

Summary of Differences between MASH and NCHRP 350

The AASHTO *Manual for Assessing Safety Hardware* (MASH) presents uniform guidelines for crash testing permanent and temporary highway safety features and recommends evaluation criteria to assess test results. This manual is recommended for highway design engineers, bridge engineers, safety engineers, maintenance engineers, researchers, hardware developers, and others concerned with safety features used in the highway environment.

MASH is an update to and supersedes NCHRP Report 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features*, for the purposes of evaluating new safety hardware devices. MASH does not supersede any guidelines for the design of roadside safety hardware, which are contained within the AASHTO *Roadside Design Guide*. An implementation plan for MASH that was adopted jointly by AASHTO and FHWA states that all highway safety hardware accepted prior to the adoption of MASH – using criteria contained in NCHRP Report 350 – may remain in place and may continue to be manufactured and installed. In addition, highway safety hardware accepted using NCHRP Report 350 criteria is not required to be retested using MASH criteria. However, new highway safety hardware not previously evaluated must utilize MASH for testing and evaluation.

MASH was developed through National Cooperative Highway Research Program (NCHRP) Project 22-14(02), “Improvement of Procedures for the Safety-Performance Evaluation of Roadside Features,” and contains revised criteria for impact performance evaluation of virtually all highway safety features, based primarily on changes in the vehicle fleet. Major differences between MASH and NCHRP Report 350 include:

Changes in Test Matrices

- The small car impact angle is increased from 20 to 25 degrees to match the impact angle used with light truck testing
- The impact speed for the single-unit truck test is increased from 80 km/h to 90 km/h to better distinguish the TL-4 test from TL-3
- The impact angle for length-of-need testing of terminals and crash cushions is increased from 20 to 25 degrees to match that for longitudinal barriers
- The impact angle for oblique end impacts for gating terminals and crash cushions is reduced from 15 to 5 degrees
- Length-of-need tests with the pickup truck are required to meet occupant risk criteria
- A head-on test with the mid-size car is added for staged impact attenuation systems
- The barrier mounting height is recommended to be set at the maximum for small car tests and at the minimum for pickup truck tests
- The critical impact point for the small car terminal test is defined as the point where the terminal behavior changes from redirection to gating
- The critical impact point for reverse direction impacts requires testing at the transition from backup structure to crash cushion
- Two previously optional TMA tests are now mandatory
- Variable message signs and arrow board trailers are added to the TMA crash test matrix
- A pickup truck test is added to tests of support structures and work zone traffic control devices
- Longitudinal channelizing barricades are added as a category and a test matrix is recommended
- Event data recorded and airbag deployment data to be collected on test vehicles

Changes in Test Installations

- Performance-based specifications for soil are added to the existing material-based specifications to help ensure consistency in soil strength
- The lateral width requirement for fill material is eliminated
- Any rail element splices that are used in the field are required to be installed in the impact region during testing
- Cable tension is required to be set to the value recommended for 100 degrees Fahrenheit
- More detailed documentation of components used in the test installation is required
- Minimum installation length requirements are specified more clearly

Changes in Test Vehicles

- The size and weight of test vehicles is increased to reflect the increase in vehicle fleet size:
 - the 820C test vehicle is replaced by the 1100C
 - the 2000P test vehicle is replaced by the 2270P
 - the single unit truck mass is increased from 8000 kg to 10,000 kg
 - the light truck test vehicle must have a minimum center of gravity height of 28 inches
- The option for using passenger car test vehicles older than 6 years is removed
- Truck box attachments on test vehicles are required to meet published guidelines
- External vehicle crush must be documented using NASS procedures
- A new crushable nose to be developed for use on surrogate test vehicles
- TMA designers are required to select maximum and minimum support truck weight ratings

