)	Neutral Drive Gear Neutral Drive Gear Neutral	80 * First 60 Recorded Recorded Recorded 80 *	5.0 3.0 5.0 3.0 5.0 3.0	— Same as Initial Braking Speed — Same as Initial Braking Speed —	— Immediately accelerated to max. — Immediately accelerated to max.	— 640(±150) — 1500(±300) 1500(±300) —	3 10 1 4 1 2	Recorded Recorded Recorded Recorded Recorded Recorded	Record atmospheric temp./wind velocity/time required for fade test
h	2nd Reburnish	Same as e) 1st Reburnish									
i	2nd Fade and Recovery test	1) Base Line Check P1 50 2) Fade Test P1 P2 $\sqrt{(80\%V_{max})^2}$ P3 $\sqrt{-(40\%V_{max})^2}$ P4 ≤ 100 3) High Temp. Eff. Test (optional) 4) Recovery Test 5) Eff. Spot Check (optional)	Neutral Drive Gear Neutral — Neutral	80 * First 60 Recorded Recorded 80 *	5.0 5.0 5.0 5.0 5.0	— Same as Initial Braking Speed — — —	— Immediately accelerated to max. — — —	— 640(±150) — 1500(±300) —	3 15 1 12 or above 2	Recorded Recorded Recorded Recorded Recorded	Same as g) 1st Fade Recovery Test; □ indicates changes.
j	3rd Reburnish	Same as e) 1st Reburnish									
k	Final Eff. Test (partly with optional items)	Same as d) 2nd Eff. Test; Low Temp. Eff. Test not included. May add Eff. Tests with Initial Braking Speed at 150km/h (veh. with nom. Max. speed 160-169km/h) or at 160km/h (veh. with nom. Max. speed 170km/h or more)									
l	4th Reburnish	Same as e) 1st Reburnish. May omit depend on purpose of test									
m	Water Recovery	1) Base Line Check 2) Water Immersion 3) Recovery Test	Drive Gear — Drive Gear	80 —	3.0 3.0	— 50	— —	— 800 or less	3 15	Recorded Recorded	Recovery Test within 1 minute of water immersion. Do not run veh. over 50km/h before Recovery Test. Never perform Braking opn. during this period.
n	Final Inspection Parking Brake Test (optional)	Disassemble/inspect all brakes and record results and related comments.									

Initial Brake Temp. with * mark: when difficult to raise veh. Brake temp., may lower 120°C to 80°C or 80°C to 60°C.

Explanatory Notes on Passenger cars- Service brake road test procedures

These explanatory notes serve to explain matters specified in the main text and related matters which do not constitute a part of this Standard.

1. Purpose and Background of Establishment

In response to strong demands for improvements in automobile safety, the Japan Automobile Manufacturers Association decided to establish self-regulatory safety standards for major performance items and, in October, 1967, requested the Society of Automotive Engineers of Japan, Inc. to prepare the relevant Standards. The Brake Committee was established as a standing committee and subcommittees were formed to prepare individual Standards. The subcommittees consisting of members selected from automobile and brake manufacturers, governmental agencies, and related organizations were responsible for preparing, as a general rule, one Standard each, coordinated by the Committee. Each subcommittee would discontinue its function on completion of its work and, would be recalled for review work when necessary.

2. Objective of Revision

The purpose of this Standard is to check and analyze the performance of service brakes. Criteria to be covered include effectiveness, braking stability, changing process of brake temperature, and performance variation in recovery from water immersion, etc. Conditions include the integral condition of new brakes and the worn condition of brakes with a service and thermal history.

3. Purpose and Background of the 1st Revision

JASO, as a general rule, tries to carry out regular reviews every three years. The Passenger Car Road Test Subcommittee, based on the 14th meeting of the Brake Committee, started a review of **JASO C402/JASO C403** in June, 1972.

In August, 1972, the Council for Transport Technology announced targets of automobile safety Standards. This was, followed by the announcement of revision **No.105a** of **FMVSS No.105** and a partial modification in May, 1973. The review reflected current developments and was performed in accordance with general JASO objectives and the following:

- a) The baseline of the Standard was not changed because of the usefulness of the performance analysis in comparison with past data.
- b) Without incurring basic changes, the new Standard was more oriented toward **FMVSS No.105a**, enabling similar performance analysis.
- c) Other JASO Standards related to brakes included in the test series were made optional as before and were arranged according to the objectives of **b)**.

