U.S. Department
of Transportation
Federal Highway Administration

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

SEP 17 2018

In Reply Refer To:
HSST-1 / CC-144

Mr. Felipe Almanza
TrafFix Devices Inc.
160 Avenida La Pata
San Clemente CA 92672

Dear Mr. Almanza:

This letter is in response to your June 11, 2018 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 CC-144 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:

- SLED mini to Concrete Barrier

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: SLED mini to Concrete Barrier
Type of system: Terminal
Test Level: MASH Test Level 2 (TL2)
Testing conducted by: KARCO
Date of request: June 11, 2018
Date initially acknowledged: June 20, 2018

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 CC-144 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.

- 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

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:	June 08, 2018	◉ New ○ Resubmission
	Name:	Felipe Almanza	
	Company:	TrafFix Devices Inc.	
	Address:	160 Avenida La Pata	
	Country:	United States	
	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
'CC': Crash Cushions, Attenuators, & Terminals	◉ Physical Crash Testing ○ Engineering Analysis	SLED mini to Concrete Barrier	AASHTO MASH	TL2

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:	Felipe Almanza	Same as Submitter ☒
Company Name:	TrafFix Devices Inc.	Same as Submitter ☒
Address:	160 Avenida La Pata	Same as Submitter ☒
Country:	United States	Same as Submitter ☒
Enter below all disclosures of financial interests as required by the FHWA `Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.		
TrafFix Devices Inc. and Karco Engineering LLC share no financial interests between the two organizations. This includes no shared financial interest but not limited to: i. Compensation including wages, salaries, commissions, professional fees, or fees for business referrals iii. Research funding or other forms of research support; iv. Patents, copyrights, licenses, and other intellectual property interests; vi. Business ownership and investment interests;		

PRODUCT DESCRIPTION

(•) New Hardware or Significant Modification ( ) Modification to Existing Hardware

The SLED mini is a free standing, non-redirective, gating crash cushion, designed to shield the end of a concrete barrier. The SLED mini does not require anchoring to the road surface and can be used on concrete, asphalt, gravel, and dirt surfaces. The SLED mini was tested on a concrete surface. The SLED mini can be used in TL-2 and TL-1 installations to treat the end of concrete barrier. The SLED mini test series was conducted at TL-2 conditions. The SLED mini utilizes a transition that is mechanically attached to the barrier it is shielding. The SLED mini system consists of four main components: two yellow water filled modules, one Containment Impact Sled (CIS), and one transition. The SLED mini's overall dimensions are 12.0 ft (3.7 m) long (pin to pin) X 23 in (0.58 m) wide X 32 in (0.83 m) tall. The modules have overall dimensions of 73.0 in (1.9 m) long (pin to pin) X 18.0 in (0.5 m) wide X 32.0 ft (0.8 m) tall. The yellow modules are manufactured from polyethylene that is UV stabilized. The SLED mini system consists of two water filled modules with the front module connected to the steel CIS. The water filled modules weigh approx. 1100 lbs (500 kg) when filled. The SLED mini's yellow water filled modules contain a fill lid, which incorporates a pop-up float water level indicator for identifying that modules are filled to the appropriate level. Permanently molded within the plastic modules are three corrosion resistant cables. The modules are designed with knuckles at the ends which contain a series of vertically aligned concentric holes that allow a steel t-pin to be inserted to positively connect the two-yellow water filled modules together. When modules are pinned together there are a total of eight knuckles aligned with the steel t-pin inserted. At the front of the SLED mini system is the steel CIS that is connected to the front yellow water filled module. The CIS is designed using a steel tube frame and sheet metal construction. The front yellow water filled module is connected to the CIS through the vertically aligned concentric holes in the knuckles and the t-pin connects the module and the CIS together. This is the same connection method used between the two-yellow water filled modules. Bolted to the front impact face on the CIS is the directional indicator panel. The directional indicator panel is a square sheet of plastic that contains gore point directional sheeting on one side and left, or right, directional sheeting on the opposite side. This allows the user to convert the panel to the proper direction when installing the SLED. The directional indicator panel contours to the curved shape on the front impact face on the CIS and is secured by six bolts. Other directional sheeting and markings are available. The SLED mini is attached to the barrier using two transition panels attached to both sides of the concrete barrier. The SLED mini transition is made of three main components: one steel transition frame and two symmetric transition panels. The transition frame is positively connected to the rear most water filled module through the vertically aligned concentric holes in the knuckles using a steel t-pin. This is the same connection method used between the yellow water filled modules and between the CIS and the front yellow water filled module. The transition panels are pinned to the transition frame using outboard alignment pins designed into the transition frame. The transition panels are attached to the barrier using a minimum of four mechanical fasteners per side. A minimum of eight fasteners are required to attach the SLED to the barrier.

