A Guide To Federal Regulations For Air Brake Systems

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Truck, Bus & Tractor

Compressor and Governor

Compressor Performance: 49CFR571.121 S5.1.1 The compressor must raise the air systems pressure using maximum engine rpm, from 85 psi to 100 psi within the time calculated: Actual reservoir capacity x 25 \ required reservoir capacity. (In most cases 25 seconds.)

Note: This is a requirement at the time of manufacturing. There is no “Federal Motor Carrier Safety Regulation” requiring enforcement of this provision for “Motor Carriers.”

Governor: 49CFR571.121 S5.1.1.1 Cut in pressure for a bus must be a minimum of 85 psi, for a truck 100 psi.

Reservoirs

Drain Valves: 49CFR571.121 S5.1.2.4 Every reservoir must have a manual means of draining, regardless of if it has automatic drain valves or not. 49CFR571.121 S5.1.2 Automatic drain valves must be on each service reservoir if there is no wet tank installed.

Reservoir Integrity: 49CFR571.121 S5.1.2.2 Each reservoir must withstand 5 times governor cut-out or 500 psi which ever is greater, for at least 10 minutes.

Reservoir Capacity: 49CFR571.121 S5.1.2.1 The combined service and supply reservoir volume must be; 12 times the combined service chamber volume at maximum brake chamber stroke. There is a second table of reference that may be used for calculating chamber volume so as to make use of long stroke chambers without adding reservoir volume.

FMCSR Sec. 393.50 (a) Reservoir capacity must be sufficient to make a full service brake application without depleting the air pressure below 70% of the pressure that was in the tank just before the brake application.

Check Valves: 49CFR571.121 S5.1.2.3 & FMCSR Sec. 393.50 (b) The pressure in each service reservoir must be protected from a failure of its source, this is accomplished with one-way check valves between the service reservoir and the wet tank or compressor. Check valves or whatever device is used, must be functionally tested without disconnecting any lines or fittings. This can be accomplished by draining individual tanks.
Truck, Bus & Tractor

Pressure Gauges, Warning Signal & Stop Lights

Gauges: 49CFR571.121 S5.1.4 Each service reservoir must have a gauge where the driver can see it, must be accurate within plus or minus 7 percent of compressor cut out (125 psi cut-out; plus or minus 8.75 psi).

Low Air Warning Signal: 49CFR571.121 S5.1.5 There must be a warning Signal other than a gauge, it must be continuous when the ignition is on and the service system air is below 60 psi. The signal may be visible so the driver can see it or both audible and visual.

FMCSR Sec. 393.51: Must comply to 49CFR571.121 or If the vehicle was manufactured before 121, it must be audible or visual and operate continuously when the service system pressures are at one-half of compressor cut-out or less.

Stop Lights: 49CFR571.121 S5.1.7 Must have a switch that lights the stop lights when there is 6 psi and higher in the service brakes.

FMCSR Sec. 393.24 (f) Stop lights must operate upon any application of the service brakes.

Required Brake Systems

Foot Valve: FMCSR Sec. 393.49 A single valve must be available to operate all the service brakes on the vehicle or combination.

Service Brakes: 49CFR571.121 S5.1.8 All vehicles must have a service brake system acting on all wheels.

FMCSR Sec. 393.40 All vehicles must have a service brake system. Sec. 393.42 Brakes required on all wheels. Sec. 393.48 Must be capable of operating at all times.

Front Brakes: FMCSR Sec. 393.42 Brakes required on all wheels except Trucks or Truck Tractors having three or more axles. Need not have brakes on the front wheels, if the vehicle was manufactured before July 25, 1980; or Manufactured between July 24, 1980, and October 27, 1986, must be retrofitted to meet the requirements of this section within one year from February 26, 1987, if the brake components have been removed.

