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Section 105 — Hydraulic Brake systems

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SECTION 105 — HYDRAULIC BRAKE SYSTEMS

1. INTRODUCTION

Subsections 2, 3, 4 and 5, Figures I and II, and Tables I, II, III and IV of this Chapter make up test methods referred to in section 105 of Schedule IV to the Motor Vehicle Safety Regulations, which I approve for demonstrating compliance with the requirements of section 105 of Schedule IV.

(Original signed by)

S.C. Wilson,
for the Minister of Transport,
Ottawa, Ontario

2. DEFINITIONS

"antilock system" means a portion of a service brake system of a vehicle that automatically controls the degree of rotational wheel slip at one or more road wheels of the vehicle during braking;

"backup system" means a portion of a service brake system of a vehicle, such as a pump, that supplies energy in the event of a primary brake power source failure;

"brake power assist unit" means a device installed in a hydraulic brake system of a vehicle that reduces the effort required by the operator to actuate the system, and that if inoperative does not prevent the operator from braking the vehicle by a continued application of muscular force on the service brake control;

"brake power unit" means a device installed in a brake system of a vehicle that provides the energy required to actuate the brakes, either directly or indirectly, through an auxiliary device, with the operator action consisting only of modulating the energy application level;

"hydraulic brake system" means a system that uses hydraulic fluid as a medium for transmitting force from a service brake control to the service brake, and that may incorporate a brake power assist unit or a brake power unit;

"initial brake temperature" means the average temperature of the service brakes on the hottest axle of the vehicle 322 m (0.2 miles) before any brake application;

"lightly loaded vehicle weight" means:

(a) for vehicles with a GVWR of 4 536 kg (10,000 pounds) or less, unloaded vehicle weight plus 181.5 kg (400 pounds) (including driver and instrumentation); or

(b) for vehicles with a GVWR greater than 4 536 kg (10,000 pounds) unloaded vehicle weight plus 226.8 kg (500 pounds) (including driver and instrumentation);

"parking mechanism" means a component or subsystem of the drive train that locks the drive train when the transmission control is placed in a parking or other gear position and the ignition key is removed;

"pressure component" means the brake system component that contains the brake system fluid and controls or senses the fluid pressure;

"skid number" means the frictional resistance of a pavement measured in accordance with American Society for Testing and Materials Method E-274-70 (as revised, July 1974) at 64.37 km/h (40 mph) omitting water delivery as specified in paragraph 7.1 and 7.2 of that method;

"snub" means the braking deceleration of a vehicle from a higher reference speed to a lower reference speed that is greater than zero;

"speed attainable in 3.22 km (2 miles)" means the speed attainable by accelerating at maximum rate from a standing start for a distance of 3.22 km (2 miles) on a level surface;

"spike stop" means a stop resulting from the application of 889.6 N (200 pounds) of force on the service brake control in 0.08 sec.;

"split service brake system" means a brake system consisting of two or more subsystems actuated by a single control designed so that a leakage-type failure of a pressure component in a single subsystem (except structural failure of a housing that is common to two or more subsystem) shall not impair the operation of any other subsystem;

"stopping distance" means the distance travelled by a vehicle from the point at which force is applied to the brake control to the point at which the vehicle reaches a full stop;

"variable proportioning brake system" means a system that automatically adjusts the braking force at the axles to compensate for vehicle static axle loading or dynamic weight transfer between axles during deceleration, or both.

3. BRAKE TEST PROCEDURE

Table I sets out the brake test procedure sequence and references the appropriate sections of the test methods for test procedures and the CMVSS for performance requirements.

Table I - Brake Test Procedures

Sequence and Requirements

No.		Test Load Light GVWR	Procedure	Requirements CMVSS 105
1	Instrumentation Check		5.2	
2	First (preburnish) effectiveness test	X	5.3	(5)(a)
3	Burnish procedure	X	5.4	
4	Second effectiveness	X	5.5	(5)(b)
5	First reburnish	X	5.6	
6	Parking brake	X	X	5.7
7	Third effectiveness (lightly loaded vehicle)	X	5.8	(24) to (27)
8	Partial failure	X	X	5.9
9	Inoperative brake power and power assist units		X	5.10
10	First fade and recovery		X	5.11
11	Second reburnish		X	5.12
12	Second fade and recovery		X	5.13
13	Third reburnish		X	5.14
14	Fourth effectiveness		X	5.15
15	Water recovery		X	5.16
16	Spike stops		X	5.17
17	Final inspection		X	5.18
18	Moving barrier test		X	5.19

4. TEST CONDITIONS

The performance requirements shall be met under the following conditions:
Where a range of conditions is specified, the vehicle shall be capable of meeting the requirements at all points within the range.

4.1 VEHICLE WEIGHT

- 4.1.1 Other than tests specified at lightly loaded vehicle weight in 5.7, 5.8, and 5.9, the vehicle is loaded to its GVWR such that the weight on each axle as measured at the tire ground interface is in proportion to its GAWR, except that each fuel tank is filled to any level from 100 percent of capacity (corresponding to full GVWR loading) to 75 percent capacity. However, if the weight on any axle of a vehicle at lightly loaded vehicle weight exceeds the axle's proportional share of the gross vehicle weight rating, the load required to reach GVWR is placed so that the weight on that axle remains the same as at lightly loaded vehicle weight.
- 4.1.2 For the applicable tests specified in 5.7, 5.8, 5.9, vehicle weight is lightly loaded vehicle weight, with the added weight distributed in the front passenger seat area in passenger cars, multipurpose passenger vehicles and trucks, and in the area adjacent to the driver's seat in buses.