Major specific changes and their grounds are as follows:

The sequence and individual test conditions of each test item conform to **FMVSS No.105a** wherever possible, thus including **FMVSS No.105a** in performance evaluation. However, where the test concerns performance analysis, the original objective of this test method, **SAEJ843d** remains the primary influence. The revised Standard differs from **FMVSS No.105a** in the following points related to conditions particular to Japan.

- a) Vehicles were classified into 4 categories according to their nominal maximum speeds. Category P4 was added for electric cars in the first review with test conditions coordinated with other categories.
- b) The effectiveness test was applied to deceleration. In **FMVSS No.105a**, the vehicle's shortest braking distance attainable was used for measurement. This produced problems such as inconsistent results

due to driver proficiency, vehicle brake performance, and when available, whether there is enough braking operation to respond to dynamic changes in frictional force between the tire and the road. Further discussion was considered necessary before this could be adopted as an objective scale of braking performance.

- c) The effective test at 150km/h or above, was made an optional item in consideration of the speed limits on Japanese public roads and lack of suitable test sites.
- d) The spike stop test was excluded. Although **FMVSS No.105a** required the spike stop test with the final state brake after a series of service/thermal histories, it was considered more useful to start in new condition and follow the service history specified in **JASO C410-71 Passenger Cars - Service Brake Strength Road Test Procedure**.

The original review draft was discussed in four Committee meetings through June, 1973, examined by the Committee in July, 1973, and approved by the Standards Council and Standards Committee in September, 1973.

4. Purpose and Background of the 2nd Revision

The 2nd review was conducted in 1978. As **FMVSS No.105a** had been superseded by **FMVSS No.105-75**, and **ISO TC 22/SC2** was currently under study, the 2nd review covered all the items and was not limited to JASO's conventional framework. The largest issue in this review concerned adoption of the conventional deceleration or the stopping distance (as adopted in **FMVSS No.105-75** and **EEC/71/320**) as the scale for the effectiveness test. Intensive discussions resulted in the designation of performance analysis as the primary JASO objective and the adoption of the conventional deceleration standard. The stopping distance calculation method was included in the **Explanatory Notes** for reference of criteria in relation to various regulations adopting the stopping distance standard. Since the conventional JASO procedures were continued, changes were small both in number and in scale.

- a) A test at the initial braking speed of 50km/h was added in the light load effectiveness test to confirm performance at load conditions and initial braking speed level most common in actual road use.
- b) Maintaining the policy of incorporating the International System of Units (SI), units and numerals were stated in **SI**.
- c) For convenience in actual use, **JASO C401-79 Test Procedure** and **C403-79 Performance Requirement** were integrated into the Standard.
- d) As establishment of **JIS D0210-85 General Rules of Brake Test Method** was in progress at the time of the second review, meanings of terms and test conditions were partly revised so as to correspond to the content of this JIS Standard.

The original review draft, through three discussions in the Subcommittee conducted through February, 1979, four discussions in the Committee, and one discussion in the Standards Committee, was approved by the Standards Council.

5. Purpose and Background of the Current Revision

Except for a minor revision in 1988 to complete the second phase of SI introduction, another full revision was not considered necessary for a period of 20 years. The current revision was prompted by the need to meet current technical developments and demands for conformity to **JSAE's "Short-term Brake Regulations: Technical Standards of Brakes – Passenger Cars: Establishment of Technical Standards Concerning Safety Standards of Road Transport Vehicles; JSAE Official Notice 59**, April 13, 1993 (herein referred to as the **Technical Standards**). It should be noted for reference that the test conditions of the **Technical Standards**, **FMVSS No. 135**, and **ECER 13H** were now in agreement. JASO's improved conformity to international standards required that review for domestic regulations be coordinated with U.S. and European regulations.

- a) One of the major changes concerns the 1st and 2nd fade and recovery tests. The review for the current revision was based on the domestic **Technical Standards**, and conditions for fade and recovery tests conform to the **Technical Standards**, **FMVSS No. 135**, and **ECER 13H**.

