

CMV Brake Safety Symposium

Indianapolis Dec. 5-7 2006

Session IV – Straw-Man Exercise

Document #2

**Safety & Compliance
Regulations**

PART 571
FEDERAL MOTOR VEHICLE SAFETY
STANDARDS

Standard No. 121; Air brake systems

Indicate the group that needs to know about the requirement and be able to confirm when a vehicle complies.

Column D = Driver **Column T** = Technician **Column E** = Enforcement
Indicate the level of importance: **N/A** = Not Applicable, **L** = Low, **M** = Medium, **H** = High

FMVSS 121 – S5. Requirements

Requirement	D	T	E
S5.1 Required equipment . Trucks and buses			
S5.1.1 Air compressor. The air compressor must build up from 85 psi (585.7 kPa) to 100 psi (689 kPa) in 25 seconds with the engine operating at the vehicle manufacturer’s maximum recommended RPM.			
S5.1.1.1 Air compressor cut-in pressure. The minimum air compressor governor cut-in pressure for buses is 585.7 kPa (85 psi). The minimum air compressor governor cut-in pressure for trucks is 689 kPa (100 psi).			
S5.1.2 Reservoirs. The combined volume of the supply and service air tanks must be equal to at least 12 times the combined volume of all of the service brake chambers. The system must include either an automatic drain valve for each air tank or a supply tank must be used.			
S5.1.2.2 Air tanks must be able to withstand 500 psi (3445 kPa) or five times the air compressor cut-out pressure (whichever is higher) for a period of 10 minutes.			
S5.1.2.3 Air tanks must be protected against loss of air pressure from their source by means of a one-way check valve that can be tested without disconnecting any line or fitting.			
S5.1.2.4 Each air tank must have a manual drain valve.			
S5.1.3 Towing vehicle protection system. Towing vehicles must have a way to prevent air loss resulting from a failure in the towed vehicle.			
S5.1.4 Pressure gauge. Each service air system must have a pressure gauge that shows the pressure in its air tank, which is readily visible to a person seated in the normal driving position.			
S5.1.5 Warning signal. Each vehicle must have a system that provides a continuous warning to the driver when service air pressure is below 60 psi (413.4 kPa) and the ignition is on. The signal can be visual or both visual and audible.			
S5.1.6 Antilock Brake System (ABS) Straight trucks and buses manufactured after March 1 1998 must have ABS. <ul style="list-style-type: none"> • The ABS system must control at least one front axle and one rear axle. • Other axles may be indirectly controlled. Truck tractors manufactured after March 1 1997 must have ABS. <ul style="list-style-type: none"> • The ABS system must control at least one front axle and one rear axle with the 			

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Requirement	D	T	E
<p>wheels of at least one axle being independently controlled.</p> <ul style="list-style-type: none"> Other axles may be indirectly controlled but no more than three wheels can be controlled by one modulator 			
<p>S5.1.6.2 Antilock Malfunction Signal. Vehicles requiring ABS must have a lamp that indicates ABS system malfunctions.</p> <ul style="list-style-type: none"> It must activate whenever the system is unable to perform correctly and the ignition key is in the 'on' position. Malfunction messages must be stored in the ABS system when the ignition is turned 'off' and reactivate the lamp when the ignition is turned 'on' again. The indicator lamp must activate as a check of the lamp's function when the ignition is first turned 'on' and if there are no malfunctions, shall deactivate after the lamp check cycle. <p>Truck tractors* equipped to tow other airbraked vehicles must have a separate malfunction lamp to indicate ABS malfunctions in any towed vehicles. (Manufactured after March 1, 2001)</p> <ul style="list-style-type: none"> This lamp must work in the same way as described above. 			
<p>S5.1.6.3 Antilock power circuit for towed vehicles. Vehicles requiring ABS equipped to tow airbraked trailers must provide a continuous power source for trailer ABS operation whenever the ignition is 'on'.</p>			
<p>S5.1.7 Service brake stop lamp switch. Vehicles must have a brake lamp switch that activates when brakes are applied to 6 psi or less.</p>			
<p>S5.1.8 Brake distribution and automatic adjustment. Each brake must have an automatic adjuster and a stroke indicator that shows when the brake is out of adjustment.</p>			

