U.S. Department of Transportation
Federal Highway Administration

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

September 23, 2013

In Reply Refer To:
CC-115H

Mr. Don Gripne
Trinity Highway Products
5216 Brassfield Dr. SE
Olympia Washington 98501

Dear Mr. Gripne:

This letter is in response to your request for the Federal Highway Administration (FHWA) to review roadside safety systems for eligibility for reimbursement under the Federal-aid highway program.

Name of system:	Vertical Loading Terminal (VLT)/Soft Stop with 25-foot panels
Type of system:	Energy absorbing guardrail terminals
Test Level:	MASH Test Level-2 and Test Level-3
Testing conducted by:	Original testing by Texas Transportation Institute
Task Force 13 Designator:	SEW22
Date of request:	September 3, 2013

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

- TL-2 and TL-3 VLT/Soft Stop energy absorbing guardrail terminals with 25-foot w-beam panels.

Based on a review of the analysis submitted by the manufacturer certifying the device described herein meets the crash test and evaluation criteria of the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH), the device is eligible for reimbursement under the Federal-aid highway program. Eligibility for reimbursement under the Federal-aid highway program does not establish approval or endorsement by the FHWA for any particular purpose or use.

The FHWA, the Department of Transportation, and the United States Government do not endorse products or services and the issuance of a reimbursement eligibility letter is not an endorsement of any product or service.

FHWA:HSST:NArtimovich:sf:x61331:9/19/13
File: s://directory folder/hsst/nartimovich/HSST/CC115H_VLT_SS_25footPanels.docx
cc: HSST (Reader, HSA; Chron File, HSST; NArtimovich, HSST), BFouch, HSST

Requirements
To be found eligible for Federal-aid funding, roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH).

Description
The device and supporting documentation are described in the attached form. The change covered by this letter allows the use of 25-foot long w-beam guardrail panels within the limits of the VLT / Soft Stop Terminals in lieu of spliced 12-foot, 6-inch long sections. The analysis provided shows that the test vehicle would travel less than two feet further after impacting the VLT / Soft Stop heads. This distance is still within the design length of the terminals.

Summary and Standard Provisions
Therefore, the system described and detailed in the attached form is eligible for reimbursement and may be installed under the range of conditions tested.

Please note the following standard provisions that apply to FHWA eligibility letters:

- This letter provides a AASHTO/ARTBA/AGC Task Force 13 designator that should be used for the purpose of the creation of a new and/or the update of existing Task Force 13 drawing for posting on the on-line 'Guide to Standardized Highway Barrier Hardware' currently referenced in AASHTO Roadside Design Guide.
- This finding of eligibility does not cover other structural features of the systems, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may influence system conformance with MASH will require a new reimbursement eligibility letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals safety problems, or that the system is significantly different from the version that was crash tested, we reserve the right to modify or revoke this letter.
- You are expected to supply potential users with sufficient information on design and installation 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 critiera of the MASH.
- To prevent misunderstanding by others, this letter of eligibility is designated as number CC-115H and 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 at our office 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. The FHWA does not become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.
- The Trinity Highway Products VLT / Soft-Stop terminals are patented products and considered 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 yours,

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

Enclosures

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of Transportation
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- You are expected to supply potential users with sufficient information on design and installation 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 critiera of the MASH.
- To prevent misunderstanding by others, this letter of eligibility is designated as number CC-115H and 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 at our office 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. The FHWA does not become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.
- The Trinity Highway Products VLT / Soft-Stop terminals are patented products and considered 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 yours,

(for) 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:	September 3, 2013	◉ New ○ Resubmission
	Name:	Don Gripne	Signature: Don Gripne
	Company:	Trinity Highway Products, LLC	
	Address:	5216 Brassfield Dr. SE, Olympia, WA 98501	
	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.

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'CC': Crash Cushions, Attenuators, & Terminals	◉ Physical Crash Testing ○ FEA & V&V Analysis	SOFT-STOP 25 FOOT RAIL PANELS	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.

