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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 in the passenger railroad industry are provided.



Foreword

The American Public Transportation Association is a standards development organization in North America. The process of developing standards is managed by the APTA Standards Program's Standards Development Oversight Council (SDOC). These activities are carried out through several standards policy and planning committees that have been established to address specific transportation modes, safety and security requirements, interoperability, and other topics.

APTA used a consensus-based process to develop this document and its continued maintenance, which is detailed in the [manual for the APTA Standards Program](#). This document was drafted in accordance with the approval criteria and editorial policy as described. Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

This document was prepared by the PRESS Mechanical Working Group as directed by the Passenger Rail Equipment Safety Standards Policy and Planning Committee.

This document represents a common viewpoint of those parties concerned with its provisions, namely transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. APTA standards are mandatory to the extent incorporated by an applicable statute or regulation. In some cases, federal and/or state regulations govern portions of a transit system's operations. In cases where there is a conflict or contradiction between an applicable law or regulation and this document, consult with a legal adviser to determine which document takes precedence.

This document supersedes APTA PR-M-S-006-98, Rev. 3, which has been revised. Below is a summary of changes from the previous document version:

- Nomenclature changes for consistency and readability
- Format changes to align with current formatting requirements
- Added note on moving equipment on a foreign railroad
- Updated loading requirement for grade holding capability
- Added Section 4: Electrically actuated parking brake
- Added Section 6: Annunciation
- Added recordkeeping requirement



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Introduction

This introduction is not part of APTA PR-M-S-006-98, Rev. 4, “Passenger Brake Alarm and Crew Emergency Brake Device.”

This standard applies to all:

- railroads that operate intercity or commuter passenger train service on the general railroad system of transportation; and
- 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:

- rapid transit operations in an urban area that are not connected to the general railroad system of transportation;
- tourist, scenic, historic, host railroads or excursion operations, whether on or off the general railroad system of transportation;
- operation of private cars, including business/office cars and circus trains unless otherwise required by other standards or regulations; or
- railroads that operate only on track inside an installation that is not part of the general railroad system of transportation.

Scope and purpose

This standard applies to Tier I, Tier II and Tier III passenger equipment 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. This standard does not apply to Tier III trainsets that utilize wheel chocks as parking brakes as agreed to by the authority having jurisdiction.

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 a 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% 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 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: Movement of passenger equipment by a foreign railroad shall follow the requirements contained in AAR M-1006.

2. Grade-holding capability calculation

The parking brake shall have the capability of holding a ready-to-run locomotive, AW1 car (plus standees and baggage defined by the railroad), or AW1 semipermanently coupled trainset (plus standees and baggage

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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% grade.

For passenger cars, the grade encountered in yards or sidings may be steeper than 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 weight.

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%.

The assumed wheel-to-rail adhesion shall not exceed 12% (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 5th percentile female at the operating interface of the release mechanism as defined in MIL-STD-1472E.

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. Electrically actuated parking brake

If a parking brake is electrically actuated (applied and released), a means of manual actuation shall be provided.

A cutout shall also be provided to bypass application resulting from electric activation system failure. A provision to seal the bypass application may be provided.

5. Manually operated mechanical parking brake

Installation provisions and clearances for mechanical parking brake levers/wheels are defined in the latest revision of APTA PR-M-S-016-07, "Safety Appliances for Rail Passenger Cars."

For conventional designs, the maximum input force required, as applied 3 in. (76 mm) in from the end of a lever or on the rim of a handwheel, to fully apply the mechanical parking brake shall be 125 lbf (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 excessive 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.

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.

6. Annunciation

Railroad-approved means for annunciation of parking brake application shall be provided.

7. 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.

8. 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. The test shall be conducted with new wheels.

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Records of the qualification test procedure and test results shall be maintained by the railroad for the life of the car/locomotive/trainset.

Related APTA standards

APTA PR-M-S-016-07, Rev. 1, “Safety Appliances for Rail Passenger Cars”

References

49 CFR, Part 229.47, Locomotive Safety Standards

49 CFR, Part 238, Passenger Equipment Safety Standards

AAR M-1006, Passenger Equipment Performance Specification

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

MIL-STD-1472E, “Table XIX Anthropometric Data for Common Working Positions - 5th Percentile Woman,” October 1996

MIL-STD-1472E, “Table XXV Static Muscle Strength - 5th Percentile Woman,” October 1996

UIC 544-1, Latest Revision Brakes – Braking Power

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.

manually operated: Independently activated or deactivated by hand.

parking brake: A system that is applied to prevent a stationary locomotive, passenger car, semi-permanently connected trainset from rolling due to gravity. This shall include systems referred to as handbrakes.

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.

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

Abbreviations and acronyms

in	inches
lbf	pound-force
mm	millimeters
N	Newtons

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