National Transportation Safety Board

Washington, DC 20594

Safety Recommendation

Date: February 2, 2015

In reply refer to: R-15-01 and -02

Ms. Sarah Feinberg
Acting Administrator
Federal Railroad Administration
Washington, DC 20590

The National Transportation Safety Board (NTSB) urges the Federal Railroad Administration (FRA) to take action on two safety recommendations issued in this letter. These recommendations address: (1) the FRA regulation in 49 *Code of Federal Regulations* (CFR) 238.213, which applies to strength requirements for corner posts for the forward and rearward ends of passenger railcars and (2) the FRA regulations in 49 CFR Part 238, which apply to passenger equipment safety standards. These two recommendations are derived from the NTSB's investigation of the derailment and subsequent collision of two Metro-North Railroad (Metro-North) passenger trains in Bridgeport, Connecticut, on May 17, 2013. As a result of this component of the investigation, we have issued three safety recommendations, two of which are addressed to the FRA. Information supporting these recommendations is discussed below.

Background

On Friday, May 17, 2013, at 6:01 p.m. eastern daylight time, eastbound Metro-North passenger train 1548, which had departed Grand Central Terminal, New York, toward New Haven, Connecticut, derailed at milepost (MP) 53.25 from main track 4 of the New Haven line subdivision 7 in Bridgeport, Connecticut, and was struck by westbound Metro-North passenger train 1581, which had departed New Haven bound for Grand Central Terminal. In the collision, the forward (F-end) or leading end of a passenger railcar of passenger train 1581 struck the trailing or back end (B-end) of a passenger railcar of passenger train 1548. (See Figure 1.) As a result of the collision, 63 passengers, 2 engineers, and 1 conductor were injured. Metro-North estimated that about 250 passengers were on each train at the time of the accident.

The NTSB determined that the probable cause of the derailment was an undetected broken pair of compromise joint bars on the north rail of track 4 on the Metro-North New Haven subdivision at MP 53.25 resulting from: (1) the lack of a comprehensive track maintenance program that prioritized the inspection findings to schedule proper corrective maintenance; (2) the regulatory exemption for high-density commuter railroads from the requirement to traverse the tracks they inspect; and (3) Metro-North's decisions to defer scheduled track maintenance.

Figure 1. View of the accident between Metro-North passenger trains 1548 (right) and 1581 (left).

Design Strength at Ends of M-8 Passenger Railcars

After eastbound passenger train 1548 derailed, it was struck and sideswiped westbound passenger train 1581. During the accident sequence, the F-end of passenger railcar 9193 of passenger train 1581 struck the B-end of passenger railcar 9247 of passenger train 1548. The passenger compartment of passenger railcar 9247 was breached catastrophically. NTSB investigators found that the left B-end corner post of passenger railcar 9247 fractured and separated from the passenger railcar; one piece of that corner post was found embedded in the operator compartment of passenger train 1581. Although there was impact damage to the F-end of passenger railcar 9193, its corner post was intact.

The passenger trains in the accident consisted of M-8 series passenger railcars built by Kawasaki Heavy Industries. The F-End has an operating cab; the B-End only has a mechanical coupler. The M-8 passenger railcars are designed to operate in pairs, where two passenger railcars are coupled B-end to B-end. Each M-8 passenger railcar pair operates in either travel direction on the tracks. The accident trains had four pairs of M-8 passenger railcars.

Corner posts are structural components integrated into each end of M-8 passenger railcars to provide protection during accidents. The corner posts protect the car body from deforming and intruding into the occupant space during collisions.

Title 49 CFR 238.213(a)(1) states that the B-end of passenger railcars shall have the capability of resisting:

- 150,000-pound horizontal force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting passenger railcar body structure;

- 20,000-pound horizontal force applied at the point of attachment to the roof structure, without exceeding the ultimate strength of either the post or its supporting passenger railcar body structure; and

- 30,000-pound horizontal force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting passenger railcar body structure.

Title 49 CFR 238.213(b)(2) and (b)(3) state that the F-end of passenger railcars shall have the capability of resisting:

- 300,000-pound horizontal force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting passenger railcar body structure;

- 100,000-pound horizontal force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting passenger railcar body structure;

- 45,000-pound horizontal force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting passenger railcar body structure; and

- Prior to or during structural deformation, each corner post, acting together with its supporting passenger railcar body structure, shall be capable of absorbing a minimum of 120,000 foot-pounds of energy (0.16 mega joule) with no more than 10 inches of longitudinal permanent deformation into the occupied volume.