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:	Robert Ramirez	
Engineer Signature:	Robert Ramirez Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2018.06.08 17:01:06 -07'00'	
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter ☐
Country:	United States	Same as Submitter ☐

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
2-30 (1100C)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-31 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-32 (1100C)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-33 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-34 (1100C)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-35 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-36 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-37 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
2-38 (1500A)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted

Required Test Number	Narrative Description	Evaluation Results
2-40 (1100C)	The SLED mini was positioned offset a quarter of the vehicle's width towards the passenger side. The offset position examines the risk of exceeding occupant risk values, vehicle instability, and vehicle yaw movement. The test was conducted using a commercially available 2013 Kia Rio 4-door sedan with a test inertial mass of 2,420.6 lbs (1,098.0 kg). The test vehicle impacted the SLED mini at a velocity of 45.33 mph (72.95 km/hr) and at an impact angle of 0.2°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing and rupturing the yellow water filled module within the CIS. As the vehicle continued rearward the second yellow water filled module was crushed, ruptured, and dispersed the contained water. The vehicle rotated in a clockwise direction about its yaw axis before coming to a controlled stop 19.2 ft (5.9 m) forward and 2.8 ft (0.8 m) lateral from the initial point of impact. The yellow SLED mini modules remained tethered together and securely attached to the barrier via the steel t-pins between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop, remained upright, and did not exhibit vaulting throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no in cab deformation beyond allowable limits. The maximum roll and pitch angle did not exceed 75° and occupant risk values were within limits per MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA).	PASS

2-41 (2270P)	The SLED mini was positioned in line with the center of the test vehicle. The inline centered position examines the risk of exceeding occupant risk values, vehicle instability, capacity to absorb sufficient impact energy, and the SLED mini's ability to bring the vehicle to a controlled stop. The test was conducted using a commercially available 2011 Ram 1500 4-door pickup truck with a test inertial mass of 5,017.7 lbs (2,276.0 kg). The test vehicle impacted the SLED mini at a velocity of 44.07mph (70.92 km/hr) and at an impact angle of 0°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing and rupturing the yellow water filled module within the CIS dispersing the contained water. As the vehicle continued rearward the second yellow water filled module was crushed, ruptured, and dispersed the contained water. The yellow SLED mini modules remained tethered together and securely attached to the barrier via the steel t-pins between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 29.7 ft (9.1 m) forward and 7.1 in (180 mm) lateral from the initial point of impact, remained upright, and did not exhibit vaulting throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no in cab deformation beyond allowable limits. The maximum roll and pitch angle did not exceed 75° and occupant risk values are within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.	PASS

2-42 (1100C)	The SLED mini was positioned at a nominal angle of 5° with the center of the test vehicle. The angle position examines the risk of exceeding occupant risk values, vehicle instability, capacity to absorb sufficient impact energy, and the SLED mini's ability to bring the vehicle to a controlled stop. The test was conducted using a commercially available 2012 Kia Rio 4-door sedan with a test inertial mass of 2,403.0 lbs (1,090.0 kg). The test vehicle impacted the crash cushion at a velocity of 41.91 mph (67.45 km/hr) and at an impact angle of 5.1°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing and rupturing the yellow water filled module within the CIS dispersing the contained water. As the vehicle continued rearward the second yellow water filled module was crushed, ruptured, and dispersed the contained water. The yellow SLED mini modules remained tethered together and securely attached to the barrier via the steel t-pins between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 11.4 ft (3.5 m) forward and 1.8 ft (0.5 m) lateral from the initial point of impact, remained upright, and did not exhibit vaulting throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no in cab deformation beyond allowable limits. The maximum roll and pitch angle did not exceed 75°. Occupant risk values are within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.	PASS