4.2 RESERVED

4.3 TIRE INFLATION PRESSURE

Tire inflation pressure is the pressure recommended by the vehicle manufacturer for the GVWR of the vehicle.

4.4 TRANSMISSION SELECTOR CONTROL

For 5.3, 5.5, 5.8, 5.15, 5.17, 5.11.1.2, 5.11.2.2, 5.11.3.2, and as required for 5.13, the transmission selector control is in neutral for all decelerations. For all other tests during all decelerations, the transmission selector is in the control position, other than overdrive, recommended by the manufacturer for driving on a level surface at the applicable test speed. To avoid engine stall during tests required to be run in gear a manual transmission may be shifted to neutral (or the clutch disengaged) when the vehicle speed decreases to 32.18 km/h (20 mph).

4.5 ENGINE

Engine idle speed and ignition timing settings are according to the manufacturer's recommendations. If the vehicle is equipped with an adjustable engine speed governor, it is adjusted according to the manufacturer's recommendation.

4.6 VEHICLE OPENINGS

All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) are closed except as required for instrumentation purposes.

4.7 AMBIENT TEMPERATURE

The ambient temperature is any temperature between 0°C and 37.8°C (32°F and 100°F).

4.8 WIND VELOCITY

The wind velocity is zero.

4.9 ROAD SURFACE

Road tests are conducted on a 3.66 m (12 foot) wide, level roadway having a skid number of 81. Burnish stops are conducted on any surface. The parking brake test surface is clean, dry, smooth Portland cement concrete.

4.10 VEHICLE POSITION

The vehicle is aligned in the centre of the roadway at the start of each brake application. Stops, other than spike stops, are made without any part of the vehicle leaving the roadway. Except as noted below, stops are made without lockup of any wheel at speeds greater than 16.1 km/h (10 mph). There may be controlled lockup on an antilock-equipped axle and lockup of not more than one wheel per vehicle, uncontrolled by an antilock system. Dual wheels on one side of an axle are considered a single wheel. Locked wheels at speeds greater than 16.1 km/h (10 mph) are allowed during spike stops (but not spike check stops), partial failure stops and inoperative brake power or power assist unit stops.

4.11 THERMOCOUPLES

The brake temperature is measured by plug-type thermocouples installed in the approximate centre of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in figure I. A second thermocouple may be

installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the metal rubbing surface of a drum or motor. For centre-grooved shoes or pads, thermocouples are installed within 3.2 to 6.4 mm (0.125 to 0.25 in.) of the groove and as close to the centre as possible.

4.12 INITIAL BRAKE TEMPERATURE

Unless otherwise specified the brake temperature is 65.6°C to 93.3°C (150°F to 200°F).

4.13 CONTROL FORCES

Unless otherwise specified the force applied to a brake control is not less than 66.7 N (15 pounds) and not more than 667.2 N (150 pounds).

5. TEST PROCEDURES AND SEQUENCE

Each vehicle shall be capable of meeting all performance requirements when tested according to the procedures and in the sequence set forth below, without replacing any brake system part or making any adjustments to the brake system other than as permitted in burnish and reburnish procedures and in 5.9 and 5.10. For vehicles only having to meet the requirements of CMVSS 105(2), (3), (7), (9) and (23), the applicable test procedures and sequence are 5.1, 5.2, 5.4, 5.9, 5.10 and 5.18. However, at the option of the manufacturer, the following test procedures and sequence may be conducted: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10 and 5.18. The choice of this option shall not be construed as adding to the requirements specified in CMVSS 105(7) to (12) and (23)(a) and (b). Automatic adjusters may be locked out, according to the manufacturer's recommendations, when the vehicle is prepared for testing. If this option is selected, adjusters must remain locked out for the entire sequence of tests. A vehicle shall be deemed to comply with the stopping distance requirements of CMVSS 105(5), (6), (7), (8), (22) and (23) if at least one of the stops at each speed and load specified in each of 5.3, 5.5, 5.8, 5.9, 5.10, 5.15 and 5.17 (check stops) is made within a stopping distance that does not exceed the corresponding distance specified in Table II. When the transmission selector control is required to be in neutral for a deceleration, a stop or snub shall be obtained by the following procedures:

- (1) exceed the test speed by 6.44 to 12.88 km/h (4 to 8 mph);
- (2) close the throttle and coast in gear to approximately 3.22 km/h (2 mph) above the test speed;
- (3) shift to neutral;

- (4) when the test speed is reached, apply the service brakes.

5.1 BRAKE WARMING

If the initial brake temperature for the first stop in a test procedure (other than 5.7 and 5.16) has not been reached, heat the brakes to the initial brake temperature by making not more than 10 snubs from not more than 64.4 to 16.1 km/h (40 to 10 mph), at a deceleration not greater than 3.05 m/s^2 (10 fpsps).

5.2 PRETEST INSTRUMENTATION CHECK

Conduct a general check of instrumentation by making not more than 10 stops from a speed of not more than 48.3 km/h (30 mph) or 10 snubs from a speed of not more than 64.4 to 16.1 km/h (40 to 10 mph), at a deceleration of not more than 3.05 m/s^2 (10 fpsps). If instrument repair, replacement, or adjustment is necessary, make not more than 10 additional stops or snubs after such repair, replacement, or adjustment.

