Canada Motor Vehicle Safety Standard - 121 - Air brake systems followed by: Technical Standards Document NO.121 & A Word on Recently Introduced and Proposed Federal Regulations

IMPORTANT NOTE FOR USERS

Users of this extract are cautioned that it has been prepared for use as a ready reference and has no legal force or effect. For all purposes of interpreting and applying these regulations, users should consult the Revised Status of Canada, 1985, and any pertinent amending statutory instruments.

Air Brake Systems (Standard 121)

General

121 (1) Every motor vehicle that is equipped with an air brake system and to which *Technical Standards Document No. 121, Air Brake Systems* (hereafter referred to as TSD 121) applies shall conform to TSD 121, as amended from time to time.

(2) When a truck, bus or chassis-cab is equipped with a front brake pressure limiting valve, that valve shall be automatic and shall operate while the service brakes are applied.

Technical Standards Document No. 121

(3) Every antilock brake system malfunction indicator referred to in section S5.1.6.2 of TSD 121 shall display the corresponding symbol shown for this indicator in Table II to section 101 of this Schedule, and all words accompanying the symbols shall be dis-played in both official languages.

(4) Notwithstanding section S5.2.3.3(a) of TSD 121, in addition to meeting the requirements of section S5.2.3.2 of TSD 121, each trailer and each trailer converter dolly manufactured before March 1, 2010 shall be equipped with an external antilock malfunction indicator lamp that meets the requirements of paragraphs S5.2.3.3(b) to (d).

(5) The test of the parking brake static retardation force that is referred to in section S5.6.1 of TSD 121 must be conducted in both the forward and rearward directions.

Expiry Date

(6) This section expires on March 1, 2005.

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Technical Standards Document Number 121 Air Brake Systems

Introduction

This Technical Standards Document reproduces the technical content of Federal Motor Vehicle Safety Standard No. 121, "Air brake systems", issued by the National Highway Traffic Safety Administration of the United States Department of Transportation. The general requirements governing Technical Standards Documents (TSD) are set out in section 12 of the Motor Vehicle Safety Act, which allows for the use of a TSD to incorporate enactments of a foreign government. Because the requirements of the Motor Vehicle Safety Regulations may change the provisions of a TSD, this Document should be read in conjunction with the Act and section 121 of the Regulations. As a guide, the subsection of the Regulations that alters or limits a TSD provision is indicated in the margin by the number within parentheses. Amendments to this TSD will be issued from time to time to incorporate revisions made to the reference document, and a Notice of Revision announcing an amendment will be published in the Canada Gazette Part I. The revised TSD will become effective on the date of publication of the Notice, but it is not enforceable until six months after that date.

Certain non-technical changes have been made to the U.S. standard by the Department of Transport. These include the deletion of words, phrases, and sections that do not apply under the Act or Regulations, the conversion of imperial to metric units, the deletion of superseded dates, and minor changes of an editorial nature. Additions have been added, and provisions that do not apply have been deleted. Changes have also been made where there are references in the U.S. standard that do not apply in Canada. In addition, the word "weight" has been replaced by "mass", except in the terms "gross vehicle weight rating", "gross axle weight rating", and "curb weight".
Where terms are already defined in the Regulations, their definitions have been taken out in the TSD, even where they were the same.

In the interests of accuracy, metric values have not been rounded in the conversion of imperial measures to their metric equivalents: for example, 10,000 pounds is converted to 4 536 kg rather than 4 500 kg. The metric value has been inserted before the imperial unit and underlined, and the original measurement has been retained in parentheses afterward. Section 2.1 of the Motor Vehicle Safety Regulations allows for the use of either system of measurement, but requires that the chosen system be used consistently.

Additional copies of this Technical Standards Document may be obtained by writing to:

Standards and Regulations Division (ASFBE)
Road Safety and Motor Vehicle Regulation Directorate
Transport Canada
Place de Ville, Tower C
344 Slater Street
Ottawa, Ontario K1A 0N5
Fax: (613) 990-2913

They may also be obtained by calling toll-free in Canada 1-800-333-0371 or, within the National Capital Region, (613) 998-8616.

Mr. Brian Jonah
Director, Motor Vehicle Standards and Research for the Minister of Transport,
Ottawa, Ontario

Technical Standards Document
Number 121 (Trailer)

AIR BRAKE SYSTEMS

The text of this document is based on the U.S. Code of Federal Regulations, Title 49, Part 571, Federal Motor Vehicle Safety Standard No. 121, Air brake systems, revised as of October 1, 1996, and subsequent amendments, up to and including the Final Rule, Docket 98-3345, published in the Federal Register on February 17, 1998, (Vol. 63, No. 31, p. 7724).

S1. Scope

This Technical Standards Document (TSD) establishes performance and equipment requirements for braking systems on vehicles equipped with air brake systems.

S2. Purpose

The purpose of this TSD is to insure safe braking performance under normal and emergency conditions.

(1)S3. Application

This TSD applies to -------- trailers equipped with air brake systems. (For additional applicability requirements, please see Schedule III of the Motor Vehicle Safety Regulations.) However, this TSD does not apply to:

(a) Any trailer that has a width of more than 2.6 m (102.36 in.) with extendable equipment in the fully retracted position and that is equipped with two short-track axles in a line across the width of the trailer;

(b) Any vehicle equipped with an axle that has a gross axle weight rating

(GAWR) of 13 154 kg (29,000 lb.) or more;

(c) -------

(d) -------

(e) Any trailer that has a GVWR of more than 54 432 kg (120,000 lb.) and whose body conforms to that described in the definition of "heavy hauler trailer" set forth in subsection 2(1) of the Motor Vehicle Safety Regulations;

(f) Any trailer that has an unloaded vehicle mass which is not less than 95 percent of its GVWR; and

(g) Any load divider dolly.

