



U.S. Department
of Transportation
**Federal Highway
Administration**

1200 New Jersey Ave., SE
Washington, D.C. 20590

December 19, 2017

In Reply Refer To:
HSST-1/B-290

Mrs. Karla Lechtenberg
Midwest Roadside Safety Facility
130 Whittier Research Center
2200 Vine Street
Lincoln, NE 68583-0853

Dear Mrs. Lechtenberg,

This letter is in response to your September 1, 2017 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number B-290 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following devices are eligible, with details provided in the form which is attached as an integral part of this letter:

- Midwest Guardrail System (MGS) to PCB Transition

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the AASHTO's MASH. Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: Midwest Guardrail System (MGS) to PCB Transition

Type of system: Longitudinal Barrier

Test Level: MASH Test Level 3 (TL3)

Testing conducted by: Midwest Roadside Safety Facility

Date of request: September 1, 2017

Date initially acknowledged: September 8, 2017

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within the attached form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of AASHTO's MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number B-290 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.
- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely,



Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	August 31, 2017	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Karla Lechtenberg	
	Company:	Midwest Roadside Safety Facility	
	Address:	130 Whittier Research Center, 2200 Vine Street, Lincoln, NE 68583-0853	
	Country:	USA	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device & Testing Criterion - Enter from right to left starting with Test Level

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'B': Rigid/Semi-Rigid Barriers (Roadside, Median, Bridge Railings)	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	Midwest Guardrail System (MGS) to PCB Transition	AASHTO MASH	TL3

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	Bob Bielenberg	Same as Submitter <input type="checkbox"/>
Company Name:	Midwest Roadside Safety Facility	Same as Submitter <input checked="" type="checkbox"/>
Address:	130 Whittier Research Center, 2200 Vine Street, Lincoln, NE 68583-0853	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	Same as Submitter <input checked="" type="checkbox"/>

Enter below all disclosures of financial interests as required by the FHWA 'Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

The Midwest Roadside Safety Facility (MwRSF) and its employees are requesting a letter of eligibility on behalf of the Nebraska Department of Transportation, Smart Work Zone Deployment Initiative, and Iowa Department of Transportation.

MwRSF's financial interests are as follows:

- (i) No compensation, including wages, salaries, commissions, professional fees, or fees for business referrals;
- (ii) Consulting relationships consist of answering design and implementation questions;
- (iii) Research funding or other forms of research support include continuing to fund research projects with MwRSF;
- (iv) No patents, copyrights, or other intellectual property interests for this system;
- (v) No licenses or contractual relationships for this system; and
- (vi) No business ownership and investment interests for this system.

PRODUCT DESCRIPTION

- New Hardware or Significant Modification
 Modification to Existing Hardware

The Midwest Guardrail System (MGS) to PCB Transition (STG05) consists of nested MGS, a stiffness transition, and F-shaped PCB (SWC09) at a 15H:1V flare. The nested MGS consists of two standard 12-gauge W-beam sections (RWM04a) installed with the top of the rail set at a nominal height of 31 inches. The rail is mounted on standard W6x8.5 ASTM A992 steel posts that are 72 in. long (PWE06). The posts are set at 75-in. centers and are embedded 40 in. in the ground. A 6-in. x 12-in. x 14½-in. wood blockout (PDB10a-b) is used to block the rail away from the front face of each post. The rails splices are located at mid-spans between adjacent posts. Standard guardrail bolts or ASTM A307 5/8-in. diameter x 14-in. long guardrail bolts and nuts (FBB06) are used to attach the rail to the posts.

The overlapped portion of the transition from MGS to PCB includes four blockouts between the guardrail and PCB of various sizes depending on the distance between the guardrail and PCB (PDB25a-d). The blockouts were mounted on blockout mounting plates which were secured to the PCB with two ¾-in. diameter x 6-in. long Power Wedge Bolts (FBX02). The nested MGS was connected and transitioned to the PCB at an angle of 3.8 degrees by a steel connector plate and W-beam terminal connector (REW02b). The W-beam terminal connector plate is connected to the front side of PCB no. 4 with four 1-in. diameter ASTM A325 Grade A bolts (FBX27b) through 1½-in. diameter holes, which are measured and drilled in the field. The downstream end of the connector plate is angled 8.0 degrees to be flush against the PCB. The W-beam terminal connector is attached to the front side of the connector plate with five 7/8-in. diameter x 2-in. long ASTM A325 bolts secured by ASTM A563 nuts (FBX22b) welded to the interior of the mounting bracket.