- b) As the third phase of SI introduction, all units and numerals were stated in SI. Braking deceleration, accordingly, was changed into integer multiples of 0.5m/s^2 .
- c) In accordance with WTO/TBT agreements, **JASO C404 Service Brake Road Test Performance Requirements – Passenger Cars** was canceled. The original draft of the current revision was prepared by the Subcommittee of Passenger - car Service Brake Road Test Procedure, examined by the Brake Committee and approved by the Standards Council in March, 1999

6. Explanatory Notes for Specified Items

6.1 Test Procedures (5 of the main text)

Until now braking interval was described both in distance and in time. The time interval was deleted since it is rarely used in actual tests. The term "ordinary" in the acceleration conditions was considered unnecessary and deleted.

6.1.1 Braking Operation (5.1 of the main text)

To conform to the **Technical Standards**, the maximum pedal force value was changed from 883N (90kgf) to 500N, and the lane width was changed from 3.7m to 3.5m.

6.1.2 Test Items and Sequence (5.2 of the main text)

6.1.2.1 Preburnish check (5.2a) of the main text)

The objective is to confirm proper functioning of the test equipment, the brake and vehicle. The expression "or less" was added to the values for initial braking speed, braking deceleration, and number of repetitions. Transmission control position, cooling speed, acceleration condition, and braking interval, were considered unnecessary and were deleted. Instead, initial brake temperature was specified to avoid adding an inappropriate history to the friction material.

Recording of braking deceleration was added as an important criteria in the function check of the test equipment.

6.1.2.2 First effectiveness test (5.2b) of the main text)

The maximum value of pedal force was changed from 883N(90kgf) to 500N to conform to the **Technical Standards**. The requirement for testing "when at wheel lock, the average deceleration is below $5.9\text{m/s}^2(0.6\text{G})$ " was deleted since **Performance Requirements** was cancelled and analysis of performance change in friction material was not the major objective.

6.1.2.3 Burnish (5.2c) of the main text)

Considerations to change the initial braking speed and braking deceleration should be changed (to conform to **FMVSS No.1** item **35**) were rejected due to insufficient reasons and the possibility that increase in initial braking speed could produce test course limitations.

The braking interval was changed from 1,600m to 1,500m to conform to the **Technical Standards**. For braking interval, the specification of "120°C or above" was changed to "1500m or 120°C, whichever is attained earlier" for clarity.

6.1.2.4 Second effectiveness test (5.2d) of the main text)

6.1.2.4.1 Low temperature effectiveness test (5.2d) 1) of the main text)

The low temperature effectiveness test was added to expand the temperature range to meet actual road conditions. The initial brake temperature was set to 50°C or less to take into consideration tests conducted during summertime.

6.1.2.4.2 Normal temperature effectiveness test (5.2.d) 2) of the main text)

With the addition of the **Low temperature effectiveness test**, the title of the **Second effectiveness test** was changed to the **Normal effectiveness test**.

For power performance, the maximum values for the normal effectiveness test and the initial braking speed, were set to about 90% of the lower limit values of the nominal maximum speeds for each vehicle classification. When the specified initial speed for the effectiveness test cannot be obtained because of test course limitations, etc., the maximum obtainable initial speed shall be used. The results are taken as reference data. Results shall be evaluated according to the purpose of each test. Even if the specified speed is not achieved, the overall road tests are still considered valid.

6.1.2.5 Light load effectiveness test (5.2f) of the main text)

Terms of average deceleration were deleted in calculating the number of repetitions due to the reasons mentioned in **6.1.2.2 First effectiveness test**, including cancellation of **Performance Requirements**.

6.1.2.6 First fade and recovery test (5.2g) of the main text)

Previous test conditions based on **SAEJ843d** and **FMVSS No.105a** were adjusted to conform to the **Technical Standards**.

Braking decelerations in the base line check, the high temperature effectiveness test, and the recovery test were all set at 5.0m/s^2 so that performance change due to friction material history could be easily determined. The value of 5.0m/s^2 was determined based on the requirement: 4.82 m/s^2 for the high temperature braking test specified in the **Technical Standards**.

6.1.2.6.1 Base line check (5.2.g) 1) of the main text)

The initial braking speed, the transmission control position, and the braking deceleration were changed to conform to the **Technical Standards**.

