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PRESS Mechanical Working Group

Passenger Electronic 26C Emulation Braking System—Performance Requirements

Abstract: This safety standard contains the minimum performance requirements for passenger electronic 26C emulation brake systems operating on passenger cars in Emulation operation when operating in trains with 26C brake control equipment.

Keywords: 26C brake control, brake, ECP, Emulation, rail car, train

Summary: This Standard was formerly titled “Passenger Electronic 26C Emulation Braking System—Performance Requirements for Passenger Applications” in the previous publication of this document. This standard identifies the minimum performance requirements for the operation of passenger electronic 26C emulation brake systems in service on passenger train equipment. Emulation operation allows ECP-equipped cars to be interoperable with cars outfitted with conventional pneumatic brake valves, such as a car equipped with a conventional 26C valve. This document addresses the performance requirements for entering/exiting Emulation, operating in Emulation, fault detection in Emulation, and the key features and functions of Emulation.

Scope and purpose: This standard has been developed to ensure that vehicles equipped with APTA-approved ECP brake systems from different manufacturers are interoperable and function consistently and uniformly, and that such APTA-approved electronic brake systems meet a high standard for safety and reliability.

Table of Contents

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Introduction

This introduction is not part of the standard requirements of APTA PR-M-S-020-17, latest revision, "Passenger Electronic 26C Emulation Braking System—Performance Requirements," (Electronically Controlled Pneumatic 26C Emulation Braking System—Performance Requirements for Passenger Applications).

Sections 2.1 through 2.7 inclusive are recommended for codified in 49 CFR 238.

This standard applies to all:

1. Railroads that operate intercity or commuter passenger train service on the general railroad system of transportation; and
2. Railroads that provide commuter or other short-haul rail passenger train service in a metropolitan or suburban area, including public authorities operating passenger train service.

This standard does not apply to:

1. Rapid transit operations in an urban area that are not connected to the general railroad system of transportation;
2. Tourist, scenic, historic, or excursion operations, whether on or off the general railroad system of transportation;
3. Operation of private cars, including business/office cars and circus trains; or
4. Railroads that operate only on track inside an installation that is not part of the general railroad system of transportation.

Passenger Electronic 26C Emulation Braking System—Performance Requirements

1. Description of Emulation braking systems for passenger applications

An electronically controlled pneumatic (ECP) brake system is a train-powered braking system actuated by compressed air and controlled by electronic signals originating from a lead locomotive or cab car. The electronic signals are used to communicate service and emergency brake applications, as well as to control power and receive feedback from other devices in the train. Since brake commands are derived from electronic signals, the brake pipe will typically remain charged and provide backup brake commands. The performance requirements for ECP brake systems are covered in APTA PR-M-S-021-17, latest revision, "ECP Passenger Cable-Based Braking System – Performance Requirements."

Emulation is a mode that ECP systems can enter in the event that trainline messages are not received from the locomotive head end unit (HEU). In this mode of operation, the car control device (CCD) will monitor brake pipe (BP) pressure and develop/release brake cylinder (BC) pressure in response to changes in the BP pressure.

Emulation may provide two modes of operation: Passenger and Freight Compatibility. Alternate performance characteristics may be required based on customer needs; this document outlines a basic set of requirements for two modes of operation common to the passenger market.

The primary source of power for Emulation operation is the 74 VDC main car battery. The ECP control valve battery shall provide a secondary power source.

2. Functional and performance specifications

ECP brake systems shall provide Emulation braking functionality that shall comply with the functional requirements defined in this section.

2.1 General requirements

Emulation systems may provide two modes of operation: Passenger and Freight Compatibility.

Emulation systems shall be interoperable with cars equipped with the pneumatic control valve. Emulation systems may be interoperable with ABD/DB pneumatic control valves. Emulator CCD: A CCD may optionally emulate the function of the pneumatic control valve while in a conventionally braked train. A suitable power source shall be provided to allow the emulator CCD to function as specified at all train speeds for a minimum of 48 h. The functions and performance of pneumatic brake emulation must adhere to the requirements of AAR Standards S-461, S-462, S-464 and S-467.

Emulation systems shall control the brake cylinder control pilot pressure (16 pipe pressure) based on conventional brake pipe pressure changes rather than ECP trainline messaging when in Emulation mode.