A minimum length of 137.5 ft of nested MGS and eleven PCB segments (SWC09) placed at a 1V:15H flare is recommended. A minimum of eight PCB segments (SWC09) should be placed downstream from the point where the W-beam guardrail attaches to the PCB. A minimum of three PCB segments (SWC09) are required to extend behind the nested MGS at the 1V:15H flare, which corresponds to attachment of the end of the guardrail on upstream end of the fourth PCB segment transition. Additional length of PCB segments flared behind the nested MGS is acceptable. The connector plate bolts (FBX27b) that extend through the PCB must be mounted a minimum of 12¼ in. from the upstream edge of the PCB segment (SWC09). A minimum of five 150 in. long, nested W-beam sections (RWM04a) must be used upstream from the W-beam terminal connector (RWE02b). Conversion from the 1V:15H flared PCB to tangent-to-roadway PCB should not begin until a minimum of two PCB segments (SWC09) downstream from the W-beam terminal connector (RWE02b). The PCB segments (SWC09) in the transition that are not installed on a paved surface should be installed on a 6" [152] deep bed of crushed limestone. The compacted crushed limestone bed should extend 12" [305] in front of the PCB segments (SWC09), underneath the PCB segments (SWC09), and a minimum lateral width of 48" [1219] behind the PCB segments (SWC09).

For further information on implementation guidance, including minimum installation parameters, allowable tolerances on blockout geometry and placement, grading and surfacing requirements, repair recommendations, and integration with other barrier systems, see chapter 12 of MwRSF report no. TRP-03-335-17.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Bob Bielenberg	
Engineer Signature:	Robert Bielenberg	Digitally signed by Robert Bielenberg DN: cn=Robert Bielenberg, o=Midwest Roadside Safety Facility, ou, email=rbielenberg2@unl.edu, c=US Date: 2017.09.01 06:49:04 -05'00'
Address:	130 Whittier Research Center, 2200 Vine Street, Lincoln, NE 68583-0853	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	Same as Submitter <input checked="" type="checkbox"/>

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-10 (1100C)	Test no. 3-10 is not applicable for this type of system.	Non-Relevant Test, not conducted
3-11 (2270P)	Test no. 3-11 is not applicable for this type of system.	Non-Relevant Test, not conducted
3-20 (1100C)	<p>The results of test no. MGSPCB-2, conducted on July 30, 2015 are found in MwRSF report no. TRP-03-335-17. A 2,436-lb small car with a simulated occupant seated in the right-front seat, impacted the MGS to PCB transition at a speed of 65.1 mph and at an angle of 24.0 degrees. At 0.232 sec after impact, the vehicle became parallel to the system with a speed of 43.6 mph. At 0.437 sec, the vehicle exited the barrier at a speed of 41.2 mph and at an angle of 13.6 degrees. The vehicle was smoothly redirected. Exterior vehicle damage was moderate and the interior occupant compartment deformations were moderate, with a maximum of 2.83 in., consequently not violating the limits established in MASH. Damage to the barrier was moderate, consisting of rail deformation, contact marks on the front face of the concrete segments, and spalling of the concrete. The maximum lateral dynamic dynamic rail, post, and PCB deflections were 26.3 in., 3.1 in., and 28.1 in., respectively. The working width of the system was 61.4 inches. All occupant risk measures were well below recommended values. The test vehicle showed no tendency for rollover and did not penetrate or ride over the barrier.</p>	PASS

