U.S. Department
of Transportation
Federal Highway Administration

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

January 28, 2014

In Reply Refer To:
HSST/CC-120B

Mr. Gerrit A. Dyke, P.E.
Barrier Systems, Inc.
3333 Vaca Valley Parkway, Suite 800
Vacaville, CA 95688

Dear Mr. Dyke:

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

Name of system: X-Lite Tangent and X-Lite Flared Soil Plate Modification
Type of system: W-Beam Guardrail Terminal
Test Level: NCHRP 350 Test Level 3 (TL-3)
Original Testing conducted by: Safe Technologies, Inc.
Finite Element Analysis conducted by: Politecnico di Milano, Italy
Task Force 13 Designator: SEW23B Tangent; SEW24B Flared
Date of request: July 16, 2013
Date of completed package: December 17, 2013

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

- X-Lite Tangent and X-Lite Flared Soil Plate Modification

Based on a review of FEA Analysis and Verification and Validation as per FHWA Memorandum "Roadside Safety Hardware-Federal-aid Reimbursement Eligibility Process", Dated May 21, 2012 of the modified device compared to original crash test results submitted by the manufacturer certifying the device described herein meets the crashworthiness criteria of the National Cooperative Highway Research Program (NCHRP) Report 350, 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.

Requirements
Roadside safety devices should meet the guidelines contained in NCHRP Report 350 (Report 350) if tested prior to January 1, 2011, or the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH) if tested after that date. The FHWA Memorandum "Identifying Acceptable Highway Safety Features", dated July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Description
The modified device and supporting documentation are described in the attached form.

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 criteria of the MASH.
- To prevent misunderstanding by others, this letter of eligibility is designated as number CC-120B 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 X-Lite Tangent (TX) Modified, X-Lite Flared (FX) Modified 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

Enclosure

Request for Federal Aid Reimbursement Eligibility Of Highway Safety Hardware

Submitter	Date of Request:	December 17, 2013	◉ New ○ Resubmission
	Name:	Gerrit Dyke, P.E.	Signature:
	Company:	Lindsay Transportation Solutions, Inc.	
	Address:	180 River Road, Rio Vista, CA 94571	
	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.

Help

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'CC': Crash Cushions, Attenuators, & Terminals	○ Physical Crash Testing ◉ FEA & V&V Analysis	X-Lite Tangent and X-Lite Flared Soil Plate Modification	NCHRP Report 350	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 NCHRP Report 350 (Report 350) and that the evaluation results meet the appropriate evaluation criteria in the Report 350.

Identification of the individual or organization responsible for the product:

Contact Name:	Gerrit Dyke, P.E.	Same as Submitter ☒
Company Name:	Lindsay Transportation Solutions, Inc.	Same as Submitter ☒
Address:	180 River Road, Rio Vista, CA 94571	Same as Submitter ☒
Country:	USA	Same as Submitter ☒

This request is for a determination of Federal-aid reimbursement eligibility using Finite Element Analysis and Verification and Validation Analysis [NCHRP Web-Only Document 179] (WD-179) for a structural change to previously eligible hardware where the effect on the crash test performance of the hardware is uncertain.

FEA PRODUCT DESCRIPTION	
FEA PRODUCT DESCRIPTION	
Modification to Existing Hardware	○ Non-Significant - Effect is Uncertain ◉ Non-Significant - Effect is Positive or Inconsequential

FEA PRODUCT DESCRIPTION

The X-Lite Systems use a soil plate mounted to Post 2 to help distribute longitudinal loading of the post. The soil plate used during the original NCHRP Report 350 testing measured 24in x 24in x 1/4in. The soil plate was sized much larger than necessary to maintain proper performance of the X-Lite system in a variety of soil conditions including AASHTO grade. Analysis was performed to evaluate, verify, and validate the performance of an alternative smaller soil plate. The alternative soil plate measures 18in x 18in x 5/16in and has chamfered corners to assist in the installation or driving of the post. The material is equivalent for both soil plate options.

The analysis utilized FEA models of the Post 2 and soil plate configurations in AASHTO soil. The force vs. deflection characteristics were compared for the loading conditions of the post. The performance of the alternative soil plate correlates with the original soil plate indicating the modification is inconsequential. Full scale push/pull tests were performed on the Post 2 and soil plate to validate the FEA models. Reference report by Marco Anghileri of Politecnico Di Milano titled "X-Lite soil plate modification. Finite element evaluation" dated December 2013.

