June 14, 2022

AMERICAN PUBLIC TRANSPORTATION ASSOCIATION

Department of Transportation
Docket Operations
M–30, West Building Ground Floor, Room W12–140
1200 New Jersey Avenue S.E.
Washington, DC 20590

Subject: Docket No. FRA-2020-0058
RIN: 2310-AC76

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Dear Docket Clerk:

On behalf of the more than 1,500 member organizations of the American Public Transportation Association (APTA), submits the following comments in response to the Federal Railroad Administration's (FRA) Notice of Proposed Rulemaking (NPRM) for Safety Glazing Standards for Railroad Equipment published in the *Federal Register* on April 18, 2022, at 87 FR 22847.

First, APTA appreciates FRA undertaking the task of updating and modernizing safety glazing standards. APTA's members recognize the benefits of codifying longstanding waivers in lieu of repeatedly granting waiver extensions. In addition, it is important to modernize the large object impact testing to not only account for the difficulties in procuring the materials to conduct the large-scale object impact test but also to establish an alternative means to conduct the large-scale object impact test that is both repeatable and more consistent. APTA has separated this letter into two separate parts – one reviewing regulatory relief and the second part reviewing the alternative proposal for the large object impact using a cinder block.

<u>Regulatory Relief for Older Equipment Operating at Low Speeds</u>

Regulatory relief for glazing requirements on equipment that do not exceed 30-mph will be helpful to the numerous organizations that have submitted waiver petitions to the FRA. APTA members understand that upon promulgation of the final rule, impacted organizations will no longer need to provide technical justification for the waiver on a 5-year cycle and that the legacy glazing would be deemed acceptable and grandfathered.

<u>Alternative Proposal for the Large Object Impact using a Cinder Block</u>

As stated previously, APTA appreciates the FRA has proposed alternative requirements for the 24-lb cinder block large object impact test.

While the cinder block test has been used for many years, and based on service history, has proven to generally qualify Type 1 and Type 2 glazing, and the test has some limitations that support the need to consider an alternative approach. First and foremost is the repeatability and consistency of the test will vary from cinder block to cinder block and, therefore, impact to impact due to variations in geometry and construction of the cinder block and the fact it typically fractures inconsistently upon impact. Another limitation of the test is the material specified for the cinder block. While this material was readily available when the rule was first promulgated, the referenced cinder block in the Appendix A of Part 223 is no longer readily available. Sometimes a heavier cinder block is used, and it is reduced to the desired mass by chipping or grinding away material, which interjects a certain amount of inconsistency. In addition to the lack of availability of the material, it can also be difficult to ensure the test cinder block impacts the glazing on a corner of the cinder block within the allowable target diameter. Therefore, including an alternative repeatable test is highly desirable, and the 12-pound steel sphere as proposed by FRA is reasonable test, but we are concerned with the proposed object speed at impact.

The NPRM proposes the alternative test using lows for use of a 12-pound steel sphere utilizing the same initial kinetic impact energy of the 24-pound cinder block test. Based on review of the proposal, and the work APTA has done with alternative testing for glazing, APTA is concerned with this approach. The proposed 12-pound steel sphere test is more demanding than the current cinder block testing because not all the initial kinetic energy is imparted to the glazing sample being tested since the cinder block itself consumes some of the kinetic energy as it breaks apart upon contact with the glazing. Thus, the two options are not equivalent, with the alternative option being the more stringent and conservative one. The alternative test will result in the need to re-design and retrofit the manner of attachment because a thicker piece of glazing may be required, which may result in continued testing using the current 24-pound cinder block test. Should an incident occur that results in damages or injuries based on compromised glazing from an impact, the railroad may be held liable since the alternative testing may result in a thicker or stronger glazing material than based on the 24-pound cinder block testing. APTA's members recommend the alternative test method provide an equivalent level of safety, and not be more stringent than the method currently included in 49 CFR Part 223.

