

# Electronically Controlled Pneumatic 26C Emulation Braking System— Performance Requirements for Passenger Applications

**Abstract:** This safety standard contains the minimum performance requirements for electronically controlled pneumatic (ECP) brake systems operating on passenger cars in 26C Emulation operation.

**Keywords:** brake, ECP, emulation, rail car, train

**Summary:** This standard identifies the minimum performance requirements for the operation of ECP brake systems in 26C Emulation service on passenger train equipment. 26C Emulation operation allows ECP-equipped cars to be interoperable with cars outfitted with conventional 26C pneumatic brake valves. This document addresses the performance requirements for entering/exiting 26C Emulation, operating in 26C Emulation, fault detection in 26C Emulation, and the key features and functions of 26C 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.

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## **Introduction**

*This introduction is not part of APTA PR-M-S-020-17, "Electronically Controlled Pneumatic 26C Emulation Braking System — Performance Requirements for Passenger Applications."*

APTA recommends the use of this document by:

- individuals or organizations that operate rail transit systems;
- individuals or organizations that contract with others for the operation of rail transit systems; and
- individuals or organizations that influence how rail transit systems are operated (including but not limited to consultants, designers and contractors).

# Electronically Controlled Pneumatic 26C Emulation Braking System — Performance Requirements for Passenger Applications

## 1. Description of 26C 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-021-16, “Electronically Controlled Pneumatic Cable-Based Braking System—Performance Requirements for Passenger Applications.”

26C 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.

26C 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 26C Emulation operation is the 74 VDC car battery. The ECP control valve battery shall provide a secondary power source.

## 2. Functional and performance specification

ECP brake systems shall provide 26C Emulation braking functionality that shall comply with the functional requirements defined in this section.

### 2.1 General requirements

26C Emulation systems may provide two modes of operation: Passenger and Freight Compatibility.

26C Emulation systems shall be interoperable with cars equipped with the 26C pneumatic control valve. 26C Emulation systems may be interoperable with ABD/DB pneumatic control valves.

26C 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 26C Emulation mode.

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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.

26C Emulation systems Passenger mode shall support trains with up to 2520 effective ft of 1¼ in. diameter brake pipe.

26C Emulation systems Freight Compatibility mode shall support trains with up to 5880 effective ft of 1¼ in. diameter brake pipe.

26C Emulation systems shall be capable of passing an APTA PR-M-S-005-98 type single-car test.

The 26C 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 26C 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 26C 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 26C 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.

26C 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 26C Emulation**

The 26C Emulation shall follow the requirements for entering 26C Emulation, as defined in the APTA standard APTA PR-M-S-021-16, “Electronically Controlled Pneumatic Cable-Based Braking System—Performance Requirements for Passenger Applications,” Section 2.2.8, “Passenger Emulation Mode.”

Upon initial power-up into 26C 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 BPP 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 BPP.

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

In Passenger 26C Emulation mode, 16 pipe pressure shall increase at a rate not to exceed 52 psi/s.

In Freight Compatibility 26C 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 BPP drops below 35 psi, the valve shall transition to emergency brake cylinder control pressures.

26C 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 allows for 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 26C Emulation system.

The 26C 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 26C 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 26C 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 26C 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 26C Emulation**

The 26C Emulation system shall follow the requirements for exiting 26C Emulation and entering ECP as defined in APTA PR-M-S-021-16, “Electronically Controlled Pneumatic Cable-Based Braking System—Performance Requirements for Passenger Applications,” Section 2.2.8 “Passenger Emulation Mode.”

## **2.6 CCD shutdown**

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

## **2.7 Additional 26C Emulation functions**

The 26C Emulation system shall be capable of providing the functions described in the following sections.

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### **2.7.1 Quick Service**

A preliminary quick service feature shall be provided. This feature shall create a local reduction in BPP 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 BPP 3 to 4 psi in 1½ to 2 s.

### **2.7.2 Backup BC limiting**

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

## **2.8 Additional 26C Emulation features**

The 26C 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**

26C 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**

26C Emulation may provide a snow brake application in response to the snow brake trainline.

Implementation of snow brake shall be application specific.

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## **Related APTA standards**

**APTA PR-M-S-005-98, 98, Rev. 2.1**, “Code of Tests for Passenger Car Equipment Using Single Car Testing”

**APTA PR-M-S-021-17**, “Electronically Controlled Pneumatic Cable-Based Braking System—Performance Requirements for Passenger Applications”

## **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-021-16, “Electronically Controlled Pneumatic Cable-Based Braking System—Performance Requirements for Passenger Applications.”

The 26C 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 local car battery power are not present.

**emulation mode:** Non-ECP mode of operation in which the electronic pneumatic components emulate the performance of the 26C control valve and follow the brake pipe for determining brake cylinder pressure.

**freight compatibility:** Service operating with both passenger and freight cars in direct release.

**local car battery:** Battery power source provided by the passenger car backup 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.

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## **Abbreviations and acronyms**

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

## **Document history**

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