Front Axle Limiting Valves: FMCSR Sec. 393.48 Manual limiting valves can be used on front steer axles on vehicles manufactured before March 1, 1975 and only be used to limit the front brakes in adverse road conditions. Automatic limiting valves may be used on vehicles manufactured after this date. Both may reduce braking force by as much as 50% and automatics must not limit above 85 psi.
Truck, Bus & Tractor
Required Brake Systems (cont’d)

Service Brake Stopping Distance: 49CFR571.121 S5.3.1 As of March 1, 1997 for Tractors and Trucks designed to tow other vehicles and March 1, 1998 for all other single unit vehicles (Truck or bus); the service brakes must perform to several stopping distance requirements. 49CFR571.121 S5.3.1 Must not leave the roadway. 49CFR571.121 S6.1.7 The test roadway unless otherwise specified is 12 foot wide.

FMCSR Sec. 393.52 All vehicle service brakes must perform to a 20 mph stopping distance requirement or exhibit specific brake forces when measured with an approved “Performance Based Brake Testers.”

Note: At a road side inspection D.O.T. Officers have always had jurisdiction to enforce the FMCSR Sec. 393.52 (a) Stopping distance requirements, although rarely performed, do to lack of proper location and the likelihood of damage incurring to freight. As of February 5, 2003, Officers will have the option to enforce these requirements using approved “Performance Based Brake Testers,” rather than actual stopping distances.

Parking Brakes: 49CFR571.121 S5.6 Every vehicle must have a park brake system. Park brakes must hold by mechanical means (spring brakes). The park brakes must hold the vehicle by either of two ways: 49CFR571.121 S5.6.1 Static draw bar hold test or 49CFR571.121 S5.6.2 On a 20% grade. 49CFR571.121 S5.6.3.3 Park brakes must set up and hold within 3 seconds of actuating the park control valve.

Parking Brake Control: 49CFR571.121 S5.6.4 The park brake control must be separate from the service brake control. The Parking brakes must not be capable of release unless capable of an immediate reapplication.

FMCSR Sec. 393.41 Basically says the same thing as 49CFR571.121.

Emergency Brakes: 49CFR571.121 S5.7 Each vehicle must have an emergency brake system.

49CFR571.121 S5.7.2 The emergency brakes must be applied, released and modulated by the service brake control (foot valve).

FMCSR Sec. 393.40 (2) All vehicles must have an emergency brake system either part of the service brake system or a system separate from. FMCSR Sec. 393.44 Every bus must be able to apply the rear brakes in the event any brake line to the front brakes is broken.

Note: To meet these requirements, manufactures use a dual service brake system and in most cases split between the front and rear brakes. The emergency brakes become the service brake system that hasn’t experienced a failure. In order to meet the emergency stopping distance requirement, during a rear brake system failure, a special valve (Inversion or SR-1) is installed to allow a modulated spring (parking) brake application using the front brake system air, controlled by the foot control valve.
Tractor Emergency Brake Operation: 49CFR571.121 S5.7.3 In addition to the above provisions, a truck designed to tow another vehicle or a tractor; must be capable of modulating the service/control line to the trailer with any single service system failure.

Note: Tractor manufactures accomplished this by separating the front and rear service brake control signals to the trailer with a double check valve.

FMCSR Sec. 393.43 (b) Every truck or truck tractor equipped with air brakes, when used for towing other vehicles equipped with air brakes (trailers), shall be equipped with two means of activating the emergency features of the trailer brakes. One of these means shall operate automatically in the event of reduction of the towing vehicle (tractor) air supply to a fixed pressure which shall not be lower than 20 pounds per square inch nor higher than 45 pounds per square inch. The other means shall be a manually controlled device readily operable by a person seated in the driving seat. Its emergency position or method of operation shall be clearly indicated. In no instance may the manual means be so arranged as to permit its use to prevent operation of the automatic means. The automatic and manual means required by this section may be, but are not required to be, separate.