S4. Definitions

Agricultural commodity trailer means a trailer that is designed to transport bulk agricultural commodities in off-road harvesting sites and to a processing plant or storage location, as evidenced by skeletal construction that accommodates harvest containers, a maximum length

of 8.54 m (28 ft.), and an arrangement of air control lines and reservoirs that minimizes damage in field operations. (remorque pour produits agricoles)

Air-over-hydraulic brake subsystem means a subsystem of the air brake system that uses compressed air to transmit a force from the driver control to a hydraulic brake system to actuate the service brakes. (sous-système de freins hydropneumatiques)

Auto transporter means a truck and a trailer designed for use in combination to transport motor vehicles, in that the towing vehicle is designed to carry cargo at a location other than the fifth wheel and to load this cargo only by means of the towed vehicle. (porte-autos)

Common diaphragm means a single brake chamber diaphragm which is a component of the parking, emergency, and service brake systems. (membrane commune)

Container chassis trailer means a semi-trailer of skeleton construction limited to a bottom frame, one or more axles, especially built and fitted with locking devices for the transport of intermodal shipping containers, so that when the chassis and container are assembled, the units serve the same function as an over-the-road trailer. (remorque porte-conteneurs)

Directly controlled wheel means a wheel for which the degree of rotational wheel slip is sensed, either at that wheel or on the axle shaft for that wheel, and corresponding signals are transmitted to one or more modulators that adjust the brake actuating forces at that wheel. Each modulator may also adjust the brake actuating forces at other wheels that are on the same axle or in the same axle set in response to the same signal or signals. (roue commandée directement)

Effective projected luminous lens area means that area of the projection on a plane perpendicular to the lamp axis of that portion of the light-emitting surface that directs light to the photometric test pattern, and does not include mounting hole bosses, reflex reflector area, beads, or rims that may glow or produce small areas of increased intensity as a result of uncontrolled light from small areas (0.50- degree radius around the test point). (surface effective de projection lumineus des systèmes de frein de service, de frein de stationnement et de frein de secours. (common diaphragm)
Independently controlled wheelmeans a directly controlled wheel for which the modulator does not adjust the brake actuating forces at any other wheel on the same axle. (roue commandée séparément)

Indirectly controlled wheel means a wheel at which the degree of rotational wheel slip is not sensed, but at which the modulator of an antilock braking system adjusts its brake actuating forces in response to signals from one or more sensed wheel(s). (roue commandée indirectement)

Initial brake temperature means the average temperature of the service brakes on the hottest axle of the vehicle 0.32 km (0.2 mi.) before any brake application in the case of road tests, or 18 seconds before any brake application in the case of dynamometer testing. (température initiale des freins)

Intermodal shipping container means a reusable, transportable enclosure that is especially designed with integral locking devices for securing the container to the trailer to facilitate the efficient and bulk shipping and transfer of goods by, or between, various modes of transport, such as highway, rail, sea, and air. (conteneur universel)

Pulpwood trailer means a trailer that is designed exclusively for harvesting logs or pulpwood and constructed with a skeletal frame with no means for attachment of a solid bed, body, or container, and with an arrangement of air control lines and reservoirs designed to minimize damage in off-road operations. (remorque pour bois à pâte)
Straddle trailermeans a trailer that is designed to transport bulk agricultural commodities from the harvesting location, as evidenced by a framework that is driven over the cargo and lifting arms that suspend the cargo for transit. (chariot cavalier)

Wheel lockup means 100 percent wheel slip. (blocage des roues)

S5. Requirements

Each vehicle shall meet the following requirements under the conditions specified in **S6.**

S5.2 Required equipment — Trailers

Each trailer shall have the following equipment:

S5.2.1 Reservoirs. One or more reservoirs to which the air is delivered from the towing vehicle.

S5.2.1.1 The total volume of each service reservoir shall be at least eight times the combined volume of all service brake chambers serviced by that reservoir. For each brake-chamber type having a full stroke at least as great as the first number in Column 1 of Table V, but no more than the second number in Column 1, the volume of each brake chamber, for the purposes of calculating the required total service reservoir volume, shall be either that number specified in Column 2 of Table V or the actual volume of the brake chamber at maximum travel of the brake piston or pushrod, whichever is lower. The volume of a brake chamber not listed in Table V is the volume of the brake chamber at maximum travel of the brake piston or pushrod. The reservoirs on a heavy hauler trailer and the trailer portion of an auto transporter need not meet this requirement for reservoir volume.

S5.2.1.2 Each reservoir shall be capable of withstanding an internal hydrostatic pressure of 3 445 kPa (500 psi) for 10 minutes.

S5.2.1.3 Each reservoir shall have a condensate drain valve that can be manually operated.

S5.2.1.4 Each service reservoir shall be protected against loss of air pressure due to failure or leakage in the system between the service reservoir and its source of air pressure by check valves or equivalent devices.

S5.2.2 Brake distribution and automatic adjustment. Each vehicle shall be equipped with a service brake system acting on all wheels.

(a) *Brake Adjuster.* Wear of the service brakes shall be compensated for by means of a system of automatic adjustment. When inspected pursuant to S5.9, the adjustment of the service

brakes shall be within the limits recommended by the vehicle manufacturer.

(b) *Brake Indicator*. For each brake equipped with an external automatic adjustment mechanism and having an exposed pushrod, the condition of service brake under-adjustment shall be displayed by a brake adjustment indicator in a manner that is discernible when viewed with 20/40 vision from a location adjacent to or underneath the vehicle, when inspected pursuant to S5.9.