A pneumatic emergency application shall always be available, provided that there is adequate BP and supply reservoir pressure to support actuation of the emergency application.

Emulation systems Passenger mode shall support trains with up to 2520 effective ft of 1¼ in. diameter brake pipe.

Emulation systems Freight Compatibility mode shall support trains with up to 5880 effective ft of 1¼ in. diameter brake pipe.

Emulation systems shall be capable of passing an APTA PR-M-S-005-98 type single-car test.

The Emulation system shall include a pneumatic backup function that is always active. This feature shall provide a means to pneumatically apply emergency 16 pipe pressure without electrical power if brake pipe vents below a set pressure. When the CCD is cut in, the electronic Emulation operation takes precedence over the pneumatic backup in the control of 16 pipe pressure. The pneumatic emergency backup 16 pipe pressure is not variable load sensitive.

The pneumatic backup remains active when the Emulation valve is electrically cut out or shut down (including due to a failure/fault condition, etc.). A pneumatic emergency brake application will be released when the brake pipe pressure is increased above a set pressure or when electronic CCD operation has taken precedence.

The primary means of car supply reservoir charging shall be from the train main reservoir (MR) equalizing pipe, but the Emulation system shall be able to charge supply reservoir from BP whenever MR pressure is below BP pressure.

> **NOTE:** The conventional 26C valve will charge an 11,360 cu in. reservoir from 0 to 110 ±2 psi in 300 s with BP pressure charged to 110 psi.

Emulation systems shall be designed to allow a car that has been set out of service (with a fully charged CCD battery) for seven days to be moved without head end power (HEP) connected. The car shall be able to pass a brake test that consists of fully charging brake pipe, making a 20 psi reduction and verifying brake application, followed by recharging of BP verifying that car brakes fully release.

2.2 Entering Emulation

The Emulation shall follow the requirements for entering Emulation as defined in APTA PR-M-S-021-17, “ECP Passenger Cable-Based Braking System – Performance Requirements,” (as presently codified in 49 CFR part 238).

Upon initial power-up into Emulation mode, the control valve shall default to the minimum supported release pressure (feed valve). If BP is greater than this pressure, then the valve shall release. If BP is less than this pressure, then the valve shall make a brake application based on the reduction from the release pressure. If BP is less than the emergency threshold, then the valve shall make an emergency application.

The default recognized feed valve pressure shall be a maximum of 90 psi (±2 psi).

The emergency threshold shall be a minimum of 35 psi (±2 psi).

2.3 Application requirements

The minimum rate of BP reduction required to enter a brake application state from release shall be 0.5 psi/s.

Subsequent applications shall respond to 1 psi drops in BP.

16 pipe pressure shall develop at 2.9 to 3.1 psi for each 1.0 psi of brake pipe reduction.

In Passenger Emulation mode, 16 pipe pressure shall increase at a rate not to exceed 52 psi/s.

In Freight Compatibility Emulation mode, 16 pipe pressure shall build at a rate of 6 psi/s in service applications.

In Freight Compatibility mode, 16 pipe pressure shall build at a rate of 18 psi/s in emergency applications.

When BP drops below 35 psi, the valve shall transition to emergency brake cylinder control pressures.

Emulation systems shall be capable of adjusting the output BCP based on the requirements of the application. BCP between 60 and 120 percent of the calculated 16 pipe pressure shall be supported.

> **NOTE:** This permits J1 BC relay valves to be used for all applications, which replaces amplifying/reducing relay valves with a J1 relay valve.

Once an application has been detected, a minimum 16 pipe pressure ranging from 6 to 16 psi shall be developed by the Emulation system.

The Emulation system shall provide a service limiting feature that shall restrict the 16 pipe pressure during service applications. This shall range from 28 to 85 psi.

The Emulation system shall provide an emergency limiting feature that shall restrict the 16 pipe pressure during emergency applications. This shall range from 36 to 100 psi.

2.4 Release requirements

In graduated release or Passenger Emulation operation, 16 pipe pressure shall release by 4 to 5 psi for each pound per square inch of BP rise.

In direct release or Freight Compatibility Emulation operation, a 3 psi or greater rise in BP at any rate shall result in 16 pipe pressure fully releasing from a service application.

2.5 Exiting Emulation

The Emulation system shall follow the requirements for exiting Emulation and entering ECP as defined in APTA PR-M-S-021-17, “ECP Passenger Cable-Based Braking System – Performance Requirements,” (as presently codified in 49 CFR part 238).”

