APTA STANDARDS DEVELOPMENT PROGRAM

STANDARD

American Public Transportation Association
1300 I Street, NW, Suite 1200 East, Washington, DC 20006

APTA PR-M-S-006-98, Rev. 3

First Published: March 4, 1999
First Revision: February 13, 2004
Second Revision: June 2, 2007
Third Revision: June 1, 2017
PRESS Mechanical Working Group

Parking Brakes for Passenger Locomotives and Cars

Abstract: This document provides standards for parking brake systems for passenger locomotives and passenger cars.

Keywords: grade holding, handbrake

Summary: Design standards for parking brake systems for passenger locomotives and cars for the passenger railroad industry are provided.

Scope and purpose: This standard applies to North American passenger locomotive and car parking brake systems and is intended to promote safe, efficient and reliable operation. This standard recognizes the existence of service proven equipment that may not meet all provisions of this standard, primarily in areas of required brake actuating force and design safety factors. In these cases, the existing requirements are accepted and indicated accordingly; however, it is intended that all new designs shall meet the updated requirements. Specific areas addressed are grade-holding requirements; prevention of equipment damage; and human interface for parking brake operation, as well as annunciation, manual release provisions, validation and related safety issues.

Table of Contents

Participants

The American Public Transportation Association greatly appreciates the contributions of the members of the **Mechanical Brake Sub-Working Group of the PRESS Mechanical Working Group**, who provided the primary effort in the drafting of the latest revision of this document:

Paul E. Jamieson, SNC-Lavalin Rail & Transit, *Chair*

B.A. Black, *Virginkar & Associates*
James Dewberry, *Wabtec Corporation*
Adam Eby, *AMTRAK*
Kenneth Hesser, *LTK Engineering Services*
William Jubeck, *Pittsburgh Air Brake*
Andrew Long, *CH2M*
Bryan McLaughlin, *New York Air Brake*
Allen Nutt, *LTK Engineering Services*
George Payne, *PDI Rail Solutions*
Danial Rice, *Wabtec Corporation*
Ron Truitt, *AMTRAK*
Steven Zuiderveen, *FRA*

At the time this standard was revised, the **Mechanical Working Group** included the following members:

Rex Springston, CH2M, *Chair*

Allen Bieber, *ACB RailTech Services*
Brad Black, *Virginkar & Associates*
Greg Blasco, *West Coast Express*
Stephen Bonina, *WSP | Parsons Brinckerhoff*
Glenn Brandimarte, *ORX Rail*
Tony Brown, *MTA of Harris County*
Michael Burshtin, *AMTRAK*
Gordon Campbell, *Crosslinx Transit Solutions*
Kevin Carmody, *STV Incorporated*
Steve Chrismer, *LTK Engineering Services*
John Condrasky, *Wabtec Corporation*
Joshua Coran, *Talgo*
Brendan Crowley, *New York Air Brake*
Richard Curtis, *Curtis Engineering Consulting*
Steven Dedmon, *Standard Steel*
James Dewberry, *Wabtec Corporation*
Joe Di Liello, *VIA Rail Canada*
Matthew Dick, *ENSCO*
Adam Eby, *AMTRAK*
Gary Fairbanks, *FRA*
Robert Festa, *MTA Long Island Rail Road*
Steve Finegan, *SNC-Lavalin Rail & Transit*
Gavin Fraser, *CH2M*
Jeff Gordon, *American Truck Wash Systems*
Jeffrey Gordon, *Volpe*
Mark Hartong, *FRA*
James Herzog, *LTK Engineering Services*
Kenneth Hesser, *LTK Engineering Services*
Christopher Holliday, *STV Incorporated*
George Hud, *LTK Engineering Services*
Paul Jamieson, *SNC-Lavalin Rail & Transit*
John Janiszewski, *LTK Engineering Services*
Kevin Kesler, *FRA*
Peter Klauser
Heinz-Peter Kotz, *Siemens AG*
Tammy Krause, *AMTRAK*
Pallavi Lal, *LTK Engineering Services*
Peter Lapre, *Volpe*
Nicolas Lessard, *Bombardier Transportation*
Cameron Lonsdale, *Standard Steel*
Francesco Maldari, *MTA Long Island Rail Road*
Brian Marquis, *Volpe*
Eloy Martinez, *LTK Engineering Services*
Raynald Masse, *AMT*
Robert May, *LTK Engineering Services*
Ronald Mayville, *Simpson Gumpertz & Heger*
Richard Mazur, *Wabtec Corporation*
Bryan McLaughlin, *New York Air Brake*
Luke Morscheck, *LTK Engineering Services*
Allen Nutt, *LTK Engineering Services*
Chris Nuttall, *Thales*
Paul O'Brien, *First Transit*
John Pearson, *LTK Engineering Services*
Martin Petzoldt, *Railroad Friction Products*
Ian Pirie, *STV Incorporated*
Danial Rice, *Wabtec Corporation*