- End of '121' Required Equipment: Trucks and Buses -

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Requirement	D	T	E
S5.2 Required equipment — Trailers Each trailer shall have the following equipment:			
S5.2.1 Reservoirs. Trailers must have one or more air tanks: <ul style="list-style-type: none"> • Volume must be equal to at least eight times the combined volume of all service brake chambers. • Must be able to withstand 500 psi (3445 kPa) for a period of 10 minutes. • Must have a manual drain valve. • Must be protected against loss of air pressure from their source by means of a one-way check valve or equivalent. 			
S5.2.2 Brake distribution and automatic adjustment. Each brake must have an automatic adjuster and a stroke indicator that shows when the brake is out of adjustment.			
S5.2.3 Antilock Brake System. Trailers and converter dollies manufactured on or after March 1, 1998, must have ABS. Semi-trailers and converter dollies must have at least one axle controlled. Full trailers must have at least one front and one rear axle controlled. Other axles may be directly or indirectly controlled.			
S5.2.3.2 ABS malfunction signal. Trailers and dollies manufactured on or after March 1, 2001 must have a means of sending an ABS malfunction signal to the towing vehicle. Trailers and dollies manufactured on or after March 1, 1998, and before March 1, 2009 must have a yellow ABS malfunction lamp with the letters ABS at least 1in. high, on the lamp, its housing or within 6 in. (150 mm) of the lamp. The lamp must be located no closer than 150 mm (5.9 in.), and no farther than 600 mm (23.6 in.) from the red rear side marker lamp on the left side of the trailer.			

- End of '121' Required Equipment: Trailers -

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Requirement						D	T	E
Brake Performance - Combinations								
S5.3.3 Brake actuation times								
Brake actuation time (in seconds) from first movement of the brake pedal to reaching 60 psi in each brake chamber or the test reservoir shall not exceed:								
	Truck or bus	tractor	trailer	converter dolly	Towing trailer			
Vehicle	0.45	0.45	0.50	0.55	0.60			
Test reservoir*	n/a	0.35**	n/a	0.55**	0.50**			
*0.819-L (50-cu. in.) test reservoir connected to the control line output coupling								
** At the option of the vehicle manufacturer the actuation time must be either not later than the time of the fastest brake chamber on the vehicle or the time shown in the table.								
S5.3.3 Brake release times								
Brake release time (in seconds) starting with 95 psi and dropping to 5 psi, from first movement of the brake control (pedal) shall not exceed:								
				converter dolly	Towing trailer			
Vehicle				1.10	1.00			
Test reservoir*	n/a	0.75	n/a	1.10	1.00			
*0.819-L (50-cu. in.) test reservoir connected to the control line output coupling								
S5.3.5 Control signal pressure differential								
Pressure differential between the control line and test reservoir used to test vehicles designed to tow other vehicles shall be less than:								
<ul style="list-style-type: none"> • 1 psi for pressure values from 5 to 20 psi • 2 psi for pressure values from 20 to 40 psi • 5% for pressure values above 40 psi 								

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Requirement	D	T	E
S5.4.1 Brake retardation force. Vehicles designed to be towed by another vehicle must meet specified minimum brake force values.			
S5.5 Antilock brake systems			
S5.5.1 Antilock brake system malfunction. ABS malfunctions can't increase actuation or release times. (Tractors manufactured on or after March 1, 1997)			
S5.5.2 Antilock system power. ABS power must be continuous from the ignition and back up power must be provided from the stop lamp circuit. (Trailers manufactured on or after March 1, 1998)			

- End of '121' Brake Performance – Combinations -

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Requirement	D	T	E
Parking & Emergency Brakes			
S5.6 Parking brake system			
S5.6.1 Static retardation force. Brake force produced by the parking brakes shall be at least <ul style="list-style-type: none"> • .28/GAWR • .28/GAWR for the drive axle only of a 2 axle unit • .14/GAWR for the combined axles of a truck tractor with more than 2 axles 			
S5.6.2 Grade holding. The vehicle must remain stationary facing uphill and facing downhill on a 20-percent grade, both when loaded to its GVWR, and empty			
S5.6.3 Application and holding. The parking brake must hold even when there is a leakage-type failure in the brake system.			
S5.6.4 Parking brake control The parking brake control shall be: <ul style="list-style-type: none"> • be separate from the service brake control • be operable by a person seated in the normal driving position • be identified in a manner that specifies the method of control operation. • control the parking brakes of the vehicle and of any vehicle that it is designed to tow 			
S5.7 Emergency brake system for trucks and buses			
S5.7.2 Emergency brake system operation. The emergency brake system shall be operated by means of the service brake control.			

