STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0016

Janet T. Mills
GOVERNOR

Bruce A. Van Note
COMMISSIONER

Title: MaineDOT Process for determination of crashworthiness of roadside safety hardware	**Issue Date: June 12, 2020** **Revision Date: June 11, 2025**
Originators: Atlee Mousseau – Regional Program **Jeff Folsom – Project Development** **Rich Myers/Tim Aguilar – Bridge Program** **Dawn Bickford – Research and Innovation Office**	
Approved by: Joyce Taylor, P.E., Chief Engineer	

Per the Federal Highway Administration Memo dated April 9, 2018, State DOTs will have an acceptable process for determining the crashworthiness of roadside safety hardware used on the National Highway System (NHS) as well as non-NHS roadways. This document specifies the process used by MaineDOT for all highway and bridge safety hardware.

Roadside safety hardware shall meet the requirements of the December 21, 2015, "AASHTO/FHWA Joint Implementation Agreement for MASH". Manufacturer submittals and crash test reports will be reviewed against the evaluation criteria contained in the Manual for Assessing Safety Hardware, Second Edition (MASH 2016), and passing tests are required for hardware to be given further consideration.

For highway-related safety hardware physically tested to MASH 2016, the following section applies:

All documentation provided by manufacturers to the MaineDOT will be reviewed including but not limited to:

- FHWA eligibility letters
- Manufacturer brochures and technical data sheets (TDS)
- Crash testing reports
- 3rd party review of crash testing results
- Crash test videos
- Installation and inspection procedures

The instructions and forms for submitting new products may be accessed at the following MaineDOT web address: https://www.maine.gov/dot/doing-business/bid-opportunities/qplprogram

An operational analysis of the hardware will also be done. The analysis will include but will not be limited to:

- Installation details – Installation details will be evaluated to ensure that construction practices, tolerances, and quality control will result in correctly installed systems as well as ease of installation for contractors.

- Maintainability – Evaluation of how practical the system or device is to maintain, requirements for new maintenance protocols, need for new inventory stock.
- Replacement or Repair – Evaluation of replacement or repair due to damage will be made including potential damage due to snow removal.
- Expected Service Life – Consideration will also be given to the expected service life of the system including the future degradation due to environmental exposure and corrosion based on Maine's climate.
- Compatibility – compatibility with legacy hardware shall be considered.
- Performance Data – In-service performance data from other users such as State DOTs.

MaineDOT's Highway, Safety, and Traffic New Products Committee is responsible for and evaluates all new and modified highway related roadside safety hardware products in accordance with the New Product Evaluation Process. The committee includes representation from across MaineDOT's Bureaus, Divisions, and Offices as voting members, and the FHWA Division Office as a non-voting member. As part of the evaluation process, product manufacturers shall submit (and the committee review) crash test results, videos, and test summary sheets that are completed and reported by accredited laboratories and in accordance with AASHTO MASH. The review shall be documented in the committee meeting notes.

FHWA eligibility letters are not the sole basis for MaineDOT's determination that a roadside safety hardware product is crashworthy. In some cases, for example, even though an eligibility letter exists, the operational analysis may determine whether a device is too difficult to install or not right for Maine's climate. In other cases, an eligibility letter may not exist, but crash test results and an operational analysis may determine that a device is acceptable for use.

Once the committee completes the evaluation and determines the roadside safety hardware product is crashworthy, the product is added to the appropriate qualified products list posted on MaineDOT's website.

Any changes and/or modifications to qualified roadside safety hardware shall be submitted by the manufacturer to MaineDOT's Product Evaluation Program. The Highway, Safety, and Traffic New Products Committee will review these in the same manner described herein.

For Existing or New Bridge rail Systems physically tested to MASH 2016, the following section applies:

The Bridge rail crash testing reports will be reviewed regarding the evaluation criteria contained in MASH. Where performance criteria are borderline passing; the system contains unusual details and/or geometrics; or minor enhancements being considered are present, further analysis may be warranted. Such further analysis may be qualitative or require more advanced analysis such as finite element analysis (FEA) modeling.

The Bridge rail will be evaluated for constructability and maintainability. Construction details will be evaluated to ensure that typical construction practices, tolerances, and quality control will result in correctly installed railing consistent with the design. An evaluation of the details regarding replacement or repair due to damage will be made.

Consideration will also be given to the expected service life of the railing including the future degradation due to environmental exposure and corrosion.

