SAE EBS Working Group
FMVSS 121 Modifications for Electronic Controlled Air Brake Systems

FMVSS 121 AIR BRAKE SYSTEMS

Re-Draft to accommodate Electronic Control of Service, Emergency and Parking Brake Systems

(Amendments and additions are in italics).

S4. Definitions

"Agricultural commodity trailer" means a trailer ..and an arrangement of air
and/or electrical
control lines and reservoirs that minimizes damages in field operations

"Air brake system" means a system
mechanical components
An Electronic Controlled Brake System (ECBS) is also considered to be an air brake system.

"Data communication " means the transfer of data

"Electronic Controlled Air Brake System" means an air brake system that uses electronic control to transmit signals from the driver control to a compressed air system which actuates the service brakes. This definition includes full pneumatic, full electrical and combined pneumatic/electronic control systems.The emergency and parking brake systems may also use electronic control signals from the driver controls.

"Electric trailer control line" means an electrical connection between towing vehicles and towed vehicles, which provides the braking control function. It comprises the electrical wiring and the connectors and includes the parts for data communication and the electrical energy supply for the control transmission of the towed vehicle.

"Pulpwood trailer" means a trailer and an arrangement of air
and/or electrical
control lines and reservoirs designed to minimize damage in off-road operations

S5 Requirements

S5.1.2*A Air* reservoirs

S5.1.2B Electrical energy reservoirs (batteries)
a) In the event of a failure of the electrical energy source and starting from the nominal value of the battery energy level, as specified by the vehicle OEM, after 10 minutes of full-treadle brake application. it shall meet the requirements specified in S5.3.1

b) When the battery voltage falls below a value at which the stopping distances specified in S5.3.1 can no longer be achieved the red brake system indicator lamp specified in S5.1.5B shall be activated.

c) After the red brake system indicator lamp has been activated it should be possible to apply the service and parking brake controls and obtain at least the emergency braking performance specified in S5.7.1. and the parking brake performance specified in S5.6.1 or 5.6.2, respectively.

S5.1.5*A* Warning signal

A signal . . . . . audible and visual
A red brake system indicator lamp as specified in S5.1.5.B may be used to satisfy this requirement.

S5.1.5.*B* Brake system indicator lamp

Each motor vehicle equipped with ECBS shall have one red brake system inidicator lamp and if the vehicle is designed to pull trailer(s), the motor vehicle shall have another red brake system indicator lamp for the trailer brake system, the lamp(s) mounted in front of an in clear view of the driver, which meets the requirements of S5.1.5.B(1) through S5.1.5.B(3)

S5.1.5.B(1)

The brake system indicator lamp shall be activated whenever the following conditions occur:

(a) A loss of electrical continuity (e.g. breakage, disconnection) in the service brake control system (excluding the battery) such that the stopping distances specified in S5.3.1 can no longer be achieved.

(b) When the battery voltage falls below a value at which the stopping distances specified in S5.3.1 can no longer be achieved

(c) A loss of electrical continuity (eg. breakage, disconnection) in the parking brake control system (excluding the battery) such that the performance specified in S5.6.1 or S5.6.2 can no longer be achieved.

(d) When a truck tractor without a pneumatic control line is coupled to a trailer without an electrical trailer control line. (figure 4)

Additionally, any truck tractor with ECBS connected to a trailer with ECBS via an electric trailer control line shall activate the trailer brake system indicator lamp whenever the following conditions occur-

(c) A loss of electrical continuity (eg. breakage, disconnection) in the trailer service and parking brake control systems such that the retardation forces specified in S5.4.1 and 5.6.1 or 5.6.2. respectively, can no longer be achieved.

(f) When there is an electrical failure (eg. interruption or defect in the data communication) in the electric trailer control line.

S5.1.5.B(2)

The indicator lamp shall rematn activated as long as on above mentioned condition exists, whenever the ignition (start) switch is in the "on " position whether or not the engine is running. Each message about the existence of such a condition shall be stored after the ignition switch is turned to the "off" position and automatically reactivated when the ignition switch is again turned to the "on" position.

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S5.1.5.B(3)

The indicator lamp shall also be activated as a check of lamp function whenever the ignition is turned to the "on" or "run" position. The indicator shall be deactivated at the end of the check of lamp function unless there is on above-mentioned condition or a message about such a condition that existed when the key switch was last turned to the "off" position.

S5.1.6*A* Antilock Brake System

S5.1.6.B Electronic Controlled Brake System (ECBS)

(a) The electric trailer control line (signal) shall transmit braking data between the tractor and trailer(s) for control of trailer(s) braking. Other information may be transferred by this line provided that the braking functions have priority and are maintained in the normal and failed modes. The transmission of other information shall not delay the braking functions.

(b) A truck tractor equipped with an electric trailer control line and pneumatic control line shall recognize that the coupling of a trailer equipped only with a pneumatic control line is not compatible; and when the system is energized the brakes on either vehicle shall be automatically applied with at least the effectiveness prescribed for the parking brake performace in S5.6.1 or 5.6.2. The red indicator light (S5.1.5.B(1)(d), together with the trailer. A RS malfunction light (S5.1.6.2(b)). shall warn the driver. See Figure 4.

