U.S. Department of Transportation
Federal Highway Administration

May 13, 2020

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

In Reply Refer To:
HSST-1/CC-161

Mr. Robby Ramirez
TrafFix Devices, Inc.
160 Avenida La Pata
San Clemente, CA 92673
USA

Dear Mr. Ramirez:

This letter is in response to your January 3, 2020 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-161 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 Lo-Ro

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 Lo-Ro
Type of system: Crash cushion
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: Applus IDIADA KARCO Engineering, LLC.
Date of request: January 3, 2020

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-161 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

Submitter	Date of Request:	January 03, 2020	◉ New ○ Resubmission
	Name:	Robby Ramirez	
	Company:	TrafFix Devices, Inc.	
	Address:	160 Avenida La Pata San Clemente, CA 92673	
	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, Attenua Attenuators, & Terminals	◉ Physical Crash Testing ○ Engineering Analysis	SLED Lo-Ro	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:	Robby Ramirez	Same as Submitter ☒
Company Name:	TrafFix Devices, Inc.	Same as Submitter ☒
Address:	160 Avenida La Pata San Clemente, CA 92673	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 Applus IDIADA 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
ii. Research funding or other forms of research support;
iii. Patents, copyrights, licenses, and other intellectual property interests;
iv. Business ownership and investment interests.

PRODUCT DESCRIPTION

Help

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

The SLED Lo-Ro is a non-redirective gating crash cushion designed to shield the end of the Low Rotation (Lo-Ro) Water Cable Barrier. The SLED system consists of two (2) main components: one (1) Containment Impact Sled (CIS) and one (1) primary element. The as-tested crash cushion was 75.75 in. (1924 mm) long measured from pin to pin by 27.25 in. (692 mm) wide, with a maximum height of 36.63 in. (930 mm). The SLED Lo-Ro Water is free standing and does not require anchoring to the road surface and can be used on concrete, asphalt, gravel, and dirt surfaces. The SLED Lo-Ro is designed and tested for TL-2 (44 mph/70 km/h) applications and can also be used in TL-1 (31 mph/50 km/h) applications.

At the front of system is the steel CIS connected to the water filled front module. The module is identical in design to the other water filled modules. The CIS is designed using a steel tube frame and sheet metal construction and weighs approximately 197.0 lbs. (89.5 kg). The CIS is approximately 88.0 in. (2.2 m) long by 27.25 in. (692 mm) wide by 30.5 in. (775 mm) tall. The primary module is connected to the CIS through the vertically aligned concentric holes in the knuckles using the vertical drop t-pin. This is the same connection method used between adjacent modules.

The modules are 6.3 ft. (1.9 m) long measured from pin to pin by 22.5 in. (572 mm) wide by 36.0 in. (914 mm) tall. The modules were manufactured from polyethylene that is UV stabilized to minimize degradation. The system has one (1) water filled front module pinned to the steel CIS. The empty module weights approximately 159.0 lbs (72.2 kg) and the water filled modules weigh approximately 1,633 lbs. (740.8 kg).

Molded within the plastic modules are a series of three (3) corrosion resistant wire rope cables. The cables are permanently molded into the modules during the manufacturing process. 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 connect adjacent modules. When adjacent modules are pinned together there are a total of nine (9) knuckles aligned with the steel t-pin inserted. This provides a positive connection between adjacent modules.

Each water filled module contains a fill lid which incorporates a water level indicator. The water level indicator pop up float is a visual indicator for identifying that the modules are filled to the appropriate water level.

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:	Steven Matsusaka	
Engineer Signature:	Steven Matsusaka Digitally signed by Steven Matsusaka DN: cn=Steven Matsusaka, email=steven.matsusaka@idiada.com, c=US Date: 2020.01.24 17:42:21 -08'00'	
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☐

A brief description of each crash test and its result: Help

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

Required Test Number	Narrative Description	Evaluation Results
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
2-40 (1100C)	Test report number P39135-01, conducted on 05/13/19. Test 2-40 involves an 1100C test vehicle impacting the system at a nominal speed and angle of 44 mph (70 km/h) and 0° with the system offset one quarter the vehicles overall width. The offset orientation examines the risk of exceeding occupant risk values, vehicle instability, and yaw movement. The test vehicle was a commercially available 2007 Kia Rio with a test inertial mass of 2,439.4 lbs (1,106.5 kg). The vehicle impacted the system at a speed and angle of 44.34 mph (71.36 km/h) and 0.4°, respectively. Upon impact the vehicle pushed the SLED downstream and ruptured the primary module. The vehicle rotated about it's yaw axis before exiting the system. The vehicle remained upright and was brought to a controlled stop. The vehicle came to rest 15.8 ft. (4.8 m) downstream from the initial point of contact with the CIS. The SLED and Lo-Ro modules remained tethered together via the steel t-pin between module knuckles which connects directly to the internal molded in steel cables. There were no detached elements that showed potential to penetrate the vehicle or present undue hazards to personnel in a work zone. The Occupant Impact Velocities (OIV) and Ridedown accelerations were within the specified limits of MASH. The roll and pitch angles did not exceed 75° and there was minimal occupant compartment deformation. The SLED Lo-Ro met all the requirements for MASH Test 2-40.	PASS