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Requirement	D	T	E
S5.8 Trailer pneumatic system failure performance			
<p>S5.8.1 Emergency braking capability. Trailers shall have a parking brake system that applies when the air pressure in the supply line is at atmospheric pressure.</p> <p>A trailer converter dolly can have:</p> <ul style="list-style-type: none"> (a) A parking brake system that applies 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 above 137.8 kPa (20 psi) and the supply line is at atmospheric pressure. 			
<p>S5.8.2 Supply line pressure retention. A leakage-type failure in the service brake system can't result in the pressure at the trailer supply coupling falling below 482.3 kPa (70 psi). (Except for a failure of the supply line, a valve directly connected to the supply line, or a component of a brake chamber housing)</p>			
<p>S5.8.3 Automatic application of parking brakes. When air pressure in the supply line is 482.3 kPa (70 psi) or higher, the parking brakes can't provide any brake force.</p>			

- End of '121' Parking & Emergency Brakes -

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PART 393

PARTS AND ACCESSORIES NECESSARY FOR SAFE OPERATION

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Requirement	D	T	E
§393.40 Required brake systems.			
(a) Each commercial motor vehicle must have brakes adequate to control the movement of, and to stop and hold, the vehicle or combination of vehicles.			
(b) Service brakes (2) Vehicles must have a service brake system that meets the requirements of FMVSS No. 121 in effect on the date of manufacture.			
(c) Parking brakes Vehicles must have a parking brake system that meets the requirements of 393.41.			
(d) Emergency brakes (2) Vehicles must have an emergency brake system that meets the requirements of FMVSS No. 121 in effect on the date of manufacture.			
(f) Interconnected systems. (1) When brake systems are interconnected, they must be designed, constructed, and maintained so that in case of a failure the vehicle will have operative brakes.			
§393.41 Parking brake system.			
(b) The parking brake shall be capable of holding the vehicle or combination of vehicles stationary.			
§393.43 Breakaway and emergency braking.			
(a) Towing vehicle protection system. Every vehicle used to tow a trailer shall be capable of stopping the towing vehicle in the case of a breakaway of the trailer. The tractor protection valve or similar device shall operate automatically when the air pressure is between 20 and 45 psi.			
(b) Emergency brake requirements, air brakes. Every vehicle used to tow a trailer shall be equipped with two means of activating the emergency features of the trailer brakes. One shall operate automatically when the air pressure is between 20 and 45 psi. The other shall operate manually. The control must be readily operable by a person seated in the driving seat. Its emergency position or method of operation shall be clearly indicated.			
(d) Breakaway braking requirements for trailers. Every trailer shall have brakes that apply automatically and immediately upon breakaway from the towing vehicle.			

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Requirement	D	T	E
(e) Emergency valves. Air brake systems on towed vehicles must have "no bleed back" relay emergency valves or equivalent devices. Air for the brakes shall be prevented against backflow to the towing vehicle upon reduction of the towing vehicle air pressure.			
§393.44 Front brake lines, protection.			
In the event any brake line to any of the front wheels is broken on a bus, the driver must be able to apply the brakes on the rear wheels. The means used to apply the brakes may be located forward of the driver's seat as long as it can be operated manually by the driver when restrained by the seat belt.			
§393.45 Brake tubing and hoses; hose assemblies and end fittings.			
(a) General construction requirements for tubing and hoses, assemblies, and end fittings. All brake tubing and hoses, brake hose assemblies, and brake hose end fittings must meet the applicable requirements of FMVSS No. 106 (49 CFR 571.106).			
(b) Brake tubing and hose installation. Brake tubing and hose must: <ul style="list-style-type: none"> (1) Be long and flexible enough to accommodate without damage all normal motions of the parts to which it is attached; (2) Be secured against chaffing, kinking, or other mechanical damage; and (3) Be installed in a manner that prevents it from contacting the vehicle's exhaust system or any other source of high temperatures. 			
(c) Nonmetallic brake tubing. Coiled nonmetallic brake tubing may be used for connections between towed and towing motor vehicles or between the frame of a towed vehicle and the unsprung subframe of an adjustable axle of the motor vehicle if- <ul style="list-style-type: none"> (1) The coiled tubing has a straight segment (pigtail) at each end that is at least 51 mm (2 inches) in length and is encased in a spring guard or similar device which prevents the tubing from kinking at the fitting at which it is attached to the vehicle; and (2) The spring guard or similar device has at least 51 mm (2 inches) of closed coils or similar surface at its interface with the fitting and extends at least 38 mm (1 ½ inches) into the coiled segment of the tubing from its straight segment. 			
(d) Brake tubing and hose connections. All connections for braking systems shall be installed so as to ensure an attachment free of leaks, constrictions or other conditions which would adversely affect the performance of the brake system.			