TABLE II
STOPPING DISTANCE FOR TESTS INDICATED
First (preburnish)*, Fourth Effectiveness**, and
Spike Effectiveness Check§

COLUMN I									
Vehicle Speed Test		(a)		(b)		(c)		(d)	
km/h	mph	metres	feet	metres	feet	metres	feet	metres	feet
48.28	30	†17.38	†57	†‡19.82	†‡65	†‡21.04* †‡19.82**§ †21.95	†‡69* †‡65**§ †72	†26.83	†88
56.33	35	22.56	74	25.30	83	27.74	91	40.24	132
64.37	40	29.27	96	32.93	108	36.28	119	52.74	173
72.42	45	36.89	121	41.77	137	45.73	150	66.46	218
80.47	50	45.73	150	51.52	169	56.40	185	80.49	264
88.51	55	55.18	181	62.20	204	68.29	224	99.39	326
96.56	60	†65.85	†216	†73.78	†242	†81.40	†267	†118.29	†388
128.75	80	†123.48	†405	†139.94	†459	†155.49	†510	NA	NA
152.89	95	†185.06	†607	NA	NA	NA	NA	NA	NA
160.93	100	†205.18	†673	NA	NA	NA	NA	NA	NA

TABLE II (Continued)
STOPPING DISTANCE FOR TESTS INDICATED
 Second Effectiveness

COLUMN II							
Vehicle Speed Test		(a)		(b) and (c)		(d)	
km/h	mph	metres	feet	metres	feet	metres	feet
48.28	30	†16.46	†54	†17.38	†57	†24.70	†81
56.33	35	21.34	70	22.56	74	40.24	132
64.37	40	27.74	91	29.27	96	52.74	173
72.42	45	35.06	115	36.89	121	66.46	218
80.47	50	43.29	142	45.73	150	80.49	264
88.51	55	52.44	172	55.18	181	99.39	326
96.56	60	†62.20	†204	†65.85	†216	†118.29	†388
128.75	80	†116.77	†383	NA	NA	NA	NA
152.89	95	NA	NA	NA	NA	NA	NA
160.93	100	NA	NA	NA	NA	NA	NA

† Distances for specified tests

‡ Applicable to school buses only

NA = Not applicable

* Applies only to the First (preburnish) Test

** Applies only to the Fourth Effectiveness Test

§ Applies only to the Spike Effectiveness Check Test

(a) Passenger cars

(b) Vehicles other than passenger cars with a GVWR of less of 3 629 kg (8,000 pounds)

(c) Vehicles with a GVWR of not less than 3 629 kg (8,000 pounds) and not more than 4 536 kg (10,000 pounds)

(d) Vehicles with a GVWR greater than 4 526 kg (10,000 pounds)

TABLE II (Continued)
STOPPING DISTANCE FOR TESTS INDICATED
 Third (lightly loaded vehicle) Effectiveness

COLUMN III									
Vehicle Speed Test		(a)		(b)		(c)		(d)	
km/h	mph	metres	feet	metres	feet	metres	feet	metres	feet
48.28	30	15.55	51	†17.38	†57	19.82	65	24.70	81
56.33	35	20.43	67	22.56	74	25.30	83	40.24	132
64.37	40	26.52	87	29.27	96	32.93	108	52.74	173
72.42	45	33.54	110	36.89	121	41.77	137	66.46	218
80.47	50	41.16	135	45.73	150	51.52	169	80.49	264
88.51	55	49.70	163	55.18	181	62.20	204	99.39	326
96.56	60	†59.15	†194	†65.85	†216	†73.78	†242	†118.29	†388
128.75	80	NA	NA	NA	NA	NA	NA	NA	NA
152.89	95	NA	NA	NA	NA	NA	NA	NA	NA
160.93	100	NA	NA	NA	NA	NA	NA	NA	NA

TABLE II (Continued)
STOPPING DISTANCE FOR TESTS INDICATED
 Inoperative Brake Power and Power Assist Unit Test
 and Partial Failure Test

COLUMN IV							
Vehicle Speed Test		(a)		(b) and (c)		(d)	
km/h	mph	metres	feet	metres	feet	metres	feet
48.28	30	34.76	114	39.63	130	51.83	170
56.33	35	47.26	155	53.66	176	68.60	225
64.37	40	61.59	202	69.82	229	87.80	288
72.42	45	78.35	257	88.72	291	109.15	358
80.47	50	96.65	317	109.45	359	132.62	435
88.51	55	116.77	383	132.01	433	161.59	530
96.56	60	†139.02	†456	†157.62	†517	†186.89	†613
128.75	80	NA	NA	NA	NA	NA	NA
152.89	95	NA	NA	NA	NA	NA	NA
160.93	100	NA	NA	NA	NA	NA	NA

† Distances for specified tests

NA = Not applicable

- (a) Passenger cars
- (b) Vehicles other than passenger cars with a GVWR of less of 3 629 kg (8,000 pounds)
- (c) Vehicles with a GVWR of not less than 3 629 kg (8,000 pounds) and not more than 4 536 kg (10,000 pounds)
- (d) Vehicles with a GVWR greater than 4 526 kg (10,000 pounds)

5.3 SERVICE BRAKE SYSTEM - FIRST (PREBURNISH) EFFECTIVENESS TEST

Make six stops from 48.3 km/h (30 mph). Then make six stops from 96.6 km/h (60 mph).

5.4 SERVICE BRAKE SYSTEM - BURNISH PROCEDURE

5.4.1 Burnish for Vehicles with GVWR of 4 536 kg (10,000 pounds) or less

Burnish the brakes by making 200 stops from 64.4 km/h (40 mph) at 3.66 m/s² (12 fpsps) (the 667.2 N (150 pounds) control force limit does not apply here). The interval from the start of one service brake application to the start of the next shall be either the time necessary to reduce the initial brake temperature to between 110°C to 132°C (230°F and 270°F), or the distance of 1.6 km (1 mile), whichever occurs first. Accelerate to 64.4 km/h (40 mph) after each stop and maintain that speed until making the next stop.