3-21 (2270P)	<p>The results of test no. MGSPCB-1, conducted on July 20, 2015 are found in MwRSF report no. TRP-03-335-17. A 4,914 lb pickup truck with a simulated occupant seated in the right-front seat, impacted the MGS to PCB transition at a speed of 63.2 mph and at an angle of 25.3 degrees. At 0.520 sec, the vehicle exited the barrier at a speed of 38.6 mph and at an angle of 21.0 degrees. The vehicle was smoothly redirected. Exterior vehicle damage was moderate and maximum interior occupant compartment deformations were 0.87 in., consequently not violating the limits established in MASH. Damage to the barrier was moderate, consisting of rail deformation, bending of the steel posts, contact marks on the front face of the concrete segments, and spalling of the concrete. The maximum lateral dynamic dynamic rail, post, and PCB deflections were 36.1 in., 27.7 in., and 6.7 in., respectively. The working width of the system was 58.7 inches. All occupant risk measures were well below recommended values. The test vehicle showed no tendency for rollover and did not penetrate or ride over the barrier.</p> <p>In addition, a reverse-direction impact of test designation no. 3-21 with the 2270P vehicle was required to evaluate the transition for installations that require two-way traffic adjacent to the barrier. The results of this test, test no. MGSPCB-3, conducted on August 25, 2015 are found in MwRSF report no. TRP-03-335-17. A 5,012 lb pickup truck with a simulated occupant seated in the right-front seat, impacted the MGS to PCB transition at a speed of 63.1 mph and at an angle of 24.6 degrees. At 0.606 sec, the vehicle exited the barrier at a speed of 43.2 mph and at an angle of 11.3 degrees. The vehicle was smoothly redirected. Exterior vehicle damage was moderate and maximum interior occupant compartment deformations were 0.53 in., consequently not violating the limits established in MASH. Damage to the barrier was moderate, consisting of cracking of the concrete, contact marks on the front and top face of the concrete segments, and spalling of the concrete. The maximum lateral dynamic dynamic rail, post, and PCB deflections were 30.6 in., 0.4 in., and 37.2 in., respectively. The working width of the system was 58.7 inches. All occupant risk measures were below recommended values. The test vehicle showed no tendency for rollover and did not penetrate or ride over the barrier.</p>	PASS
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Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Midwest Roadside Safety Facility	
Laboratory Signature:	Karla Lechtenberg	<small>Digitally signed by Karla Lechtenberg DN: cn=Karla Lechtenberg, o=Midwest Roadside Safety Facility (MwRSF), ou, email=kpolivka2@unl.edu, c=US Date: 2017.09.01 09:17:07 -05'00'</small>
Address:	130 Whittier Research Center, 2200 Vine Street, Lincoln, NE 68583-0853	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	Same as Submitter <input checked="" type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	A2LA Certificate Number: 2937.01, Valid to November 30, 2017	

Submitter Signature*: **Karla Lechtenberg**

Digitally signed by Karla Lechtenberg
DN: cn=Karla Lechtenberg, o=Midwest
Roadside Safety Facility (MwRSF), ou,
email=kpolivka2@unl.edu, c=US
Date: 2017.09.01 09:17:38 -05'00'

Submit Form

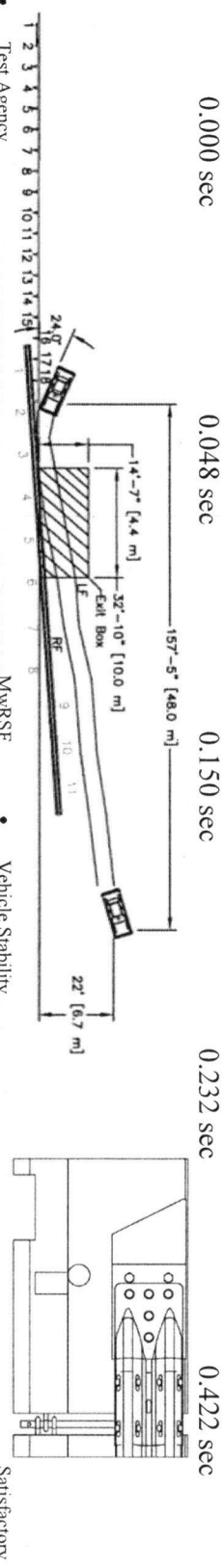
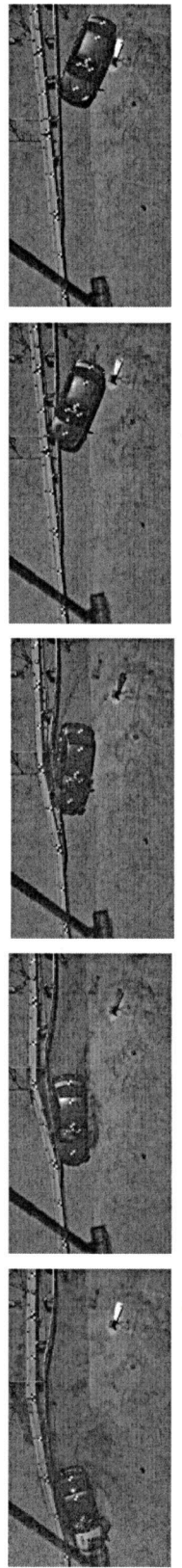
ATTACHMENTS