2-43 (2270P)	The SLED mini was positioned at a nominal angle of 5° with the center of the test vehicle. The angle position examines the risk of exceeding occupant risk values, vehicle instability, capacity to absorb sufficient impact energy, and the SLED mini's ability to bring the vehicle to a controlled stop. The test was conducted using a commercially available 2011 Ram 1500 4-door pickup truck with a test inertial mass of 5,024.3 lbs (2,290.0 kg). The test vehicle impacted the crash cushion at a velocity of 46.36 mph (74.61 km/hr) and at an impact angle of 5.1°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing and rupturing the yellow water filled module within the CIS dispersing the contained water. As the vehicle continued rearward the second yellow water filled module was crushed, ruptured, and dispersed the contained water. The yellow SLED mini modules remained tethered together and securely attached to the barrier via the steel t-pins between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 25.0 ft (7.6 m) forward and 2.9 ft (0.9 m) lateral from the initial point of impact, remained upright, and did not exhibit vaulting throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no in cab deformation beyond allowable limits. The maximum roll and pitch angle did not exceed 75°. Occupant risk values are within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.	PASS

2-44 (2270P)	The SLED mini was positioned at a nominal angle of 20° with the center line of the impacting vehicle directed at the corner of the concrete barrier that is connected to the rear SLED mini yellow water filled module. The side angled impact test is to evaluate the SLED mini's ability to bring the impacting vehicle to a controlled stop. This angle and intersection directed the test vehicle into the front of the steel Containment Impact Sled (CIS) at its CIP as defined in MASH for test procedures for Gating Non-Redirective Crash Cushion. The test was conducted using a commercially available 2013 Ram 1500 4-door pickup truck with a test inertial mass of 5,022.0 lbs (2,278.0 kg). The test vehicle impacted the crash cushion at a velocity of 45.80 mph (73.70 km/hr) and at an impact angle of 19.7°. The test vehicle made initial contact with the leading edge of the CIS and the yellow SLED mini water filled module. Upon impact the CIS began to rotate in a counter clockwise direction and began fracturing and dispersed the water contained in the yellow water filled module within the CIS. As the vehicle continued to move forward the second yellow water filled module also rotated counterclockwise and was crushed and ruptured dispersing the water contained within the module. The yellow SLED mini modules remained tethered together via the steel t-pins between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 28.2 ft (8.6 m) forward and 0.9 ft (0.3 m) lateral from the initial point of impact, remained upright, and did not exhibit vaulting throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no in cab deformation beyond allowable limits. The maximum roll and pitch angles did not exceed 75°.	PASS
2-45 (1500A)	The SLED Mini is not a staged crash cushion and therefore, per MASH, the test is not required.	Non-Relevant Test, not conducted

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:	KARCO Engineering	
Laboratory Signature:	AB Digitally signed by Alex Beltran DN: cn=Alex Beltran, o=KARCO Engineering, ou=Testing Laboratory, email=abeltran@karco.com, c=US Date: 2018.06.08 17:06:37 -07'00'	
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter ☐
Country:	United States	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	October 12, 2017 - July 1, 2018	

Submitter Signature*: Felipe Almanza Digitally signed by Felipe Almanza DN: cn=Felipe Almanza, o=TrafFix Devices Inc., ou=Engineering, email=falmanza@traffixdevices.com, c=US Date: 2018.06.11 17:00:27 -07'00'

Submit Form

ATTACHMENTS

Attach to this form:

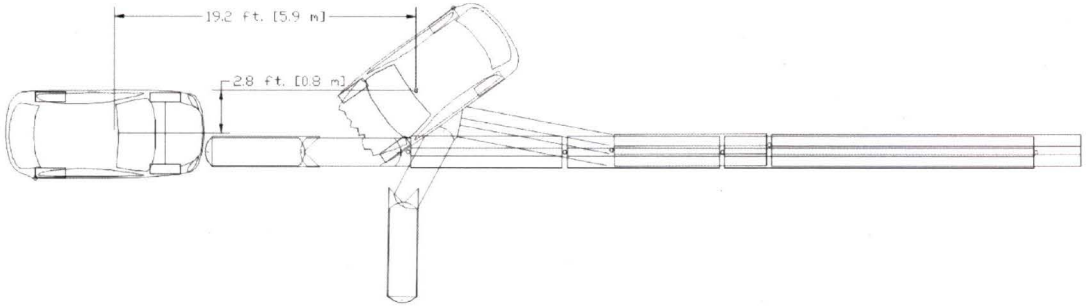
1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware 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