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Requirement	D	T	E
§393.47 Brake actuators, slack adjusters, linings/pads and drums/rotors.			
(a) General requirements. Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle.			
(b) Brake chambers. The service brake chambers and spring brake chambers on each end of an axle must be the same size.			
(c) Slack adjusters. The effective length of the slack adjuster on each end of an axle must be the same.			
(d) Linings and pads. The thickness of the brake linings or pads shall meet the applicable requirements of this paragraph: (1) Steering axle brakes. The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than the prescribed minimum thickness. (2) Non-steering axle brakes. An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm (1/4 inch) or to the wear indicator if the lining is so marked (measured at the shoe center for drum brakes); or less than 3.2 mm (1/8 inch) for disc brakes.			
(e) Clamp and Roto-Chamber Brake Actuator Readjustment limits. The pushrod travel for clamp and roto-chamber type actuators must be less than the brake adjustment limit.			
(f) Wedge Brake Adjustment. The movement of the scribe mark on the lining shall not exceed 1.6 mm (1/16 inch).			
(g) Drums and rotors. The thickness of the drums or rotors shall not be less than the limits established by the brake drum or rotor manufacturer.			
§393.48 Brakes to be operative.			
(a) General rule. Except as provided in paragraphs (b) and (c) of this section, all brakes with which a commercial motor vehicle is equipped must be operable at all times.			

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Requirement	D	T	E
<p>(b) Devices to reduce or remove front-wheel braking effort. A commercial motor vehicle may be equipped with a device to reduce the front wheel braking effort</p> <p>(1) Manually operated devices. Manually operated devices to reduce or remove front-wheel braking effort may only be used on buses, trucks, and truck tractors manufactured before March 1, 1975. Such devices must not be used unless the vehicle is being operated under adverse conditions such as wet, snowy, or icy roads.</p> <p>(2) Automatic devices. Automatic devices must not reduce the front-wheel braking force by more than 50 percent of the braking force. The device must not be operable by the driver. The device must not be operable when the brake control application pressure exceeds 85 psig.</p>			
§393.49 Single valve to operate all brakes.			
Every motor vehicle must have one application valve to operate all the service brakes on the motor vehicle or combination of motor vehicles. This requirement does not prohibit additional valves to be used to operate the brakes on a trailer.			
§393.50 Reservoirs required.			
(a) Reservoir capacity must meet the reservoir requirements of FMVSS No. 121.			
(c) Safeguarding of air. Each air tank shall be protected by check valves or equivalent devices that can be checked without disconnecting any air line or fitting.			
(d) Drain valves for air braked vehicles. Each reservoir must have a drain valve that can be manually operated. Automatic drain valves may be used provided they can be operated manually or a manual means of draining the tanks is retained.			
§393.51 Warning signals, air pressure gauges.			
(a) General Rule. Every vehicle must be equipped with a signal that provides a warning to the driver when a failure occurs in the vehicle's service brake system.			
<p>(c) Air brakes.</p> <p>(1) A pressure gauge, visible to a person seated in the normal driving position, which indicates the air pressure (in kilopascals (kPa) or pounds per square inch (psi)) available for braking; and</p> <p>(2) A warning signal that is audible or visible to a person in the normal driving position and provides a continuous warning to the driver whenever the air pressure in the service reservoir system is at 379 kPa (55 psi) and below, or one-half of the compressor governor cutout pressure, whichever is less.</p>			

