U.S. Department
of Transportation
Federal Highway
Administration

January 29, 2019

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

In Reply Refer To:
HSST-1 / CC-151

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

Dear Mr. Almanza:

This letter is in response to your October 24, 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-151 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 to SentryII

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 to SentryII
Type of system: Terminal
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: KARCO
Date of request: October 25, 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.

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	October 24, 2018	◉ New ○ Resubmission
	Name:	Felipe Almanza	
	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, Attenuators, & Terminals	◉ Physical Crash Testing ○ Engineering Analysis	SLED to Sentry II	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.

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 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 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 is a, non-redirective, gating crash cushion, designed to shield the end of Sentry II Water Cable Barrier (WCB). The SLED is free standing, does not require anchoring to the road surface and can be used on concrete, asphalt, gravel, and dirt surfaces. The surface used for these tests was concrete. The SLED system consists of two main components: one empty yellow Module and one Containment Impact Sled (CIS). The SLED has overall dimensions of aprox. 88.0 in (2.2 m) length X 27.25 in (0.7 m) wide X 45.875 in (1.2 m) tall. The empty yellow module has overall dimensions of approximately 75.75 in (1.9 m) long (pin to pin) X 22.5 in (0.6 m) wide X 45.875 in (1.2 m) tall. The empty yellow module is manufactured from polyethylene that is UV stabilized. A TL-3 SLED end treatment system for shielding the end of Sentry II WCB consists of one empty yellow module connected to the steel CIS. The empty yellow module with the CIS weighs approx. 322 lbs. (146 kg). Permanently molded within the SLED and Sentry II plastic modules are four corrosion resistant cables. The SLED is designed to shield the end of Sentry II WCB of unlimited length with a minimum Length of Need (LON) of 15 connected Sentry II water filled barrier modules.

The connection between the yellow SLED module and the orange or white Sentry II WCB modules is the same as that between the Sentry II WCB modules. The modules have a series of eleven mating knuckles with vertically aligned concentric holes into which, a steel t-pin is inserted. This provides a positive connection between the SLED and Sentry II WCB. The empty yellow SLED module is positioned inside the CIS and is positively connected to it with a steel t-pin. The yellow SLED empty module is visually identical to the Sentry II barrier modules. The yellow SLED module contains drain holes added to prevent the module from being filled. The CIS is designed using a steel tube frame and sheet metal construction. The CIS has overall dimensions of approx. 88 in (2.2 m) long X 27.25 in (0.7 m) wide X 30.5 in (0.77 m) tall and weighs approx.197 lbs (89.9 kg). 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 directional sheeting on both sides. This allows the user to convert the panel to the proper direction when installing the SLED. Other directional sheeting types and colors are available. The directional indicator panel contours to the curved shape on the front impact face on the CIS and is secured by six bolts. The MASH tested and passed SLED TL-3 end treatment, described above, is used in concert with the MASH Sentry II Water Cable Barrier and the NCHRP-350 Sentry as described within the FHWA Eligibility Letter B-130 and B-279. The MASH tested and passed SLED TL-3 described above is the same product as the previously tested and passed NCHRP-350 SLED TL-3 crash cushion criteria (Reference CC-114). The design manufacturing process, installation is identical between the MASH and NCHRP-350 tested products. Existing inventory is interchangeable as no design changes have been made since the inception of the SLED in February 2011.