MASH Test 2-40 Summary

0.000 s | 0.050 s | 0.200 s | 0.400 s | 1.200 s



General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P37267-01
Test Designation	2-40
Test Date	09/28/17

Test Article

Name / Model	SLED Mini
Type	Crash Cushion
Installation Length	52.7 ft. (16.1 m)
Terminal Length	12.0 ft. (3.7 m)
Road Surface	Concrete

Test Vehicle

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,522.0 lbs (1,144.0 kg)
Test Inertial Mass	2420.6 lbs (1,098.0 kg)
Gross Static Mass	2,590.4 lbs (1,175.0 kg)

Impact Conditions

Impact Velocity	45.33 mph (72.95 km/h)
Impact Angle	0.2°
Location / Orientation	16.8 in. (427 mm) right of vehicle CL
Kinetic Energy	166.3 kip-ft (225.4 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	19.2 ft (5.9 m) downstream 2.8 ft. (0.8 m) left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-3.7°
Maximum Pitch Angle	0.9°
Maximum Yaw Angle	-125.4°

Occupant Risk

Longitudinal OIV	28.9 ft/s (8.8 m/s)
Lateral OIV	0 ft/s (0.0 m/s)
Longitudinal RA	-8.2 g
Lateral RA	5.8 g
THIV	28.9 ft/s (8.8 m/s)
PHD	9.8 g
ASI	1.02

Test Article Deflections

Static	7.8 ft. ft. (2.4 m)
Dynamic	N/A
Working Width	9.7 ft. (3.0 m)

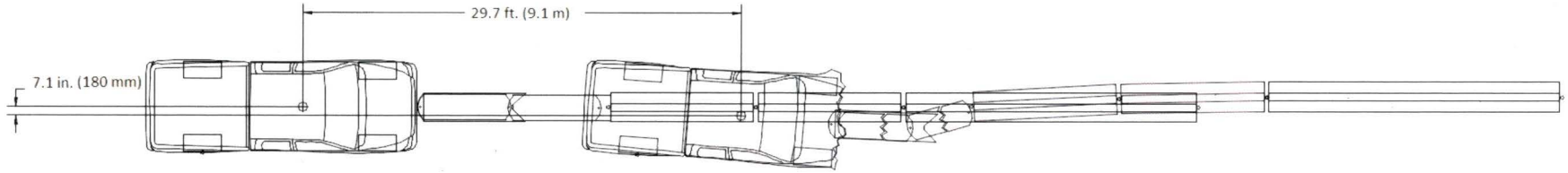
Vehicle Damage

Vehicle Damage Scale	12-FD-3
CDC	12FDEW2
Maximum Intrusion	0.29 in. (7 mm)

Figure 2 Summary of Test 2-40

MASH Test 2-41 Summary

0.000 s 0.100 s 0.200 s 0.300 s 0.400 s



General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P37263-01
Test Designation	2-41
Test Date	08/10/17

Test Article

Name / Model	SLED mini
Type	Crash Cushion
Installation Length	52.7 ft. (16.1 m)
Terminal Length	12.0 ft. (3.7 m)
Road Surface	Concrete

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2011 RAM 1500
Curb Mass	5,066.1 lbs (2,298.0 kg)
Test Inertial Mass	5,017.7 lbs (2,276.0 kg)
Gross Static Mass	5,017.7 lbs (2,276.0 kg)

Impact Conditions

Impact Velocity	44.07 mph (70.92 km/h)
Impact Angle	0°
Location / Orientation	0.2 in (5 mm) left of vehicle centerline
Kinetic Energy	325.8 kip-ft (441.7 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	29.7 ft (9.1 m) downstream 7.1 in. (180 mm) right
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	4.1°
Maximum Pitch Angle	1.3°
Maximum Yaw Angle	4.5°