(c) In the case of a truck tractor equipped with both pneumatic and electric trailer control lines, both control signals shall be present at the coupling head and at the connector. When such a truck tractor is connected to a trailer which is also equipped with both pneumatic and electric trailer control lines. then both signals shall be present at the trailer, and the trailer shall decide which control signal to use.

(d) A trailer may be equipped with an electric trailer control line and no pneumatic control line, provided that it can only he operated in conjunction with a towing vehicle with an electric trailer control line. Otherwise, when connected to an incompatible vehicle, the trailer parking brakes shall remain applied. or be automatically applied, and the trailer ABS malfunction light shall also be activated (S5.1.6.2(b)). See figure 4.

(e) It must be passable to apply and release the service brakes when the ignition is switched "off", and provide a full control signal for the service braking system of the trader. It must also be possible to apply and release the parking brake when the ignition is switched "off".

(f) Any electrical auxilary equipment (eg. lights wipers) shall not adversely affect the service. emergency and parking brake performance, either in normal operations or after a failure in such auxiliary devices.

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S5.1.6.2(b)

Each truck tractor manufactured..... is capable of transmitting a malfunction signal from the antilock brake system(s) on one or more towed vehicles (eg. trailers and dollies),
and ECBS failures as described in S5.1.5.B(1)(d), (e) and (f), and where a towing vehicle without an electric trailer control line is coupled to a trailer without a pneumatic control line,
to the trailer ABS malfunction lamp.....unless a trailer ABS malfunction signal is present.

S5.1.7 Service brake stop lamp switch

A switch *or signal* that lights the stop lamps...

S5.5.1 Antilock System Malfunction
.....antilock system shall not increase the actuation and release times of the service *brakes beyond the requirements of S5.3.3 and S5.3.1.*

S5.6.3.1 (Parking brake system - Application and holding)

The parking brake system shall.....are at the levels determined in S5.6.3.4.
In the case of a parking brake system with electric control, the driver shall be able to apply the parking brake with any single break in the electric wiring of the parking brake control system, and achieve the performance specified in SS.6.1 or S5.6.2, unless the parking brake is fully applied automatically. The appropriate red brake system indicator light shall also be activated (S5.1.5.B(1)(c)).

N.B. *THIS FAILURE MODE ("any single break in the electric wiring of the parking brake control* system") MAY ALSO BE RELEVANT TO THE FOLLOWING PARAGRAPHS DEALING WITH "any single leakage-type failure" -:
S5.6.3.3, S5.6.1.4, S5.6.5.1, S5.6.5.3, S5.6.6.1, S5.6.6.3, S5.6.6.4 and S5.6.6.6

S5.7.1 Emergency Brake System Performance

When stopped six times.....on a road service having a PFC of 0.9. with a single failure in the service brake system.
resulting from a loss of electrical continuity (eg. breakage, disconnection) in the service brake control system (excluding the battery), or
of a part designed to contain compressed air or brake fluid. ..... .and with unlimited wheel lockup permitted at any speed.

S5.7.3 Towing Vehicle Emergency Brake Requirements

(d) In the case of towing vehicles equipped with ECBS be capable of providing modulated control to the trailer by means of the service brake control, with a single failure in the towing vehicle service brake system as specified in S5.7.1

