

the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(ii) A 100,000-pound longitudinal force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting car body structure;

(iii) A 45,000-pound longitudinal force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure;

(iv) A 100,000-pound lateral force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(v) A 30,000-pound lateral force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting car body structure; and

(vi) A 20,000-pound lateral force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure.

(4) Prior to or during structural deformation, the two posts in combination acting together with their supporting body structure shall be capable of absorbing a minimum of 120,000 foot-pounds of energy (0.16 megajoule) in accordance with the following:

(i) The corner posts shall be loaded longitudinally at a height of 30 inches above the top of the underframe;

(ii) The load shall be applied with a fixture, or its equivalent, having a width sufficient to distribute the load directly into the webs of the post, but of no more than 36 inches and either:

(A) A flat plate with a height of 6 inches; or

(B) A curved surface with a diameter of no more than 48 inches; and

(iii) The corner post located behind the stepwell shall have no more than 10 inches of longitudinal, permanent deformation. There shall be no complete separation of the corner post located behind the stepwell, its connection to the underframe, its connection to either the roof structure or anti-telescoping plate (if used), or of its supporting car body structure. The corner

post ahead of the stepwell is permitted to fail. (A graphical description of the forward end of a cab car or an MU locomotive utilizing low-level passenger boarding on the non-operating side of the cab end is provided in Figure 1 to subpart C of this part.)

[75 FR 1229, Jan. 8, 2010]

§ 238.215 Rollover strength.

(a) Each passenger car shall be designed to rest on its side and be uniformly supported at the top ("roof rail"), the bottom cords ("side sill") of the side frame, and, if bi-level, the intermediate floor rail. The allowable stress in the structural members of the occupied volumes for this condition shall be one-half yield or one-half the critical buckling stress, whichever is less. Local yielding to the outer skin of the passenger car is allowed provided that the resulting deformations in no way intrude upon the occupied volume of the car.

(b) Each passenger car shall also be designed to rest on its roof so that any damage in occupied areas is limited to roof sheathing and framing. Other than roof sheathing and framing, the allowable stress in the structural members of the occupied volumes for this condition shall be one-half yield or one-half the critical buckling stress, whichever is less. Deformation to the roof sheathing and framing is allowed to the extent necessary to permit the vehicle to be supported directly on the top chords of the side frames and end frames.

§ 238.217 Side structure.

Each passenger car shall comply with the following:

(a) *Side posts and corner braces.* (1) For modified girder, semi-monocoque, or truss construction, the sum of the section moduli in inches³—about a longitudinal axis, taken at the weakest horizontal section between the side sill and side plate—of all posts and braces on each side of the car located between the body corner posts shall be not less than 0.30 multiplied by the distance in feet between the centers of end panels.

(2) For modified girder or semi-monocoque construction only, the sum of the section moduli in inches³—about a transverse axis, taken at the weakest horizontal section between the side sill

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and side plate—of all posts, braces and pier panels, to the extent available, on each side of the car located between body corner posts shall be not less than 0.20 multiplied by the distance in feet between the centers of end panels.

(3) The center of an end panel is the point midway between the center of the body corner post and the center of the adjacent side post.

(4) The minimum section moduli or thicknesses specified in paragraph (a) of this section may be adjusted in proportion to the ratio of the yield strength of the material used to that of mild open-hearth steel for a car whose structural members are made of a higher strength steel.

(b) *Sheathing.* (1) Outside sheathing of mild, open-hearth steel when used flat, without reinforcement (other than side posts) in a side frame of modified girder or semi-monocoque construction shall not be less than 1/8 inch nominal thickness. Other metals may be used of a thickness in inverse proportion to their yield strengths.

(2) Outside metal sheathing of less than 1/8 inch thickness may be used only if it is reinforced so as to produce at least an equivalent sectional area at a right angle to reinforcements as that of the flat sheathing specified in paragraph (b)(1) of this section.

(3) When the sheathing used for truss construction serves no load-carrying function, the minimum thickness of that sheathing shall be not less than 40 percent of that specified in paragraph (b)(1) of this section.

§ 238.219 Truck-to-car-body attachment.

Passenger equipment shall have a truck-to-car-body attachment with an ultimate strength sufficient to resist without failure the following individually applied loads: 2g vertically on the mass of the truck; and 250,000 pounds in any horizontal direction on the truck, along with the resulting vertical reaction to this load. For purposes of this section, the mass of the truck includes axles, wheels, bearings, the truck-mounted brake system, suspension system components, and any other component attached to the truck by design.

[67 FR 19991, Apr. 23, 2002]

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§ 238.221 Glazing.

(a) Passenger equipment shall comply with the applicable Safety Glazing Standards contained in part 223 of this chapter, if required by that part.

(b) Each exterior window on a locomotive cab and a passenger car shall remain in place when subjected to:

(1) The forces described in part 223 of this chapter; and

(2) The forces due to air pressure differences caused when two trains pass at the minimum separation for two adjacent tracks, while traveling in opposite directions, each train traveling at the maximum authorized speed.

§ 238.223 Locomotive fuel tanks.

Locomotive fuel tanks shall comply with either the following or an industry standard providing at least an equivalent level of safety if approved by FRA under § 238.21:

(a) *External fuel tanks.* External locomotive fuel tanks shall comply with the requirements contained in Appendix D to this part.

(b) *Internal fuel tanks.* (1) Internal locomotive fuel tanks shall be positioned in a manner to reduce the likelihood of accidental penetration from roadway debris or collision.

(2) Internal fuel tank vent systems shall be designed so they do not become a path of fuel loss in any tank orientation due to a locomotive overturning.

(3) Internal fuel tank bulkheads and skin shall, at a minimum, be equivalent to a 5/16-inch thick steel plate with a yield strength of 25,000 pounds per square inch. Material of a higher yield strength may be used to decrease the required thickness of the material provided at least an equivalent level of strength is maintained. Skid plates are not required.

[67 FR 19991, Apr. 23, 2002]

§ 238.225 Electrical system.

All passenger equipment shall comply with the following:

(a) *Conductors.* Conductor sizes shall be selected on the basis of current-carrying capacity, mechanical strength, temperature, flexibility requirements, and maximum allowable voltage drop.