APTA's Construction & Structural Working Group is currently working on establishing an appropriate method to scale the kinetic energy for the large object impact test to account for the kinetic energy that is typically absorbed by the cinder block when the block impacts the glazing. This approach will mimic the imparted energy to the glazing from the cinder block test, so it ensures an equivalent level of safety as the current requirements while addressing the availability and repeatability concerns of the cinder block test. **Attachment A** provides a detailed description of APTA's evaluation of an alternative test. In summary, APTA modeled a polycarbonate window in FEA and conducted three impact scenarios using a cinderblock, and a rigid proxy object. The glazing sample was modeled with both shell and solid elements for the impact with the rigid proxy object. The goal of the analysis was to determine an equivalent kinetic impact energy imparted to the glazing sample when it is struck by a non-energy absorbing proxy object. The solid proxy object resulted in approximately double the imparted energy to the glazing when compared to the deformable cinder block. APTA's recommendation is that the NPRM needs to be modified to scale the kinetic energy based on imparted energy from the cinder block, not the actual theoretical initial kinetic energy at impact.

Analysis of the Railroad Accident/Incident Reporting System (RAIRS) Database

To justify that the existing test requirements have proven to be valid for qualifying windows, APTA conducted a query of the FRA RAIRS database. APTA conducted a query for the years 2000 through 2019. The filters included "windshield", "window" and "glazing". This query resulted in 21 incidents that capture these keywords. Nine of these 21 incidents were caused by striking a tree fouling the track that damaged the windshield. Four incidents were related to catenary impacts – such as an insulator or hanging catenary wire. Three were related to grade crossing/crossing gate impacts. The remaining incidents related to striking other objects, such as concrete falling off an overhead bridge and other miscellaneous objects. Only one of these incidents resulted in an injury to the engineer as reported in the commentary for each incident. This incident involved striking a crossing gate and the gate penetrating through the windshield injuring the engineer.

APTA then developed a comparison of incident rates for glazing incidents to compare to other incident types. The Bureau of Transportation Statistics was utilized to develop and average train miles for Amtrak and Commuter rail vehicles to develop total vehicles miles for the 20 years. The results are shown in **Table 1**. Overall, glazing incidents are orders of magnitude less than other incident types.

The current window qualification requirements appear to be adequate for prevention of serious glazing incidents. This data supports maintaining existing requirements rather than increasing the test requirements.

Table 1: Incident Rates by Type

Operating Environment	Derailments	Train-Train Collisions	Obstruction Collisions	Glazing Incidents
Northeast Corridor	0.086	0.062	0.163	0.0029
Commuter lower freight	0.094	0.038	0.225	
Commuter higher freight	0.082	0.074	0.186	
Amtrak Corridor	.315	0.010	0.384	
Amtrak Lon Distance	0.343	0.060	0.294	

Conclusion

APTA supports FRA's efforts to codify longstanding waivers for legacy equipment that operate at speeds lower than 30 mph and are subject to five-year waiver petitions. APTA also supports the addition of an alternative large object impact testing. However, APTA strongly recommends that FRA reconsider the methodology to scale the kinetic energy from the 24-pound cinder block test. APTA is available to support the FRA in revising the alternative large object impact test.

If you have any questions regarding this letter, please contact APTA's Chief Counsel, Ms. Linda Ford, at lford@apta.com or (202) 496-4808.

Sincerely,

Paul P. Skoutelas

Paul P. Skoutelas
President and CEO

Attachment A

1.0 Simulation

Industry has conducted a series of preliminary finite element analyses to determine the equivalence of the initial kinetic energy when using a rigid generic proxy object in lieu of the 24 lbs. cinderblock. The model inputs are available for review and comment and will be made available upon request.