2-41 (2270P)	Test report number P39136-01, conducted on 05/14/19. Test 2-41 involves an 2270P test vehicle impacting the system at a nominal speed and angle of 44 mph (70 km/h) and 0° with the system aligned with the centerline of the test vehicle. The centerline impact orientation examines the risk of exceeding occupant risk values, vehicle instability, and the capacity of the SLED to absorb sufficient kinetic energy. The test vehicle wasa commercially available 2014 RAM 1500 with a test inertial mass of 4,948.2 lbs (2,244.5 kg). The vehicle impacted the system at aspeed and angle of 44.03 mph (70.86 km/h) and 0.1°, respectively. The vehicle remained in contact with the system throughout the event and came to rest 13.0 ft. (4.0 m) downstream from its initial point of contact. The SLED Lo-Ro brought the vehicle to a controlled stop and remained upright. There were no detached elements that showed potential to penetrate the vehicle or present undue hazards to personnel in a work zone. The Occupant Impact Velocities (OIV) and Ridedown accelerations were within the specified limits of MASH. The roll and pitch angles did not exceed 75° and there was no occupant compartment deformation. The SLED Lo-Ro met all the requirements for MASH Test 2-41.	PASS

2-42 (1100C)	Test report number P39204-01, conducted on 06/20/19. Test 2-42 involves an 1100C test vehicle impacting the system at a nominal speed and angle of 44 mph (70 km/h) and 5° with the nose of the system aligned with the centerline of the vehicle. The angled orientation examines the risk of exceeding occupant risk values, vehicle instability and yaw movement. The test vehicle was a commercially available 2006 Kia Rio with a test inertial mass of 2,390.9 lbs (1,084.5 kg). The vehicle impacted the system at a speed and angle of 44.78 mph (72.07 km/h) and 5.0°, respectively. Upon impact the vehicle pushed the SLED downstream and ruptured the primary module and the first Lo-Ro module. The vehicle remained upright and was brought to a controlled stop. The vehicle came to rest 0.7 ft. (0.2 m) rearward from its initial point of contact with the CIS. The SLED and Lo-Ro modules remained tethered together via the steel t-pin between module knuckles which connects directly to the internal molded in steel cables. There were no detached elements that showed potential to penetrate the vehicle or present undue hazards to personnel in a work zone. The Occupant Impact Velocities (OIV) and Ridedown accelerations were within the specified limits of MASH. The roll and pitch angles did not exceed 75° and there was minimal occupant compartment deformation. The SLED Lo-Ro met all the requirements for MASH Test 2-42.	PASS

2-43 (2270P)	Test report number P39205-01, conducted on 06/21/19. Test 2-43 involves an 2270P test vehicle impacting the system at a nominal speed and angle of 44 mph (70 km/h) and 5° with the nose of the system aligned with the centerline of the vehicle. The angled orientation examines the risk of exceeding occupant risk values, vehicle instability, and yaw movement. The test vehicle was a commercially available 2013 RAM 1500 with a test inertial mass of 4,994.5 lbs (2,265.5 kg). The vehicle impacted the system at a speed and angle of 45.19 mph (72.73 km/h) and 5.1°, respectively. Upon impact the vehicle pushed the SLED downstream and ruptured the primary module and the first three Lo-Ro modules. The vehicle remained upright and was brought to a controlled stop. The vehicle came to rest 12.9 ft. (3.9 m) downstream from its first point of contact with the CIS. The SLED and Lo-Ro modules remained tethered together via the steel t-pin between module knuckles which connects directly to the internal molded in steel cables. There were no detached elements that showed potential to penetrate the vehicle or present undue hazards to personnel in a work zone. The Occupant Impact Velocities (OIV) and Ridedown accelerations were within the specified limits of MASH. The roll and pitch angles did not exceed 75° and there was minimal occupant compartment deformation. The SLED Lo-Ro met all the requirements for MASH Test 2-43.	PASS

