CREAFORM ENGINEERING

Subject: Post Crash Safety requirements for Heavy vehicles

FMVSS No. 305a : Electric-Powered Vehicles: Electric Powertrain Integrity

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We understand the concern of NHTSA to limit post-crash safety using full vehicle crash tests for heavy vehicles as state in this NPRM. Our position in term of expert in crash simulation is that the REESS must also meet vehicle integration requirements. Component-level tests of the REESS must withstand direct impact/choc or crush test, but the effect of the integration on the vehicle is not considered in those tests.

From our experience, full vehicle crashes can impose higher loads on an unprotected REESS than quasi-static crush tests, depending on the REESS's location in the vehicle. In a crash, the load on the REESS is rarely uniform; other vehicle components often create localized forces that can lead to thermal runaway. Sub-structure components may contact the REESS, concentrating crushing loads. The current Mechanical Integrity Test does not account for these scenarios.

The Mechanical Shock Test mitigates risks in indirect impacts (e.g., frontal impacts) but does not cover direct impacts on the REESS. The load experienced by the REESS mounting points during direct versus indirect impacts cannot be compared. REESS are often mounted on vibration dampers, which typically show weakness in shear strength. Our experience indicates that the Mechanical Shock Test does not mitigate the risk of post-crash REESS retention in direct impacts.

We perceive higher risks for configurations where REESS are located at the rear of vehicles, often without protective barriers such as bumpers. Rear impacts frequently occur at higher speeds (e.g., 80 km/h), and the lack of a physical barrier results in high contact forces not covered by component-level tests. IIHS has demonstrated in it's latest rear underride guards on semitrailers studies[1] that existing underride guard are often inadequate. REEES located at that position is likely to be impacted. Since underride guards are non mandatory, the risk of fatal injurie involving REESS thermal runway is higher. Diesel fuel tanks are most likely located on heavy vehicle side, the parallel with FMVSS 301 and 303 in not applicable for rear impact.

The risk of thermal runaway from a direct impact is real, and given the danger, it is evident that passenger transport vehicles (buses or trucks) should be subject to requirements forcing manufacturers to protect batteries from direct impact. Adjusting the Mechanical Integrity and Mechanical Shock Test parameters at the component level will not cover all risks.

Based on our experience in developing heavy vehicle structures and buses, creating such protective barriers for REESS integration is achievable. Although heavy vehicles are usually custom-made with various configurations based on purchaser needs and produced in low volumes, conducting crash tests on a small volume of representative vehicles could be cost-prohibitive. However, advanced numerical simulations offer an excellent low-cost alternative. Numerical simulations have proven invaluable in the automotive industry for enhancing passenger security in ways physical tests cannot. This approach should be part of the solution, as it is currently accepted in some regulations (e.g., UN-ECE R66) to develop REESS protection and mitigate risks in direct impacts.

Furthermore, a requirement involving post-crash safety at the vehicle level would influence design differently than relying solely on the REESS to resist direct impact. Manufacturers are likely to design solutions that mitigate failure risks when such requirements exist. In recent years, developing new electric heavy vehicles without clear regulations regarding direct impact, we have seen manufacturers develop rear and side bumpers to withstand crash loads and adapt vehicle architecture to place the REESS in the middle of the vehicle, reducing the risk of direct impact on the REESS.

References

1. https://www.iihs.org/news/detail/underride-guards-can-be-lifesavers-but-most-could-be-improved