The preliminary simulations conducted use the following three types of models:

> **Scenario 1:** Cinderblock and shell element window. Cinderblock has a mass of 10.9 kg (24 lbs.), impacts on its corner the center of the glazing sample at a speed of 13.4 m/s (44 ft/s) with an initial kinetic energy of 980 J.
>
> **Scenario 2:** Generic rigid proxy impactor and shell element window. Generic rigid proxy impactor has a mass of 5.45 kg (12 lbs.) with an initial velocity of 18.9 m/s (62 ft/s) and an initial kinetic energy of 980 J
>
> **Scenario 3**: Generic rigid proxy impactor and solid element window. Generic rigid proxy impactor has a mass of 5.45 kg (12 lbs.) with an initial velocity of 18.9 m/s (62 ft/s) and an initial kinetic energy of 980 J

Standard material models were used for the cinderblock (available upon request). The polycarbonate glazing utilized stress strain material taken from an industry peer reviewed paper[1.]. The glazing sample analyzed uses the size proposed from the test protocol discussed in Section 2. The boundary condition was consistent between all analyses and implemented a fully fixed condition around the perimeter of the glazing sample.

The models were developed using standard industry best practices in terms of number of elements, mesh refinement, checks for global energy balances and the results are considered reasonable. Figures 1, 2 and 3 depict the deflection time, impact force time, and impact force deflection curves obtained.

[1] Curve source from “Experimentation and Modeling of the Tension Behavior of Polycarbonate at High Strain Rates” by Xu, Gao, Wang and Zhang