S5.2.3 Antilock Brake System

S5.2.3.1

(a) Each semi-trailer (including a trailer converter dolly) shall be equipped with an antilock brake system that directly controls the wheels of at least one axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

(b) Each full trailer, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle of the vehicle and at least one rear axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

S5.2.3.2 Antilock malfunction signal. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 2001, that is equipped with an antilock brake system shall be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this antilock brake system malfunction signal circuit to the towing vehicle. The electrical circuit need not be separate or dedicated exclusively to this malfunction signaling function. The signal shall be present whenever there is a malfunction that affects the generation or transmission of response or control signals in the trailer's antilock brake system. The signal shall remain present as long as the malfunction exists, whenever power is supplied to the antilock brake system. Each message about the existence of such a malfunction shall be stored in the antilock brake system whenever power is no longer supplied to the system, and the malfunction signal shall be automatically reactivated whenever power is again supplied to the trailer's antilock brake system. In addition, each trailer manufactured on or after March 1, 2001, that is designed to tow another air-brake- equipped trailer shall be capable of transmitting a malfunction signal from the antilock brake system(s) of additional trailers it tows to the vehicle towing it.

S5.2.3.3 Antilock malfunction indicator

(4) (a) In addition to the requirements of S5.2.3.2, each trailer and trailer converter dolly manufactured before March 1, 2009, shall be equipped with an external antilock malfunction indicator lamp that meets the requirements of S5.2.3.3 (b) through (d).

(b)(1) The lamp shall be designed to conform to the performance requirements of Society of Automotive Engineers (SAE) Recommended Practice J592 JUN92 or J592e July 1972, Clearance, Side Marker, and Identification Lamps, for combination, clearance, and side marker lamps, which are marked with a "PC" or "P2" on the lens or housing, in accordance with SAE J759 Jan 95, *Lighting Identification Code*.

(2) The color of the lamp shall be yellow.

(3) The letters "ABS" shall be permanently molded, stamped, or otherwise marked or labeled in letters not less than 10 mm (0.4 in.) high on the lamp lens or its housing to identify the function of the lamp. Alternatively, the letters "ABS" may be painted on the trailer body or

dolly,or a plaque with the letters "ABS" may be affixed to the trailer body or converter dolly; the letters "ABS" shall be not less than 25 mm (1 in.) high. A portion of one of the letters in the alternative identification shall be not more than 150 mm (5.9 in.) from the edge of the lamp lens.

(c) Location requirements

(1) Each trailer that is not a trailer converter dolly shall be equipped with a lamp mounted on a permanent structure on the left side of the trailer as viewed from the rear, no closer than 150 mm (5.9 in.), and no farther than 600 mm (23.6 in.) from the red rear side marker lamp, when measured between the closest edge of the effective projected luminous lens area of each lamp.

(2) Each trailer converter dolly shall be equipped with a lamp mounted on a permanent structure of the dolly so that the lamp is not less than 375 mm (14.8 in.) above the road surface when measured from the center of the lamp with the dolly at curb weight. When a person, standing 3 m (9.8 ft.) from the lamp, views the lamp from a perspective perpendicular to the vehicle's centerline, no portion of the lamp shall be obscured by any structure on the dolly.

(3) Each trailer that is not a trailer converter dolly and on which the malfunction indicator lamp cannot be placed within the location specified in S5.2.3.3(c)(1) shall be equipped with a lamp mounted on a permanent structure on the left side of the trailer as viewed from the rear, near the red rear side marker lamp or on the front face of the left rear fender of a trailer equipped with fenders.

The lamp shall be illuminated whenever power is supplied to the antilock brake system and there is a malfunction that affects the generation or transmission of response or control signals in the trailer's antilock brake system. The lamp shall remain illuminated as long as such a malfunction exists and power is supplied to the antilock brake system. Each message about the existence of such a malfunction shall be stored in the antilock brake system whenever power is no longer supplied to the system. The lamp shall be automatically reactivated when power is again supplied to the trailer's antilock brake system. The lamp shall also be activated as a check of lamp function whenever power is first supplied to the antilock brake system and the vehicle is stationary. The lamp shall be deactivated at the end of the check of lamp function, unless there is a malfunction or a message about a malfunction that existed when power was last supplied to the antilock brake system.

S5.3 Service Brakes — Road tests

------ The service brake system on each trailer shall, under the conditions of S6, meet the requirements of S5.3.3, S5.3.4, and S5.3.5, when tested without adjustments other than those specified in this TSDstandard. However, a heavy hauler trailer ------- and trailer portions of an auto transporter need not meet the requirements of S5.3.

S5.3.2 [Reserved]

S5.3.3 Brake actuation time. Each service brake system shall meet the requirements of S5.3.3.1(a) and (b)

S5.3.3.1

(a) With an initial service reservoir system air pressure of 689 kPa (100 psi), the air pressure in each brake chamber shall, when measured from the first movement of the service brake control, reach 413.4 kPa (60 psi) in not more than ----------0.50 second in the case of trailers, other than trailer converter dollies, designed to tow another vehicle equipped with air brakes, 0.55 second in the case of trailer converter dollies, and 0.60 second in the case of trailers other than trailers designed to tow another vehicle equipped with air brakes. A vehicle designed to tow another vehicle equipped with air brakes shall meet the above actuation time requirement with a 0.819-L (50-cu. in.) test reservoir connected to the control line output coupling. A trailer, including a trailer converter dolly, shall meet the above actuation time requirement with its control line input coupling connected to the test rig shown in Figure 1.

(b) For a vehicle that is designed to tow another vehicle equipped with air brakes, the pressure in the 0.819-L (50-cu. in.) test reservoir referred to in S5.3.3.1(a) shall, when measured from the first movement of the service brake control, reach 413.4 kPa(60 psi) not later than the time the fastest brake
chamber on the vehicle reaches 413.4 kPa (60 psi) or, at the option of the manufacturer, in not more than ---------- 0.55 second in the case of trailer converter dollies, and 0.50 second in the case of trailers other than trailer converter dollies.

S5.3.4 Brake release time. Each service brake system shall meet the requirements of S5.3.4.1(a) and (b).