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Requirement	D	T	E
§393.52 Brake performance.			
(a) Upon application of its service brakes , a motor vehicle or combination of motor vehicles must under any condition of loading in which it is found on a public highway, be capable of: <ul style="list-style-type: none"> (1) Developing braking force at the specified percentage of its gross weight. (2) Decelerating to a stop from 20 miles per hour at the specified rate. (3) Stopping from 20 miles per hour in a specified distance. 			
(b) Upon application of its emergency brake system, under any condition of loading, must be capable of stopping from 20 miles per hour in a specified distance.			
(c) Conformity to the stopping distance shall be under the following conditions: <ul style="list-style-type: none"> (1) On a hard surface that is substantially level, dry, smooth, and free of loose material. (2) Must stay within a 12 foot wide lane. 			
§393.53 Automatic brake adjusters and brake adjustment indicators.			
(b) Automatic brake adjusters. Each vehicle manufactured on or after October 20, 1994 must have an automatic brake adjustment system.			
(c) Brake adjustment indicator Each vehicle manufactured on or after October 20, 1994 must have a means of showing the condition of service brake under-adjustment			
§393.55 Antilock brake systems.			
(c) Air brake systems. <ul style="list-style-type: none"> (1) Each truck tractor manufactured on or after March 1, 1997 must be equipped with ABS. (2) Each vehicle other than a truck tractor, manufactured on or after March 1, 1998 must be equipped with ABS. 			

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Requirement	D	T	E
<p>(d) ABS malfunction circuits and signals for air braked vehicles.</p> <p>(1) Each truck tractor manufactured on or after March 1, 1997, must have an electrical circuit that signals ABS malfunctions.</p> <p>(2) Each truck tractor manufactured on or after March 1, 2001, must have an electrical circuit that signals ABS malfunctions on the towed vehicle(s) to the malfunction lamp in the cab of the towing vehicle.</p> <p>(3) Each semitrailer, trailer converter dolly, and full trailer manufactured on or after March 1, 2001, must have an electrical circuit that signals a trailer ABS malfunction.</p>			
<p>(e) Exterior ABS malfunction indicator lamps for trailers. Each trailer must be equipped with an ABS malfunction indicator lamp.</p>			

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PART 396
INSPECTION, REPAIR, AND MAINTENANCE

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§396.17 Periodic inspection.

a) Every commercial motor vehicle shall be inspected as required by this section. The inspection shall include, at a minimum, the parts and accessories set forth in appendix G of this subchapter.

Appendix G to Subchapter B — Minimum Periodic Inspection Standards

A vehicle does not pass an inspection if it has one of the following defects or deficiencies:

Requirement	D	T	E
1. Brake System.			
a. Service Brakes.			
(1) Absence of braking action on any axle required to have brakes upon application of the service brakes (such as missing brakes or brake shoe(s) failing to move upon application of a wedge. S-cam, cam, or disc brake).			
(2) Missing or broken mechanical components including: shoes, lining pads, springs, anchor pins, spiders, cam rollers, push rods, and air chamber mounting bolts.			
(3) Loose brake components including air chambers, spiders, and cam shaft support brackets.			
(4) Audible air leak at brake chamber.			
(5) Readjustment limits. The maximum stroke at which brakes should be readjusted is given below. Any brake $\frac{1}{4}$ ", or more past the readjustment limit or any two brakes less than $\frac{1}{4}$ ", beyond the readjustment limit shall be cause for rejection. Stroke shall be measured with engine off and reservoir pressure of 80 to 90 psi with brakes fully applied.			

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CLAMP TYPE BRAKE CHAMBER DATA			
Type	Outside Diameter	Brake Adjustment Limit	
		Standard Stroke Chamber	Long Stroke Chamber
6	4-1/2 (114mm)	1-1/4 (32mm)	--
9	5-1/4 (133mm)	1-3/8 (35mm)	--
12	5-11/16 (145mm)	1-3/8 (35mm)	1-3/4 (45mm)
16	6-3/8 (162mm)	1-3/4 (45mm)	2 (51mm)
20	6-25/32 (172mm)	1-3/4 (45mm)	2 (51mm)
24	7-7/32 (184mm)	1-3/4 (45mm)	2 (51mm) *2.5 (64mm)
30	8-3/32 (206mm)	2 (51mm)	2.5 (64mm)
36	9 (229mm)	2-1/4 (57mm)	--

*For type 24 chambers with 3 in (76mm) rated stroke.

