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.
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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 5th 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


References


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

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Summary of document changes

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