The mechanical strength requirements in 49 CFR 238.213(a)(1) for the B-end corner posts are less than one-half of those in 49 CFR 238.213(b)(2) and (b)(3) for the F-end corner posts of passenger railcars.

Risk of B-End Collisions

The NTSB investigation examined the evolution of regulatory requirements for corner posts in passenger railcars. The strength requirements for F-end corner posts appear to be driven by the magnitude of expected collision forces in highway-rail grade crossing accidents, while the weaker requirements for B-end corner post requirements appear to be based on assumptions that mid-passenger railcar-pair collisions are unlikely. The NTSB investigation was not able to verify the rationale for the F- and B-end regulatory requirements with test findings, analytical results, or explanations of accident scenarios.

This train collision provides compelling evidence that the B-end strength requirement for passenger railcars needs revision. The accident sequence involved a common type of collision—a sideswipe or raking collision; specifically, the stronger F-end of passenger railcar 9193 impacted the weaker B-end of passenger railcar 9247. The damage to the B-end of passenger railcar 9247 was significant and posed significant risk to passengers; whereas, the damage to the F-end of passenger railcar 9193 was not significant from an intrusion point of

view. (See Figure 2.) This evidence indicates that the F-end corner posts provided adequate protection from accidents, but that the B-end corner posts were not sufficiently robust to ensure passenger safety.

Figure 2. Photograph of B-end of Metro-North passenger railcar 9247 after the collision.

Achieving Equal Safety

In a 2007 Notice of Proposed Rulemaking, the FRA identified the enhancement of strength requirements for corner posts in cab railcars and multiple-unit locomotives as a future rulemaking objective.[1] In its 2010 final rule, the FRA stated that the issue remained unresolved and that it may be addressed in future rulemaking.[2] Although the FRA has recognized that corner post-strength requirements have warranted revision for more than 14 years, the NTSB believes that action is needed now to revise the regulatory standards for the strength of passenger railcar corner posts to ensure protection of the traveling public and the railroad workforce. Therefore, the NTSB recommends that the FRA revise Title 49 *Code of Federal Regulations* (CFR) 238.213 to require the existing forward-end corner post strength requirements for the back-end corner posts of passenger railcars.

Truck-to-Car-Body-Attachment Strength

In the collision, a truck assembly from lead passenger railcar 9193 of striking passenger train 1581 detached and raked passenger railcar 9247, which was the fourth passenger railcar in passenger train 1548. The raking impact created a sidewall intrusion into the occupant space of passenger railcar 9247.

[1] *Federal Register* 72, no, 147 (August 1, 2007): 42018.
[2] *Federal Register* 75, no. 5 (January 8, 2010): 1181.

On M-8 passenger railcars, the truck assembly is attached to the car body with eight 1.25-inch diameter Grade 5 bolts at 952 foot-pounds of torque. Title 49 CFR 238.219, which applies to the minimum strength of the truck-to-railcar body attachments, states:

> 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.

The NTSB examined the failed truck-to-railcar body attachment in passenger railcar 9193 and discovered that all eight of the mounting bolts had failed. These findings led investigators to questions about the compliance of M-8 passenger railcars with 49 CFR 238.219. The railcar manufacturer provided data, which consisted of calculations and a finite element analysis, to demonstrate that the design complied with 49 CFR 238.219. However, the analytical evidence of compliance was not unequivocal, because it relied on engineering assumptions and interpretations, and because it did not include physical evidence from mechanical tests. The absence of a definitive protocol by the FRA for compliance assessment with 49 CFR 238 created considerable technical debate and work, and produced ambiguity in the compliance determination.

Title 49 *Code of Federal Regulations* (CFR) 238.219 requires passenger equipment to have a truck-to-railcar 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. On the M-8 passenger railcars, the truck assembly is attached to the passenger railcar body with Grade 5 bolts. Volpe National Transportation Systems Center (Volpe) evaluated the current Grade 5 bolts and a potential upgrade to Grade 8 bolts. Their findings indicated that Grade 5 bolts do not support the required 250,000-pound load and that Grade 8 bolts do appear to support the required load.