2-44 (2270P)	Test report number P39203-01, conducted on 06/19/19. Test 2-44 involves an 2270P test vehicle impacting the system at a nominal speed and angle of 44 mph (70 km/h) and 20° with the centerline of the vehicle directed to the leading corner of the first Lo-Ro module. This angle and barrier intersection directed the test vehicle into the front of the steel Containment Impact SLED (CIS) at its CIP as defined in MASH for non-redirective crash cushions. The side angled impact examines the risk of vehicle instability and occupant compartment deformation. The test vehicle was a commercially available 2014 RAM 1500 with a test inertial mass of 4,951.5 lbs (2,246.0 kg). The vehicle impacted the system at a speed and angle of 42.25 mph (68.00 km/h) and 19.3°, respectively. Upon impact the vehicle pushed the SLED and adjacent Lo-Ro modules to the non-traffic side. The Primary module and the first Lo-Ro modules were ruptured and released water. The vehicle remained upright and was brought to a controlled stop. The vehicle came to rest 21.1 ft. (6.4 m) downstream from its first point of contact with the CIS. The SLED and Lo-Ro modules remained tethered together via the steel t-pin between module knuckles which connects directly to the internal molded in steel cables. There were no detached elements that showed potential to penetrate the vehicle or present undue hazards to personnel in a work zone. The Occupant Impact Velocities (OIV) and Ridedown accelerations were within the specified limits of MASH. The roll and pitch angles did not exceed 75° and there was minimal occupant compartment deformation. The SLED Lo-Ro met all the requirements for MASH Test 2-44.	PASS
2-45 (1500A)	Test 2-45 is intended to evaluate the performance of staging crash cushions during impacts with mid-sized vehicles. The SLED Lo-Ro uses water to dissipate the impacting vehicles kinetic energy. All water-filled modules are physically the same in composition and contain the same amount of water. The force required to activate each module is the same throughout the system making the activation force linear as the impacting vehicle travels downstream. Therefore the SLED Lo-Ro is not a staging devices and test 2-45 is non-relevant and was not conducted.	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:	Applus IDIADA KARCO Engineering, LLC	
Laboratory Signature:	Steven Matsusaka DN: cn=Steven Matsusaka, email=steven.matsusaka@idiada.com, c=US Digitally signed by Steven Matsusaka Date: 2020.01.28 08:50:40 -08'00'	
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371: July 2019 - July 2022	

Submitter Signature*: Robert Ramirez Digitally signed by Robert Ramirez Date: 2020.01.28 09:55:41 -08'00'

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 2016 Test 2-40 Summary

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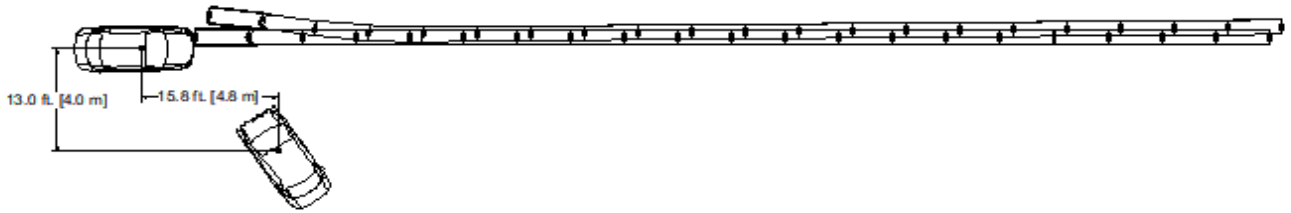

General Information

Test Agency	Applus IDIADA KARCO Eng.
Test No	P39135-01
Test Designation	2-40
Test Date	5/13/19

Test Article

Name / Model	SLED Lo-Ro
Type	Crash Cushion
Crash Cushion Length	7.3 ft (2.2 m)
Installation Length	126.3 ft. (38.5 m)
Road Surface	Concrete

Test Vehicle

Type / Designation	1100C
Year, Make, and Model	2007 Kia Rio
Curb Mass	2,330.2 lbs (1,057.0 kg)
Test Inertial Mass	2,439.4 lbs (1,106.5 kg)
Gross Static Mass	2,603.6 lbs (1,181.0 kg)

Impact Conditions

Impact Velocity	44.34 mph (71.36 km/h)
Impact Angle	0.4° CCW
Location / Orientation	1.5 ft (457 mm) to the left
Kinetic Energy	160.3 kip-ft (217.4 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	15.8 ft. (4.8 m) Downstream 13.0 ft. (4 m) Right
Exit Box Criteria Met	N/A
Vehicle Snagging	Satisfactory
Vehicle Pocketing	None
Vehicle Stability	None
Maximum Roll Angle	-6.9 °
Maximum Pitch Angle	-9.7 °
Maximum Yaw Angle	115.5 °