BOLT TYPE BRAKE CHAMBER DATA			ROTOCHAMBER DATA		
Type	Outside Diameter	Brake Adjustment Limit	Type	Outside Diameter	Brake Adjustment Limit
A	6-15/16 (176mm)	1-3/8 (35mm)	9	4-9/32 (109mm)	1-1/2 (38mm)
B	9-3/16 (234mm)	1-3/4 (45mm)	12	4-13/16 (122mm)	1-1/2 (38mm)
C	8-1/16 (205mm)	1-3/4 (45mm)	16	5-13/32 (138mm)	2 (51mm)
D	5-1/4 (133mm)	1-1/4 (32mm)	20	5-15/16 (151mm)	2 (51mm)
E	6-3/16 (157mm)	1-3/8 (35mm)	24	6-13/32 (163mm)	2 (51mm)
F	11(279mm)	2-1/4 (57mm)	30	7-1/16 (180mm)	2-1/4 (57mm)
G	9-7/8 (251mm)	2 (51mm)	36	7-5/8 (194mm)	2-3/4 (70mm)
DD-3 BRAKE CHAMBER DATA			50	8-7/8 (226mm)	3 (76mm)
*30	8-1/8 (206mm)	2-1/4 (57mm)			

*This chamber has three air lines and is found on motorcoaches.

WEDGE BRAKE DATA. —Movement of the scribe mark on the lining shall not exceed $\frac{1}{16}$ inch.

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Requirement	D	T	E
(6) Brake linings or pads.			
(a) Lining or pad is not firmly attached to the shoe;			
(b) Saturated with oil, grease, or brake fluid; or			
(c) Non steering axles: Lining with a thickness less than $\frac{1}{4}$ inch at the shoe center for air drum brakes, $\frac{1}{16}$ inch or less at the shoe center for hydraulic and electric drum brakes, and less than $\frac{1}{8}$ inch for air disc brakes.			
(d) Steering axles: Lining with a thickness less than $\frac{1}{4}$ inch at the shoe center for drum brakes, less than $\frac{1}{8}$ inch for air disc brakes and $\frac{1}{16}$ inch or less for hydraulic disc and electric brakes.			
(7) Missing brake on any axle required to have brakes.			
(8) Mismatch across any power unit steering axle of:			
(a) Air chamber sizes.			
(b) Slack adjuster length.			
b. Parking Brake System. No brakes on the vehicle or combination are applied upon actuation of the parking brake control, including driveline hand controlled parking brakes.			
c. Brake Drum or Rotors.			
(1) With any external crack or cracks that open upon brake application (do not confuse short hairline heat check cracks with flexural cracks).			
(2) Any portion of the drum or rotor missing or in danger of falling away.			
d. Brake Hose.			
(1) Hose with any damage extending through the outer reinforcement ply. (Rubber impregnated fabric cover is not a reinforcement ply). (Thermoplastic nylon may have braid reinforcement or color difference between cover and inner tube. Exposure of second color is cause for rejection.			
(2) Bulge or swelling when air pressure is applied.			
(3) Any audible leaks.			

Indicate the group that needs to know about the requirement and be able to confirm when a vehicle complies.

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(4) Two hoses improperly joined (such as a splice made by sliding the hose ends over a piece of tubing and clamping the hose to the tube).			
(5) Air hose cracked, broken or crimped.			
e. Brake Tubing			
(1) Any audible leak.			
(2) Tubing cracked, damaged by heat, broken or crimped			
f. Low Pressure Warning Device missing, inoperative, or does not operate at 55 psi and below, or $\frac{1}{2}$ the governor cut out pressure, whichever is less.			
g. Tractor Protection Valve. Inoperative or missing tractor protection valve(s) on power unit.			
h. Air Compressor.			
(1) Compressor drive belts in condition of impending or probable failure.			
(2) Loose compressor mounting bolts.			
(3) Cracked, broken or loose pulley.			
(4) Cracked or broken mounting brackets, braces or adapters.			

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