



Railroad Safety Advisory Committee
December 2, 2003

Locomotive Crashworthiness
Working Group
Report on Draft NPRM
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Crashworthiness Background

- Crashworthiness of multiple-unit (MU) locomotives addressed by 49 CFR Part 229.141, effective April 1, 1956.
- Association of American Railroads (AAR) specification S-580 adopted in 1989.
- Rail Safety Enforcement and Review Act, P.L. 102-365 enacted Sept. 3, 1992.
- FRA issued "Locomotive Crashworthiness and Cab Working Conditions Report to Congress" on September 18, 1996.



Crashworthiness Background (cont.)

- Full RSAC Established the Locomotive Crashworthiness Working Group on June 24, 1997.
- Locomotive Crashworthiness Working Group first meeting held September 8-9, 1997.
- Working Group established the Engineering Task Force to develop technical issues.
- Passenger equipment crashworthiness addressed in 49 CFR Part 238, May 12, 1999.



RSAC Crashworthiness Tasks

- Review of accident data and industry standard (S-580) in relation to full height corner posts, glazing and fuel containment.
- Investigation of improved anti-climbers and/or shelf couplers.
- Examination of methods of cab egress and effectiveness of emergency lighting.



Collision Scenarios Considered

- Coupled locomotive override.
- Colliding locomotive override.
- Locomotive impact on standing freight car.
- Raking collision between locomotive and freight car or shifted load.
- Offset collision between locomotive and freight car.



Working Group/Task Force Process

- Twenty-three representative collisions were studied by the task force.
- Additional analysis performed by contractor Arthur D. Little, Inc.
- Working group analyzed the benefits and costs of the proposed changes to S-580 and made recommendations.



Task Force Conclusions

- Braced collision posts, corner posts and crash energy management were endorsed.
- Uniform sill heights, rollover protection, and crash refuges found to be ineffective use of resources.
- Strength of collision posts, cab corners and the locomotive front end were identified as areas for further development.



Locomotive Crashworthiness NPRM

- Notice of Proposed Rulemaking for Locomotive Crashworthiness has been drafted by FRA based on the findings of the Working Group.
- Draft will be circulated to Working Group members for comments.
- Final draft NPRM will be the recommendation of the Working Group to the full RSAC.



NPRM Overview

- Goal is to improve locomotive crash-worthiness in areas which will effect the greatest reduction in cab crew injuries and fatalities.
- Performance standards used where possible.
- AAR Standard S-580 is to be referenced as an alternate model design standard.



NPRM – Alternate Standards & Changes

- Provisions are included for future approval of other alternate design standards.
- Provisions are made for approval of 'substantive' and 'non-substantive' changes to FRA approved standards.



NPRM - Applicability

- Effective date 3 years from adoption of Final Rule for new locomotives and remanufactured locomotives with less than 25% reused parts.
- During the phase-in period FRA will encourage, but not require, the use of locomotives built to these standards in the lead position.



NPRM – Static End Strength

- Capable of withstanding 1,000,000 lb. longitudinal load at inner draft stops without permanent deformation.
- For monocoque or semi-monocoque structure, must withstand 800,000 lb. load at inner draft stops plus 80,000 lb. at each roof rail.



NPRM – Anti-Climbers & Collision Posts

- Anti-climbers capable of withstanding 100,000 pound vertical force over a one foot wide area.
- Two collision posts attached to the front skin and roof of the short hood forward of the crew seats are required.
- Minimum 24" above cab floor.



NPRM – Collision Posts (con't.)

- Loads: 750,000 pounds in bottom 10% of height; 500,000 pounds 30 inches above the underframe.
- Angle up to 15 degrees off axis.
- For monocoque and semi-monocoque locomotives, loads are 500,000 pounds and 200,000 pounds.



NPRM – Short Hood & Corner Posts

- Short hood skin $\frac{1}{2}$ " thick or determined by formula given in regulation.
- Corner posts at all corners of the cab sized for loads of 300,000 pounds at underframe; 100,000 pounds 30" above cab floor and 45,000 pounds above 30".
- Monocoque and semi-monocoque designs must have 2 forward corner posts.



NPRM – Additional Requirements 1

- One opening suitable for emergency exit shall be available in any locomotive orientation.
- Brightness and duration of emergency lighting specified to facilitate safe exit by the crew.
- Rounding and padding of interior edges shall be used to reduce impact injuries.



NPRM – Additional Requirements 2

- Seats and other cab appurtenances shall withstand up to 3g's longitudinally, 1.5g's laterally and 2.0g's vertically.
- External fuel tanks to meet AAR Standard S-5506.
- Internal fuel tanks to meet same requirements as in 49 CFR 238.223.



NPRM - Appendices

- Appendix D - Performance Criteria for Locomotive Crashworthiness
- Appendix E – AAR Standard S-580-xx “Locomotive Crashworthiness Requirements.”
- Appendix F – AAR Standard S-5506 “Performance Requirements for Diesel Locomotive Fuel Tanks” (Oct. 1, 2001)