March 31, 2020

Ms. Shelby G. Carlson
Wyoming Department of Transportation
5300 Bishop Blvd.
Cheyenne, WY 82009
United States

Dear Ms. Carlson:

This letter is in response to your November 18, 2019 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-334 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

- Box Beam Guardrail

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: Box Beam Guardrail  
Type of system: Longitudinal Barrier  
Test Level: MASH Test Level 3 (TL3)  
Testing conducted by: Texas A&M Transportation Institute  
Date of request: November 18, 2019

FHWA concurs with the recommendation of the accredited crash testing laboratory on 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-334 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.

- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

Sincerely,

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

Enclosures
**Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware**

<table>
<thead>
<tr>
<th>Date of Request:</th>
<th>November 18, 2019</th>
<th>New</th>
<th>Resubmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td>Roger Bligh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company:</td>
<td>Texas A&amp;M Transport Institute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address:</td>
<td>3135 TAMU, College Station, TX 77843-3135</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country:</td>
<td>U.S.A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To:</td>
<td>Michael S. Griffith, Director FHWA, Office of Safety Technologies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>System Type</th>
<th>Submission Type</th>
<th>Device Name / Variant</th>
<th>Testing Criterion</th>
<th>Test Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>'B': Rigid/Semi-Rigid Barriers</td>
<td>Physical Crash Testing, Engineering Analysis</td>
<td>Box Beam Guardian</td>
<td>AASHTO MASH</td>
<td>TL3</td>
</tr>
</tbody>
</table>

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:**

<table>
<thead>
<tr>
<th>Contact Name:</th>
<th>Shelby G. Carlson, P.E., Chief Engineer</th>
<th>Same as Submitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Name:</td>
<td>Wyoming Department of Transportation</td>
<td>Same as Submitter</td>
</tr>
<tr>
<td>Address:</td>
<td>5300 Bishop Blvd., Cheyenne, WY 82009</td>
<td>Same as Submitter</td>
</tr>
<tr>
<td>Country:</td>
<td>U.S.A.</td>
<td>Same as Submitter</td>
</tr>
</tbody>
</table>

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

Texas A&M Transportation Institute (TTI) was contracted by Wyoming Department of Transportation to perform full-scale crash testing of the Box Beam Guardian. There are no shared financial interests in the Box Beam Guardian by TTI, or between Wyoming Department of Transportation and TTI, other than costs involved in the actual crash tests and reports for this submission to FHWA.
PRODUCT DESCRIPTION

The Box Beam guardrail system, also known as the G3 guardrail system, consists of an HSS6 x 6 x 3/16 inch steel rail supported by S3 x 5.7 steel posts embedded 3 ft and spaced at 72 inches. The posts have 8 x 24 x 1/4 inch soil plates attached. The box beam rail rests on a 5 x 3 1/2 x 3/8 inch steel angle such that the top of the beam is nominally 28 inches above grade. A 3/8-inch diameter x 7 1/2-inch long A307 through bolt attaches the box beam rail to the angle, and a 1/2-inch diameter x 1 1/2-inch long A307 bolt attaches the angle to the post. The rail splices consist of two interior 5 3/8 x 27 x 5/8 inch steel steel plates (one on the top and one on the bottom of the beam), each having four 3/4-inch diameter x 2-inch long A325 bolts.

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: Roger P. Bligh, Ph.D., P.E.
Engineer Signature: Digitally signed by Roger Bligh
Date: 2019.11.15 09:27:20-06'00'
Address: TTI; 3135 TAMU, College Station, TX 77843-3135
Country: U.S.A.

A brief description of each crash test and its results:

<table>
<thead>
<tr>
<th>Required Test Number</th>
<th>Narrative Description</th>
<th>Evaluation Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-10 (1100C)</td>
<td>Test 3-10 was sponsored by Wyoming DOT to complete the MASH test matrix on the Box Beam guardrail. The results of test 610031-01-1 conducted on January 11, 2019 are found in TTI Test Report No. 610031-01-1 (Wyoming DOT Report No. WY-1903F). The Box Beam guardrail successfully contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic lateral deflection of the rail during the test was 28.8 inches. The vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 11° and 6°, respectively. Occupant risk indices (occupant impact velocity and ridedown accelerations) were within the preferred values of MASH. No deformation or intrusion of the vehicle occupant compartment was observed.</td>
<td>PASS</td>
</tr>
<tr>
<td>Required Test Number</td>
<td>Narrative Description</td>
<td>Evaluation Results</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>3-11 (2270P)</td>
<td>Test 3-11 was sponsored by NCHRP under Project 22-14(03), which evaluated the impact performance of common roadside safety systems following MASH criteria. The results of test 476460-1-6 conducted on May 15, 2009 are found in NCHRP Web-Only Document 157: Volume I: Evaluation of Existing Roadside Safety Hardware Using Updated Criteria and TTI Test Report No. 476460-1-6 Appendix I: MASH TL-3 Testing and Evaluation of the G3 Weak Post Box-Beam Guardrail. The Box Beam guardrail successfully contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection of the rail during the test was 4.8 ft. The vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 14° and 8°, respectively. Occupant risk indices (occupant impact velocity and ridedown accelerations) were within the preferred values of MASH. Maximum occupant compartment deformation was 0.75 inches in the lateral area across the cab at the driver’s side kickpanel.</td>
<td>PASS</td>
</tr>
<tr>
<td>3-20 (1100C)</td>
<td>MASH2016 Test Designation 3-20 evaluates transitions. The Box Beam guardrail is not a transition and, therefore, Test 3-20 is not relevant.</td>
<td>Non-Relevant Test, not conducted</td>
</tr>
<tr>
<td>3-21 (2270P)</td>
<td>MASH2016 Test Designation 3-21 evaluates transitions. The Box Beam guardrail is not a transition and, therefore, Test 3-21 is not relevant.</td>
<td>Non-Relevant Test, not conducted</td>
</tr>
</tbody>
</table>

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.):

<table>
<thead>
<tr>
<th>Laboratory Name:</th>
<th>Texas A&amp;M Transportation Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Signature:</td>
<td>Digitally signed by Darrell L. Kuhn</td>
</tr>
<tr>
<td>Date:</td>
<td>2019.11.14 14:27:08-06'00</td>
</tr>
<tr>
<td>Address:</td>
<td>TTI; 3135 TAMU, College Station, TX 77843-3135</td>
</tr>
<tr>
<td>Country:</td>
<td>U.S.A.</td>
</tr>
<tr>
<td>Accreditation Certificate Number and Dates of current Accreditation period:</td>
<td>ISO 17025-2017 Laboratory A2LACertificate Number: 2821.01 Valid To: April 30, 2021</td>
</tr>
</tbody>
</table>
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:

<table>
<thead>
<tr>
<th>Eligibility Letter</th>
<th>Number</th>
<th>Date</th>
<th>Key Words</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Figure 5.7. Summary of Results for MASH Test 3-10 on Wyoming Box Beam Shoulder Barrier.
### General Information
- **Test Agency**: Texas Transportation Institute
- **Test No.**: RF478460-1-6
- **Date**: 2009-05-15

### Test Article
- **Type**: Longitudinal Barrier
- **Name**: G3 Weak Post Box-Beam guardrail
- **Installation Length**: 240 ft
- **Material or Key Elements**: Box-Beam rail element on S3x5.7 posts spaced 6 ft.

### Soil Type and Condition
- **Type**: Crushed Limestone, Dry

### Test Vehicle
- **Type/Designation**: 2270P
- **Make and Model**: 2007 Chevrolet Silverado Pickup
- **Mass**: 4942 lb
- **Curb**: 5011 lb
- **Test Inertia**: 5011 lb

### Impact Conditions
- **Speed**: 63.2 mi/h
- **Angle**: 25.4 degrees
- **Exit Conditions**
  - **Speed**: Not obtainable
  - **Angle**: parallel

### Occupant Risk Values
- **Impact Velocity**
  - Longitudinal: 11.2 ft/s
  - Lateral: 15.1 ft/s
- **Ridedown Accelerations**
  - Longitudinal: -5.7 G
  - Lateral: 7.2 G
  - THIV: 18.9 km/h
  - PHD: 7.2 G
- **Max. 0.050-s Average**
  - Longitudinal: -3.5 G
  - Lateral: 3.2 G
  - Vertical: 1.8 G