5.4.2 Burnish for Vehicles with GVWR Greater than 4 536 kg (10,000 pounds)

5.4.2.1 Burnish

Burnish the brakes by making 500 snubs from 64.4 km/h (40 mph) to 32.2 km/h (20 mph) at a rate of deceleration of 3.05 m/s² (10 fpsps). Except when an adjustment is specified, after each braking application accelerate to 64.4 km/h and maintain that speed until making the next braking application at a distance of 1.6 km (1.0 mile) from the location where the brakes were first applied during the previous snub. If the vehicle cannot attain a speed of 64.4 km/h within 1.6 km, continue to accelerate until the vehicle attains 64.4 km/h or until the vehicle has traveled 2.4 km (1.5 miles) from the location where the brakes were first applied during the previous snub, whichever occurs first. The brakes will be adjusted in accordance with the manufacturer's recommendations after 125, 250, and 375 snubs.

5.4.2.2 Burnish

The following burnish may be used as an alternative to the burnish specified in 5.4.2.1 up to, but not after September 1, 1993. Burnish the brakes by making 500 snubs at 3.05 m/s² (10 fpsps) in the sequence specified in Table III and within the speed ranges indicated. After each

brake application accelerate to the next speed specified and maintain that speed until making the next brake application at a point 1.6 km (1 mile) from the initial point of the previous brake application. If a vehicle cannot attain any speed specific in 1.6 km (1 mile), continue to accelerate until the speed specified is reached or until 2.4 km (1.5 mile) from the initial point of the previous brake application is reached, whichever occurs first. If during any of the brake applications specified in Table III the temperature of the hottest brake exceeds 260°C (500°F) make the remainder of the 500 applications from that snub condition, except that a higher or lower snub condition shall be followed (up to the 96.6 km/h (60 mph) initial speed) as necessary to maintain a temperature of 260°C $\pm$ 10°C (500°F $\pm$ 50°F). However, if at a snub condition of 64.4 km/h (40 mph) to 32.2 km/h (20 mph), the temperature of the hottest brake exceeds 260°C make the remainder of the 500 brake applications from that snub condition, without regard to brake temperature. The brakes shall be adjusted three times during the burnish procedure, in accordance with the manufacturer's recommendations, after 125, 250, and 375 snubs.

Table III

Series	Snubs	Snub Conditions (highest speed indicated)	
		km/h	(miles per hour)
1	175	64.4 - 32.2	(40-20)
2	25	72.4 - 32.2	(45-20)
3	25	80.5 - 32.2	(50-20)
4	25	88.5 - 32.2	(55-20)
5	250	96.6 - 32.2	(60-20)

5.4.3 Brake Adjustment - Post Burnish

After burnishing, adjust the brakes in accordance with the manufacturer's recommendation.

5.5 SERVICE BRAKE SYSTEM - SECOND EFFECTIVENESS TEST

Repeat 5.3. Then, for passenger cars and vehicles with a GVWR of 4 536 kg (10,000 pounds) or less, make four stops from 128.8 km/h (80 mph) if the speed attainable in 3.22 km (2 miles) is not less than 135.2 km/h (84 mph).

5.6 FIRST REBURNISH

Repeat 5.4, except make 35 burnish stops or snubs. In the case of vehicles burnished in accordance with 5.4.2.2, reburnish the vehicle by making 35 snubs from 96.6 to 32.2 km/h (60 to 20 mph), but if the hottest brake temperature reaches $260^{\circ}\text{C} \pm 28^{\circ}\text{C}$ ($500^{\circ}\text{F} \pm 50^{\circ}\text{F}$), make the remainder of the brake applications from the highest snub condition listed in Table III that will maintain the hottest brake temperature at $260^{\circ}\text{C} \pm 28^{\circ}\text{C}$ ($500^{\circ}\text{F} \pm 50^{\circ}\text{F}$). If at a snub condition of 64.4 to 32.2 km/h (40 to 20 mph), the temperature of the hottest brake exceeds 288°C (550°F) make the remainder of the 35 brake applications from that snub condition without regard to brake temperature.

5.7 PARKING BRAKE TEST

The parking brake tests for any vehicle on different grades, in different directions, and for different loads may be conducted in any order. The force required for actuation of a hand-operated brake system shall be measured at the centre of the hand grip area or at a distance of 38 mm (1.5 inches) from the end of the actuation lever, as illustrated in Figure II.

5.7.1 Test Procedures for Requirements on Vehicles with Transmissions not Incorporating a Parking Mechanism

- 5.7.1.1 Condition the parking brake friction elements so that the temperature at the beginning of the test is at any level not more than 65.6°C (150°F) (when the temperature of components on both ends of an axle are averaged).
- 5.7.1.2 Drive the vehicle, loaded to GVWR, onto the specified grade with the longitudinal axis of the vehicle in the direction of the slope of the grade. Stop the vehicle and hold it stationary by application of the service brake control, and place the transmission in neutral.
- 5.7.1.3 With the vehicle held stationary by means of the service brake control, apply the parking brake by a single application of the force specified in (a) or (b), except that a series of applications to achieve the specified force may be made in the case of a parking brake system design that does not allow the application of the specified force in a single application:
 - a) In the case of a passenger car or other vehicle with a GVWR of 4 536 kg (10,000 pounds) or less, not more than 556 N (125 pounds) for a foot operated system, and not more than 400.3 N (90 pounds) for a hand-operated system; and

- b) In the case of a school bus with a GVWR of more than 4 536 kg (10,000 pounds), not more than 667.2 N (150 pounds) for a foot-operated system, and not more than 556 N (125 pounds) for a hand-operated system.
- 5.7.1.4 Following the application of the parking brake in accordance with 5.7.1.3, release all force on the service brake control and commence the measurement of time if the vehicle remains stationary. If the vehicle does not remain stationary, reapplication of the service brake to hold the vehicle stationary, with reapplication of a force to the parking brake control at the level specified in 5.7.1.3 (a) or (b) as appropriate for the vehicle being tested (without release of the ratcheting or other holding mechanism of the parking brake) may be used twice to attain a stationary position.
- 5.7.1.5 Following observation of the vehicle in a stationary condition for the specified time in one direction, repeat the same test procedure with the vehicle orientation in the opposite direction on the specified grade.
- 5.7.1.6 Check the operation of the parking brake application indicator specified in (31)(d) of CMVSS 105.

