

ENGINEERING DIRECTIVE

Patricia Leavenworth (signature on original)

CHIEF ENGINEER

MASH Implementation Plan

The purpose of this Engineering Directive is to provide guidance on the use of roadside hardware that conforms to the American Association of State Highway Transportation Officials (AASHTO) 2016 *Manual for Assessing Safety Hardware* (MASH).

This Engineering Directive supersedes E-95-006, E-14-005, E-16-004, E-17-001, and E-19-003.

Background

Since 1993, the National Cooperative Research Program Report 350: *Recommended Procedures for the Safety Performance Evaluation of Highway Features* (NCHRP 350) has been used as evaluation criteria for determining if a roadside hardware device is suitable from a crash worthiness perspective for use on the National Highway System (NHS).

However, the typical vehicle size and weight on national highways has changed since the publication of NCHRP 350 and additional research has been performed to determine more accurate critical impact angles, speeds, and other crash testing criteria. In response to these evolving conditions, AASHTO published MASH in 2009 as a successor to NCHRP 350. A new edition of MASH was published in 2016.

With exception to low volume road or bridge projects off the NHS and the other scenarios noted below, MassDOT has adopted MASH crash testing criteria for all roadside hardware used on projects both on- and off-NHS that have an advertisement date of April 18, 2020, or later. In addition, this applies to any existing roadside hardware that has been damaged beyond repair and will be fully replaced through maintenance contracts and/or Accident Recovery.

Proprietary Hardware

Proprietary hardware is designed and developed by private entities and typical devices include end treatments, crash cushions, high-tension cable barrier, and most work zone devices. MassDOT maintains a Qualified Traffic Control Equipment (QTCE) list for several types of proprietary hardware that meet department needs and performance specifications. Manufacturers and/or distributors of proprietary hardware typically submit crash testing results and analysis to FHWA's Office of Safety for a Federal Aid Eligibility Letter.

Proprietary hardware does not, however, require a Federal Aid Eligibility Letter in order to be considered for use on a MassDOT project. As stated in their Frequently Asked Questions on FHWA Eligibility Letters for Safety Hardware Devices, revised 4/8/16, "Eligibility Letters are

provided as a service to the States and are not a requirement for roadside safety hardware to be eligible for reimbursement.” It is also not reasonable to expect that all hardware will be tested under all conditions. For example: a crash cushion may have been successfully tested protecting a 2’ wide object and an 8’ wide object, but no intermediate widths. After reviewing the crash testing reports and identifying no significant outliers in the testing, it can be reasonably assumed that this crash cushion can safely protect any object that is between 2’ and 8’ wide, even though the Federal Aid Eligibility Letter does not cover those intermediate widths.

Care should be taken, however, by both Designers and Contractors when considering proprietary devices that may not have been tested under the conditions where they are proposed. During the design of both advertised construction contracts and Highway Access Permits, it is the responsibility of the Designer to identify such devices prior to the 100% submission, and failure to do so may result in the rejection of the design. It is also the responsibility of Contractors to make requests or clarifications via the Bidder Question process prior to Bid Opening, and failure to do so may result in the rejection of a shop drawing. The only exception to this is for emergency work when other options, including doing nothing, is not viable.

MassDOT will, at a minimum, evaluate the following when considering proprietary devices that do not have a Federal Aid Eligibility Letter for the condition in which they are proposed:

1. Has this product been successfully crash tested to MASH 2016?
 - a. If yes, why does it not have a Federal Aid Eligibility Letter for the condition in which it is proposed?
 - b. If no, has this product been crash tested to other standards (MASH 2009, NCHRP 350, EN 1317, etc.)?
 - c. If no, has it failed a MASH 2016 crash test?
2. Have alternative test methods such as simulation or finite element analysis been evaluated?
3. Are there other products or designs available that could be used in place of what has been proposed?
4. Have all other feasible options been evaluated (i.e., change in hardware type, geometric changes to the approach, etc.)?
5. Is the proposed use of the product likely a more desirable alternative to doing nothing?

Proprietary hardware with Federal Aid Eligibility Letters will be considered for inclusion on the QTCE list. Proprietary hardware that is being considered for an application other than what was tested may be considered for the QTCE with concurrence from the FHWA Division Office or may be approved on a project-by-project basis. Proprietary hardware that does not have a Federal Aid Eligibility Letter will not be considered for inclusion on the QTCE but may be approved on a project-by-project basis in concurrence with FHWA.

Non-Proprietary Hardware

Non-proprietary roadside hardware is typically designed through a state DOT or consortium of state DOTs in a pooled fund study. Typical non-proprietary hardware includes guardrail, permanent concrete barrier, bridge rail, and breakaway sign supports.

For various reasons, non-proprietary hardware may not always be submitted to FHWA’s Office of Safety for a Federal-Aid Eligibility Letter. Similar to proprietary hardware, non-proprietary devices may also not be crash tested under all scenarios and/or geometric conditions encountered in the field. However, these generic designs may still be eligible for federal aid and use on MassDOT projects.

MassDOT will evaluate crash testing, finite element analysis, and engineering opinions on non-proprietary hardware. If a Federal-Aid Eligibility Letter does not exist for a device or for how it is deployed under certain conditions, MassDOT will work with the FHWA Division Office to determine its suitability and eligibility for federal aid. Designs that are determined to meet the needs of the Department and are eligible for federal aid may be added to the Construction Standards, as necessary, or approved on a project-by-project basis.

Work Zone Devices

Sunset dates have been established for work zone devices, as listed below. With exception to temporary barrier, Contractors may continue to deploy used NCHRP 350 devices that conform to NCHRP 350 standards and meet the American Traffic Safety Services Association’s *Quality Guidelines for Work Zone Traffic Control Devices* on projects that are advertised prior to these dates, but may not purchase and deploy any new NCHRP 350 devices for work on MassDOT projects. Work zone device types that are included in MassDOT projects advertised after their respective Sunset Dates and any newly purchased device on any contract must conform to MASH 2016.

<u>Device Type</u>	<u>Sunset Date</u>
*Temporary Barrier	1/22/17
Cones and Tubular Markers	1/1/22
Drums	1/1/22
Temporary Sign Stands	1/1/22
Temporary Lane Separator Systems	1/1/23
Vertical Delineators	1/1/23
Type III Barricades	1/1/23
Pedestrian Barricades and/or Channelization Devices	1/1/23
Temporary Impact Attenuators	1/1/25
Truck- or Trailer-Mounted Attenuators	1/1/25

*(Previously sunset via Engineering Directive E-16-004)

MassDOT personnel may continue to deploy existing NCHRP 350 devices for maintenance and emergency applications until the sunset dates listed above but shall only purchase new devices that conform to MASH 2016.

Availability

It is acknowledged that there may be gaps in designs and/or hardware types that are MASH compliant and readily available. It is the responsibility of the Designer to minimize or avoid, if possible, the inclusion of design elements that are not MASH compliant. Roadside hardware that is proposed and not MASH compliant shall be documented by the Designer and submitted to the

Project Manager for the project file and concurrence from the Chief Engineer that it is acceptable for use at the proposed locations.

It is the also responsibility of the Designer to identify proprietary product designs, such as flared guardrail end treatments, that may have fewer than 3 MASH compliant manufacturers and would thus be considered by Massachusetts General Laws to be a proprietary specification. In these cases, the Designer shall follow MassDOT's Standard Operating Procedures for the specification of proprietary products, justifying the request by the lack of MASH compliant products.