S5.3.4.1

(a) With an initial service brake chamber air pressure of 654.6 kPa (95 psi), the air pressure in each brake chamber shall, when measured from the first movement of the service brake control, fall to 34.5 kPa(5 psi) in not more than ---- 1.00 second in the case of trailers, other than trailer converter dollies, designed to tow another vehicle equipped with air brakes, 1.10 seconds in the case of trailer converter dollies, and 1.20 seconds in the case of trailers other than trailers designed to tow another vehicle equipped with air brakes. A vehicle designated to tow another vehicle equipped with air brakes shall meet the above release time requirement with a 0.819-L (50-cu. in.) test reservoir connected to the control line output coupling. A trailer, including a trailer converter dolly, shall meet the above release time requirement with its control line input coupling connected to the test rig shown in Figure 1.

(b) For vehicles designed to tow another vehicle equipped with air brakes, the pressure in the 0.819-L (50-cu. in.) test reservoir referred to in S5.3.4.1(a) shall, when measured from the first movement of the service brake control, fall to 34.5 kPa (5 psi) in not more than ----- 1.10 seconds in the case of trailer converter dollies, and 1.00 second in the case of trailers other than trailer converter dollies.

S5.3.5 Control signal pressure differential — Converter dollies and trailers

designed to tow another vehicle equipped with air brakes

(a) For a trailer designed to tow another vehicle equipped with air brakes, the pressure differential between the control line input coupling and a 0.819-L (50-cu. in.) test reservoir attached to the control line output coupling shall not exceed the values specified in S5.3.5(a)(1), (2), and (3) under the conditions specified in S5.3.5(b)(1) through (4):

(1) 6.9 kPa (1 psi) at all input pressures equal to or greater than 34.5 kPa (5 psi), but not greater than 137.8 kPa (20 psi); and

(2) 13.8 kPa (2 psi) at all input pressures equal to or greater than 137.8 kPa (20 psi), but not greater than 275.9 kPa (40 psi); and

(3) not more than a 5 percent differential at any input pressure equal to or greater than 275.9 kPa (40 psi).

(b) The requirements in S5.3.5(a) shall be met

(1) When the pressure at the input coupling is steady, increasing, or decreasing;

(2) When air is applied to or released from the control line input coupling using the trailer test rig shown in Figure 1;

(3) With a fixed orifice consisting of a 0.46-mm (0.0180-in.) diameter hole (no. 77 drill bit) in a 0.81-mm (0.032-in.) thick disc installed in the control line between the trailer test rig coupling and the vehicle's control line input coupling; and

(4) When operating the trailer test rig in the same manner and under the same conditions as it is operated during testing to measure brake actuation and release times, as specified in S5.3.3 and S5.3.4, except for the installation of the orifice in the control line to restrict the airflow rate.

S5.4 Service brake system — Dynamometer tests

When tested without prior road testing, under the conditions of S6.2, each brake assembly shall meet the requirements of S5.4.1, S5.4.2, and S5.4.3 when tested in sequence and without adjustments other than those specified in the TSD. For the purposes of the requirements of S5.4.2 and S5.4.3, an average deceleration rate is the change in velocity divided by the deceleration time measured from the onset of deceleration.

S5.4.1 Brake retardation force. The sum of the retardation forces exerted by the brakes on each vehicle designed to be towed by another vehicle equipped with air brakes shall be such that the quotient sum of the brake retardation forces/sum of GAWR's, relative to brake chamber air pressure, shall have values not less than those shown in Column 1 of Table III. The retardation force shall be determined as follows:

Table III — Brake retardation force

Column 1 Brake retardation force/GAWR	Column 2 Brake chamber pressure, kPa (psi)
0.05	137.8 (20)
0.12	206.7 (30)
0.18	(40)
0.25	344.5 (50)
0.31	413.4 (60)
0.37	482.3 (70)
0.41	551.2 (80)

S5.4.1.1 After burnishing the brake pursuant to S6.2.6, retain the brake assembly on the inertia dynamometer. With an initial brake temperature between 51.7ºC and 93.3ºC (125ºF and 200ºF), conduct a stop from 80.5 km/h (50 mph), maintaining brake chamber air pressure at a constant 137.8 kPa (20 psi). Measure the average torque exerted by the brake from the time the specified air pressure is reached until the brake stops and divide by the static loaded tire radius specified by the tire manufacturer to determine the retardation force. Repeat the procedure six times, increasing the brake chamber air pressure by 68.9 kPa (10 psi) each time. After each stop, rotate the brake drum or disc until the temperature of the brake falls to between 51.7ºC and 93.3ºC (125ºF and 200ºF).

S5.4.2 Brake power. When mounted on an inertia dynamometer, each brake shall be capable of making 10 consecutive decelerations at an average rate of 2.72 m/s2 (9 fpsps) from 80.5 km/h (50 mph) to 24.2 km/h (15 mph), at equal intervals of 72 seconds, and shall be capable of decelerating to a stop from 32.2 km/h (20 mph) at an average deceleration rate of 4.27 m/s2 (14 fpsps) 1 minute after the 10th deceleration. The series of decelerations shall be conducted as follows:

S5.4.2.1 With an initial brake temperature between 65.6ºC and 93.3ºC (150ºF and 200ºF) for the first brake application, and the drum or disc rotating at a speed equivalent to 80.5 km/h (50 mph), apply the brake and decelerate at an average deceleration rate of 2.72 m/s2 (9 fpsps) to 24.2 km/h (15 mph). Upon reaching 24.2 km/h (15 mph), accelerate to 80.5 km/h (50 mph) and apply the brake for a second time 72 seconds after the start of the first application. Repeat the cycle until 10 decelerations have been made. The service line air pressure shall not exceed 689 kPa (100 psi) during any deceleration.