Occupant Risk

Longitudinal OIV	35.1 ft/s (10.7 m/s)
Lateral OIV	4.3 ft/s (1.3 m/s)
Longitudinal RA	-6.4 g
Lateral RA	-1.7 g
THIV	35.4 ft/s (10.8 m/s)
PHD	6.4 g
ASI	1.33

Test Article Deflections

Static	2.6 ft. (0.8 m)
Dynamic	4.2 ft. (1.3 m)
Working Width	4.8 ft. (1.5 m)
Debris Field	N/A

Vehicle Damage

Vehicle Damage Scale	12-FL-4
CDC	12FLEW3
Maximum Intrusion	1.1 in. (27 mm) at wheel well / footwell

Figure 2 Summary of Test 2-40

MASH 2016 Test 2-41 Summary

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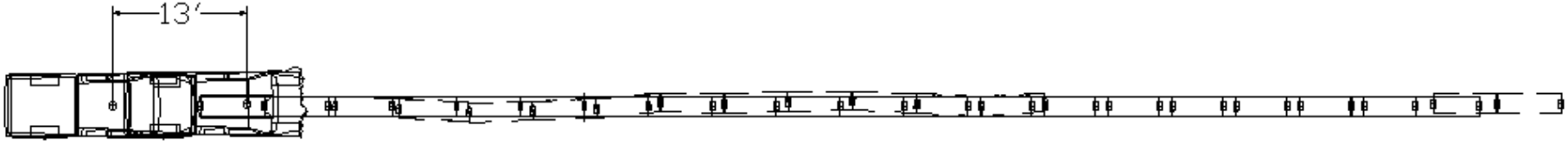

General Information

Test Agency	Applus IDIADA KARCO Eng.
KARCO Test No.	P39136-01
Test Designation	2-41
Test Date	05/14/19

Test Article

Name / Model	SLED Low Rotation
Type	Crash Cushion
Installation Length	126.3 ft. (38.5 m)
Crash Cushion Length	7.3 ft. (2.2 m)
Road Surface	Concrete

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2014 Ram 1500
Curb Mass	4,930.6 lbs (2,236.5 kg)
Test Inertial Mass	4,948.2 lbs (2,244.5 kg)
Gross Static Mass	4,948.2 lbs (2,244.5 kg)

Impact Conditions

Impact Velocity	44.03 mph (70.86 km/h)
Impact Angle	0.1°
Location / Orientation	Vehicle CL to Crash Cushion
Kinetic Energy	320.7 kip-ft (434.8 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	13.0 ft. (4 m) dw
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	1.4 °
Maximum Pitch Angle	3.4 °
Maximum Yaw Angle	-2.8 °

Occupant Risk

Longitudinal OIV	27.6 ft/s (8.4 m/s)
Lateral OIV	2.3 ft/s (0.7 m/s)
Longitudinal RA	-6.7 g
Lateral RA	1.7 g
THIV	27.6 ft/s (8.4 m/s)
PHD	6.7 g
ASI	0.8

Test Article Deflections

Static	10.4 ft. (3.2 m)
Dynamic	10.4 ft. (3.2 m)
Working Width	3.0 ft. (0.9 m)
Debris Field	100.8 ft. (30.7 m) dw 19.3 ft. (5.9 m) Right

Vehicle Damage

Vehicle Damage Scale	12-FC-3
CDC	12FCLN3
Maximum Intrusion	N/A

Figure 2 Summary of Test 2-41

MASH Test 2-42 Summary

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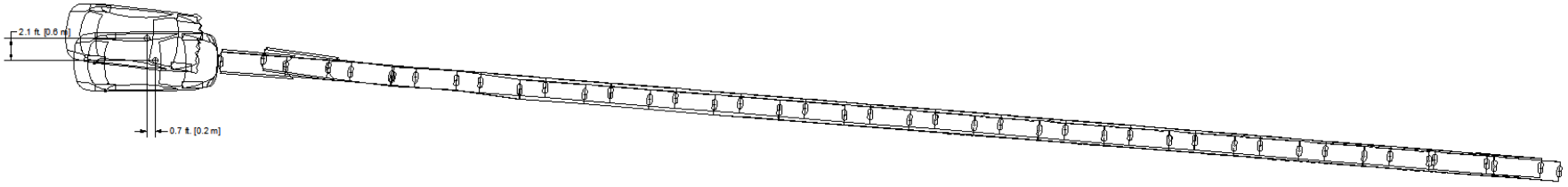

GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P39204-01
Test Designation	2-42
Test Date	06/20/19