Occupant Risk

Longitudinal OIV	23.0 ft/s (7.0 m/s)
Lateral OIV	1.0 ft/s (0.3 m/s)
Longitudinal RA	-13.3 g
Lateral RA	2.1 g
THIV	23.0 ft/s (7.0 m/s)
PHD	13.3 g
ASI	0.60

Test Article Deflections

Static	1.3 ft. (0.4 m)
Dynamic	N/A
Working Width	3.0 ft. (0.9 m)

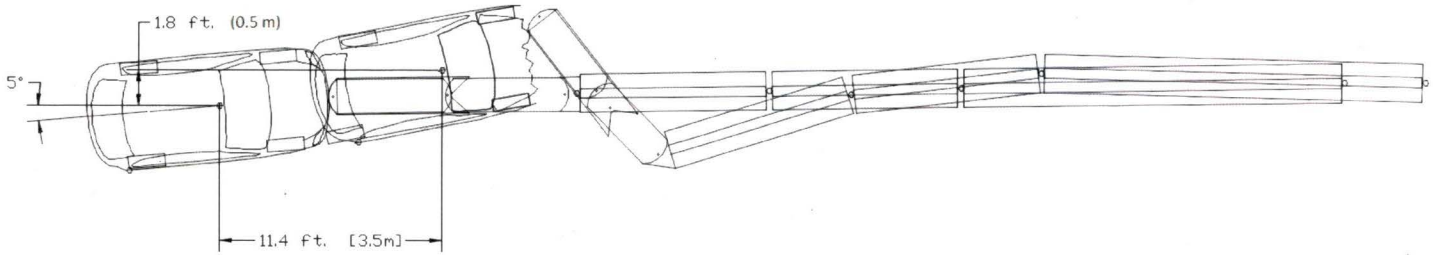
Vehicle Damage

Vehicle Damage Scale	12-FC-3
CDC	12FCLN3
Maximum Intrusion	0.2 in. (5 mm)

Figure 2 Summary of Test 2-41

MASH Test 2-42 Summary

0.000 s 0.120 s 0.240 s 0.600 s 1.080 s



General Information	
Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P37284-01
Test Designation	2-42
Test Date	08/04/17

Test Article	
Name / Model	SLED mini
Type	Crash Cushion
Installation Length	52.7 ft. (16.1 m)
Terminal Length	12.0 ft. (3.7 m)
Road Surface	Concrete

Test Vehicle	
Type / Designation	1100C
Year, Make, and Model	2012 Kia Rio
Curb Mass	2,401.9 lbs (1,089.5 kg)
Test Inertial Mass	2,403.0 lbs (1,090.0 kg)
Gross Static Mass	2,572.8 lbs (1,167.0 kg)

Impact Conditions	
Impact Velocity	41.91 mph (67.45 km/h)
Impact Angle	5.1°
Location / Orientation	0.3 in. (8 mm) right of vehicle CL
Kinetic Energy	141.1 kip-ft (191.3 kJ)

Exit Conditions	
Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	11.4 ft (3.5 m) downstream 1.8 ft. (0.5 m) left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	3.5°
Maximum Pitch Angle	1.8°
Maximum Yaw Angle	-9.3°

Occupant Risk	
Longitudinal OIV	26.6 ft/s (8.1 m/s)
Lateral OIV	0.7 ft/s (0.2 m/s)
Longitudinal RA	-7.0 g
Lateral RA	-2.1 g
THIV	26.6 ft/s (8.1 m/s)
PHD	7.0 g
ASI	0.93

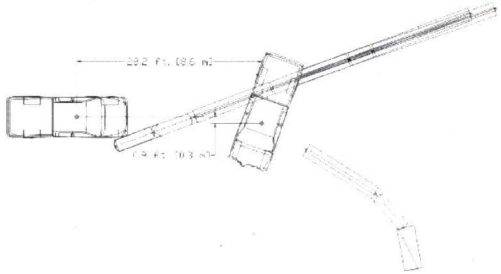
Test Article Deflections	
Static	50.5 in. (1.3 m)
Dynamic	N/A
Working Width	60.0 in. (1.5 m)