Attach to this form:

- 1) Additional disclosures of related financial interest as indicated above.
- 2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
- 3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words

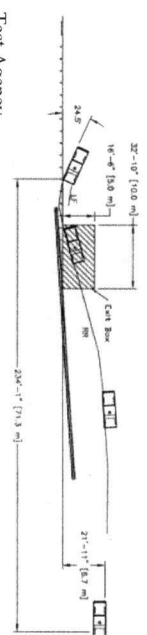


- Test Agency MWRRSF
- Test Number MGSPCB-2
- Date 7/30/2015
- MASH Test Designation 3-20
- Test Article MGS to PCB Transition
- Total Length 240.1 ft (73.2 m)
- Key Component – W-beam Guardrail
 - Thickness 12 ga. (2.66 mm)
 - Mounting Height 31 in. (787 mm)
- Key Component – ASTM 992 Steel Post
 - Length 72 in. (1,829 mm)
 - Embedment Depth 40 in. (1,016 mm)
 - Spacing 75 in. (1,905 mm)
- Key Component – 5,000 psi PCB
 - Length 150 in. (3,810 mm)
 - Width 22½ in. (572 mm)
 - Height 32 in. (813 mm)
 - Soil Type Coarse Crushed Limestone
- Vehicle Make /Model 2008 Kia Rio
- Curb 2,434 lb (1,104 kg)
- Test Inertial 2,436 lb (1,105 kg)
- Gross Static 2,601 lb (1,180 kg)
- Impact Conditions
 - Speed 65.1 mph (104.8 km/h)
 - Angle 24.0 deg
- Impact Location
 - 99% in. (2,527 mm) U.S. from centerline of 2nd splice U.S. from end shoe
 - Impact Severity (IS) 57.2 kip-ft (77.6 kJ) > 51 kip-ft (69.7 kJ) limit from MASH
- Exit Conditions
 - Speed 41.2 mph (66.3 km/h)
 - Angle 13.6 deg
 - Exit Box Criterion Pass

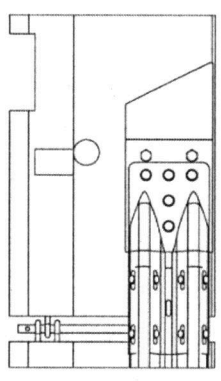
- Vehicle Stability Satisfactory
- Vehicle Stopping Distance 157 ft – 5 in. (48.0 m) downstream
- Lateral 22 ft (6.7 m) in front
- Vehicle Damage Moderate
- VDS [16] 01-RFQ-6
- CDC [17] 01-FRAW-6
- Maximum Interior Deformation 2.83 in. (72 mm)
- Test Article Damage Moderate
- Maximum Test Article Deflections
 - Permanent Set 25¼ in. (657 mm)
 - Dynamic 28.1 in. (714 mm)
 - Working Width 61.4 in. (1,560 mm)
- Transducer Data