Identification of the individual or organization responsible for the product:

Contact Name:	Brian Smith	Same as Submitter ☐
Company Name:	Trinity Highway Products, LLC	Same as Submitter ☐
Address:	2525 Stemmons Freeway, Dallas, TX 75207	Same as Submitter ☐
Country:	USA	Same as Submitter ☐

PRODUCT DESCRIPTION

Modification to Existing Hardware Significant

The original crash test of the Trinity Soft Stop (TTI Crash Report 2009) as per Eligibility Letter CC-115 dated December 19, 2011 specified steel post and w-beam guardrail using 12-inch wood block out. The crash test report was conducted by Texas Transportation Institute (TTI) entitled NCHRP 350 Crash Testing and Evaluation of the Vertical Squisher' dated February 2009 (TTI Crash Report 2009). Eligibility Letter CC-115A dated September 7, 2012 was issued to include 8-inch wood block out for both line posts and post no 2 within the Trinity Soft Stop Terminal system. This modification also includes an offset 2-foot from tangent of the 12-inch and 8-inch Trinity Soft Stop Terminal system using a flare rate of 25:1. Eligibility letters CC-115D, CC-115E, and CC-115F dated May 1, 2013 were issued for the Soft-Stop TL-3, TL-2, and TL-1 Terminal.

To determine what effect the elimination of two rail splices for the MASH TL-3 Soft-Stop Terminal and one rail splice for the MASH TL-2 Soft-Stop Terminal, the crash test data was reviewed.

From the high speed video for the Dodge Pickup end-on impact, using analysis times and applying them to the acceleration data,it was seen there is a slight increase in deceleration of the truck as the splice traverses the soft stop head with 12.5' W-beam rail panels. To simulate the removal of the splice, the average acceleration from the w-beam going through the head was applied to the region of the desired splice and the data was re-integrated to determine new stopping distance and associated time.

It was determined that with one splice removed there would be an increased stopping distance of 0.72 feet and with two splices removed, there would be an increased stopping distance of 1.47 feet.. Based on these numbers, the amount of rail needed to stop the vehicle for the TL-3 system with two splices removed to be approximately 43.5' and for the TL-2 system with one splice removed to be approximately 21.8'. The length of the TL-3 system is 50'-9 1/2" and length of the TL-2 system is 25'-9 1/2".

The supporting data for this analysis is on file.

This request is to accept the as-tested article as per CC-115, CC-115A, CC-115D, CC-115E, and CC-115F for the following:

1. A MASH TL-1 and MASH TL-2 Soft Stop Terminal with a single rail length of 25'-9 1/2".
2. A MASH TL-3 Soft Stop Terminal with a rail length of 25'-9 1/2" and 25'-0".

This modification is considered Non-significant, Effect is Positive or Inconsequential.

CRASH TESTING

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-30 (1100C)	As per TTI Crash Report 2009, an 1100C (2425lb) passenger car impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 0 degree, respectively, with the quarter point of the vehicle aligned with the center line of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria. The SOFT -STOP slowed and redirected the 1100C vehicle. No occupant compartment deformation occurred. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 25 degrees, and maximum pitch was 7 degrees. Occupant risk factors were within the limits specified for MASH test 3-30. The vehicle subsequently came to rest 27 feet downstream of impact and 34 feet toward traffic lanes. The SOFT-STOP performed acceptably according to the evaluation criteria of MASH test 3-30.Does not apply to non-gating/ energy absorbing devices.	WAIVER REQUESTED

The original crash test of the Trinity Soft Stop (TTI Crash Report 2009) as per Eligibility Letter CC-115 dated December 19, 2011 specified steel post and w-beam guardrail using 12-inch wood block out. The crash test report was conducted by Texas Transportation Institute (TTI) entitled NCHRP 350 Crash Testing and Evaluation of the Vertical Squisher' dated February 2009 (TTI Crash Report 2009). Eligibility Letter CC-115A dated September 7, 2012 was issued to include 8-inch wood block out for both line posts and post no 2 within the Trinity Soft Stop Terminal system. This modification also includes an offset 2-foot from tangent of the 12-inch and 8-inch Trinity Soft Stop Terminal system using a flare rate of 25:1. Eligibility letters CC-115D, CC-115E, and CC-115F dated May 1, 2013 were issued for the Soft-Stop TL-3, TL-2, and TL-1 Terminal.