The MaineDOT Bridge Program is responsible for evaluating each of these criteria. The Bridge Program will consider each railing type and configuration and submit a recommendation on crashworthiness and test level to the Engineering Council for approval.

For Existing Bridge Rail Systems without full scale MASH crash testing results, the following section applies:

In the absence of the full suite of MASH crash tests, an existing system may be considered crashworthy with the following approach:

The bridge rail system shall have been crash tested under the requirements of NCHRP 350. For the purposes of this requirement, minor modifications to a NCHRP 350 crash tested rail previously accepted as crashworthy by this agency or FHWA will be considered as satisfying this requirement. A non-linear finite element analysis using software such as LS-DYNA must be done by a qualified engineer, demonstrating acceptable performance under MASH standards. Available data from prior crash testing should be used to validate the FEA model.

It must be demonstrated that the bridge rail system has a history of acceptable in-service performance. The rail system must have been installed on corridors with traffic volume and speed consistent with the Test Level it is being considered for. MaineDOT will gather and evaluate bridge maintenance reports, crash reports and consider the length of time and number of installations to evaluate these criteria.

The bridge rail must meet minimum height criteria of 30 inches, 36 inches, and 42 inches for Test Level (TL) 3, 4, and 5 respectively. This criterion is based on available research and testing information recommending these minimums for vehicle stability.

An evaluation of the potential for vehicle snagging during impact will be made. The values for post setback, vertical clear opening, and ratio of vertical clear opening to rail height will be evaluated by the criteria and figures contained in Appendix A13 of the AASHTO LRFD Bridge Design Specification as well as comparison to other successfully MASH tested bridge rail systems. The results from FEA modeling will also be used for this evaluation.

The bridge rail must be shown to be of sufficient strength for the AASHTO MASH loadings by analysis. The bridge rail strength will be evaluated by both the procedure detailed in NCHRP 20-07 Task 395 Final Report as well as consideration of the results from the FEA analysis.

The Bridge rail will be evaluated for constructability and maintainability. Construction details will be evaluated to ensure that typical construction practices, tolerances, and quality control will result in correctly installed railing consistent with the design. An evaluation of the details regarding replacement or repair due to damage will be made.

Consideration will also be given to the expected service life of the railing including the future degradation due to environmental exposure and corrosion.

The MaineDOT Bridge Program is responsible for evaluating each of these criteria. The Bridge Program will consider each railing type and configuration and submit a recommendation on crashworthiness and test level to the Engineering Council for approval.

Low Volume Bridge Rail systems:

Low Volume Bridge Rails as provided for in the MaineDOT Bridge Design Guide may be approved for use up to a TL-3 level. The MaineDOT Bridge Program is responsible for determining the appropriate Test Level based on the MaineDOT Bridge Design Guide and specific project needs.

Each of the criteria in the section above for existing bridge rail systems without full scale MASH crash testing results shall be used to evaluate Low Volume Bridge Rails except for the need for any crash testing or FEA.

The MaineDOT Bridge Program is responsible for evaluating each of these criteria. The Bridge Program will consider each railing type and configuration and submit a recommendation on crashworthiness and test level to the Engineering Council for approval.

Roadside Safety Hardware Systems – MASH 2016 Exceptions

Based on AASHTO's "Clarifications on Implementing the AASHTO Manual for Assessing Safety Hardware, 2016 Updated: November 19, 2019", in some instances, Maine DOT may specify a MASH 2009-compliant or NCHRP 350-compliant device or system. This is acceptable when:

- A MASH 2016-compliant device does not exist to address the situation
- A MASH 2016-compliant device exists but does not meet the State's needs, given project or regional conditions
- The State is awaiting completion of MASH-2016 testing for a specific device, in which case the State must document the plan for testing the device that will be used on future projects in lieu of the specified NCHRP 350 device
- The device is a temporary work zone device that has been in use prior to December 31, 2019, and is still within its normal service life

The above instances require an analysis of the reason for any exceptions to installation of a MASH 2016-compliant device or system. The analysis shall include other options reviewed and an explanation of why the option is not appropriate for said installation.

Once the committee completes the evaluation and determines the roadside safety hardware product is crashworthy, the product is added to a qualified products list posted on MaineDOT's website, (for example: QPL for Terminals for W-Beam Guardrail Systems). In instances where it is a reviewed exception, the product will not be added to the QPL and will require evaluation on a case-by-case basis.

All reviews for new hardware and for exceptions will be kept on file with the Research and Innovation Office of MaineDOT.