Figure 1 – Deflection – time plot for all three impact scenarios

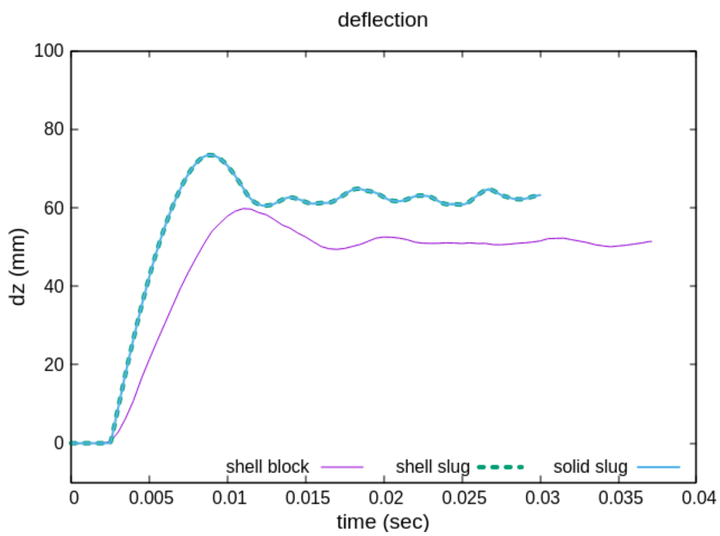


Figure 2 – Impact force – deflection for all three impact scenarios

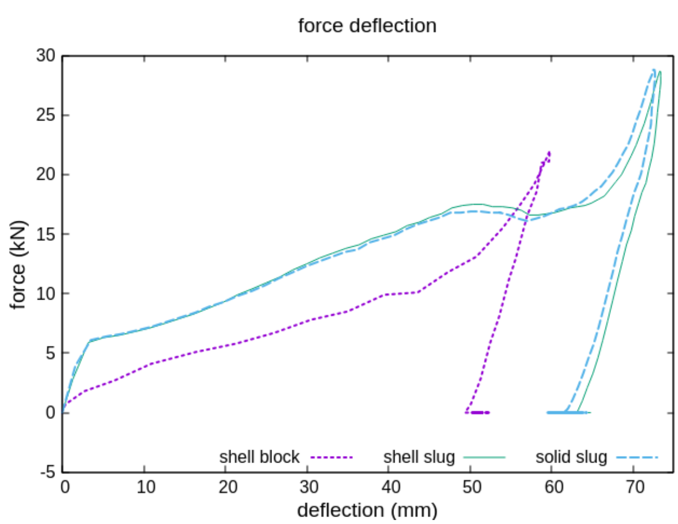


Figure 3 – Force-Deflection – time plot for all three impact scenarios

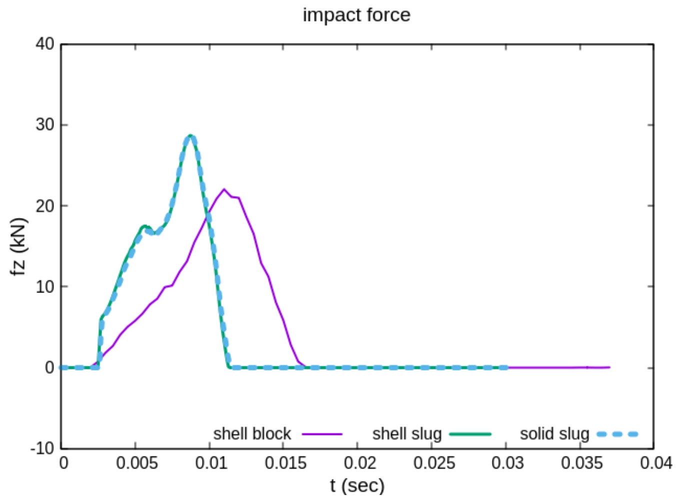


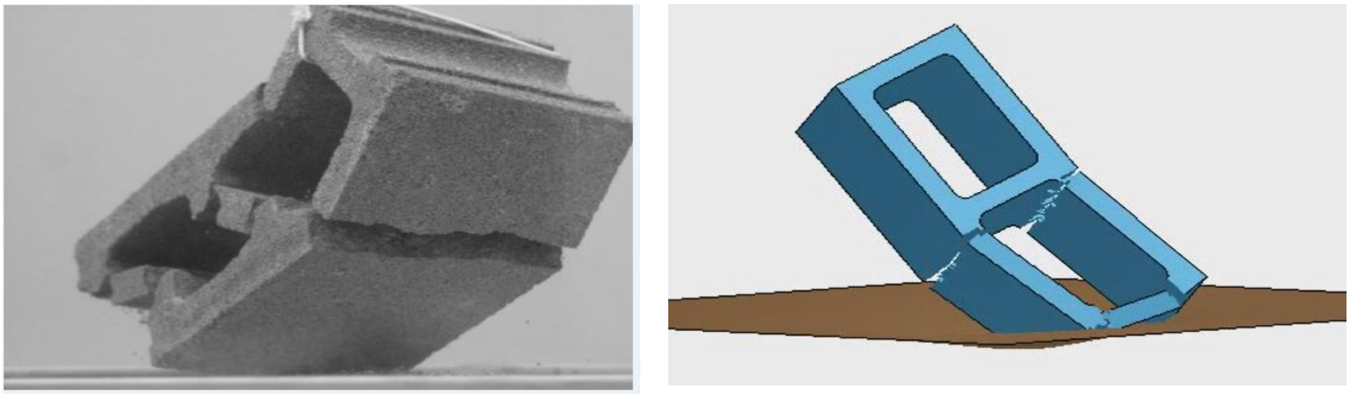
Table 2 summarizes key impact parameters determined for each scenario analyzed.

Table 2 – Impact Parameters by Scenario

SCENARIO	ENERGY ABSORBED BY WINDOW PEAK/END (J)	PEAK DEFLECTION (MM)	END DEFLECTION (MM)
1	496/385	59.8	51.1
2	865/882	69.2	62.5
3	841/856	68.2	61.9

The key results from the analyses is that the energy that is absorbed by the glazing sample from the cinderblock is on the order of 500 J. That is, of the original 980 J available approximately 480 J is absorbed by the cinderblock as it crumbles during impact with the glazing sample. Figure 4 is a comparison of the simulated cinderblock deformation with an extracted still photo from a high-speed video taken of a compliance test.

Figure 4 – Comparison of Deformation Modes of Standard Cinderblock (Simulated and Tested)



As the results comparing the shell and solid element formulations provide similar predicted deflections, a fourth preliminary analysis was conducted scaling the initial kinetic energy of the generic rigid proxy impactor to 500 J keeping all other boundary and analysis conditions equal. The results from this fourth analysis are compared with those from the 49 CFR Part 223 Appendix A large object impact condition using a 24 lbs. cinderblock in Figure 5.

Figure 5 Comparison of Deformation Plots of Glazing Sample Subject to Scenarios 1 & 4