To determine what effect the elimination of two rail splices for the MASH TL-3 Soft-Stop Terminal and one rail splice for the MASH TL-2 Soft-Stop Terminal, the crash test data was reviewed.

From the high speed video for the Dodge Pickup end-on impact, using analysis times and applying them to the acceleration data,it was seen there is a slight increase in deceleration of the truck as the splice traverses the soft stop head with 12.5' W-beam rail panels. To simulate the removal of the splice, the average acceleration from the w-beam going through the head was applied to the region of the desired splice and the data was re-integrated to determine new stopping distance and associated time.

It was determined that with one splice removed there would be an increased stopping distance of 0.72 feet and with two splices removed, there would be an increased stopping distance of 1.47 feet.. Based on these numbers, the amount of rail needed to stop the vehicle for the TL-3 system with two splices removed to be approximately 43.5' and for the TL-2 system with one splice removed to be approximately 21.8'. The length of the TL-3 system is 50'-9 1/2" and length of the TL-2 system is 25'-9 1/2".

The supporting data for this analysis is on file.

This request is to accept the as-tested article as per CC-115, CC-115A, CC-115D, CC-115E, and CC-115F for the following:

1. A MASH TL-1 and MASH TL-2 Soft Stop Terminal with a single rail length of 25'-9 1/2".
2. A MASH TL-3 Soft Stop Terminal with a rail length of 25'-9 1/2" and 25'-0".

This modification is considered Non-significant, Effect is Positive or Inconsequential.

CRASH TESTING

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-30 (1100C)	As per TTI Crash Report 2009, an 1100C (24251b) passenger car impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 0 degree, respectively, with the quarter point of the vehicle aligned with the center line of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria. The SOFT -STOP slowed and redirected the 1100C vehicle. No occupant compartment deformation occurred. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 25 degrees, and maximum pitch was 7 degrees. Occupant risk factors were within the limits specified for MASH test 3-30. The vehicle subsequently came to rest 27 feet downstream of impact and 34 feet toward traffic lanes. The SOFT-STOP performed acceptably according to the evaluation criteria of MASH test 3-30.Does not apply to non-gating/ energy absorbing devices.	WAIVER REQUESTED