S5.4.2.2 One minute after the end of the last deceleration required by S5.4.2.1 and with the drum or disc rotating at a speed of 32.2 km/h (20 mph), decelerate to a stop at an average deceleration rate of 4.27 m/s2 (14 fpsps).

S5.4.3 Brake recovery. Except as provided in S5.4.3(a) and (b), starting two minutes after completing the tests required by S5.4.2, a vehicle's brake shall be capable of making 20

consecutive stops from 48.3 m/h (30 mph) at an average deceleration rate of3.66 m/s2 (12 fpsps), at equal intervals of one minute measured from the start of each brake application. The service line air pressure needed to attain a rate of 3.66 m/s2 (12 fpsps) shall be not more than 585.7 kPa (85 psi), and not less than137.8 kPa (20 psi), for a brake not subject to the control of an antilock brake system, or 82.7 kPa (12 psi) for a brake subject to the control of an antilock brake system.

S5.5 Antilock brake system

S5.5.2 Antilock system power — Trailers. On a trailer (including a trailer converter dolly) that is equipped with an antilock system that requires electrical power for operation, the power shall be obtained from the towing vehicle through one or more electrical circuits which provide continuous power whenever the powered vehicle's ignition ("start") switch is in the "on" ("run") position. The antilock system shall automatically receive power from the stop lamp circuit, if the primary circuit or circuits are not functioning. Each trailer (including a trailer converter dolly) that is equipped to tow another air-braked vehicle shall be equipped with one or more circuits which provide continuous power to the antilock system on the vehicle(s) it tows. Such circuits shall be adequate to enable the antilock system on each towed vehicle to be fully operable.

S5.6 Parking brake system

(a) Except as provided in S5.6(b) and S5.6(c), each vehicle other than a trailer converter dolly shall have a parking brake system that under the conditions of S6.1 meets the requirements of:

(1) S5.6.1 or S5.6.2, at the manufacturer's option, and

(2) S5.6.3, S5.6.4, S5.6.5, and S5.6.6.

(b) At the option of the manufacturer, for vehicles equipped with brake systems which incorporate a common diaphragm, the performance requirements specified in S5.6(a), which must be met with any single leakage-type failure in a common diaphragm, may instead be met with the level of leakage-type failure determined in S5.6.7. The election of this option does not affect the performance requirements specified in S5.6(a), which apply with single leakage-type failures other than failures in a common diaphragm.

(c) At the option of the manufacturer, the trailer portion of any agricultural commodity trailer, heavy hauler trailer, or pulpwood trailer may meet the requirements of §393.43 of Title 49 of the Code of Federal Regulations (the most recent edition) instead of the requirements of S5.6(a).

(5) S5.6.1 Static retardation force. With all other brakes rendered inoperative, during a static drawbar pull in a forward or rearward direction, the static retardation force produced by the

application of the parking brakes shall be:

In the case of a vehicle -----, such that the quotient static retardation force/GAWR is not less than 0.28 for any axle other than a steerable front axle; and

---

S5.6.2 Grade holding. With all parking brakes applied, the vehicle shall remain stationary facing uphill and facing downhill on a smooth, dry, portland cement concrete roadway with a 20-percent grade, both:
(a) when loaded to its GVWR, and

(b) at its unloaded vehicle mass weight plus 226.8 kg (500 lb.) (including driver and instrumentation).

S5.6.3 Application and holding. Each parking brake system shall meet the requirements of S5.6.3.1 through S5.6.3.4.

S5.6.3.1 The parking brake system shall be capable of achieving the minimum performance specified either in S5.6.1 or S5.6.2 with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (excluding failure of a component of a brake chamber housing, but including failure of any brake chamber diaphragm that is part of any other brake system, including a diaphragm which is common to the parking brake system and any other brake system), when the pressures in the vehicle's parking brake chambers are at the levels determined in S5.6.3.4.

S5.6.3.2 A mechanical means shall be provided that, after a parking brake application is made with the pressures in the vehicle's parking brake chambers at the levels determined in S5.6.3.4, and all air and fluid pressures in the vehicle's braking systems are then bled down to zero, and without using electrical power, holds the parking brake application with sufficient parking retardation force to meet the minimum performance specified in S5.6.3.1 and in either S5.6.1 or S5.6.2.

S5.6.3.3 --------- For trailers, with the supply line initially pressurized to 689 kPa (100 psi) using the supply line portion of the trailer test rig (Figure 1) and, if designed to tow a vehicle equipped with air brakes, with a 0.819-L (50-cu. in.) test reservoir connected to the rear supply line coupling, no later than three seconds from the time venting to the atmosphere of the front supply line coupling is initiated, the mechanical means referred to in S5.6.3.2 shall be actuated. This requirement shall be met for ------- trailers both with and without any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.3.4 The parking brake chamber pressures for S5.6.3.1 and S5.6.3.2 are determined as follows. --------- For trailers, with the supply line initially pressurized to 689 kPa (100 psi) using the supply line portion of the trailer test rig (Figure 1) and, if designed to tow a vehicle equipped with air brakes, with a 0.819-L (50-cu. in.) test reservoir connected to the rear supply line coupling, any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The front supply line coupling is vented to the atmosphere and the pressures in the vehicle's parking brake chambers are measured three

seconds after that venting is initiated.

S5.6.5 Release performance. Each parking brake system shall meet the requirements specified in S5.6.5.1 through S5.6.5.4.