6.1.2.6.2 Fade test (5.2g) 2) of the main text)

Initial braking speed and braking deceleration were changed to conform to the **Technical Standards**. Initial braking speed was previously specified as; "approximately 70% of the lower limit value of the normal maximum speed for each vehicle classification". Since this is nearly equal to $\sqrt{(80\%V_{\text{max}})^2 - (40\%V_{\text{max}})^2}$ ($\approx 69\%V_{\text{max}}$, where 100km/h is the maximum value), the description of the **Technical Standards** was adopted.

The braking interval and the number of repetitions remain unchanged. Considerations to conform to the **Technical Standards** (925m, 15 repetitions), were rejected based on the similarity of temperature change and general ease of use.

6.1.2.6.3 High temperature effectiveness test (5.2 g)5) of the main text)

For effectiveness evaluation in fade conditions, this test was added to conform to the **Technical Standards**.

6.1.2.6.4 Recovery test (5.2g) 5) of the main text)

Revisions were made in accordance with changes in test conditions for the base line check.

6.1.2.6.5 Effectiveness spot check (5.2 g) 6) of the main text)

Although the **Technical Standards** do not provide a corresponding item, this check was retained as an optional item to enable comparison of test conditions with to those of the fade test.

6.1.2.7 Second fade and recovery test (5.2.i) of the main text)

Although the **Technical Standards** do not specify a corresponding test, this test was retained with some adjustments as an important part of the performance analysis.

The initial braking speed for the base line check and the recovery test was set at 50km/h . There was some discussion to revise the speed to correspond to that of the first fade recovery test. This was rejected due the possibilities of unfavorable conditions resulting from the repetition of recovery steps at high speed, including improper brake temperature drop and unobservable recovery performance. The following measures attempt to compensate for complications arising from conditions from the first fade and recovery test.

- a) Braking deceleration for test items evaluating effectiveness was set at 5.0m/s^2 with the transmission control position at neutral.
- b) The high temperature effectiveness test and the effectiveness spot check were included as optional items.

6.1.2.7.1 Fade test (5.2 i)2) of the main text)

Braking deceleration here differs from that in the first fade recovery test. Rather than being lowered, it was unified to 5.0m/s^2 to reduce complications. For systems equipped with a proportioning valve, conditions can be made less severe by setting the valve at 3.0m/s^2 thereby changing braking power proportion between the front and rear. When fade is assumed to take place on mountain roads, the conventional level of braking deceleration better simulates actual road conditions.

6.1.3 Allowable Modifications (5.3 of the main text)

6.1.3.1 Initial brake temperature (5.3.a) 2) of the main text)

The initial brake temperature was changed from $\pm 15^{\circ}\text{C}$ -> $\pm 10^{\circ}\text{C}$ to improve data accuracy.

When it is necessary to lower temperature conditions for any item, they should be lowered proportionately for all other items. The initial temperature of 60°C was retained in the fade test to accommodate comparison of test results. The term "vehicles of special construction" includes those equipped with forced cooling brakes.

6.1.3.2 Braking deceleration (53 b) 1) of the main text)

The previously specified value of ${}^{+0.2}_{0} \text{ m/s}^2$ was considered unrealistic for actual tests and was changed to ${}^{+0.5}_{0} \text{ m/s}^2$ to conform to the **Technical Standards**.

6.1.4 Unspecified Braking Operations (5.4 of the main text)

Braking operations for any purpose other than testing at speed/deceleration higher or lower than the level specified for burnish should be avoided. In braking operations required to achieve the initial brake temperature, the vehicle weight condition for the light load effectiveness test need not be adjusted to that of burnish.

6.1.5 Modification of Vehicle Classification (5.5 of the main text)

Tests may be conducted under conditions specified for a higher vehicle category if necessary for performance analysis. However, vehicles are generally expected to be subjected to the tests for their specific category.

6.1.6 Additional Test Items (5.6 of the main text)

The previously noted optional items (emergency brake, test/air servo and vacuum servo tests) which can affect the history of friction materials were deleted as this Standard is primarily concerned with "service brakes."

The **Parking Brake Test (JASO C428)** was retained but without sequence designation.