Steven Roman, *LTK Engineering Services*
Carol Rose, *STV Incorporated*
Thomas Rusin, *Rusin Consulting Corporation*
Mehrdad Samani, *CH2M*
Martin Schroeder, *CH2M*
Richard Seaton, *TDG Transit Design Group*
Patrick Sheeran, *LTK Engineering Services*
Melissa Shurland, *FRA*
Mark Stewart, *SNC-Lavalin Rail & Transit*
Narayana Sundaram, *ENSCO*
Ali Tajaddini, *FRA*
Jeff Thompson, *SEPTA*
Ronald Truitt, *AMTRAK*
Brian Whitten, *SNC-Lavalin Rail & Transit*
Todd Williams, *Penn Machine Company*
Gregory Yovich, *NICTD*

Project team
Charles Joseph, *American Public Transportation Association*
Nathan Leventon, *American Public Transportation Association*
Louis Sanders, *American Public Transportation Association*

Introduction

This introduction is not part of APTA PR-M-S-006-98, Rev. 3, "Parking Brakes for Passenger Locomotives and Cars."

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).

Parking Brakes for Passenger Locomotives and Cars

1. General requirements

The parking brake may employ a system that utilizes stored energy (spring), hydraulics, pneumatic or electrical energy, mechanical ratchets, screw mechanisms, chains, cables, lever and linkages, or any combination thereof.

A power assist may be utilized when power is available, but the parking brake design shall allow the parking brake to be applied or released manually (or passively, if so designed), without power assist.

An effective parking brake shall be provided on each locomotive or passenger car and be located where it can be safely operated by the railroad employee.

The parking brake shall be independent of, but operate in harmony with, the power brake.

Unless anti-compounding protection (defined in Section 3) is provided, internal components and fixations of package disc or tread brake units shall be capable of transmitting loads from an applied parking brake superimposed on maximum brake cylinder pressure (usually emergency) without any damage to the components or mountings.

Expected truck alignment conditions together with wear within design limitations shall neither render a parking brake less than 100 percent effective nor cause an unintended application or release.

The parking brake design shall be capable of maintaining the minimum specified output force as defined in Section 2, without auxiliary power (electrical, hydraulic, pneumatic, etc.) for an unlimited time period. The output force of new equipment designs shall have a minimum safety factor of 1.1.

The process and procedures for setting and releasing of the parking brake shall be determined by the specific operator's rules.

Instructions showing the process and procedures for mechanical release and reset of the parking brake are recommended and may be provided on the car, visible to crews responsible for moving the car as determined by the specific operator's safety program.

NOTE: A parking brake status indication may be specified by the operating authority if required by its "system safety plan."

2. Grade holding capability calculations

The parking brake shall have the capability of holding a Ready-to-Run locomotive or AW1 car (plus standees and baggage defined by the railroad) used in passenger service on the steepest operating grade as specified by the operator, but in no case shall the holding capability be less than that required for a 3 percent grade.

For passenger cars, the grade encountered in yards or sidings may be steeper than those of the operating grade. If the passenger car is left on these grades, the car weight shall be assumed to be the ready-to-run (AW0) car mass.

For passenger cars, the operating or yard/siding grade requiring the highest holding force shall be utilized in the calculation.

Calculations shall use the minimum static coefficient of friction as specified by the friction material supplier.

The assumed parking brake force of the tread brake unit and disc brake actuator/calipers shall not exceed the minimum value/efficiency specified by the supplier.

The calculation for disc brake actuator/caliper systems shall assume new wheels at the maximum design diameter.

The assumed mechanical efficiency of the mechanical operated parking brake cables/chains and wheel/lever shall not exceed 90 percent.

The assumed wheel-to-rail adhesion shall not exceed 12 percent. (Ref. UIC 544-1)

> **NOTE:** For existing passenger cars and locomotives, when more stringent grade holding requirements, a reduction in the brake material coefficient of friction or significant changes in the loading or other parameters used in the parking brake calculations occur, the parking brake design inputs shall be revised and recalculated to confirm that the holding force is adequate.