TEST ARTICLE

Name / Model	SLED Lo-Ro
Type	Crash Cushion
Crash Cushion Length	7.3 ft. (2.2 m)
Installation Length	126.3 ft. (38.5 m)
Road Surface	Concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2006 Kia Rio
Curb Mass	2,470.2 lbs (1,120.5 kg)
Test Inertial Mass	2,390.9 lbs (1,084.5 kg)
Gross Static Mass	2,565.0 lbs (1,163.5 kg)

Impact Conditions

Impact Velocity	44.78 mph (72.07 km/h)
Impact Angle	5.0°
Location / Orientation	0.1 ft (30 mm) left of vehicle CL
Kinetic Energy	160.3 kip-ft (217.3 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	0.7 ft. (0.2 m) Downstream 2.1 ft. (0.6 m) Left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-5.0°
Maximum Pitch Angle	4.5°
Maximum Yaw Angle	-16.3°

Occupant Risk

Longitudinal OIV	10.7 m/s (35.1 ft/s)
Lateral OIV	0.0 m/s (0.0 ft/s)
Longitudinal RA	-6.8 g
Lateral RA	-1.7 g
THIV	10.7 m/s (35.1 ft/s)
PHD	6.8
ASI	1.55

Test Article Deflections

Static	37.2 in. (0.9 m)
Dynamic	62.4 in. (1.6 m)
Working Width	4.7 in. (0.1 mm)

Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW2
Maximum Intrusion	0.3 in. (9 mm) at wheel well / footwell

Figure 2 Summary of Test 2-42

MASH Test 2-43 Summary

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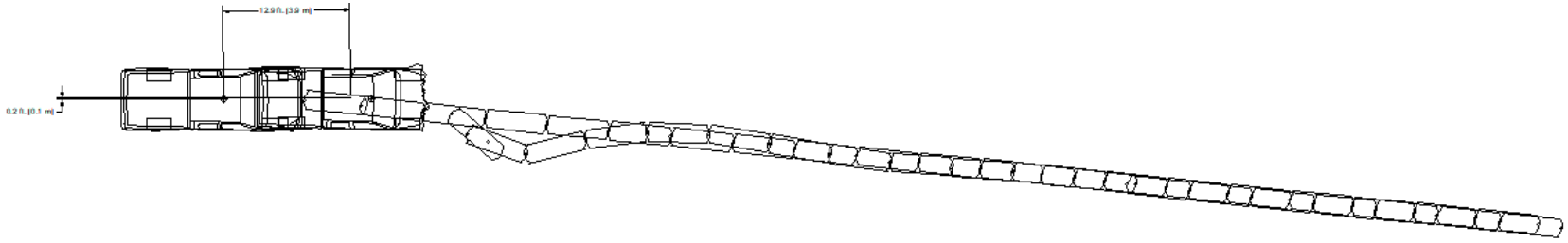


GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P39205-01
Test Designation	2-43
Test Date	6/21/19

TEST ARTICLE

Name / Model	SLED Lo-Ro
Type	Crash Cushion
Installation Length	126.3 ft. (38.5 m)
Crash Cushion Length	7.3 ft. (2.2 m)
Road Surface	Concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2013 Ram 1500
Curb Mass	4,781.7 lbs (2,169.0 kg)
Test Inertial Mass	4,994.5 lbs (2,265.5 kg)

Impact Conditions

Impact Velocity	45.19 mph (72.73 km/h)
Impact Angle	5.1°
Location / Orientation	0.8 in. (21 mm) right
Kinetic Energy	341.0 kip-ft (462.3 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	12.9 ft. (3.9 m) Downstream 0.2 ft. (0.1 m) Left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-1.4°
Maximum Pitch Angle	2.4°
Maximum Yaw Angle	-2.8°

Occupant Risk

Longitudinal OIV	27.9 ft/s (8.5 m/s)
Lateral OIV	1.6 ft/s (0.5 m/s)
Longitudinal RA	-4.9 g
Lateral RA	-0.9 g
THIV	27.9 ft/s (8.5 m/s)
PHD	4.9 g
ASI	0.97