Note: Trailer manufactures design the emergency brakes to apply when the emergency/supply line between the tractor and trailer is vented to atmosphere. To meet the above regulation tractor manufacturers use a pressure sensitive trailer dash control valve which can be manually operated by the driver and automatically sets the trailer emergency brakes when the tractor’s air system falls between 20 psi and 45 psi. When testing a vehicle’s compliance to this regulation the tractor to trailer air lines (supply/emergency) & (service/control) should remain connected and the tractor’s air system should be reduced by pumping down the service brakes until the trailer emergency brakes apply. For tractor protection & breakaway procedures see the following regulations and note.

Tractor Protection & Breakaway: 49CFR571.121 S5.1.3 If the vehicle is intended to tow another vehicle equipped with air brakes, a system to protect the air pressure in the towing vehicle from effects of a loss of air pressure in the towed vehicle.

FMCSR Sec. 393.43 (a) Every motor vehicle, if used to tow a trailer equipped with brakes, shall be equipped with means for providing that in case of breakaway of such trailer the service brakes on the towing vehicle will be sufficiently operative to stop the towing vehicle.

Note: These two regulations state; there must be a system on the tractor to protect the air and/or service brakes on the tractor, so it can be stopped in the event the trailer becomes disconnected and breaks away. They give no pressure levels at which it must be protected and no stopping distance requirement. In a breakaway situation; the trailer dash control valve in combination with the tractor protection valve accomplish this. When testing a vehicle’s
Truck, Bus & Tractor
Required Brake Systems (cont’d)

Tractor Protection & Breakaway (cont’d):
compliance to this regulation: Release all brakes on both the tractor & trailer combination,
airsystems fully charged, disconnect both the emergency & service glad-hands between the
tractor and trailer, wait until air stops flowing from the tractor’s glad-hands, note the air
pressure remaining in the tractor’s air systems (should be at least 20 psi). If not released,
release the tractor parking brakes, make a service brake application with the foot control
valve, no air should exhaust from the tractors glad-hands.

Emergency Stopping Performance and Distance:

49CFR571.121.S5.7.1 The emergency brakes
must perform to a specific stopping distance requirement.

FMCSR Sec. 393.52 (b) The emergency brakes must comply with a 20 mph stopping distance
however loaded for the roadway.

Note: The emergency brakes are the un-failed service brake system, not the spring parking
brakes. At a road side inspection D.O.T. Officers have always had jurisdiction to enforce the
FMCSR Sec. 393.52 (b) Stopping distance requirements, although rarely performed, do to lack
of proper location and the likelihood of damage incurring to freight. As of February 5, 2003,
Officers will have the option to enforce these requirements using approved “Performance
Based Brake Testers,” rather than actual stopping distances.

Automatic Brake Adjusters & Stroke Indicators

FMCSR Sec. 393.53 (b) All vehicles manufactured on or after October 20, 1994 must comply to
the following 49CFR571.121 regulation.

49CFR571.121.S5.1.8 (a) All vehicles must have automatic brake adjusters.
49CFR571.121.S5.1.8 (b) All vehicles with external brake adjusters (slack adjusters) and
an exposed pushrod must have a stroke indicator. The indicator must indicate an under
condition (over stroke condition). The indicator must be visible from underneath or just
next to the vehicle.

The CDL Handbook Sec 10 Pre-Trip Inspection: Slack Adjusters - Look for broken, loose or
missing parts. The angle between the push rod and adjuster arm should be a little over
90 degree when the brakes are released and not less than 90 degree when the brakes are
applied. When pulled by hand, the brake rod should not move more than 1” (with the
brakes released).

Note: This inspection requirement is suggested for successful passage of the Commercial Drivers
License Pre-Trip Inspection Test. There is no “Federal Motor Carrier Safety Regulation” requiring
enforcement of this provision for “Motor Carriers.”
Truck, Bus & Tractor

Antilock Brakes (ABS)

Trucks and Buses: 49CFR571.121 S5.1.6.1(a) Each single-unit vehicle manufactured on or after March 1, 1998, shall be equipped with an antilock brake system. The system must directly control the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

Note: The minimum allowable configuration is: Four wheel sensors (4S) two ABS modulators (valves) (4S 2M). Most, if not all, vehicle manufacturers have standardized to a higher configuration: four sensors four modulators, 4S 4M. Indirectly controlled wheels means; brake chambers of wheels without sensors may be slaved to nearby ABS valves.