2.6 CCD shutdown

The CCD shall be capable of being shut down for the purposes of car maintenance and storage.

2.7 Additional Emulation functions

The Emulation system shall be capable of providing the functions described in the following sections.

2.7.1 Quick service

A preliminary quick service feature shall be provided. This feature shall create a local reduction in BP when the brakes transition from a release into an apply state.

On a car with 85 ft of brake pipe (1000 cu in.) the quick service feature, when activated, will reduce BP 3 to 4 psi in 1½ to 2 s.

2.7.2 Backup BC limiting

The air source for BC pressure is the car supply. As such, the BC volume can be charged as high as MR pressure. Therefore, a pneumatic limiting valve shall be included to limit the BCP, which will be developed when the CCD is cut out.

2.8 Additional Emulation features

The Emulation system shall be capable of providing the features and functions described in this section where applicable, based on operating authority requirements.

2.8.1 Variable load compensation

Emulation may provide variable load compensation based on the air spring pressure.

Implementation of variable load shall be application-specific.

2.8.2 Snow brake

Emulation may provide a snow brake application in response to the snow brake trainline.

Implementation of snow brake shall be application-specific.

Related APTA standards

APTA PR-M-S-005-98, "Code of Tests for Passenger Car Equipment Using Single Car Testing Device"

The following standards are the complete set of Passenger ECP standards:

APTA PR-M-S-020-17, "Passenger Electronic 26C Emulation Braking System—Performance Requirements"
APTA PR-M-S-021-17, "ECP Passenger Cable-Based Braking System—Performance Requirements"
APTA PR-M-S-022-19, "ECP Passenger Cable-Based Brake System Cable, Connectors and Junction Boxes—Performance Requirements"
APTA PR-M-S-023-19, "ECP Passenger Cable-Based Brake DC Power Supply—Performance Requirements"
APTA PR-M-S-024-19, "Intratrain Communication Requirements for ECP Cable-Based Passenger Train Control Systems"
APTA PR-M-S-025-19, "ECP Passenger Cable-Based and Passenger Emulation Braking System—Approval Procedure"
APTA PR-M-S-026-19, "ECP Passenger Cable-Based Braking System—Interoperability Procedure"
APTA PR-M-S-027-19, "ECP Passenger Cable-Based Braking System—Configuration Management"

References

AAR Manual of Standards and Recommended Practices Electronically Controlled Brake Systems: AAR Standard S-4200, "Electronically Controlled Pneumatic (ECP) Cable-Based Brake Systems – Performance Requirements" (adopted 1999; revised: 2002, 2004, 2008).

Definitions

For ECP-specific definitions, refer to APTA PR-M-S-021-17, Latest revision, "ECP Passenger Cable-Based Braking System—Performance Requirements."

The Emulation system shall include the following additional definitions:

16 pipe: Control pilot pressure for brake cylinder.

backup battery: The battery source that is part of the CCD and is used to power the system when the trainline power and the main car battery power are not present.

Emulation mode: Non-ECP mode of operation in which the electronic pneumatic components emulate the performance of the control valve and follow the brake pipe for determining brake cylinder pressure.

Freight Compatibility mode: Service operating with both passenger and freight cars in direct release.

local car battery: Battery power source provided by the passenger car battery. This term is used to differentiate it from the backup battery, which is an integral part of the CCD.

Passenger mode: Service operating with passenger cars in graduated release.

snow brake: Means of applying a light brake cylinder pressure on a vehicle to prevent the accumulation of ice and snow between the friction material and the braking surface.

variable load: Local adjustment of brake cylinder pressure based on the current passenger weight of the vehicle.

Abbreviations and acronyms

ABD/DB	type of conventional pneumatic control valves
BCP	brake cylinder pressure
BP	brake pipe
CCD	car control device
CFR	Code of Federal Regulations
ECP	electronically controlled pneumatic
HEP	head end power
HEU	head end unit
MR	main reservoir
NATSA	North American Transportation Services Association
psi	pounds per square inch
s	seconds
VDC	volts direct current

Summary of document changes

- New section added: “Summary of document changes.”
- Scope broadened to encompass emulation of brake valves other than the 26C. As such, most previous mentions of 26C Emulation are now just Emulation.

Document history

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