5.7.2 Test Procedures for Requirements of Vehicles with Transmissions that Incorporate a Parking Mechanism

- a) Check that transmission must be placed in park position to release key;
- b) Test as in 5.7.1, except in addition place the transmission control to engage the parking mechanism;
- c) Test as in 5.7.1 except on a 20 percent grade with the parking mechanism not engaged.

5.7.3 Lightly Loaded Vehicle

Repeat 5.7.1 or 5.7.2 (as applicable except with the vehicle at lightly loaded vehicle weight).

5.7.4 Non-service Brake Type Parking Brake Systems

For vehicles with parking brake systems not utilizing the service brake friction elements, burnish the friction elements of such systems prior to parking brake test according to the manufacturer's published recommendations as furnished to the

purchaser. If no recommendations are furnished, run the vehicle in an unburnished condition.

5.8 SERVICE BRAKE SYSTEM - LIGHTLY LOADED VEHICLE (THIRD EFFECTIVENESS TEST)

Make six stops from 96.56 km/h (60 mph) with vehicle at lightly loaded vehicle weight. This test is not applicable to a vehicle, other than a school bus, that has both a GVWR of not less than 3 629 kg (8,000 pounds) and not more than 4 536 kg (10,000 pounds).

5.9 SERVICE BRAKE SYSTEM TEST - PARTIAL FAILURE

- 5.9.1 With the vehicle at lightly loaded vehicle weight, alter the service brake system to produce any one rupture or leakage type of failure other than a structural failure of a housing that is common to two or more subsystems. Determine the control force, pressure level or fluid level, (as appropriate for the indicator being tested) necessary to activate the brake system failure indicator lamp. Make four stops if the vehicle is equipped with a split service brake system, or 10 stops if the vehicle is not so equipped, each from 96.56 km/h (60 mph), by a continuous application of the service brake control. Restore the service brake system to normal at completion of this test.
- 5.9.2 Repeat 5.9.1 for each of the other subsystems.
- 5.9.3 Repeat 5.9.1 and 5.9.2 with vehicle at GVWR. Restore the service brake system to normal at the completion of the test.
- 5.9.4 (For vehicles with antilock and/or variable proportioning brake systems). With vehicle at GVWR disconnect functional power source, or otherwise render antilock system inoperative. Disconnect variable proportioning brake system. Make four stops, each from 96.56 km/h (60 mph). If more than one antilock or variable proportioning brake subsystem is provided, disconnect or render one subsystem inoperative and run as above. Restore system to normal at completion of this test. Repeat for each subsystem provided. Determine whether the brake system indicator lamp is activated when the electrical power source to the antilock or variable proportioning unit is disconnected.

5.10 SERVICE BRAKE SYSTEM - INOPERATIVE BRAKE POWER UNIT OR BRAKE POWER ASSIST UNIT TEST

(For vehicles equipped with brake power assist unit or brake power unit).

5.10.1 Regular Procedure

(This test need not be run if the option in 5.10.2 is selected). On vehicles with brake power assist units, render the brake power assist unit inoperative, or one of the brake power assist unit subsystems if two or more subsystems are provided, by disconnecting the relevant power supply. Exhaust any residual brake power reserve capability of the disconnected system. On vehicles with brake power units, disconnect the primary source of power. Make four stops, each from 96.56 km/h (60 mph), by a continuous application of the service brake control. Restore the system to normal at completion of this test. For vehicles equipped with more than one brake power unit or brake power assist unit, conduct tests of each in turn.

5.10.2 Optional Procedures

On vehicles with brake power assist units, the unit is charged to maximum prior to start of test. (Engine may be run up in speed, then throttle closed quickly to attain maximum charge on vacuum assist units). Brake power units shall also be charged to maximum accumulator pressure prior to start of test. No recharging is allowed after the start of test.

- a) (For vehicles with brake power assist units). Disconnect the primary source of power. Make six stops each from 96.56 km/h (60 mph) to achieve the average deceleration for each stop as specified in Table IV. Apply the brake control as quickly as possible. Maintain control force until vehicle has stopped. At the completion of the stops specified above, deplete the system of any residual brake power reserve capability. Make one stop from 96.56 km/h (60 mph) at an average deceleration of not lower than 2.13 m/s^2 (7 fpsps) for passenger cars (equivalent stopping distance 168.8 m (554 feet)), or 1.83 m/s^2 (6 fpsps) for vehicles other than passenger cars (equivalent stopping distance 197.0 m (646 feet)), and determine whether the control force exceeds 667.2 N (150 pounds).
- b) (For vehicles with brake power units with accumulator type systems). Test as in 5.10.2(a), except make 10 stops instead of 6 and, at the completion of the 10 stops, deplete the failed element of the brake power unit of any residual brake power reserve capability before making the final stop.