Vehicle Damage	
Vehicle Damage Scale	12-FD-3
CDC	12FDEW2
Maximum Intrusion	0.2 in. (5 mm)

Figure 2 Summary of Test 2-42

MASH Test 2-44 Summary

0.000 s | 0.050 s | 0.300 s | 0.700 s | 1.900 s



General Information	
Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P37270-01
Test Designation	2-44
Test Date	10/04/17

Test Article	
Name / Model	SLED mini
Type	Crash Cushion
Installation Length	57.7 ft. (17.6 m)
Terminal Length	12.0 ft. (3.7 m)
Road Surface	Concrete

Test Vehicle	
Type / Designation	2270P
Year, Make, and Model	2013 RAM 1500
Curb Mass	4,908.5 lbs (2,226.5 kg)
Test Inertial Mass	5,022.0 lbs (2,278.0 kg)
Gross Static Mass	5,022.0 lbs (2,278.0 kg)

Impact Conditions	
Impact Velocity	45.80 mph (73.70 km/h)
Impact Angle	19.7°
Location / Orientation	1.0 in (25 mm) right of vehicle centerline
Kinetic Energy	352.2 kip-ft (477.5 kJ)

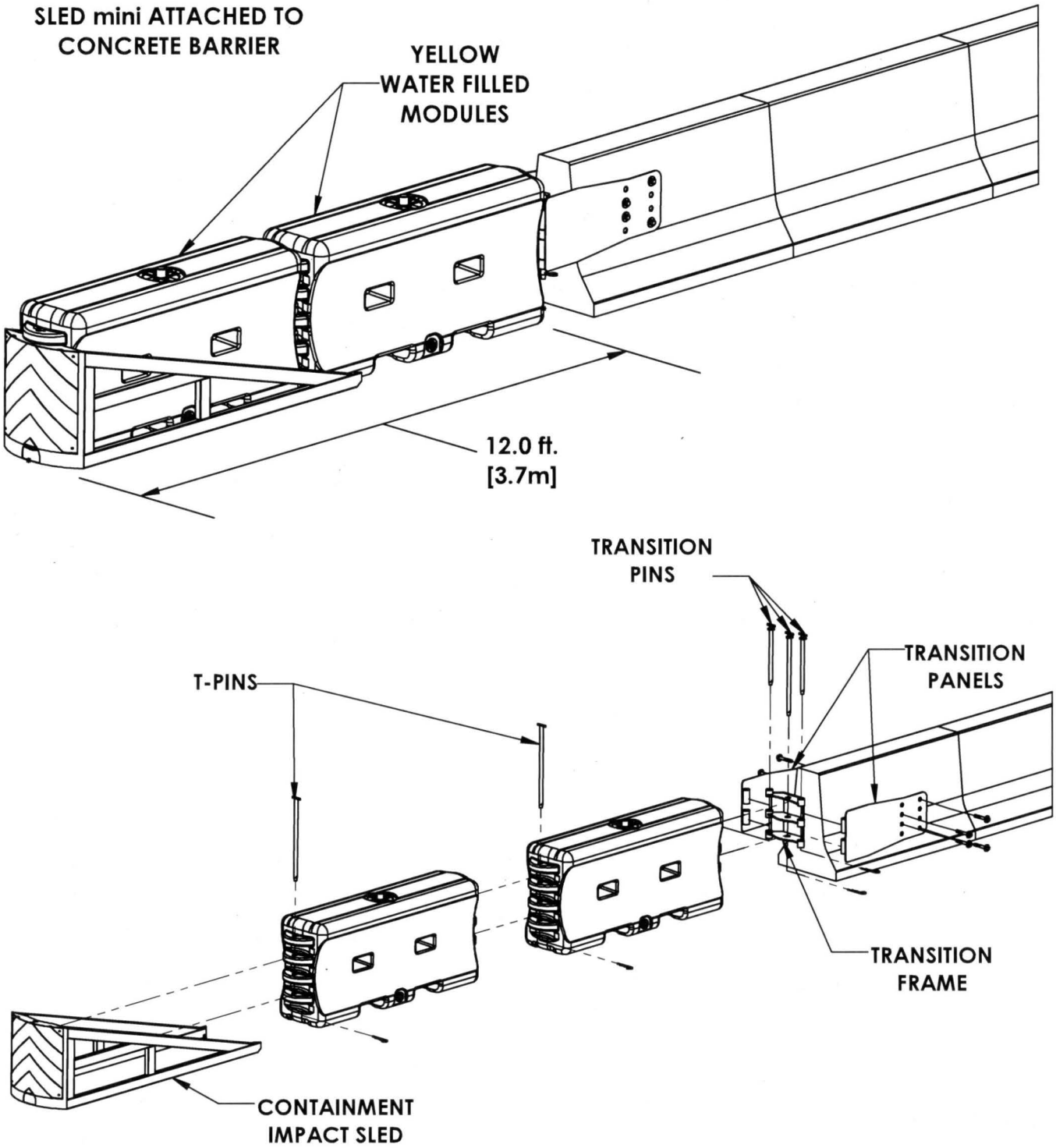
Exit Conditions	
Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	28.2 ft (8.6 m) downstream 0.9 ft. (0.3 m) right
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-23.4°
Maximum Pitch Angle	-16.9°
Maximum Yaw Angle	-62.0°