FEA ANALYSIS OF CRASH TESTING

A brief description of each analysis and its result:

Required Test Number	Narrative Description	FEA Analysis Results According to Report 350?	V&V Analysis Results in accordance to WD-179?
3-30 (820C)	Original X-Lite Tangent and Flared tests were performed by Safe Technologies, Inc., test numbers XTL12 (10/28/10) and XTL09 (10/20/10) respectively. FEA analysis was used to demonstrate that the load capacity and post behavior is equivalent to the original design and therefore the soil plate modification does not effect the performance of the system and is inconsequential.	WAIVER REQUESTED	YES
S3-30 (700C			
3-31 (2000P)	Original X-Lite Tangent and Flared tests were performed by Safe Technologies, Inc., test numbers XTL14 (11/3/10) and XTL10 (10/21/10) respectively. FEA analysis was used to demonstrate that the load capacity and post behavior is equivalent to the original design and therefore the soil plate modification does not effect the performance of the system and is inconsequential.	WAIVER REQUESTED	YES
3-32 (820C)			
S3-32 (700C)			
3-33 (2000P)			
3-34 (820C)			
S3-34 (700C)	NA	WAIVER REQUESTED	YES

Required Test Number	Narrative Description	FEA Analysis results according to AASHTO MASH?	V&V Analysis Results in accordance to WD-179?
3-35 (2000P)	Original X-Lite Flared test was performed by Safe Technologies, Inc., test number XTL04 (9/28/10). FEA analysis was used to demonstrate that the load capacity and post behavior is equivalent to the original design and therefore the soil plate modification does not effect the performance of the system and is inconsequential.	WAIVER REQUESTED	YES
3-36 (820C)			
S3-36 (700C)			
3-37 (2000P)			
3-38 (2000P)			
3-39 (2000P)			
3-40 (2000P)			
S3-40 (700C)			
3-41 (2000P)			
3-42 (820C)			
S3-42 (700C)			
3-43 (2000P)			
3-44 (2000P)			

The submitted Finite Element Analysis was conducted in compliance with FHWA Memorandum 'Roadside Safety Hardware -Federal-Aid Reimbursement Eligibility Process', dated May 21, 2012 including all updates to this memorandum by the following accredited laboratory (cite laboratory's accreditation status in the FEA Analysis final report):

FEA & V&V Laboratory Name:	Politecnico di Milano, Italy	
FEA & V&V Laboratory Contact:	Prof. Ing. Marco Anghileri	Same as Submitter ☐
Address:	Via La Masa 34 - 20158 Milano	Same as Submitter ☐
Country:	Italy	Same as Submitter ☐
Accreditation Certificate Number and Date:	NA	

ATTACHMENTS

Attach to this form:

Finite Element Analysis using LS-Dyna that shows the modified hardware will perform in a similar manner to the NCHRP Report 350 crash testing that was first used to evaluate roadside hardware.

2) Validation and Verification (V&V) analysis and report conforming to Appendix E as per the NCHRP W 179 [NCHRP Web-Only Document 179] shall be submitted for both the original model compared to the baseline test and the model of the non-significant change compared to the baseline test.

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 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
CC120B	January 07, 2014	SEW23 Tangent SEW24 Flared	W-Beam Terminal; soil plate mounted to Post 2

Date: 2013 12 14

Finite Element Analysis Determination of Elibibility for Reimbursement under the Federal-Aid Highway Program (FHWA Memorandum)

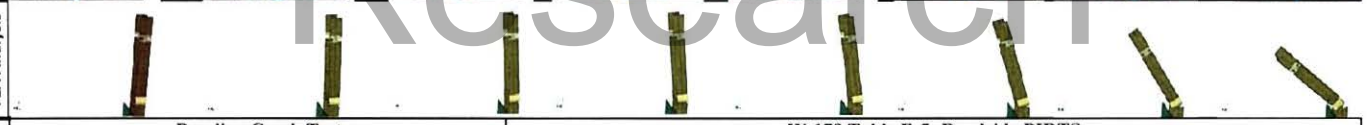
System Type: LINDSAY XLITE
Device Name:/Variant:
Testing Criterion: Static test Xlite post nr.2
Test Level:
FHWA Letter:

Comparison: Crash tested original design to FEA of original design

Submissions Type:	
	Non-Significant -- Effect is Uncertain
	Non-Significant -- Effect is Positive
	Non-Significant -- Effect is Inconsequential
X	Baseline Validation of Crash Test to FEA Analysis.