- c) (For vehicles with brake power assist or brake power units with backup systems). If the brake power or brake power assist unit operates in conjunction with a backup system and the backup system is activated automatically in the event of a primary power failure the backup system is operative during this test. Disconnect the primary source of power of one subsystem. Make 15 stops, each from 96.56 km/h (60 mph), with the backup system activated for the failed subsystem, to achieve an average deceleration of 3.66 m/s² (12 fpsps) for each stop.
- d) Restore systems to normal at completion of these tests. For vehicles equipped with more than one brake power assist or brake power unit, conduct tests of each in turn.

Table IV

INOPERATIVE BRAKE POWER ASSIST AND BRAKE POWER UNITS
Average Deceleration

STOP P NO.	COLUMN 1				COLUMN 2			
	Brake Power Assist				Brake Power Unit			
	(a)		(b) and (c)		(a)		(b) and (c)	
	m/s ²	fpsps	m/s ²	fpsps	m/s ²	fpsps	m/s ²	fpsps
1	4.88	16.0	4.27	16.0	4.88	16.0	3.96	13.0
2	3.66	12.0	3.66	13.0	3.96	13.0	3.35	11.0
3	3.05	10.0	3.05	10.0	3.66	12.0	3.05	10.0
4	2.74	9.0	2.59	8.5	3.35	11.0	2.90	9.5
5	2.44	8.0	2.29	7.5	3.05	10.0	2.74	9.0
6	2.29	7.5	2.04	6.7	2.90	9.5	2.59	8.5
7	†2.13	†7.0	†1.83	†6.0	2.74	9.0	2.44	8.0
8	NA	NA	NA	NA	2.59	8.5	2.29	7.5
9	NA	NA	NA	NA	2.44	8.0	2.13	7.0
10	NA	NA	NA	NA	2.29	7.5	2.04	6.7
11	NA	NA	NA	NA	†2.13	†7.0	†1.83	†6.0

Table IV (Continued)

INOPERATIVE BRAKE POWER ASSIST AND BRAKE POWER UNITS
Equivalent Stopping Distance

STOP NO.	COLUMN 3				COLUMN 4			
	Brake Power Assist				Brake Power Unit			
	(a)		(b) and (c)		(a)		(b) and (c)	
	metres	feet	metres	feet	metres	feet	metres	feet
1	73.8	242	87.5	277	73.8	242	90.6	298
2	98.5	323	98.5	323	90.8	298	107.3	352
3	118.3	388	118.3	388	98.5	323	118.3	388
4	131.4	431	139.0	456	107.3	352	124.7	409
5	147.6	484	157.6	517	118.3	388	131.4	431
6	157.6	517	176.8	580	124.7	409	139.0	456
7	168.9	554	196.6	646	131.4	431	147.6	484
8	NA	NA	NA	NA	139.0	456	157.6	517
9	NA	NA	NA	NA	147.6	484	168.9	554
10	NA	NA	NA	NA	157.6	517	181.7	596
11	NA	NA	NA	NA	168.9	554	196.6	646

† Depleted

NA = Not applicable

(a) Passenger cars

(b) Vehicles other than passenger cars with a GVWR of 4 536 kg (10,000 pounds) or less

(c) Vehicles with a GVWR greater than 4 536 kg (10,000 pounds)

5.11 SERVICE BRAKE SYSTEM – FIRST FADE AND RECOVERY TEST

5.11.1 Baseline Check Stops or Snubs

5.11.1.1 Vehicles with GVWR of 4 536 kg (10,000 pounds) or Less

Make three stops from 48.28 km/h (30 mph) at 3.05 m/s² (10 fpsps) for each stop. Control force readings may be terminated when vehicle speed falls to 805 km/h (5 mph). Average the maximum brake control force required for the three stops.

5.11.1.2 Vehicles with GVWR greater than 4 536 kg (10,000 pounds)

With transmission in neutral (or declutched), make three snubs from 64.37 to 32.18 km/h (40 to 20 mph) at 3.05 m/s^2 (10 fpsps) for each snub. Average the maximum brake control force required for the three snubs.

5.11.2 Fade Stops or Snubs

5.11.2.1 Vehicles with GVWR of 4 536 kg (10,000 pounds) or Less

Make 5 stops from 96.56 km/h (60 mph) at 4.57 m/s^2 (15 fpsps) followed by 5 stops at the maximum attainable deceleration between 1.52 and 4.57 m/s^2 (5 and 15 fpsps) for each stop. Establish an initial brake temperature before the first brake application of 54.4°C to 65.6°C (130°F to 150°F). Initial brake temperatures before brake applications for subsequent stops are those occurring at the distance intervals. Attain the required deceleration within 1 second and, as a minimum, maintain it for the remainder of the stopping time. Control force readings may be terminated when vehicle speed falls to 8.05 km/h (5 mph). Leave an interval of 0.64 km (0.4 mile) between the start of brake applications. Accelerate immediately to the initial test speed after each stop. Drive 1.6 km (1 mile) at 48.28 km/h (30 mph) after the last fade stop, and immediately follow the recovery procedure specified in 5.11.3.1.

5.11.2.2 Vehicles with GVWR Greater than 4 536 kg (10,000 pounds)

With transmission in neutral (or declutched) make 10 snubs from 64.37 to 32.18 km/h (40 to 20 mph) at 3.05 m/s^2 (10 fpsps) for each snub. Establish an initial brake temperature before the first brake application of 54.4°C to 65.6°C (130°F to 150°F). Initial brake temperatures before brake application for subsequent snubs are those occurring in the time intervals specified below. Attain the required deceleration within 1 second and maintain it for the remainder of the snubbing time. Leave an interval of 30 seconds between snubs (start of brake application to start of brake application). Accelerate immediately to the initial test speed after each snub. Drive for 2.4 km (1.5 mile) at 64.37 km/h (40 mph) after the last snub and immediately follow the recovery procedure specified in 5.11.3.2.