FMCSR 393.55 (c)(2) Each air braked commercial motor vehicle other than a truck tractor, manufactured on or after March 1, 1998 (except commercial motor vehicles engaged in drive away, tow away operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(a) for trucks and buses.

Trucks Designed to Tow, Tractor: 49CFR571.121 S5.1.6.1(b) Each truck tractor manufactured on or after March 1, 1997, shall be equipped with an antilock brake system. The system must directly control the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle, with the wheels of at least one axle being independently controlled. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system. A truck tractor shall have no more than three wheels controlled by one modulator.

Note: The minimum allowable configuration is: Four wheel sensors (4S) three ABS modulators (valves) (4S 3M). Most, if not all, vehicle manufacturers have standardized to a higher configuration: four sensors four modulators, 4S 4M. Indirectly controlled wheel means; brake chambers of wheels without sensors may be slaved to nearby ABS valves.

FMCSR 393.55 (c)(1) Each truck tractor manufactured on or after March 1, 1997 (except truck tractors engaged in drive away, tow away operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121.

Vehicles Specifically Exempt From Antilock Requirements

While the ABS standard now applies to all air-braked trucks & buses some configurations are exempt. They are mostly slow-moving vehicles such as cranes and heavy-haul equipment. The regulations state ABS is not required on:

49CFR571.121 S3(b) Any vehicle equipped with an axle that has a gross axle weight rating (GAWR) of 29,000 pounds or more.
Truck, Bus & Tractor
Vehicles Specifically Exempt From Antilock Requirements (cont’d)

49CFR571.121 S3(c) Any truck or bus that cannot reach a speed of more than 33 mph in two miles.

49CFR571.121 S3(d) Any truck that cannot go more than 45 mph in two miles, has an unloaded weight that is more than 95% of its gross vehicle weight rating (GVWR) and no capacity to carry occupants other than the driver and operating crew.

Antilock Malfunction Signal and Circuit

Antilock Malfunction Light: 49CFR571.121 S5.1.6.2 Each Truck Tractor manufactured on or after March 1, 1997, and each single unit vehicle (Truck, Bus) manufactured on or after March 1, 1998, shall be equipped with an indicator lamp, mounted in front of and in clear view of the driver (in the dash). The light must do a self test each time the ignition is turned on; it must come on and go off again if no malfunction is detected. If at any time a malfunction is detected while the key is on, the light must come on and stay on until the key is turned off. Each malfunction of the ABS must be stored in the Electronic Control Unit and be retrievable when the key is on.

FMCSR 393.55 (d)(1) Refers to this section in 49CFR571.121.

Separate Trailer Light for Trucks and Tractors: 49CFR571.121 S5.1.6.2 (a) & (b) Each truck tractor manufactured on or after March 1, 2001, and each single unit vehicle manufactured on or after March 1, 2001, that is equipped to tow another air-braked vehicle must have an additional ABS warning light for the trailer’s ABS (usually found in the dash next to the tractor’s ABS light). The truck tractor must have a circuit attached to the trailer for receiving the signal from the trailer to activate this light.

Note: All truck and trailer manufactures have standardized on a circuitry Known as Power Line Carrier (PLC). The trailer’s ECU sends signals through the blue auxiliary wire (power (+) ) and communicates to the tractor’s ABS ECU when to turn on the trailer ABS light.

FMCSR 393.55 (d)(2) Refers to this section in 49CFR571.121.