Required Test Number	Narrative Description	Evaluation Results
3-31 (2270P)	As per TTI Crash Report 2009, A 2270P (5000 lb) pickup truck impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 0 degree, respectively, with the center line of the vehicle aligned with the center line of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria. The SOFT-STOP brought the 2270P vehicle to a controlled stop. No occupant compartment deformation occurred. The 2270P vehicle remained upright during and after the collision event. Maximum roll was 4 degrees, and maximum pitch was -3 degrees. Occupant risk factors were within the limits specified for MASH test 3-31. The 2270P vehicle came to rest within the installation. The SOFT-STOP performed acceptably according to the evaluation criteria of MASH test 3-31.	WAIVER REQUESTED
3-32 (1100C)	As per TTI Crash Report 2009, an 1100C (24251b) passenger car impacting the terminal end-on at a nominal impact speed and angle of 62 mph and 5/15 degrees, respectively, with the center line of the vehicle aligned with the center line of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria. The SOFT -STOP slowed and stopped the 1100C vehicle. No occupant compartment deformation occurred. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 28 degrees, and maximum pitch was -26 degrees. Occupant risk factors were within the limits specified for MASH test 3-32. The vehicle subsequently came to rest with the front of the vehicle adjacent to post 4 of the terminal, with most of the vehicle toward the field side. The SOFT -STOP performed acceptably according to the evaluation criteria of MASH test 3-32.	WAIVER REQUESTED
3-33 (2270P)	As per TTI Crash Report 2009, the 2000P vehicle, traveling at an impact speed of 62.7 mi/h, impacted the nose of the Vertical Squisher end-on at an impact angle of 16.3 degrees. At 0.044 s after impact, the head of the terminal began to move along the rail, and at 0.093 s, the 2000P vehicle began to redirect toward the field side. The front right tire contacted the terminal at 0.207 s. The vehicle began to travel parallel with the guardrail at 0.285 s, at a speed of 48.2 mi/h (77.6 km/h). At 0.372 s, the 2000P vehicle overrode the terminal and lost contact with the guardrail and was traveling at an exit speed and angle of 51.7 mi/h (83.2 km/h) and 1.8 degrees, respectively. After completely exiting the installation, the 2000P vehicle partially traversed a steep mound of soil and came to rest on its right side 242 ft downstream and 30 ft toward the field side.	WAIVER REQUESTED

3-34 (1100C)	As per TTI Crash Report 2009, an 1100C (2425lb) passenger car impacting the terminal at a nominal impact speed and angle of 62 mi/h and 15 degrees, respectively, with the comer of the vehicle bumper aligned with the critical impact point (CIP) of the length of need (LON) of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria. The SOFT-STOP contained and redirected the 1100C vehicle. The vehicle did not penetrate or override the installation. Maximum dynamic deflection was 1.96 feet and the head fed through 6.2 feet of w-beam rail element. Maximum occupant compartment deformation was 1.0 inch inward in the area of the instrument panel on the left side. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 10 degrees, and maximum pitch was -4 degrees. Occupant risk factors were within the limits specified for MASH test 3-34. The vehicle subsequently came to rest 15 feet toward traffic lanes in front of post 8. The SOFT -STOP performed acceptably according to the evaluation criteria of MASH test 3-34.	WAIVER REQUESTED
3-35 (2270P)	As per TTI Crash Report 2009, a 2270P (5000 lb) pickup truck impacting the terminal at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively, with the comer of the vehicle bumper aligned with the beginning of the LON of the terminal. This test is primarily intended to evaluate structural adequacy and vehicle trajectory criteria. The SOFT-STOP contained and redirected the 2270P. The vehicle did not under ride or override the installation. Although the w-beam rail anchorage released late in the impact event, the vehicle did not penetrate the installation. While the vehicle was in contact with the w-beam, the maximum dynamic deflection was I 0.4 feet. However, the upstream anchor released and as the vehicle lost contact with the w-beam, the w-beam continued to deflect, reaching a maximum displacement of 11.6 feet. The kickpanel of the left side was deformed inward 0.4 inch. The 2270P vehicle remained upright during and after the collision event. Maximum roll was -30 degrees, and maximum pitch was -12 degrees. Occupant risk factors were within the preferred limits specified for MASH test 3-31. The 2270P vehicle exited within the exit box. The SOFT -STOP performed acceptably according to the evaluation criteria of MASH test 3-35.	WAIVER REQUESTED
3-36 (2270P)	As per TTI Crash Report 2009, a 2270P (5000 lb) pickup truck impacting the terminal at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively, with the comer of the vehicle bumper aligned with the CIP with respect to the transition to the stiff barrier or backup structure. As a w-beam guardrail terminal, the SOFT-STOP will never be attached directly to a backup structure, and the transition to a stiff barrier is basically at Post 3. Therefore, Trinity feels that Test 3-36 is irrelevant and was therefore not conducted. Eligibility Letter CC-115 indicated that MASH test 3-36 may be waived because the SOFT-STOP will not be connected to any stiffer device than	WAIVER REQUESTED