5.11.3 Recovery Stops or Snubs

5.11.3.1 Vehicles with GVWR of 4 536 kg (10,000 pounds) or Less

Make five stops from 48.28 km/h (30 mph) at 3.05 m/s^2 (10 fpsps) for each stop. Control force readings may be terminated when vehicle speed falls to 8.05 km/h (5 mph). Allow a braking distance interval of 1.6 km (1 mile).

Immediately after each stop accelerate at maximum rate to 48.28 km/h (30 mph) and maintain that speed until making the next stop. Record the maximum control force for each stop.

5.11.3.2 Vehicles with GVWR greater than 4 536 kg (10,000 pounds)

With transmission in neutral (or declutched) make five snubs from 64.37 to 32.18 km/h (40 to 20 mph) at 3.05 m/s^2 (10 fpsps) for each snub. After each snub, accelerate at maximum rate to 64.37 km/h (40 mph) and maintain that speed until making the next brake application at a point 2.4 km (1.5 miles) from the point of the previous brake application. Record the maximum control force for each snub.

5.12 SERVICE BRAKE SYSTEM - SECOND REBURNISH

Repeat 5.6.

5.13 SERVICE BRAKE SYSTEM - SECOND FADE AND RECOVERY TEST

Repeat 5.11 except in 5.11.2 run 15 fade stops or 20 snubs instead of 10.

5.14 THIRD REBURNISH

Repeat 5.6.

5.15 SERVICE BRAKE SYSTEM - FOURTH EFFECTIVENESS TEST

Repeat 5.5. Then (for passenger cars) make four stops from either 152.9 km/h (95 mph) if the speed attainable in 3.22 km (2 miles) is 159.3 to (but not including) 167.38 km/h (99 to 104 mph) or 160.9 km/h (100 mph) if the speed attainable in 3.22 km (2 miles) is 167.38 km/h (104 mph) or greater.

5.16 SERVICE BRAKE SYSTEM - WATER RECOVERY TEST

5.16.1 Baseline Check Stop

Make three stops from 48.28 km/h (30 mph) at 3.05 m/s^2 (10 fpsps) for each stop. Control force readings may be terminated when vehicle speed falls to 8.05 km/h (5 mph). Average the maximum brake control force required for the three stops.

5.16.2 Wet Brake Recovery Stops

With the brakes fully released at all times, drive the vehicle for 2 minutes at a speed of 8.05 km/h (5 mph) in any combination of forward and reverse directions, through a trough having a water depth of 152 mm (6 in.). After leaving the trough, immediately accelerate at maximum rate to 48.28 km/h (30 mph) without a brake application. Immediately upon reaching that speed make five stops each from 48.28 km/h (30 mph) at 3.05 m/s² (10 fpfps) for each stop. After each stop (except the last), accelerate the vehicle immediately at a maximum rate to a speed of 48.28 km/h (30 mph) and begin the next stop.

5.17 SPIKE STOPS

Make 10 successive spike stops from 48.28 km/h (30 mph) with the transmission in neutral, with no reverse stops. Make spike stops by applying a control force of 889.6 N (200 pounds) while recording control force versus time. Maintain control force until vehicle has stopped. At completion of 10 spike stops, make six effectiveness stops from 96.56 km/h (60 mph).

5.18 FINAL INSPECTION

Inspect:

- (a) The service brake system for detachment or fracture of any components, such as brake springs and brake shoes or disc pad facing.
- (b) The friction surface of the brake, the master cylinder, wheel cylinders or brake power unit reservoir cover and seal and filler openings, for leakage of brake fluid or lubricant.
- (c) The master cylinder or brake power unit reservoir for compliance with volume and labeling requirements specified in (38) and (39) of CMVSS 105. In determining the fully applied worn condition assume that the lining is worn to:
 - (1) rivet or bolt heads on riveted or bolted linings,
 - (2) within 0.8 mm (0.031 in.) of shoe or pad mounting surface on bonded linings, or
 - (3) the limit recommended by the manufacturer, whichever is larger relative to the total possible shoe or pad movement. Drums or rotors are assumed to be at nominal design drum diameter or rotor thickness. Linings are assumed adjusted for normal operating clearance in the released position.

- (d) The brake system indicator light(s) for compliance with operation in various key positions, lens color, labeling, and location in accordance with requirements specified in (29), (30), (34), (35), and (36) of CMVSS 105.

5.19 MOVING BARRIER TEST

(Only for vehicles that have been tested according to 5.7.2). Load the vehicle to GVWR, release parking brake, and place the transmission selector control to engage the parking mechanism. With a moving barrier as described in paragraph 3.3 of SAE Recommended Practice J972 "Moving Barrier Collision Tests", November 1966, impact the vehicle from the front at 4 km/h (2.5 mph). Keep the longitudinal axis of the barrier parallel with the longitudinal axis of the vehicle. Repeat the test, impacting the vehicle from the rear. The vehicle used for this test need not be the same vehicle that has been used for the braking tests.