Test Article Deflections

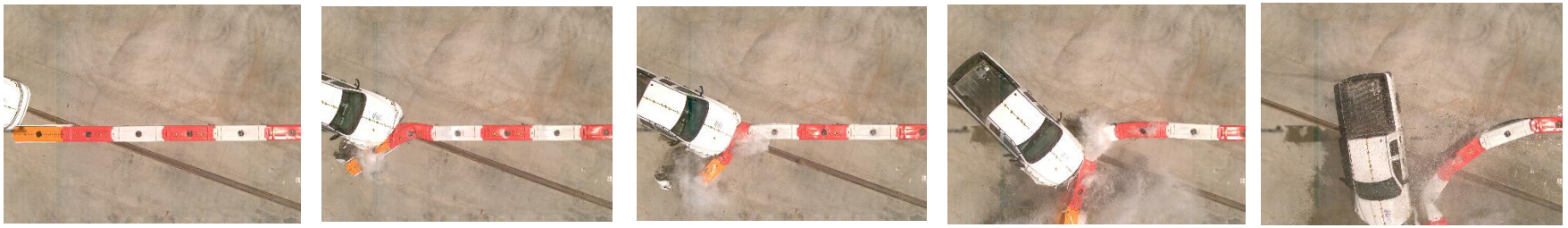
Static	19.7 ft. (6.0 m)
Dynamic	19.7 ft. (6.0 m)
Working Width	5.3 ft. (1.6 m)

Vehicle Damage

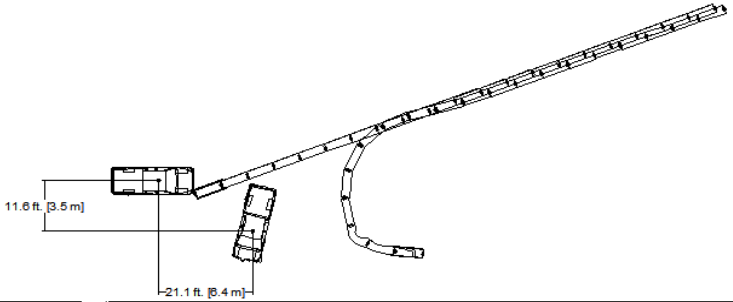
Vehicle Damage Scale	12-FD-4
CDC	12FDEW3
Maximum Intrusion	0.2 in (5 mm) at the wheel well / footwell

Figure 2 Summary of Test 2-43

MASH Test 2-44 Summary



0.000 s | 0.100 s | 0.250 s | 0.500 s | 1.000 s



General Information

Test Agency	Applus IDIADA KARCO
Test No	P39203-01
Test Designation	2-44
Test Date	06/19/19

Test Article

Name / Model	SLED Low Rotation (Lo-Ro)
Type	Crash Cushion
Crash Cushion Length	7.3 ft. (2.2 m)
Installation Length	126.3 ft. (38.5 m)
Road Surface	Concrete

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2014 RAM 1500
Curb Mass	5,062.8 lbs (2,296.5 kg)
Test Inertial Mass	4,951.5 lbs (2,246.0 kg)
Gross Static Mass	4,951.5 lbs (2,246.0 kg)

Impact Conditions

Impact Velocity	42.25 mph (68.00 km/h)
Impact Angle	19.3°
Location / Orientation	1.9 in. (49 mm) Right
Kinetic Energy	295.5 kip-ft (400.6 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	21.1 ft. (6.4 m) Downstream 11.6 ft. (3.5 m) Right
Exit Box Criteria Met	N/A
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	3.8 °
Maximum Pitch Angle	-12.6 °
Maximum Yaw Angle	-66.2 °

Occupant Risk

Longitudinal OIV	23.6 ft/s (7.2 m/s)
Lateral OIV	3.3 ft/s (1.0 m/s)
Longitudinal RA	-4.1 g
Lateral RA	2.3 g
THIV	23.6 ft/s (7.2 m/s)
PHD	4.2 g
ASI	0.71