S5.6.5.1 -----

S5.6.5.3 For trailers, with initial conditions as specified in S5.6.5.4, at all times after actuation of the parking brakes by venting
the front supply line coupling to the atmosphere, and with any subsequent level of pressure, or combination of levels of pressure, in the reservoirs of any of the vehicle's brake systems, the parking brakes shall not be releasable by repressurizing the supply line using the supply line portion of the trailer test rig (Figure 1) to any pressure above 482.3 kPa (70 psi), unless the parking brakes are capable, after such release, of reapplication by subsequent venting of the front supply line coupling to the atmosphere, at a level meeting the minimum performance specified either in S5.6.1 or S5.6.2. This requirement shall be met both with and without any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.5.4 The initial conditions for S5.6.5.3 are as follows. The reservoir system and supply line are pressurized to 689 kPa (100 psi), using the supply line portion of the trailer test rig (Figure 1). If the vehicle is designed to tow a vehicle equipped with air brakes, a 0.819-L (50-cu. in.) test reservoir is connected to the rear supply line coupling.

S5.6.6 Accumulation of actuation energy. Each parking brake system shall meet the requirements specified in S5.6.6.1 through S5.6.6.6.

S5.6.6.4 For trailers, with initial conditions as specified in S5.6.6.5, the parking brake system shall be capable of meeting the minimum performance specified either in S5.6.1 or S5.6.2, with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), at the conclusion of the test sequence specified in S5.6.6.6.

S5.6.6.5 The initial conditions for S5.6.6.4 are as follows. The reservoir system and supply line are pressurized to 689 kPa (100 psi), using the supply line portion of the trailer test rig (Figure 1). If the vehicle is designed to tow a vehicle equipped with air brakes, a 0.819-L (50-cu. in.) test reservoir is connected to the rear supply line coupling.

S5.6.6.6 The test sequence for S5.6.6.4 is as follows. Any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The front supply line coupling is vented to the atmosphere. Thirty seconds after the initiation of such venting, the supply line is repressurized with the trailer test rig (Figure 1). Thirty seconds after the initiation of such repressurizing of the

supply line, the front supply line is vented to the atmosphere. This procedure is conducted either by connection and disconnection of the supply line coupling or by use of a valve

installed in the supply line portion of the trailer test rig near the supply line coupling.

(For Common Diaphragm system)

S5.6.7 *Maximum level of common diaphragm leakage-type failure (Equivalent level of leakage from the air chamber containing that diaphragm). In the case of vehicles for which the option in S5.6(b)has been elected, determine the maximum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) according to the procedures set forth in S5.6.7.1 through S5.6.7.2.3.*

S5.6.7.2 Trailers

S5.6.7.2.1 According to the following procedure, determine the threshold level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which the vehicle's parking brakes become unreleasable. With an initial reservoir system and supply line pressure of 689 kPa (100 psi), no application of any of the vehicle's brakes, and, if the vehicle is designed to tow a vehicle brakes, a 0.819-L (50-cu. in.) test reservoir connected to the supply line coupling, introduce a leakage-type failure of the common diaphragm (or equivalent leakage equipped with air from the air chamber containing that diaphragm). Make a parking brake application by venting the front supply line coupling to the atmosphere, and reduce the pressures in all of the vehicle's reservoirs to zero. Pressurize the supply line by connecting the trailer's front supply line coupling to the supply line portion of the trailer test rig (Figure 1) with the regulator of the trailer test rig set at 689 kPa (100 psi), and determine whether all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2. Repeat this procedure with progressively decreasing or increasing levels (whichever is applicable) of leakage- type diaphragm failures or equivalent leakages, to determine the minimum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2.

S5.6.7.2.2 At the level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) determined in S5.6.7.2.1, and using the following procedure, determine the threshold maximum reservoir leakage rate (in kPa [psi] per minute). With an initial reservoir system and supply line pressure of 689 kPa (100 psi), no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 0.819-L (50-cu. in.) test reservoir connected to the rear supply line coupling, make a parking brake application by venting the front supply line coupling to the atmosphere. Determine the maximum reservoir leakage rate (in kPa [psi] per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application.

S5.6.7.2.3 Using the following procedure, introduce a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm) that results in a maximum reservoir leakage rate that is three times the threshold maximum reservoir leakage rate determined in S5.6.7.2.2. With an initial reservoir system and supply line pressure of 689 kPa (100 psi), no application of any of the vehicle's brakes and, if the vehicle is

designed to tow a vehicle equipped with air brakes, a 0.819-L (50-cu. in.) test reservoir connected to the rear supply line coupling, make a parking brake application by venting the front supply line coupling to the atmosphere. Determine the maximum reservoir leakage rate (in kPa [psi] per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application. The level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) associated with this reservoir leakage rate is the level that is to be used under the option set forth in S5.6(b).

S5.8 Trailer pneumatic system failure performance

Each trailer shall meet the requirements of S5.8.1 through S5.8.3.

S5.8.1 Emergency braking capability. Each trailer other than a trailer converter dolly shall have a parking brake system that conforms to S5.6 and that applies with the force specified in S5.6.1 or S5.6.2 when the air pressure in the supply line is at atmospheric pressure. A trailer converter dolly shall have, at the manufacturer's option,

(a) A parking brake system that conforms to S5.6 and that applies with the force specified in S5.6.1 or S5.6.2 when the air pressure in the supply line is at atmospheric pressure, or

(b) An emergency system that automatically applies the service brakes when the service reservoir is at any pressure above 137.8 kPa (20 psi) and the supply line is at atmospheric pressure. However, any agricultural commodity trailer, heavy hauler trailer, or pulpwood trailer shall meet the requirements of S5.8.1 or, at the option of the manufacturer, the requirements of §393.43 of Title 49 of the Code of Federal Regulations (the most recent edition), this title.

S5.8.2 Supply line pressure retention. Any single leakage-type failure in the service brake system (except for a failure of the supply line, a valve directly connected to the supply line, or a component of a brake chamber housing) shall not result in the pressure in the supply line falling below 482.3 kPa (70 psi), as measured at the forward trailer supply coupling. A trailer shall meet the above supply line pressure retention requirement with its brake system connected to the trailer test rig shown in Figure 1, with the reservoirs of the trailer and test rig initially pressurized to 689 kPa (100 psi) and the regulator of the trailer test rig set at 689 kPa (100 psi), except that a trailer equipped with an air-applied, mechanically held parking brake system and not designed to tow a vehicle equipped with air brakes, at the manufacturer's option, may meet the requirements of S5.8.4 rather than those of S5.8.2 and S5.8.3.