### Post-Impact Trajectory
- **Stopping Distance**: 51.1 ft downstream; adjacent traffic face

### Vehicle Stability
- **Maximum Yaw Angle**: 34 degrees
- **Maximum Pitch Angle**: 8 degrees
- **Maximum Roll Angle**: 14 degrees
- **Vehicle Snagging**: No
- **Vehicle Pocketing**: No

### Test Article Deflections
- **Dynamic**: 57.7 inches
- **Permanent**: 39.5 inches
- **Working Width**: 5.6 ft

### Vehicle Damage
- **VDS**: 11LFQ4
- **CDC**: 11FLEW4
- **Max. Exterior Vehicle Crush**: 14.0 inches
- **Max. Occupant Compartment Deformation**: 0.75 inches

---

**Figure 76.** Summary of results for MASH test 3-11 on the G3 Weak Post Box-Beam guardrail.
Plan View

Elevation View

Section A-A
Scale 1 : 20
Typical Posts 2 - 33

Detail B
Scale 1 : 5

Detail C
Scale 1 : 10
Typ 6 places

1a. All steel components, including hardware, shall be galvanized.
1b. Threads not shown on bolts for clarity.

Texas A&M Transportation Institute

Roadside Safety and Physical Security Division - Proving Ground

Project #610031  Wyoming Box Beam Rail  2019-02-28

Drawn by GES  Scale 1:300  Sheet 1 of 5  Test Installation
Type 1 End Anchorage

Typical each end

See Detail C, previous sheet

Type I End Anchor Rail

Ground Line

Detail E
Scale 1 : 10

Nut, 3/4 heavy hex (x 2)
Washer, 3/4 SAE Hardened (x 2)
Anchor Bolt (x 2)

Detail D
Scale 1 : 10

See Detail B, previous sheet, for connection details

2a. All steel components, including hardware, shall be galvanized.

Texas A&M Transportation Institute

Roadside Safety and Physical Security Division - Proving Ground

Project #610031 Wyoming Box Beam Rail
2019-02-28

Drawn by GES | Scale 1:40 | Sheet 2 of 5 Type 1 End Anchorage
3a. All welding must be performed by certified welders using industry standard practices.

3b. Galvanize all components after fabrication is complete.

3c. Cut 3 sides (inverted V-shape, 5/8" wide at bottom), bend, and weld.
4a. All welding must be performed by certified welders using industry standard practices.
4b. Galvanize all components after fabrication is complete.
5a. All welding must be performed by certified welders using industry standard practices.
5b. Galvanize all components after fabrication is complete.
Plan View

228'-0" (to Rail ends)
226'-10" (to Anchor Block centers)
72" Typ
186'-0"

Type I End Anchorage (see next sheet)

Elevation View

Washer, 3/8 USS flat
Bolt, 3/8 x 7 1/2" hex A307

Bolt, 3/4 x 2" hex A325 (x 8)
Washer, 3/4 SAE Hardened (x 8)

1a. All steel components, including hardware, shall be galvanized.
1b. Threads not shown on bolts for clarity.

Section A-A
Scale 1 : 20
Typical Posts 2 - 33

Detail B
Scale 1 : 5
Type 1 End Anchorage
Typical each end

Wyoming DoT Class B Concrete (3250 psi)

2a. All steel components, including hardware, shall be galvanized.
3a. All welding must be performed by certified welders using industry standard practices.
3b. Galvanize all components after fabrication is complete.
3c. Cut 3 sides (inverted V-shape, 5/8" wide at bottom), bend, and weld.

**Rail Details**

**Box Beam Rail**
- Plan View
  - Symmetric about CL
  - HSS 6" x 6" x 3/16"
  - ASTM A500 Grade B

**Type I End Anchor Rail**
- Plan View
  - Symmetric about CL
  - HSS 6" x 6" x 3/16"
  - ASTM A500 Grade B

**Detail F**
- Scale 1:10

Roadside Safety and Physical Security Division - Proving Ground

Project #610031 Wyoming Box Beam Rail

Drawn by GES | Scale 1:50 | Sheet 3 of 5 Rail Details
4a. All welding must be performed by certified welders using industry standard practices.
4b. Galvanize all components after fabrication is complete.
5a. All welding must be performed by certified welders using industry standard practices.

5b. Galvanize all components after fabrication is complete.