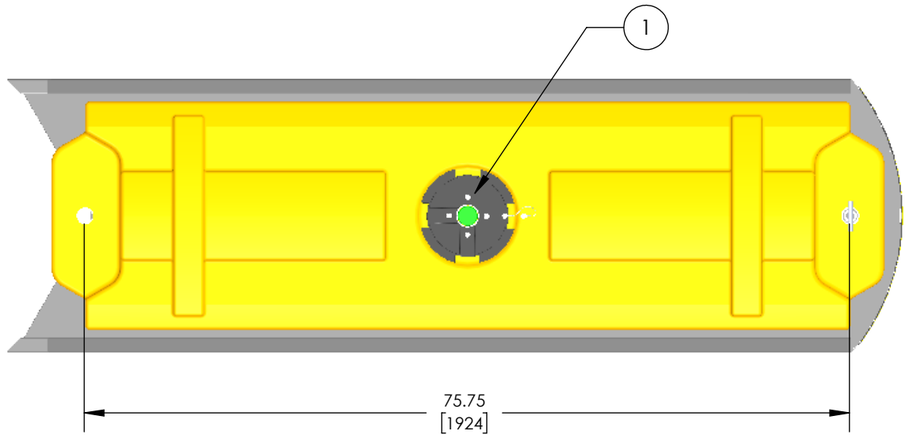
Test Article Deflections

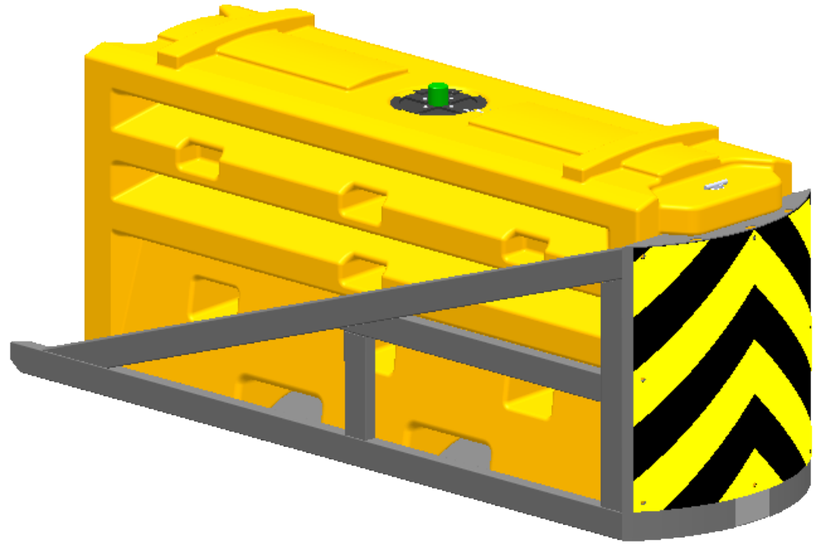
Static	42.6 ft. (13.0 m)
Dynamic	42.6 ft. (13.0 m)
Working Width	32.2 ft. (9.8 m)
Debris Field	35.1 ft. (10.7 m) 14.9 ft. (4.5 m)

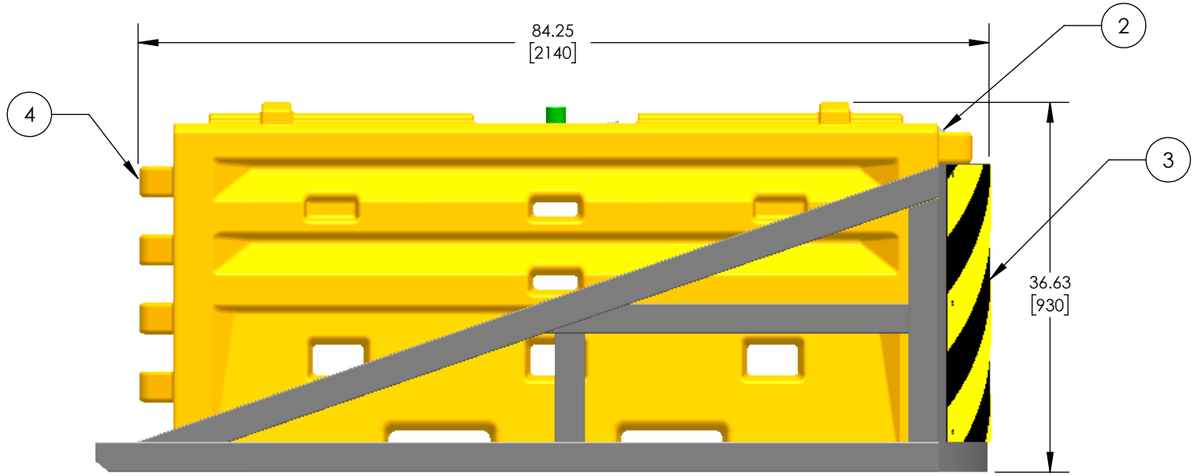
Vehicle Damage

Vehicle Damage Scale	12-FR-6
CDC	12FDEW1
Maximum Intrusion	3.2 in. (80 mm) at Right Front Wheel Well

Figure 2 Summary of Test 2-44







ITEM NO.	DESCRIPTION
1	8" Dia. Fill Hole w/ Twist Lock Lid
2	Connection T-Pin
3	SLED Low Rotaion CIS Frame
4	SLED Low Rotation Module

1. Units: Inches [mm]

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES[mm].
TOLERANCES:
DECIMAL: X.X ± .0625"
X.XX ± .032"
X.XXX ± .015"
DEGREES: ± 0.5°

DRAWN BY: Christopher Jaime	DATE: 5/8/19	
CHECKED BY: FA	DATE: 5/8/19	
APPROVED BY: FA	DATE: 5/8/19	