S5.8.3 Automatic application of parking brakes. With an initial reservoir system pressure of 689 kPa (100 psi) and an initial supply line pressure of 689 kPa (100 psi), and if designed to tow a vehicle equipped with air brakes, with a 0.819-L (50-cu. in.) test reservoir connected to the rear supply line coupling, and with any subsequent single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), whenever the air pressure in the supply line is 482.3 kPa (70 psi) or higher, the parking brakes shall not provide any brake retardation as a result of complete or partial automatic application of the parking brakes.

S5.8.4 Automatic application of air-applied, mechanically held parking brakes. With its brake system connected to the supply line portion of the trailer test rig (Figure 1) and the

regulator of the trailer test rig set at 689 kPa (100 psi), and with any single leakage-type failure in the service brake system (except for a failure of the supply line, a valve directly connected to the supply line, or a component of a brake chamber, but including failure of any common diaphragm), the parking brakes shall not provide any brake retardation as a result of complete or partial automatic application of the parking brakes.

S5.9 Final inspection

Inspect the service brake system for the condition of adjustment and for the brake indicator display in accordance with S5.1.8 and S5.2.2.

S6. Conditions

The requirements of S5 shall be met by a vehicle when it is tested according to the conditions set in this S6, without replacing any brake system part or making any adjustments to the brake system except as specified. Unless otherwise specified, where a range of conditions is specified, the vehicle must be capable of meeting the requirements at all points within the range. On vehicles equipped with automatic brake adjusters, the automatic brake adjusters must remain activated at all times. Compliance of vehicles manufactured in two or more stages may, at the option of the final-stage manufacturer, be demonstrated to comply with this TSD by adherence to the instructions of the incomplete vehicle manufacturer provided with the vehicle in accordance with §568.4(a)(7)(ii) and §568.5 of Title 49 of the Code of Federal Regulations (the most recent edition).

S6.1 Road test conditions

S6.1.2 The inflation pressure is as specified by the vehicle manufacturer for the GVWR.

S6.1.3 Unless otherwise specified, the transmission selector control is in "neutral" or the clutch is disengaged during all decelerations and during static parking brake tests.

S6.1.4 All vehicle openings (doors, windows, hood, trunk, cargo doors, etc.) are in a closed position, except as required for instrumentation purposes.

S6.1.5 The ambient temperature is between 0ºC and 37.8ºC (32ºF and 100ºF).

S6.1.6 The wind velocity is zero.

S6.1.8 For vehicles with parking brake systems not utilizing the service brake friction elements, burnish the friction elements of such systems prior to the parking brake test according to the manufacturer's recommendations.

For vehicles with parking brake systems utilizing the service brake friction elements, burnish the brakes as follows. With the transmission in the highest gear appropriate for a speed of 64.4 km/h (40 mph), make 500 snubs between 64.4 km/h and 32.2 km/h (40 mph and 20 mph) at a deceleration rate of 3.05 m/s2 (10 fpsps), or at the vehicle's maximum deceleration rate if less than 3.05 m/s2 (10 fpsps). Except where an adjustment is specified, after each brake application accelerate to 64.4 km/h (40 mph) and maintain that speed until making the next brake application at a point 1.6 km (1 mi.) from the initial point of the previous brake application. If the vehicle cannot attain a speed of 64.4 km/h (40 mph) in 1.6 km (1 mi. mph), continue to accelerate until the vehicle reaches 64.4 km/h (40 mph) or until the vehicle has traveled 2.4 km (1.5 mi.) from the initial point of the previous brake application, whichever occurs first. Any automatic pressure limiting valve is in use to limit pressure as designed. The brakes may be adjusted up to three times during the burnish procedure, at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing, in accordance with the vehicle manufacturer's recommendation.

S6.1.9 Static parking brake tests for a semi-trailer are conducted with the front end supported by an unbraked dolly. The mass of the dolly is included as part of the trailer load.

S6.1.11 Special drive conditions. A vehicle equipped with an interlocking axle system or a front-wheel drive system that is engaged and disengaged by the driver is tested with the system disengaged.

S6.1.12 Liftable axles. A vehicle with a liftable axle is tested at GVWR with the liftable axle down and at unloaded vehicle mass with the liftable axle up.

S6.1.13 Trailer test rig

(a) The trailer test rig shown in Figure 1 is calibrated in accordance with the calibration curves shown in Figure 3. For the requirements of S5.3.3.1 and S5.3.4.1, the pressure in the trailer test rig reservoir is initially set at 689 kPa (100 psi) for actuation tests and 654.6 kPa (95 psi) for release tests.

(b) The trailer test rig shown in Figure 1(a) is capable of increasing the pressure in a 0.819-L (50-cu. in.) reservoir from atmospheric to 413.4 kPa (60 psi) in 0.06 second, measured from the first movement of the service brake control to apply service brake pressure, and of releasing pressure in such a reservoir from 654.6 to 34.5 kPa (95 to 5 psi) in 0.22 second, measured from the first movement of the service brake control to release service brake pressure.

S6.1.15 Initial Brake Temperature. Unless otherwise specified, the initial brake temperature is not less than 65.6°C (150ºF) and not more than 93.3°C (200ºF).

S6.2 Dynamometer test conditions

S6.2.1 The dynamometer inertia for each wheel is equivalent to the load on the wheel with the axle loaded to its GAWR. For a vehicle having additional GAWRs specified for

operation at reduced speeds, the GAWR used is that specified for a speed of 80.5 km/h (50 mph), or, at the option of the manufacturer, any speed greater than 80.5 km/h (50 mph).