3-37 (2270P)	As per TTI Crash Report 2009, a 2270P (5000 lb) pickup truck impacting the terminal at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively, mid-point between the nose and the end of the terminal in the reverse direction. This test is intended to evaluate the performance of a terminal for a "reverse" hit. However, researchers at TTI believe that the reverse direction impact would be more critical for the 1100C (2425 lb) passenger car than for the 2270P pickup. Therefore, an 1100C (2425 lb) passenger car was used in Test 3-37. Eligibility Letter CC-115 indicated that the substitution of the 1100C vehicle to evaluate the reverse direction impact was appropriate.	WAIVER REQUESTED
3-38 (1500A)	As per TTI Crash Report 2009, a 1500A (33071b) passenger car impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 0 degree, respectively, with the center line of the vehicle aligned with the center line of the nose of the terminal. This test is primarily intended to evaluate the performance of the staged attenuator/terminal when impacted by a mid-size vehicle. The SOFT-STOP is not a staged device. Therefore Test3-38 was not conducted. However, as per Appendix G of MASH, calculations based on Test 3-31 have been performed to predict the occupant risk values for the 1500A (33071b) vehicle. The results of these calculations (shown on the enclosed document) predict that in crash testing with the 1500A (33071b) vehicle, the SOFT-STOP Terminal, would perform acceptably according to the Test Level 3 (TL-3) evaluation criteria set out in the MASH guidelines for terminals. Eligibility Letter CC-115 indicates that test 3-38 is not necessary because the SOFT-STOP is not a staged device and that manufacturers calculations predict crash worthy performance with the 1500A vehicle.	WAIVER REQUESTED
3-40 (1100C)	Does not apply to non-gating/energy absorbing devices.	
3-41 (2270P)	Does not apply to non-gating/energy absorbing devices.	
3-42 (1100C)	Does not apply to non-gating/energy absorbing devices.	
3-43 (2270P)	Does not apply to non-gating/energy absorbing devices.	
3-44 (2270P)	Does not apply to non-gating/energy absorbing devices.	
3-45 (1500A)	Does not apply to non-gating/energy absorbing devices.	

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:	Texas Transportation Institute	
Laboratory Contact:	Dean C. Alberson, Ph.D, P.E.	Same as Submitter ☐
Address:	Texas A&M Transportation Institute	Same as Submitter ☐
Country:	USA	Same as Submitter ☐
Accreditation Certificate Number and Date:	ISO 17025-2005; A2LA Certificate 2821.01	

ATTACHMENTS

Attach to this form:

1) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
2) 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 key to understanding the performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		AASHTO TF13	
Number	Date	Designator	Key Words
CC-115H	September 20, 2013	SEW22	Vertical Loading Terminal Soft Stop Terminal w-beam guardrail terminal 25-foot guardrail panels

SOFT STOP SPICE ANALYSIS	DCA	AUG 30, 2013

WITH 3 SPLICES

TIME TO STOP – 0.9311 SEC

DIST TO STOP – 41.966 FT

WITH MIDDLE SPLICE REMOVED

TIME TO STOP – 0.9415 SEC

DIST TO STOP – 42.685 FT

WITH 1ST & 3rd SLICE REMOVED

TIME TO STOP – 0.963 SEC

DIST TO STOP – 43.439 FT

CHANGE IN TIME

	% CHANGE
1 SPLICE REMOVED (MIDDLE)	
0.9415 – 0.9311 = 0.0104 SEC (10 ms)	1.1 %
2 SPLICES REMOVED (1st & 3rd)	
0.963 – 0.9311 = 0.0319 SEC (32 ms)	3.4 %

CHANGE IN DISTANCE

1 SPLICE REMOVED (MIDDLE)	
42.685 – 41.966 = 0.719 FT	1.7 %
2 SPLICES REMOVED (1st & 3rd)	
43.439 – 41.966 = 1.473 FT	3.5 %