Evaluation Criteria	Transducer		MASH Limit	
	SLICE-1 (primary)	SLICE-2		
OIV ft/s (m/s)	Longitudinal	-23.82 (-7.26)	-22.86 (-6.97)	±40 (12.2)
	Lateral	-22.38 (-6.82)	-22.03 (-6.71)	±40 (12.2)
ORA g's	Longitudinal	-6.14	-5.79	±20.49
	Lateral	-6.85	-7.20	±20.49
MAX ANGULAR DISP. deg	Roll	-9.62	-10.49	±75
	Pitch	-5.92	-6.46	±75
	Yaw	-43.56	-43.68	Not required
THIV – ft/s (m/s)	PHD – g's	29.54 (9.00)	29.38 (8.95)	Not required
	ASI	1.72	1.71	Not required

Figure 78. Summary of Test Results and Sequential Photographs, Test No. MGSPCB-2



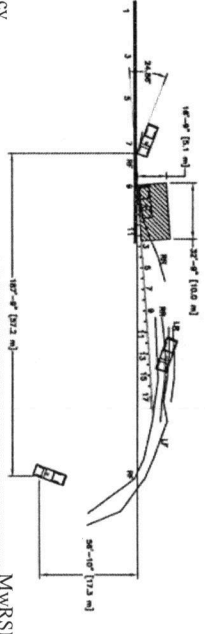
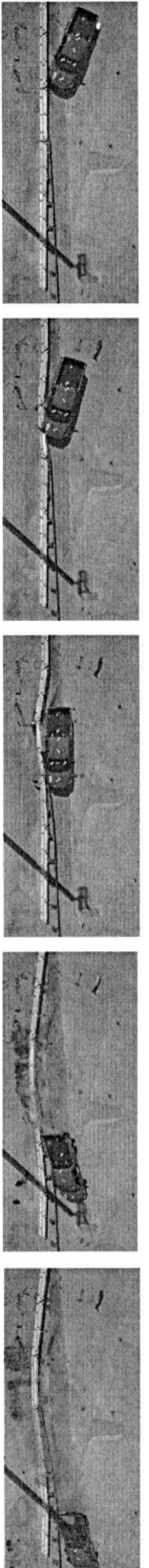
- Test Agency: MWRSF
- Test Number: MGSPCB-1
- Date: 7/20/2015
- MASH Test Designation: 3-21
- Test Article: MGS to PCB Transition
- Total Length: 240.1 ft (73.2 m)
- Key Component – W-beam Guardrail: 12 ga. (2.66 mm)
- Thickness: 31 in. (787 mm)
- Mounting Height: 72 in. (1,829 mm)
- Key Component – ASTM 992 Steel Post: 40 in. (1,016 mm)
- Length: 75 in. (1,905 mm)
- Embedment Depth: 150 in. (3,810 mm)
- Spacing: 22½ in. (572 mm)
- Key Component – 5,000 psi PCB: 32 in. (813 mm)
- Length: 2008 Dodge Ram 1500
- Width: 4,977 lb (2,258 kg)
- Height: 4,914 lb (2,229 kg)
- Soil Type: Coarse Crushed Limestone
- Vehicle Make / Model: 2008 Dodge Ram 1500
- Curb: 4,977 lb (2,258 kg)
- Test Inertial: 4,914 lb (2,229 kg)
- Gross Static: 5,079 lb (2,304 kg)
- Impact Conditions: 63.2 mph (101.8 km/h)
- Speed: 25.3 deg
- Angle: 2½ in. (64 mm) downstream from post no. 14
- Impact Location: 119.6 kip-ft (162.2 kJ) > 106 kip-ft (144 kJ) limit from MASH
- Impact Severity (IS): 38.6 mph (62.1 km/h)
- Exit Conditions: 21.0 deg
- Speed: Pass
- Angle: Satisfactory
- Exit Box Criterion: Satisfactory
- Vehicle Stability: Satisfactory



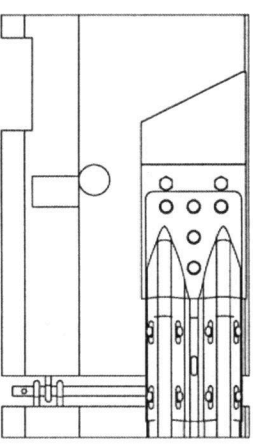
- Vehicle Stopping Distance: 234 ft – 1 in (71.3 m) downstream
- Lateral: 21 ft – 11 in (6.7 m) in front
- Vehicle Damage: Moderate
- VDS [16]: 01-RTQ-4
- CDC [17]: 01-RDEW-4
- Maximum Interior Deformation: 0.87 in. (22 mm)
- Test Article Damage: Moderate
- Maximum Test Article Deflections: 26¼ in. (679 mm)
- Permanent Set: 36.1 in. (917 mm)
- Dynamic: 58.7 in. (1,491 mm)
- Working Width: 58.7 in. (1,491 mm)
- Transducer Data