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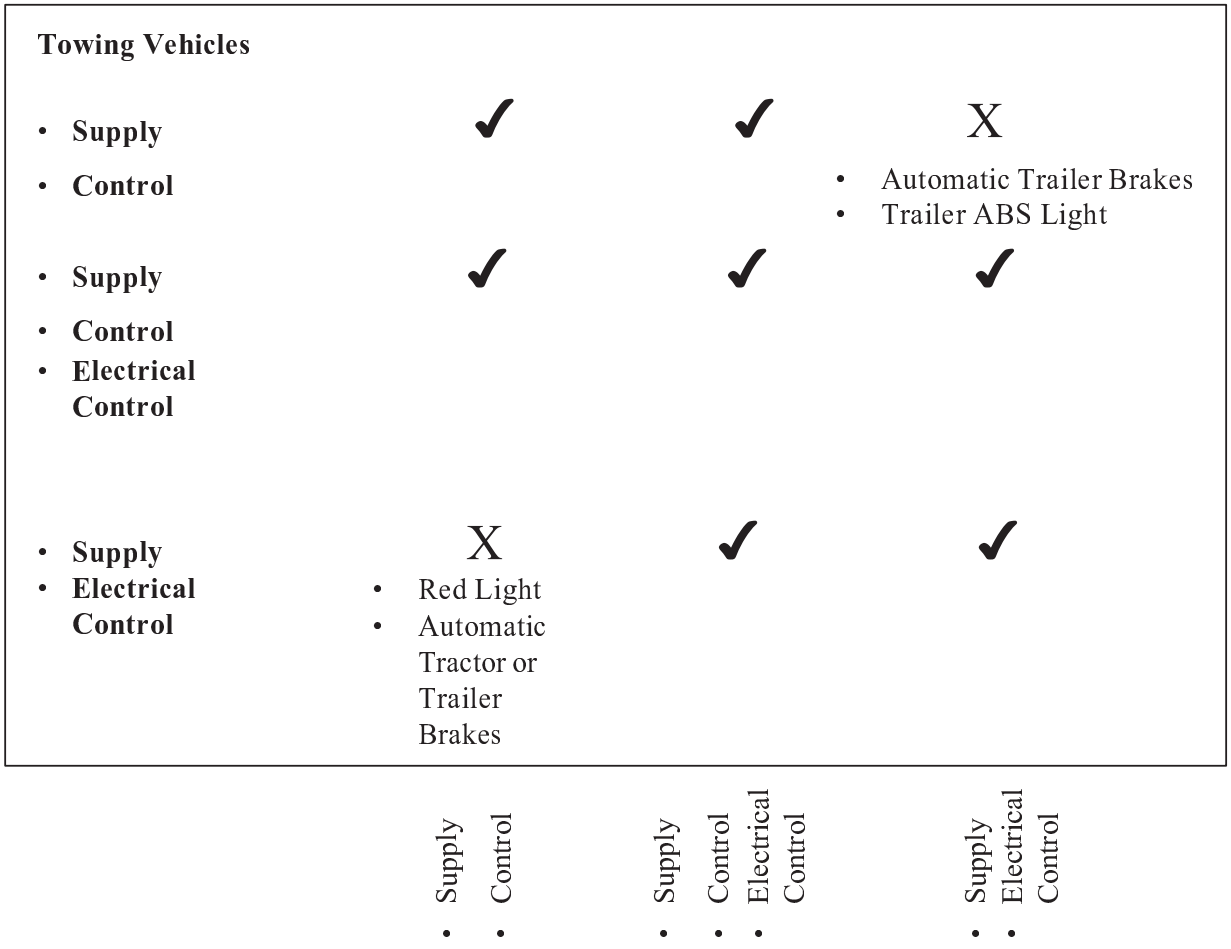
Tractor-Trailer Coupling Interfaces
-- FIGURE 4 --



X = Not Compatible
✓ = Compatible

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BRAKE SYSTEM INDICATION LAMP OPERATION

(FIGURE 5)

S5.1.5B (Proposed)	Red (Truck, Bus, Tractor)	Red (Trailer)	Yellow (ABS) (Truck, Bus, Tractor)	Yellow (ABS) (Trailer)
A. Service Brake Electrical Control	X			
B. Battery Low Voltage	X			
C. Parking Brake Electrical Control	X			
D. Tractor ECL with Trailer PCL (Fig. 4)	X	X		
E. Trailer Service and Parking Brake Electrical Control		X		
F. ECL Data Defect		X		
S5.1.6.2(b) (Proposed) Tractor ECL with Trailer PCL		X		
S5.1.6.2(b) (Proposed) Tractor PCL with Trailer ECL				X
S5.1.5.A (Current) Low Pressure	Optional			
S.5.1.6.2(a) and (b) (Current) ABS Malfunction			X(a)	X(b)

Note: ECL = Electronic Control Line
PCL = Pneumatic Control Line

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WARNING LIGHTS AND BRAKE PERFORMANCE AFTER ELECTRICAL 'FAILURES'
- FIGURE 6 -

SB = Service Brake Performance S5.3.1 EB = Emergency Brake Performance S5.7.1 PB = Parking Brake Performance S5.6.1 or 5.6.2		**WARNING LIGHT**	**PERFORMANCE**	**ECL = Electric Trailer Control Line PCL = Pneumatic Control Line COMMENTS**
S5.1.2.B(b),(c) S5.1.5.B(1)(b)	Battery – Low Voltage	Red (Truck)	EB – PB	
S5.1.2.B(a)	Energy Source Failure		SB	After 10 minutes full-treadle apply
S5.7.1, S5.7.3 S5.1.5.B(1)(a)	Service Brake Electrical Failure	Red (Truck)	EB	Modulated Electronic Control to Trailer
S5.1.5.B(1)(c) S5.6.3.1	Parking Brake Electrical Failure	Red (Truck)	PB	
S5.1.6.2(b) S5.1.5.B(1)(c)	Trailer Service Brake Electrical Failure	Red (Trailer)		
S5.1.5.B(1)(c) S5.1.6.2(b)	Trailer Parking Brake Electrical Failure	Red (Trailer)	PB	
S5.1.5.B(1)(f)	Data Defect in ECL	Red (Trailer)		
S5.1.6.B(b) S5.1.5.B(1)(d)	Tractor ECL with Trailer PCL	Red (Trailer)		Automatic PB Application
S5.1.6.B(d)	Tractor PCL with Trailer ECL	Yellow ABS (Trailer)		Automatic Trailer PB Application
S5.1.6.B(e)	Ignition Switch "Off"		SB – EB – PB	
S5.1.6.B (f)	Auxiliary Electrical Equipment (including failure)		SB – EB – PB	No Adverse Effects