As part of the NTSB investigation, the FRA commissioned the Volpe National Transportation Systems Center (Volpe) to conduct an evaluation of the failed truck-to-railcar body attachment. Part of the Volpe evaluation addressed the compliance of the truck-to-railcar body design with 49 CFR 238.219. The Volpe evaluation spanned 7 months of work, involved many technical meetings among experts, and required appraisals of the analytical findings and the associated numerical modeling procedures. Topics debated among experts ranged from data validity, through the appropriateness of assumptions underlying the calculations, to identifying methods appropriate for the evaluation of design compliance. Due to the lack of clear compliance assessment procedures for 49 CFR Part 238, the NTSB believes that prevailing approaches for compliance assessment are unnecessarily arduous and subject to misinterpretations and errors, even among experts in the relevant technical communities.

The Volpe evaluation of the truck-to- railcar body attachment provided two conclusions:

- [The M-8 truck] design, with Grade 5 bolts, does not appear capable of supporting a lateral truck load of 250,000 pounds, if the traction link does not fail and the entire load goes through the traction link.

- [The M-8 truck] design, with Grade 8 bolts, does appear capable of supporting a lateral truck load of 250,000 pounds, even if the traction link does not fail and the entire load goes through the traction link. However, other calculation, design, and performance choices need to be weighed carefully.

However, Kawasaki objected to the conclusions of the Volpe evaluation, citing differing interpretations of the technical requirements. Without a clear protocol for compliance assessment, it is unlikely that compliance with 49 CFR Part 238 can be determined unambiguously.

Compliance Certification

The NTSB believes that compliance with the technical standards established in 49 CFR Part 238 is critical for the safety of the traveling public and the railroad workforce. Moreover, the NTSB believes that compliance with 49 CFR Part 238 should not rely on manufacturers' evidence following a design failure, as done in this accident. Rather, the NTSB believes that a passenger railcar design should be evaluated through a clear and valid protocol conducted by an independent technical authority prior to placing the passenger railcar into service.

The NTSB notes that Pipeline and Hazardous Materials Safety Administration regulations in 49 CFR 179.5 require a certificate of construction before tank railcars are placed into service, as stated below.

> §179.5 Certificate of construction.
>
> (a) Before a tank car is placed in service, the party assembling the completed car shall furnish a Certificate of Construction, Form AAR [Association of American Railroads] 4-2 to the owner and the Executive Director—Tank Car Safety, AAR, certifying that the tank, equipment, and car fully conforms to all requirements of the specification.
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> (b) When cars or tanks are covered in one application and are identical in all details are built in series, one certificate will suffice for each series when submitted to the Executive Director—Tank Car Safety, AAR.
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> (c) If the owner elects to furnish service equipment, the owner shall furnish the Executive Director—Tank Car Safety, AAR, a report in prescribed form, certifying that the service equipment complies with all the requirements of the specifications.

> (d) When cars or tanks which are covered on one application and are identical in all details are built in series, one certificate shall suffice for each series when submitted to the Executive Director—Tank Car Safety, AAR. One copy of the Certificate of Construction must be furnished to the Executive Director—Tank Car Safety, AAR for each car number of consecutively numbered group or groups covered by the original application.

The NTSB believes that a similar procedure should be adopted for compliance with 49 CFR Part 238. Therefore, the NTSB recommends that the FRA:

> Revise Title 49 *Code of Federal Regulations* (CFR) 238.213 to require the existing forward-end corner post strength requirements for the back-end corner posts of passenger railcars. (R-15-01)

> Revise Title 49 *Code of Federal Regulations* Part 238 to incorporate a certificate of construction, similar to the one found at Title 49 *Code of Federal Regulations* 179.5, and require that the certificate be furnished prior to the in-service date of the railcar. (R-15-02)

We also issued one safety recommendation to the Metro-North Railroad.

The NTSB is vitally interested in these recommendations because they are designed to prevent accidents and save lives. We would appreciate receiving a response from you within 90 days, as required by 49 *United States Code* section 1135, detailing the actions you have taken or intend to take to implement them. When replying, please refer to the safety recommendations by number and submit your response electronically to correspondence@ntsb.gov.

[Original Signed]

By: Christopher A. Hart,
Acting Chairman