Changes in Evaluation Criteria

- Windshield damage evaluation uses quantitative, instead of qualitative, criteria
- Windshield damage criteria is applied to permanent support structures in addition to work zone traffic control devices
- The occupant compartment damage evaluation uses quantitative, instead of qualitative, criteria
- All evaluation criteria will be pass/fail, eliminating the “marginal pass”
- All longitudinal barrier tests are required to meet flail space criteria
- Maximum roll and pitch angles are set at 75 degrees
- The subjective criteria for evaluating exit conditions are eliminated; reporting the exit box evaluation criterion is required
- Documentation on vehicle rebound in crash cushion tests is required

Changes in Test Documentation

- CAD drawings of the test device and test installation are required
- Additional documentation of the test and evaluation results is required

Changes in Performance Evaluation

- Language emphasizing the importance of in-service evaluation is added

AASHTO/FHWA Joint Implementation Plan for the AASHTO Manual for Assessing Safety Hardware, 2009

Background

NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features contains the existing guidelines for evaluating the safety performance of highway features, such as longitudinal barriers, terminals, crash cushions, work zone elements, and breakaway structures. This document was published in 1993 and was formally adopted as the national standard by the Federal Highway Administration (FHWA) later that year with an implementation date of late 1998.

The American Association of State Highway and Transportation Officials (AASHTO) created a Task Force on NCHRP 350 Implementation and in July 1998 AASHTO and FHWA agreed that most types of safety features installed along the National Highway System must meet the safety-performance evaluation criteria contained in *NCHRP Report 350*. One outcome of these task force efforts was the recommendation that AASHTO play a stronger role in the future development, approval, and maintenance of the evaluation procedures. The process of accepting hardware under *NCHRP Report 350* on the National Highway System has been undertaken by FHWA. AASHTO, through its Technical Committee on Roadside Safety, has undertaken the role of establishing and updating the evaluation criteria.

The AASHTO *Manual for Assessing Safety Hardware, 2009 (MASH)* has been developed under NCHRP Project 22-14(02), "Improvement of Procedures for the Safety-Performance Evaluation of Roadside Features." *MASH* contains revised criteria for safety-performance evaluation of virtually all highway safety features, based primarily on changes in the vehicle fleet, and will replace *NCHRP Report 350* for the evaluation of new devices.

Requirements in Section 1408 of SAFETEA-LU state that "The Secretary, in cooperation with the Association [i.e., AASHTO], shall publish updated guidance regarding the conditions under which States, when choosing to improve or replace highway features on the National Highway System, should improve or replace such features..."

Implementation Plan

Implementation of the *MASH* on the National Highway System will be as follows:

- The AASHTO Technical Committee on Roadside Safety is responsible for developing and maintaining the evaluation criteria as adopted by AASHTO. FHWA shall continue its role in the review and acceptance of highway safety hardware.
- All highway safety hardware accepted prior to adoption of *MASH* using criteria contained in *NCHRP Report 350* may remain in place and may continue to be manufactured and installed.
- Highway safety hardware accepted using *NCHRP Report 350* criteria is not required to be retested using *MASH* criteria.
- If highway safety hardware that has been accepted by FHWA using criteria contained in *NCHRP Report 350* fails testing using *MASH* criteria, AASHTO and FHWA will jointly review the test results and determine a course of action.

- Upon adoption of *MASH* by AASHTO, any new highway safety hardware not previously evaluated shall utilize *MASH* for evaluation and testing.
- Any new or revised highway safety hardware under development at the time the *MASH* is adopted may continue to be tested using the criteria in *NCHRP Report 350*. However, FHWA will not issue acceptance letters for new or revised highway safety hardware tested using *NCHRP Report 350* criteria after January 1, 2011.
- Highway safety hardware installed on new construction and reconstruction projects shall be those accepted under *NCHRP Report 350* or *MASH*.
- Agencies are encouraged to upgrade existing highway safety hardware that has not been accepted under *NCHRP Report 350* or *MASH*:
 - during reconstruction projects,
 - during 3R projects, or
 - when the system is damaged beyond repair.
- Highway safety hardware not accepted under *NCHRP Report 350* or *MASH* with no suitable alternatives available may remain in place and may continue to be installed.

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