3. Spring-applied/air-release parking brake

For vehicles equipped with a spring-applied parking brake, application shall occur when parking brake air pressure is depleted from the parking brake air chamber of the tread brake unit or disc brake actuator. The number of actuators that supply the parking brake effort, as well as the required number of braked wheels shall be determined by the calculations specified in Section 2.

A spring-applied/air-release parking brake shall incorporate a manual mechanical release feature. When this feature is activated, it shall fully release the parking brake force. Following activation of a manual mechanical release, the parking brake shall not reapply until it is reset according to defined reset procedures. Operating force of the manual mechanical release feature for new designs shall allow for use by a 5^{th} percentile female at the operating interface of the release mechanism.

Anti-compounding protection prevents the addition of parking brake and service/emergency brake forces that may cause damage due to overload of the brake components or their mountings. If anti-compounding protection features are employed, the parking brake shall apply prior to the depletion of the brake cylinder pressures required to meet the requirements of Sections 1 and 2.

4. Manually operated mechanical parking brake

The input force required, as applied 3 in. (7.6 cm) in from the end of a lever or on the rim of a handwheel, to fully apply the mechanical parking brake shall be 125 lb. force (556 N). For new equipment designs, the manual application shall allow for use by a 5th percentile female at the operating interface of the application mechanism. Full application shall be defined as that force that meets the grade holding capability determined by the calculations required by Section 2.

With the brake in the release position, there shall be no excess slack in the mechanical parking brake chain/cable or other connections. Where a chain winds on a drum, provisions shall be made in the design for winding the chain uniformly on the drum without overlapping.

Installation clearances for mechanical parking brake levers/wheels are defined in APTA SS-M-016-07, latest revision, "Safety Appliances for Rail Passenger Cars."

When a quick-release feature is used, it shall be arranged to operate so that a parking brake wheel or lever will not move when the brake is released by this means.

A suitable means shall be provided at pulleys to prevent chains/cables from leaving the turning groove.

Provisions shall be made that, when piston travel is maintained within operational standards, normal wear shall not cause the hand brake to bind or bottom with less than full braking force.

The parking brake rigging and its fixations shall be designed and tested to withstand loads equal to 3 times those imposed by a nominal fully applied hand brake, without damage or permanent deformation. This does not apply to the force generating device or the power brake actuator.

5. Force Depletion Protection

A parking brake using a potentially depleting power source (e.g. hydraulic or pneumatic pressure, electric energy) shall employ a mechanical locking mechanism to prevent an unintended release in the event of loss of the actuating power source.

6. Parking brake test

A parking brake test shall be conducted for each new passenger car/locomotive type to verify the grade holding capability calculated in Section 2. The test vehicle weight shall include an additional load equal to 10% of the loaded vehicle weight defined in Section 2. Required parking brake holding force is verified by placing the car/locomotive on the maximum grade specified or by pulling the passenger car/locomotive with a force measurement device located between the coupler and the force input mechanism. In either case, the vehicle shall remain stationary for a time period not less than 10 minutes. If direct tread friction is not used to provide holding force, the test shall be conducted with new wheels.

Related APTA Standards

APTA PR-M-S-016-07, "Safety Appliances for Rail Passenger Cars" (previously numbered as APTA SS-M-016-07)

References

AAR RP-023, Handbrake Specification Passenger Car, former location E119. Manual of Standards & Recommended Practices, Section A, Part 1, Issue 1984 of Operations & Maintenance Department Mechanical Division.

UIC 544-1, Latest Revision

ASME RT-2, 2014

Definitions

AW0: Weight of a ready-to-run passenger car

AW1: Weight of a ready-to-run passenger car with a fully seated passenger load at 175 Lbs. per person.

parking brake: A system that is applied to prevent a stationary locomotive or passenger car from rolling due to gravity. This shall include systems referred to as handbrakes.

static coefficient of friction: The ratio of the magnitude of the maximum force of static friction to the magnitude of the normal force.

manually operated: Independently activated or deactivated by hand.

Ready-to-Run (RTR): A complete car or locomotive fully-equipped and outfitted for passenger service, including all fuel, fresh water and other onboard consumable supply volumes filled to capacity.

Abbreviations and acronyms

N Newtons
NATSA North American Transportation Services Association

Summary of document changes

- Nomenclature changes for consistency and readability
- Format changes to align with current formatting requirements

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	CEO Approval	Policy & Planning Approval	Publish Date
First published	June 15, 1998	—	—	—	March 17, 1999
First revision	May 5, 2003	—	—	—	Sept. 28, 2003
Second revision	May 18, 2007	—	—	—	June 2, 2007
Third revision	March 30, 2016	October 3, 2016	April 21, 2017	May 1, 2017	June 1, 2017