

(5) All electronic equipment shall be self-protected from damage or improper operation, or both, due to high voltage transients and long-term over-voltage or under-voltage conditions.

§ 238.427 Suspension system.

(a) *General requirements.* (1) Suspension systems shall be designed to reasonably prevent wheel climb, wheel unloading, rail rollover, rail shift, and a vehicle from overturning to ensure safe, stable performance and ride quality. These requirements shall be met:

(i) In all operating environments, and under all track conditions and loading conditions as determined by the operating railroad; and

(ii) At all track speeds and over all track qualities consistent with the Track Safety Standards in part 213 of this chapter, up to the maximum operating speed and maximum cant deficiency of the equipment.

(2) Passenger equipment shall meet the safety performance standards for suspension systems contained in appendix C to this part, or alternative standards providing at least equivalent safety if approved by FRA under the provisions of § 238.21.

(b) *Car body accelerations.* (1) A passenger car shall not operate under conditions that result in a steady-state lateral acceleration greater than 0.12g as measured parallel to the car floor inside the passenger compartment. During pre-revenue service acceptance testing of the equipment under § 238.111 and § 213.345 of this chapter, a passenger car shall demonstrate that steady-state lateral acceleration does not exceed 0.1g at the maximum intended cant deficiency.

(2) While traveling at the maximum operating speed over the intended route, the train suspension system shall be designed to:

(i) Limit the vertical acceleration, as measured by a vertical accelerometer mounted on the car floor, to no greater than 0.55g single event, peak-to-peak over a one second period;

(ii) Limit lateral acceleration, as measured by a lateral accelerometer mounted on the car floor, to no greater than 0.3g single event, peak-to-peak over a one second period; and

(iii) Limit the combination of lateral acceleration (a_L) and vertical acceleration (a_V) occurring over a one second period as expressed by the square root of $(a_L^2 + a_V^2)$ to no greater than 0.6g, where a_L may not exceed 0.3g and a_V may not exceed 0.55g. Compliance with the requirements of paragraph (b)(2) shall be demonstrated during the pre-revenue service acceptance testing of the equipment required under § 238.111 and § 213.345 of this chapter.

(3) For purposes of this paragraph:

(i) Car body acceleration measurements shall be processed through a filter having a cut-off frequency of 10 Hz; and

(ii) Steady-state lateral acceleration shall be computed as the mathematical average of the accelerations in the body of a curve, between the spiral/curve points. In a compound curve, steady-state lateral acceleration shall be measured separately for each curve segment.

(c) *Truck (hunting) acceleration.* Each truck shall be equipped with a permanently installed lateral accelerometer mounted on the truck frame. The accelerometer output signals shall be processed through a filter having a band pass of 0.5 to 10 Hz to determine if hunting oscillations of the truck are occurring. If hunting oscillations are detected, the train monitoring system shall provide an alarm to the operator, and the train shall be slowed to a speed at least 5 mph less than the speed at which the hunting oscillations stopped. For purposes of this paragraph, hunting oscillations are considered a sustained cyclic oscillation of the truck which is evidenced by lateral accelerations in excess of 0.4g root mean square (mean-removed) for 2 seconds.

(d) *Overheat sensors.* Overheat sensors for each wheelset journal bearing shall be provided. The sensors may be placed either onboard the equipment or at reasonable intervals along the railroad's right-of-way.

[64 FR 25660, May 12, 1999, as amended at 67 FR 19992, Apr. 23, 2002]

§ 238.429 Safety appliances.

(a) *Couplers.* (1) The leading and the trailing ends of a semi-permanently coupled trainset shall each be equipped with an automatic coupler that couples

on impact and uncouples by either activation of a traditional uncoupling lever or some other type of uncoupling mechanism that does not require a person to go between the equipment units.

(2) The automatic coupler and uncoupling device on the leading and trailing ends of a semi-permanently coupled trainset may be stored within a removable shrouded housing.

(3) If the units in a train are not semi-permanently coupled, both ends of each unit shall be equipped with an automatic coupler that couples on impact and uncouples by either activation of a traditional uncoupling lever or some other type of uncoupling mechanism that does not require a person to go between the equipment units.

(b) *Hand brakes.* Except as provided in paragraph (f) of this section, Tier II trains shall be equipped with a parking or hand brake that can be applied and released manually and that is capable of holding the train on a 3-percent grade.

(c) *Safety appliance mechanical strength and fasteners.* (1) All handrails, handholds, and sill steps shall be made of 1-inch diameter steel pipe, $\frac{5}{8}$ -inch thickness steel, or a material of equal or greater mechanical strength.

(2) All safety appliances shall be securely fastened to the car body structure with mechanical fasteners that have mechanical strength greater than or equal to that of a $\frac{1}{2}$ -inch diameter SAE grade steel bolt mechanical fastener.

(i) Safety appliance mechanical fasteners shall have mechanical strength and fatigue resistance equal to or greater than a $\frac{1}{2}$ -inch diameter SAE steel bolt.