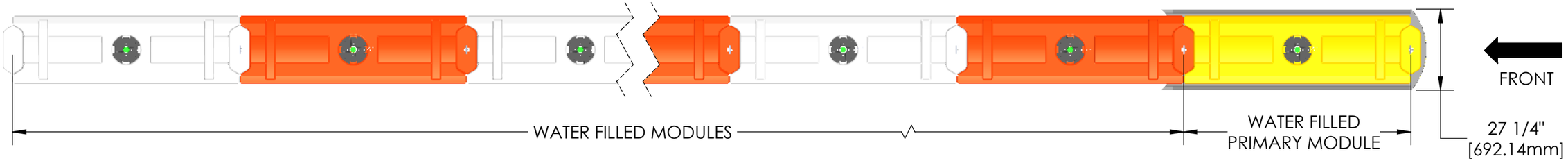
TrafFix Devices Inc.
160 Avenida La Pata
San Clemente, CA 92673
(949) 361-5663
FAX (949) 361-9205
www.traffixdevices.com

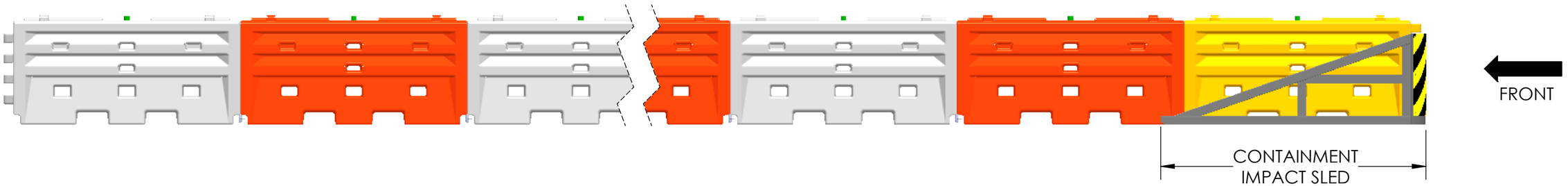
TITLE:

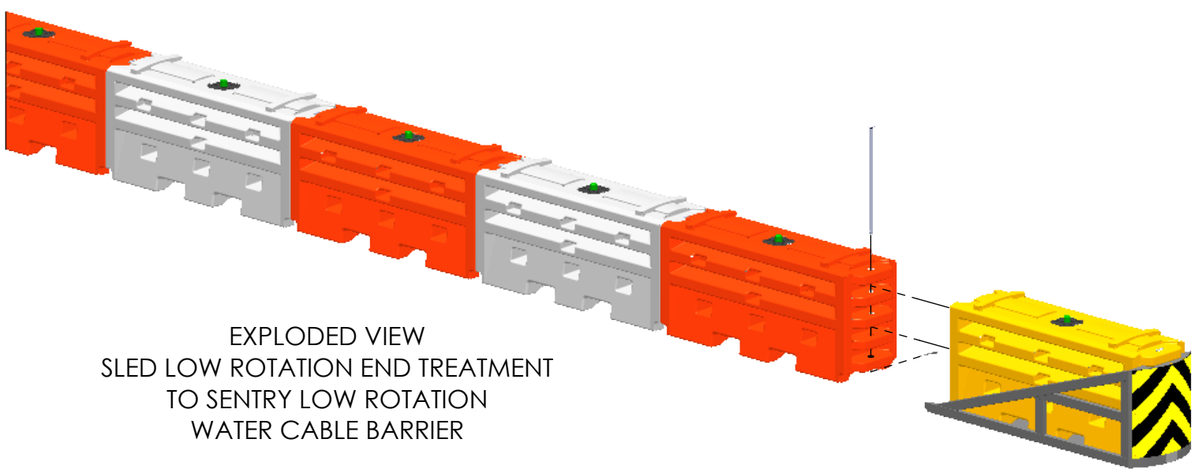
SLED Low Rotation Primary Module

SIZE	DWG. NO.	REV
B	300-327	A

SHEET 1 OF 1







EXPLODED VIEW
SLED LOW ROTATION END TREATMENT
TO SENTRY LOW ROTATION
WATER CABLE BARRIER

1. Units: Inches [mm]

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES[mm].
TOLERANCES:
DECIMAL: X.X ± .0625"
X.XX ± .032"
X.XXX ± .015"
DEGREES: ± 0.5°

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TITLE: SLED Low Rotation End Treatment to Sentry Low Rotation Water Cable Barrier

DRAWN BY: Christopher Jaime	DATE: 4/30/19	SIZE **B**	DWG. NO. 300-326	REV **A**
CHECKED BY: FA	DATE: 4/30/19			
APPROVED BY: FA	DATE: 4/30/19			SHEET 1 OF 1