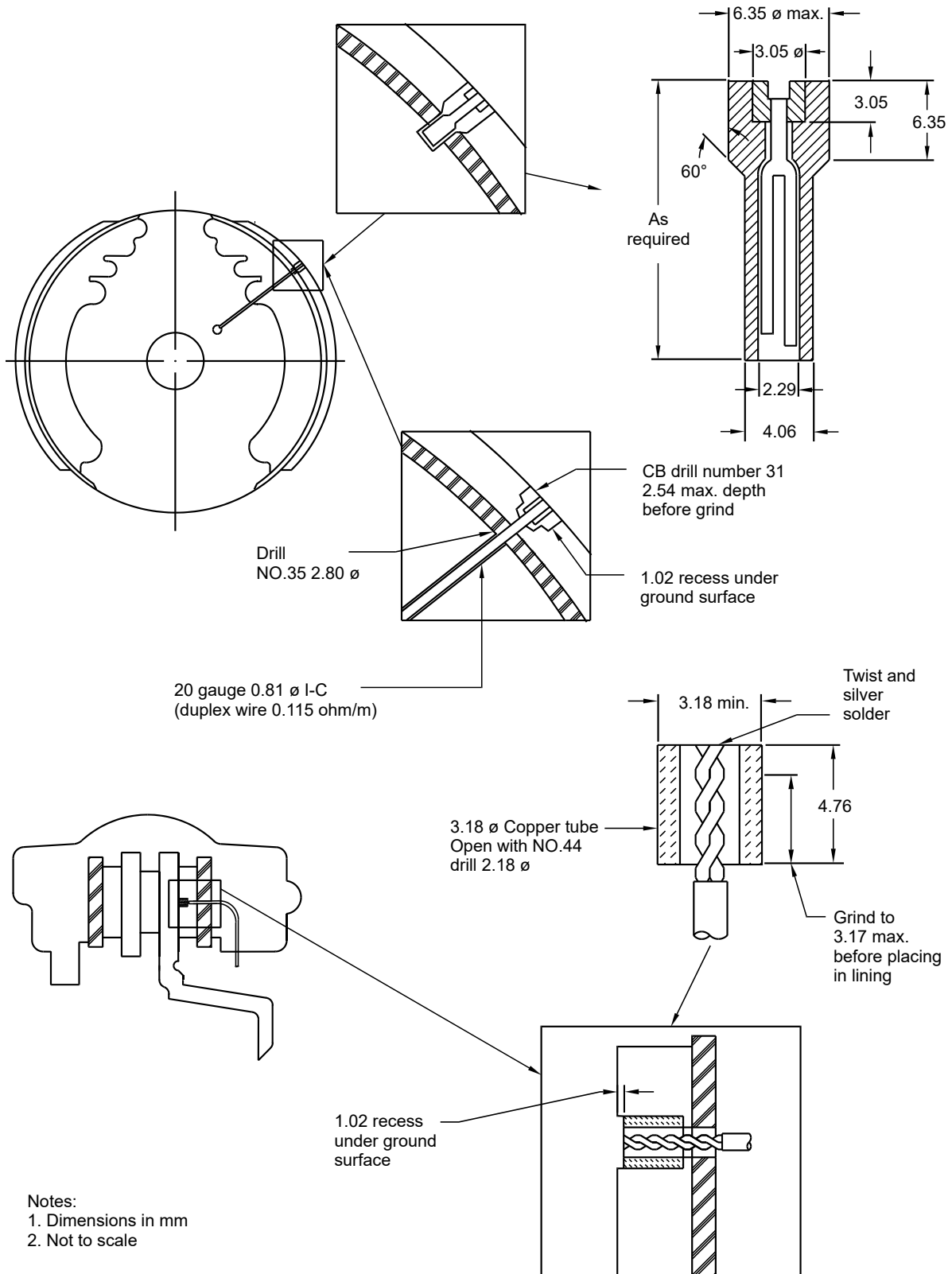
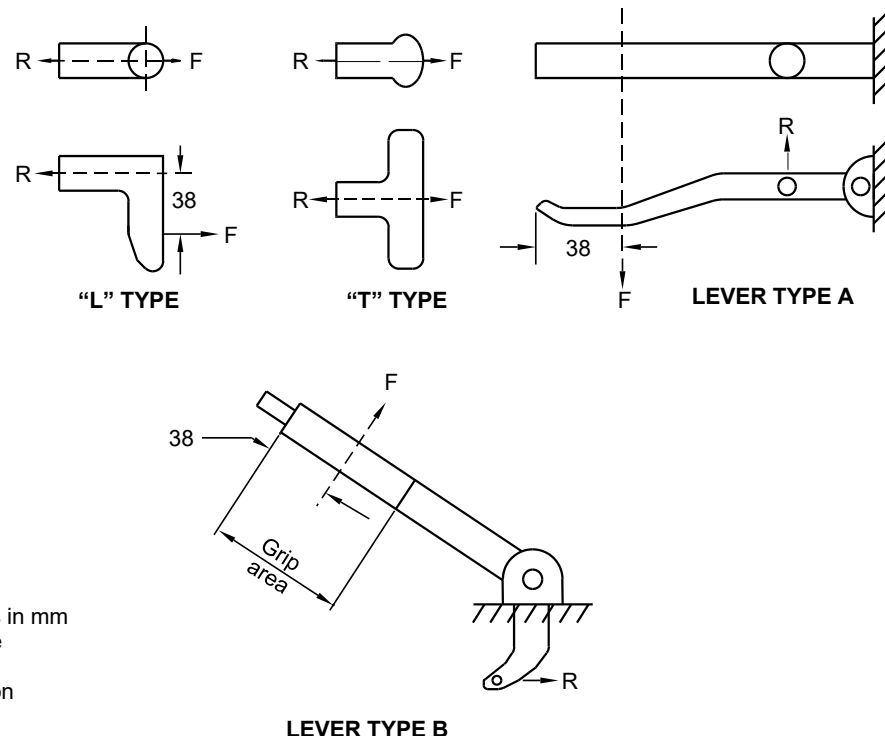


Figure 1 - Typical Plug Thermocouple Installations



**Figure 2 - Location for Measuring Brake Application Force
(Hand Brake)**