6.2 Records (6 of the main text)**6.2.1 Recording Procedures (6.1 of the main text)**

- a) The wheel lock condition is an important factor in analyzing the stability of the test vehicle during braking. It is especially important in the effectiveness test including light load. The occurrence of wheel lock and the condition of the vehicle at the time of occurrence must be recorded in detail and should include the wheel position and the timing at initial, intermediate and final braking stages, immediately before the stopping moment, etc.
- b) The specified test lane width of 3.5m is based on the amount of space assumed to be necessary for vehicles in actual road conditions. Both sides of the lane should be partitioned with barriers. Any breach of the barriers must be recorded with details of conditions and circumstances.
- c) The pedal force measured during breaking and the line pressure/pedal force measured in the stopped condition must be recorded. Pedal force during breaking may be taken from the gauge attached to the pedal, from other direct measurements, or a correlated calculation from the line pressure in the pipes. Any use of calculated pedal force value must include advanced measurements of any factors affecting the correlation between pedal force and line pressure or other items such as boost pressure at braking.
- d) Observation of the changing process (torque characteristics) of the pedal force is one of the most effective methods in tests where the braking deceleration is held constant. This Standard requires documentation of all 3 values including those for the initial, intermediate, and final stages for all test items. Special care is required to avoid ambient interference from braking operation and transient actions of the test vehicle. The revised specifications include reading the final value within the vehicle speed of 10km/h to avoid the influence of excessive tread on the brake pedal and accumulation during the period immediately prior to the stopping moment.
- e) The conditions of d) above apply to tests conducted at constant pedal force.
- f) In tests where braking deceleration is held constant, braking application meets specified conditions only when the value of braking deceleration falls within $\pm 15\%$ of the specified value. Any average value

outside that range is considered unobtainable and the actual value of braking deceleration (derived from the specified value) must be recorded together with the pedal force or line pressure.

- g) The reading sequence of the initial temperature for each wheel is clearly specified to avoid possible confusion of data caused by the time lag between initial and final readings.

6.2.2 Recording Forms (6.2 of the main text)

The average pedal force and the average deceleration, when recorded with a recording meter, should be obtained in accordance with the procedures specified in **Attached Fig. 1**. When values are read directly from measuring meters mounted on the test vehicle, they may be replaced with the respective mean values of the initial, intermediate, and final values in each braking application.

6.2.2.1 Summary Graphs of Service Brake Road Performance (Passenger Cars) (6.2a)2) of the main text)

The summary graph shall be drawn in the following manner.

- (a) When the alleviation of initial temperature condition is applied, circle "Applied". When the original condition is applied, circle "Not applied".
- (b) Enter, into the column _____m, the actual numerical value of braking interval recorded in the fade test.
- (c) For initial brake temperature, omit irrelevant numerical values.
- (d) For pedal force and line pressure, omit irrelevant values.

6.2.2.2 Summary Sheet of Service Brake Data and Road Performance (6.2b) of the main text)

The recording sheets and graphic sheets of test results per item are shown for reference and to facilitate testing.

Reference Data:

Technical Standards	Technical Standards of Brakes - Passenger Car (JSAE Official Notice 59 issued April 13, 1993)
FMVSS No.135	Passenger Car Brake Systems
FMVSS No.105a	Hydraulic Brake Systems
ECE Regulation No.13-H	Uniform Provisions Concerning the Approval of Passenger Cars with Regard to Braking
ISO 6597	Road Vehicles - Hydraulic Braking Systems - Measurement of Braking Performance
SAE J 843d	Brake System Road Test Code - Passenger Car