S6.2.2 The ambient temperature is between 23.9ºC and 37.8ºC (75ºF and 100ºF).

S6.2.3 Air at ambient temperature is directed uniformly and continuously over the brake drum or disc at a velocity of 11.18 m/s (2,200 ft./min.).

S6.2.4 The temperature of each brake is measured by a single plug-type thermocouple installed in the center of the lining surface of the most heavily loaded shoe or pad as shown in Figure 2. The thermocouple is outside any center groove.

S6.2.5 The rate of brake drum or disc rotation on a dynamometer corresponding to the rate of rotation on a vehicle at a given speed is calculated by assuming a tire radius equal to the static loaded radius specified by the tire manufacturer.

S6.2.6 Brakes are burnished before testing as follows: Place the brake assembly on an inertia dynamometer and adjust the brake as recommended by the vehicle manufacturer. Make 200 stops from 64.4 km/h (40 mph) at a deceleration of 3.05 m/s2 (10 fpsps), with an initial brake temperature on each stop of not less than 157ºC (315ºF) and not more than 196ºC (385ºF). Make 200 additional stops from 64.4 km/h (40 mph) at a deceleration of 3.05 m/s2 (10 fpsps) with an initial brake temperature on each stop of not less than 232ºC (450ºF) and not more than 288ºC (550ºF). The brakes may be adjusted up to three times during the burnish procedure, at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing, in accordance with the vehicle manufacturer's recommendation.

S6.2.7 The brake temperature is increased to a specified level by conducting one or more stops from 64.4 km/h (40 mph) at a deceleration of 3.05 m/s2 (10 fpsps). The brake temperature is decreased to a specified level by rotating the drum or disc at a constant 48.3 km/h (30 mph).

Figure 1: test rig

Figure 1(a) - Trailer test rig

Figure 2: Thermocouple installation

Figure 3:Pressure vs time for 0.819-L (50 in^3) test reservoir

Table IV — [RESERVED]

Table V — Brake chamber rated volumes

Brake chamber type (Nominal area of piston or diaphragm in sq. in.)	Column 1 Full stroke, cm (in.)	Column 2 Rated volume, L (cu. in.)
Type 9	4.45 (1.75) / 5.33 (2.10)	0.41 (25)
Type 12	4.45 (1.75) / 5.33 (2.10)	0.49 (30)
Type 14	5.72 (2.25) / 6.86 (2.70)	0.66 (40)
Type 16	5.72 (2.25) / 6.86 (2.70)	0.75 (46)
Type 18	5.72 (2.25) / 6.86 (2.70)	0.82 (50)
Type 20	5.72 (2.25) / 6.86 (2.70)	0.88 (54)
Type 24	6.35 (2.50) / 8.13 (3.20)	1.10 (67)
Type 30	6.35 (2.50) / 8.13 (3.20)	1.46 (89)
Type 36	7.62 (3.00) / 9.14 (3.60)	2.21 (135)

* Please see subsection 2(1) of the Motor Vehicle Safety Regulations for the applicable definition.

This page was last updated on Wednesday, February 24, 1999.
Motor Vehicle Standards and Research Branch
Road Safety and Motor Vehicle Regulation Directorate

TRANSPORT CANADA

A WORD ON RECENTLY INTRODUCED AND PROPOSED FEDERAL REGULATIONS :

New **- "AIR BRAKE ANTILOCK BRAKE SYSTEM (ABS)"**

New **- "CARGO LOAD SECUREMENT"**

Proposed **- "REAR IMPACT PROTECTION"**

Transport Canada has recently introduced, or is in the process of amending the regulations to

introduce, standards on the above noted subjects. This page lists the effective dates, scopes and similar U.S. activities regarding these items.

ABS REQUIREMENTS IN CANADA: The new air brake standard CMVSS 121 & TSD 121 came into effect in Canada on April 1, 2000. The standard is almost identical to the U.S. 121, including the requirement of ABS brakes on all air brake equipped vehicles manufactured after the effective date.

ABS REQUIREMENTS IN THE USA: ABS systems have been required for some time on air brake equipped vehicles manufactured for sale in the USA.

Please note that the U.S. Federal Highway Administration requires all vehicles **operating** in the USA that are manufactured after the FMVSS 121 effective dates to be fitted with ABS.

Standards 905 - TRAILER CARGO ANCHORING DEVICES: This standard came into effect in Canada on September 1, 1999. It requires a certain quantity of tie downs to be fitted to flat deck trailers and similar vehicles. The individual anchor points must be tested to withstand 67,000 N (15,000 lbs.) of force. See the corresponding 905 section in this manual for more information. Presently, there is no similar requirement in the U.S.A.

PENDING REAR IMPACT PROTECTION REQUIREMENTS IN CANADA: The Canadian version of these standards are presently being developed. Regulations on rear impact guards for vehicles manufactured for sale in Canada, are projected to be introduced in 2001.

REAR IMPACT PROTECTION REQUIREMENTS IN THE USA: FMVSS 223 and 224 came into effect on January 26, 1998. These two standards deal with rear impact guards and the installation of these devices. These standards apply to trailers and semitrailers with a GVWR of 4,536 kg or more, that are manufactured for sale in the USA.

Please note that, like the ABS requirements, the U.S. Federal Highway Administration will likely be requiring all vehicles **operating** in the USA that are manufactured after the FMVSS 223 and 224 effective dates shown above to be fitted with rear impact protection.

To obtain additional information or copies of the above mentioned regulations, please contact the following:

Peter Zongora - Transport Canada, telephone: (613) 998 2189, Fax: (613) 998 4831

Alan Tucker - CTEA, telephone: (519) 631 0414, Fax: (519) 631 1333

Websites; NHTSA: www.nhtsa.dot.gov
Transport Canada: www.tc.gc.ca

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