Evaluation Criteria	Transducer		MASH Limit	
	SLICE-1	SLICE-2 (primary)		
OIV ft/s (m/s)	Longitudinal	-12.63 (-3.85)	-12.80 (-3.90)	±40 (12.2)
	Lateral	-16.60 (-5.06)	-15.72 (-4.79)	±40 (12.2)
ORA g's	Longitudinal	19.77	20.34	±20.49
	Lateral	-11.03	-12.47	±20.49
MAX ANGULAR DISP. deg	Roll	14.35	10.20	±75
	Pitch	-5.13	-6.15	±75
	Yaw	-39.86	-40.19	not required
THIV – ft/s (m/s)		19.62 (5.98)	20.05 (6.11)	not required
PHD – g's		20.60	20.64	not required
ASI		0.82	0.85	not required

Figure 59. Summary of Test Results and Sequential Photographs, Test No. MGSPCB-1



- Test Agency MWRSF
- Test Number MGSPCB-3
- Date 8/25/2015
- MASH Test Designation 3-21
- Test Article MGS to PCB Transition
- Total Length 240.0 ft (73.2 m)
- Key Component – W-beam Guardrail
Thickness 12 ga (2.66 mm)
Mounting Height 31 in (787 mm)
- Key Component – ASTM 992 Steel Post
Length 72 in (1,829 mm)
Embedment Depth 40 in (1,016 mm)
Spacing 75 in (1,905 mm)
- Key Component – 5,000 psi PCB
Length 150 in (3,810 mm)
Width 22½ in (572 mm)
Height 32 in (813 mm)
- Soil Type Coarse Crushed Limestone
- Vehicle Make /Model 2008 Dodge Ram 1500
- Curb 5,017 lb (2,276 kg)
- Test Inertial 5,012 lb (2,273 kg)
- Gross Static 5,177 lb (2,348 kg)
- Impact Conditions
Speed 63.1 mph (101.5 km/h)
- Angle 24.6 deg
- Impact Location: approximately 12 ft – 9 in (3.9 m) US from centerline of end shoe
- Impact Severity (IS) 115.6 kip-ft (156.7 kJ) > 106 kip-ft (144 kJ) limit from MASH
- Exit Conditions
Speed 43.2 mph (69.5 km/h)
Angle 11.3 deg
- Exit Box Criterion Pass
- Vehicle Stability Satisfactory
- Vehicle Stopping Distance 187 ft – 9 in (57.2 m) downstream
56 ft – 10 in (17.3 m) behind



- Vehicle Damage Moderate
- VDS [16] 01-RFQ-5
- CDC [17] 01-RYEW-3
- Maximum Interior Deformation 0.532 in (13 mm)
- Test Article Damage Moderate
- Maximum Test Article Deflections
Permanent Set 34½ in (873 mm)
Dynamic 37.2 in (945 mm)
Working Width 58.7 in (1,491 mm)
- Transducer Data

Evaluation Criteria	Transducer		MASH Limit
	SLICE-1	SLICE-2 (primary)	
OIV ft/s (m/s)	Longitudinal	-11.26 (-3.43)	±40 (12.2)
	Lateral	-19.27 (-5.87)	±40 (12.2)
ORA g's	Longitudinal	-14.02	±20.49
	Lateral	-13.35	±20.49
	Roll	33.23	±75
MAX ANGULAR DISP. deg	Pitch	-10.60	±75
	Yaw	-42.23	not required
	THIV – ft/s (m/s)	22.84 (6.96)	not required
PHD – g's ASI	PHD	14.29	not required
	ASI	1.01	not required

Figure 96. Summary of Test Results and Sequential Photographs, Test No. MGSPCB-3