Antilock Power Circuit for Towed Vehicles: 49CFR571.121 S5.1.6.3 Each truck tractor manufactured on or after March 1, 1997, and each single unit vehicle manufactured on or after March 1, 1998, that is equipped to tow another air-braked vehicle (trailer) shall be equipped with one or more electrical circuits that provide continuous power to the antilock system on the towed vehicle (trailer) or vehicles (trailers) whenever the ignition (start) switch is in the “on” (“run”) position. Such a circuit shall be adequate to enable the antilock system on each towed vehicle to be fully operable (needs to be a large enough wire to handle the needed current for one or more trailers).
Truck, Bus & Tractor
Vehicles Specifically Exempt From Antilock Requirements
Antilock Power Circuit for Towed Vehicles (cont’d)

Note: The regulations don’t specify a specific wire or plug but most, if not all, truck and tractor manufactures standardized by wiring the ignition switch to the blue auxiliary wire at the seven way receptacle at the back of the tractor. The Motor Carrier (fleet) can move it or spec. it anywhere, so long as it performs as listed above. This circuit does not have to go off with the key but must be on when the key is on, in other words, it can be “hot” all the time.

Trailer

Reservoirs: 49CFR571.121 S5.2 Must have one or more reservoir that is supplied with air from the truck or tractor. 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. Brake chamber volume is measured at full stroke or there is a second table of reference that may be used for calculating chamber volume so as to make use of long stroke chambers without adding reservoir volume.

Reservoir Integrity: 49CFR571.121 S5.2.1.2 Each reservoir must withstand a hydrostatic pressure of 500 psi for at least 10 minutes.

Drain Valves: 49CFR571.121 S5.2.1.3 Every reservoir must have a manual means of draining.

Check Valves: 49CFR571.121 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 by check valves or equivalent devices.

Service Brakes: 49CFR571.121 S5.2.2 Each vehicle must have a service brake system acting on all wheels.

Brake Adjuster: 49CFR571.121 S5.2.2 (a) Must have automatic adjusters and must keep it within manufacturers specification. 49CFR571.121 S5.2.2 (b) All vehicles with external brake adjusters (slack adjusters) and an exposed pushrod must have a stroke indicator. The indicator must indicate an under adjustment condition (over stroke condition). The indicator must be visible from underneath or just next to the vehicle.

Antilock Brakes (ABS)

49CFR571.121 S5.2.3.1 (a) Each semitrailer, including trailer converter dollies, manufactured on or after March 1, 1998, 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.
Trailer
Antilock Brakes (ABS) (cont’d)

Note: The minimum allowable configuration is: Two wheel sensors (2S) One ABS modulator (valve)(2S 1M. Indirectly controlled wheels means; brake chambers of wheels without sensors may be slaved to nearby ABS valves.

49CFR571.121 S5.2.3.1 (b) Each full trailer manufactured on or after March 1, 1998, 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.

Note: The minimum allowable configuration is: Four wheel sensors (4S) Two ABS modulators (valves)(4S 2M. Indirectly controlled wheels means; brake chambers of wheels without sensors may be slaved to nearby ABS valves.

Antilock Malfunction Signal and Circuit

Signal: 49CFR571.121 S5.2.3.2 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 (truck/tractor).

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 other air-brake equipped trailers shall be capable of transmitting a malfunction signal from the antilock brake systems of additional trailers it tows to the vehicle towing it.

FMCSR 393.55 (d)(3) Refers to this section in CFR571.121

Note: All truck and trailer manufactures have standardized on a circuitry Known as Power Line Carrier (PLC). The trailer’s ECU sends signals through the blue auxiliary wire (power (+) ) and communicates to the tractor’s ABS ECU when to turn on the trailer ABS light.
Trailer ABS Lamp: 49CFR571.121 S5.2.3.3 (a)&(b) Each trailer and trailer converter dolly manufactured on or after March 1, 1998, and before March 1, 2009, shall be equipped with an external antilock malfunction indicator lamp. The lamp must conform to the performance requirements of SAE J592 or SAE J592E. The color of the lamp must be yellow. The letters “ABS” shall be permanently molded, stamped, or otherwise marked or labeled in letters not less than 10 mm (0.4 inches) high on the lamp lens or its housing to identify the function of the lamp. Or, 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 inch) high. A portion of one of the letters in the alternative identification shall be not more than 150 mm (5.9 inches) from the edge of the lamp lens.