Occupant Risk	
Longitudinal OIV	30.5 ft/s (9.3 m/s)
Lateral OIV	1.0 ft/s (0.3 m/s)
Longitudinal RA	-17.9 g
Lateral RA	8.3 g
THIV	7.9 ft/s (2.4 m/s)
PHD	18.8 g
ASI	1.05

Test Article Deflections	
Static	18.6 ft. (5.7 m)
Dynamic	N/A
Working Width	3.0 ft. (0.9 m)

Vehicle Damage	
Vehicle Damage Scale	12-FD-4
CDC	12FDEW3
Maximum Intrusion	0.9 in. (23 mm)

Figure 2 Summary of Test 2-44



MASH SLED mini End Treatment

TrafFix Devices Inc.

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INTENDED USE

The SLED mini is a free standing, non-redirective, gating crash cushion, designed to shield the end of concrete barrier. The SLED mini does not require anchoring to the road surface and can be used on concrete, asphalt, gravel, and dirt surfaces. The SLED mini can be used in TL-2 and TL-1 installations to treat the end of concrete barrier. The SLED mini system consists of four main components: two yellow water filled modules, one Containment Impact Sled (CIS), and one transition. The SLED mini system consists of two water filled modules with the front module connected to the steel CIS. The water filled modules weigh approx. 1100 lbs (500 kg) when filled. The SLED mini's yellow water filled modules contain a fill lid, which incorporates a pop-up float water level indicator for identifying that modules are filled to the appropriate level. When modules are pinned together there are a total of eight knuckles aligned with the steel t-pin inserted. At the front of the SLED mini system is the steel CIS that is connected to the front yellow water filled module. Bolted to the front impact face on the CIS is the directional indicator panel. The directional indicator panel is a square sheet of plastic that contains gore point directional sheeting on one side and left, or right, directional sheeting on the opposite side. This allows the user to convert the panel to the proper direction when installing the SLED. The directional indicator panel contours to the curved shape on the front impact face on the CIS and is secured by six bolts. Other directional sheeting and markings are available. The SLED mini is attached to the barrier using two transition panels attached to both sides of the concrete barrier. The SLED mini transition is made of three main components: one steel transition frame and two symmetric transition panels. The transition frame is positively connected to the rear most water filled module through the vertically aligned concentric holes in the knuckles using a steel t-pin. The transition panels are pinned to the transition frame using outboard alignment pins designed into the transition frame. The transition panels are attached to the barrier using a minimum of four mechanical fasteners per side. A minimum of eight fasteners are required to attach the SLED to the barrier.

SLED mini End Treatment for Concrete Barrier
Length: 12.0 ft (3.7 m) long (pin to pin)
Height: 32 in (0.83 m)
Width: 23 in (0.58 m)

The SLED mini End Treatment for attachment to concrete barrier has been fully tested to the procedures of MASH.

ELIGIBILITY

FHWA Eligibility Letters:

CONTACT INFORMATION

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MASH SLED mini End Treatment

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TrafFix Devices Inc.