Crash Test

FEA Analysis



Baseline Crash Test	
Test Number:	
Vehicle:	
Vehicle Mass:	
Impact Speed:	
Impact Location:	
Tested Hardware:	Original Design
FEA Hardware:	Original Design

W-179 Table E-1: Verification Evaluation Summary		
Total Energy:	2%	Pass
Hourglass Energy:	3.50%	Pass
Mass Added:	1%	Pass
Shooting Nodes:	no	Pass
Negative Volumes:	no	Pass

W-179 Table E-5: Roadside PIRTS

Structural Adequacy	Test	FEA
C1 - Acceptable perf.?	yes	yes
C2 – Dynamic Deflection:	n/a	n/a
C3 – Contact Time	n/a	n/a
C5 – Comp. Failures?	n/a	n/a
C6 – Connection Failure?	yes	yes
C7 – Wheel Snagging?	n/a	n/a
C8 – Vehicle Snagging?	n/a	n/a

Occupant Risk	Test	FEA
D – Detached elements?		
F2 – Max. Vehicle Roll		
F3 – Max. Vehicle Pitch		
F4 – Max. Vehicle Yaw		

Occupant Risk (cont.)	Test	FEA
H2 – Long. OIV	n/a	n/a
H3 – Lat. OIV	n/a	n/a
I2 – Long. ORA	n/a	n/a
I3 – Lat. ORA	n/a	n/a
Vehicle Trajectory		
K – Intruded into travel lanes?	n/a	n/a
N – Travel behind barrier?	n/a	n/a

W-179 Table E-3 (Multi-Channel Method)		
Sprague-Geer Magnitude < 40	-5.7	pass
Sprague-Geer Phase < 40	3.1	pass
ANOVA Mean	-3.5	pass
ANOVA Standard Deviation	6.7	pass

Date: 2013 12 14

Finite Element Analysis Determination of Elibibility for Reimbursement under the Federal-Aid Highway Program (FHWA Memorandum)

System Type: LINDSAY XLITE
Device Name:/Variant:
Testing Criterion: Static test Xlite post nr.2
Test Level:
FHWA Letter:

Modification to Existing Hardware:
Submissions Type:

	Soil plate
	Non-Significant -- Effect is Uncertain
	Non-Significant -- Effect is Positive
X	Non-Significant -- Effect is Inconsequential
	Baseline Validation of Crash Test to FEA Analysis.

Crash Test

Modification

Baseline numerical simulation	
Test Number:	
Vehicle:	
Vehicle Mass:	
Impact Speed:	
Impact Location:	
Tested Hardware:	Original design
FEA Hardware:	Modified design

W-179 Table E-1: Verification Evaluation Summary

Total Energy:	2%	Pass
Hourglass Energy:	3.50%	Pass
Mass Added:	1%	Pass
Shooting Nodes:	no	Pass
Negative Volumes:	no	Pass

W-179 Table E-5: Roadside PIRTS

Structural Adequacy	Test	Modified
C1 - Acceptable perf.?	yes	yes
C2 – Dynamic Deflection:	n/a	n/a
C3 – Contact Time	n/a	n/a
C5 – Comp. Failures?	n/a	n/a
C6 – Connection Failure?	yes	yes
C7 – Wheel Snagging?	n/a	n/a
C8 – Vehicle Snagging?	n/a	n/a
Occupant Risk	**Test**	**Modified**
D – Detached elements?		
F2 – Max. Vehicle Roll		
F3 – Max. Vehicle Pitch		
F4 – Max. Vehicle Yaw		

Occupant Risk (cont.)	Test	Modified
H2 – Long. OIV	n/a	n/a
H3 – Lat. OIV	n/a	n/a
I2 – Long. ORA	n/a	n/a
I3 – Lat. ORA	n/a	n/a
Vehicle Trajectory		
K – Intruded into travel lanes?	n/a	n/a
N – Travel behind barrier?	n/a	n/a

W-179 Table E-3 (Multi-Channel Method)		
Sprague-Geer Magnitude < 40	0.4	pass
Sprague-Geer Phase < 40	1	pass
ANOVA Mean	0.3	pass
ANOVA Standard Deviation	2.2	pass