Attached Table 1 of Explanatory Notes JASO C402 Comparison Table

Item	Former	New
2. Objective of Establishment		Deleted and moved to Explanatory Notes
Applicable Publications	JASO C446(General Rules of Brake Test Method)	Newly provided. JIS D0210
3. Definition of Terms		Deleted
Definition		Newly provided.
5. Test Method	Braking operation 883N(90kgf) Pedal force 883N(90kgf) 3.7m lane	500N 500N 3.5m lane
(1) Preburnish Check	Initial braking speed 50km/h Transmission control position Normal driving gear Braking deceleration $2.9\text{m/s}^2(0.3\text{G})$ Cooling speed Acceleration condition Braking interval Number of applications 10 times Records	50 km/h or less Deleted Initial brake temperature 80°C or less Added 3.0m/s^2 or less Deleted Deleted Deleted 10 or less Braking deceleration Added
(2) First (Preburnish) Effectiveness Test	First (preburnish) effectiveness test In the description of the number of applications: 883N(90kgf) In case that the average braking deceleration to cause the wheel lock ... until either of the following conditions occurs. (a)(b) Record 3.7m lane	First effectiveness test 500N Deleted Deleted 3.5m lane
(3) Burnish	Initial deceleration $3.4\text{m/s}^2(0.35\text{G})$ Acceleration condition Braking interval 1600mm or 100 seconds (initial brake temperature of 120°C or above)	3.5m/s^2 Deleted 1500m (or 120°C of the initial brake temperature, whichever is attained earlier)
(4) Second Effectiveness Test	Second effectiveness test	☐ Low temperature effectiveness test newly provided ☐ Normal temperature effectiveness Test
(6) Light Load Effectiveness Test	Number of applications	Deleted
(7) First Fade and Recovery Test	☐ Base line check Initial braking speed 50km/h Transmission control position Normal driving gear Braking deceleration $2.9\text{m/s}^2(0.3\text{G})$	V_{max} 0/-20km/h Where 100km/h is the maximum Neutral 3.0m/s^2
	☐ Fade test Initial braking speed P1 vehicle 100km/h P2 vehicle 80km/h P3/P4 vehicle 65km/h Braking deceleration $4.4\text{m/s}^2(0.45\text{G})$	$\sqrt{(80\%V_{\text{max}})^2 - (40\%V_{\text{max}})^2}$ Where, 100km/h is the maximum 3.0m/s^2

Attached Table 1 of Explanatory Notes JASO C402 Comparison Table (continued)

Item	Former	New
(7) First Fade and Recovery Test	Acceleration condition: At max. capacity immediately after stopping Braking interval Remarks: and the cooling speed in that section ... 50km/h	Maximum acceleration immediately after stopping Time deleted Deleted and moved to the cooling effectiveness test
		☐ High temperature effectiveness test newly provided ☐ Cooling effectiveness test newly provided
	☐ Recovery test Initial braking speed 50km/h Transmission control position Normal driving gear Braking deceleration 2.9m/s ² (0.3G) Cooling speed 50km/h Acceleration condition Braking interval 1600m or 120 seconds No. of applications min. 12 times	Braking interval from preceding test Added Vmax 0/-20 km/h Where, 100km/h is the maximum Neutral 5.0m/s ² Vmax 0/-20 km/h Where, 100km/h is the maximum Deleted Deleted 1
	☐ Effectiveness spot check (optional) Initial braking speed P1 vehicle 100km/h P2 vehicle 80km/h P3/P4 vehicle 65km/h Transmission control position Normal driving gear Braking deceleration 4.4m/s ² (0.45G)	$\sqrt{(80\%V_{max})^2 - (40\%V_{max})^2}$ Where, 100km/h is the maximum Neutral 3.0m/s ²
(9) Second Fade and Recovery Test	☐ Base line check Transmission control position Normal driving gear Braking deceleration 2.9m/s ² (0.3G)	Neutral 5.0m/s ²
	☐ Fade test Initial braking speed P1 vehicle 100km/h P2 vehicle 80km/h P3/P4 vehicle 65km/h Braking deceleration 4.4m/s ² (0.45G) Acceleration condition: At max. capacity immediately after stopping Braking interval	$\sqrt{(80\%V_{max})^2 - (40\%V_{max})^2}$ Where, 100km/h is the maximum 5.0m/s ² maximum acceleration immediately after stopping Time deleted
		☐ High temperature effectiveness test (optional) Newly provided
	☐ Recovery test Transmission control position Normal driving gear Braking deceleration 2.9m/s ² (0.3G) Acceleration condition Normal Braking interval 1600m or 120 seconds	Braking interval from preceding test Added Neutral 5.0m/s ² Deleted 1500m
	☐ Effectiveness spot check (optional) Initial braking speed P1 vehicle 100km/h P2 vehicle 80km/h P3/P4 vehicle 65km/h Transmission control position Normal driving gear Braking deceleration 4.4m/s ² (0.45G)	$\sqrt{(80\%V_{max})^2 - (40\%V_{max})^2}$ Where, 100km/h is the maximum Neutral 5.0m/s ²