(ii) Mechanical fasteners shall be installed with a positive means to prevent unauthorized removal. Self-locking threaded fasteners do not meet this requirement.

(iii) Mechanical fasteners shall be installed to facilitate inspection.

(d) *Handrails and handholds.* Except as provided in paragraph (f) of this section:

(1) Handrails shall be provided for passengers on both sides of all steps used to board or depart the train.

(2) Exits on a power vehicle shall be equipped with handrails and handholds

so that crewmembers can get on and off the vehicle safely.

(3) Throughout their entire length, handrails and handholds shall be a color that contrasts with the color of the vehicle body to which they are fastened.

(4) The maximum distance above the top of the rail to the bottom of vertical handrails and handholds shall be 51 inches, and the minimum distance shall be 21 inches.

(5) Vertical handrails and handholds shall be installed to continue to a point at least equal to the height of the top edge of the control cab door.

(6) The minimum hand clearance distance between a vertical handrail or handhold and the vehicle body shall be 2½ inches for the entire length.

(7) All vertical handrails and handholds shall be securely fastened to the vehicle body.

(8) If the length of the handrail exceeds 60 inches, it shall be securely fastened to the power vehicle body with two fasteners at each end.

(e) *Sill steps.* Except as provided in paragraph (f) of this section, each power vehicle shall be equipped with a sill step below each exterior door as follows:

(1) The sill step shall have a minimum cross-sectional area of $\frac{1}{2}$ by 3 inches;

(2) The sill step shall be made of steel or a material of equal or greater strength and fatigue resistance;

(3) The minimum tread length of the sill step shall be 10 inches;

(4) The minimum clear depth of the sill step shall be 8 inches;

(5) The outside edge of the tread of the sill step shall be flush with the side of the car body structure;

(6) Sill steps shall not have a vertical rise between treads exceeding 18 inches;

(7) The lowest sill step tread shall be not more than 24, preferably not more than 22, inches above the top of the track rail;

(8) Sill steps shall be a color that contrasts with the color of the power vehicle body to which they are fastened;

(9) Sill steps shall be securely fastened;

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(10) At least 50 percent of the tread surface area of each sill step shall be open space; and

(11) The portion of the tread surface area of each sill step which is not open space and is normally contacted by the foot shall be treated with an anti-skid material.

(f) *Exceptions.* (1) If the units of the equipment are semi-permanently coupled, with uncoupling done only at maintenance facilities, the equipment units that are not required by paragraph (a) of this section to be equipped with automatic couplers need not be equipped with sill steps or end or side handholds that would normally be used to safely perform coupling and uncoupling operations.

(2) If the units of the equipment are not semi-permanently coupled, the units shall be equipped with hand brakes, sill steps, end handholds, and side handholds that meet the requirements contained in § 231.14 of this chapter.

(3) If two trainsets are coupled to form a single train that is not semi-permanently coupled (i.e., that is coupled by an automatic coupler), the automatically coupled ends shall be equipped with an end handhold that is located and installed so that an individual can safely couple and uncouple the trainsets. The end handhold shall be not more than 16 inches from each side of the car and shall extend the remaining length of the end of the car. (If the equipment is designed with a tapered nose, the side of the car shall be determined based on the outer dimension of the tapered nose where the end handhold is attached.) The end handhold shall also meet the mechanical strength and design requirements contained in paragraphs (c), (d)(3), and (d)(6) of this section. If the trainsets are semi-permanently coupled, this safety appliance is not required.

(g) *Optional safety appliances.* Safety appliances installed at the option of the railroad shall be firmly attached with mechanical fasteners and shall meet the design and installation requirements provided in this section.

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§ 238.431 Brake system.

(a) A passenger train's brake system shall be capable of stopping the train from its maximum operating speed within the signal spacing existing on the track over which the train is operating under worst-case adhesion conditions.

(b) The brake system shall be designed to allow an inspector to determine that the brake system is functioning properly without having to place himself or herself in a dangerous position on, under, or between the equipment.

(c) Passenger equipment shall be provided with an emergency brake application feature that produces an irretrievable stop, using a brake rate consistent with prevailing adhesion, passenger safety, and brake system thermal capacity. An emergency brake application shall be available at any time, and shall be initiated by an unintentional parting of the train. A means to initiate an emergency brake application shall be provided at two locations in each unit of the train; however, where a unit of the train is 45 feet or less in length a means to initiate an emergency brake application need only be provided at one location in the unit.

(d) The brake system shall be designed to prevent thermal damage to wheels and brake discs. The operating railroad shall demonstrate through analysis and testing that no thermal damage results to the wheels or brake discs under conditions resulting in maximum braking effort being exerted on the wheels or discs.

(e) The following requirements apply to blended braking systems:

(1) Loss of power or failure of the dynamic brake does not result in exceeding the allowable stopping distance;

(2) The friction brake alone is adequate to safely stop the train under all operating conditions;

(3) The operational status of the electric portion of the brake system shall be displayed for the train operator in the control cab; and

(4) The operating railroad shall demonstrate through analysis and testing the maximum operating speed for safe operation of the train using only the friction brake portion of the blended