Attached Table 1 of Explanatory Notes JASO C402 Comparison Table (continued)

Item	Former	New																		
(13) Water Recovery Test	☐ Base line check Braking deceleration 2.9m/s²(0.3G)	3.0m/s ²																		
	☐ Recovery test Braking deceleration 2.9m/s²(0.3G) Acceleration condition Braking interval	Braking interval from preceding test Added 3.0m/s ² Deleted Time deleted																		
5.3 Allowable Modifications	(1)(b) Initial brake temperature ± 15°C (2)(a) Braking deceleration +0.2 +00.2 0 m/s² { 0 G }	±10°C +0.5 0 m/s ²																		
	1) Braking interval <Former> <table><tr><th>Test Item</th><th>Braking Interval</th><th>Braking Distance (m)</th><th>Time (s)</th></tr><tr><td>Fade</td><td></td><td>640±150</td><td>P1 Vehicle 35±5 P2 Vehicle 40±7 P3,P4 Vehicle 45±9</td></tr><tr><td>Preburnish Check Burnish Recovery (Fade Recovery Test)</td><td></td><td>1600±300</td><td>120±20 100±17 120±20</td></tr></table> <New> (m) Time deleted <table><tr><th>Test item</th><th>Braking Interval (distance)</th></tr><tr><td>Fade Test</td><td>640±150</td></tr><tr><td>Burnish Cooling Effectiveness Test Cooling Recovery Test</td><td>1500±300</td></tr></table>		Test Item	Braking Interval	Braking Distance (m)	Time (s)	Fade		640±150	P1 Vehicle 35±5 P2 Vehicle 40±7 P3,P4 Vehicle 45±9	Preburnish Check Burnish Recovery (Fade Recovery Test)		1600±300	120±20 100±17 120±20	Test item	Braking Interval (distance)	Fade Test	640±150	Burnish Cooling Effectiveness Test Cooling Recovery Test	1500±300
Test Item	Braking Interval	Braking Distance (m)	Time (s)																	
Fade		640±150	P1 Vehicle 35±5 P2 Vehicle 40±7 P3,P4 Vehicle 45±9																	
Preburnish Check Burnish Recovery (Fade Recovery Test)		1600±300	120±20 100±17 120±20																	
Test item	Braking Interval (distance)																			
Fade Test	640±150																			
Burnish Cooling Effectiveness Test Cooling Recovery Test	1500±300																			
5.6 Additional Test Items	1) Parking brake test Performed following the first Reburnish 2) Emergency brake test 3) Air servo and vacuum servo brake test	Sequence not designated Deleted Deleted																		
6. Records Recording Procedures Recording Forms	6.1(2) Skid control device 6.1(3) 3.7 lane 6.2(1)(a) The average value of pedal force at average braking deceleration of 0.6G(5.9m/s²) or 0.5G(4.9m/s²) in the effectiveness test ... (2)(a) Recording sheets of test results per item (Tables 3 to 7) (b) Graphic sheets of test results per item (Tables 8 to 11)	Anti-lock device 3.5m lane The average value of pedal force at average braking deceleration of 6.0m/s ² ... (Attached Tables 3 to 8) (Attached Tables 9 to 13)																		

Attached Table 1 of Explanatory Notes JASO C402 Comparison Table (continued)

Item	Former	New
Attached Table 3	First (preburnish) effectiveness test	First effectiveness test
Attached Table 4		Second effectiveness test Low temp. effectiveness test Normal temp. effectiveness test Newly provided First fade and recovery test Next page
Attached Table 5		High temp. effectiveness test & cooling effectiveness test Newly provided Second fade test Next page
Attached Table 6		High temp. effectiveness test Newly provided Final effectiveness test Next page
Attached Table 7		Final inspection Next page
Attached Table 8	Burnish graph sheet	Final inspection only
Attached Table 9	Effectiveness test graph sheet	Burnish graph sheet No. of repetitions entered
Attached Table 10	Fade and recovery test graph sheet	Effectiveness test graph sheet
Attached Table 11	Water recovery test graph sheet	First fade and recovery test graph sheet
Attached Table 12		Second fade and recovery test graph sheet
Attached Table 13		Water recovery test graph sheet