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: 2018.10.18 09:20:09 -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
3-30 (1100C)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-31 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-32 (1100C)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-33 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-34 (1100C)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-35 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-36 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-37 (2270P)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted
3-38 (1500A)	Not applicable for non-redirective crash cushion	Non-Relevant Test, not conducted

Required Test Number	Narrative Description	Evaluation Results
3-40 (1100C)	The SLED was positioned offset a quarter of the vehicle's width toward 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 2,421.7 lbs (1,098.5 kg). The test vehicle impacted the SLED at a velocity of 64.99 mph (104.59 km/hr) and at an impact angle of 0.6°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it downstream crushing and rupturing the yellow empty module within the CIS. As the vehicle continued downstream the adjacent water filled orange and white Sentry II barrier modules were crushed and ruptured, dispersing the contained water. The vehicle rotated in a clockwise direction about its yaw axis before coming to a controlled stop 51.8 ft (15.8 m) forward and 23.6 ft (7.2 m) laterally from the initial point of impact. The yellow SLED module and orange/white barrier Sentry II modules remained tethered together via the steel t-pin 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 negigible in cab deformation. 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

3-41 (2270P)	The SLED 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, the SLED's capacity to absorb sufficient impact energy, and the SLED's ability to bring the vehicle to a controlled stop. The test was conducted using a commercially available 2012 Ram 1500 4-door pickup truck with a test inertial mass of 4,983.5 lbs (2,260.5 kg). The test vehicle impacted the SLED at a velocity of 62.86 mph (101.17 km/hr) and at an impact angle of 0.1°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it downstream crushing and rupturing the empty yellow module within the CIS. As the vehicle continued downstream the adjacent water filled orange and white Sentry II barrier modules were crushed and ruptured dispersing the contained water. The yellow SLED module and orange/white barrier Sentry II modules remained tethered together via the steel t-pin between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 8.9 ft (2.7 m) forward 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 negligible in cab deformation. The maximum roll and pitch angle did not exceed 75° and occupant risk values were within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.	PASS

3-42 (1100C)	The SLED 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's ability to bring the vehicle to a controlled stop. The test was conducted using a commercially available 2013 Kia Rio 4-door sedan with a test inertial mass of 2,433.9 lbs (1,104.0 kg). The test vehicle impacted the crash cushion at a velocity of 60.19 mph (96.86 km/hr) and at an impact angle of 5.4°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing and rupturing the empty yellow module within the CIS. As the vehicle continued downstream the adjacent water filled orange and white Sentry II barrier modules were crushed and ruptured, dispersing the contained water. The yellow SLED module and orange/white Sentry II barrier modules remained tethered together via the steel t-pin between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 5.2 ft (1.6 m) forward and 6.6 ft (7.1 m) laterally 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 negligible in cab deformation. The maximum roll and pitch angle did not exceed 75°. Occupant risk values were within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.	PASS

3-43 (2270P)	The SLED 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's ability to bring the vehicle to a controlled stop. The test was conducted using a commercially available 2014 Ram 1500 4-door pickup truck with a test inertial mass of 5,000.0 lbs (2,268.0 kg). The test vehicle impacted the crash cushion at a velocity of 65.47 mph (105.36 km/hr) and at an impact angle of 4.8°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing and rupturing the empty yellow module within the CIS. As the vehicle continued downstream the adjacent water filled orange and water Sentry II barrier modules were crushed and ruptured dispersing the contained water. The yellow SLED module and orange/white barrier Sentry II modules remained tethered together via the steel t-pin between the module knuckle which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 115.6 ft (35.2 m) forward and 20.5 ft (6.3 m) laterally 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 negligible in cab deformation. The maximum roll and pitch angle did not exceed 75°. Occupant risk values were within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.	PASS

3-44 (2270P)	The SLED was positioned at a nominal angle of 20° and the centerline of the impacting vehicle was directed at the corner of the adjacent Sentry II water filled barrier module connected to the empty SLED module within the CIS. The side angled impact test is to evaluate the SLED's ability to safely bring the impacting vehicle to a controlled stop. 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 test procedures for Gating Non-Redirective Crash Cushions. The test was conducted using a commercially available 2012 Ram 1500 4-door pickup truck with a test inertial mass of 5,011.0 lbs (2,273.0 kg). The test vehicle impacted the crash cushion at a velocity of 62.19 mph (100.08 km/hr) and at an impact angle of 20.9°. The test vehicle made initial contact with the leading edge of the CIS and the empty yellow SLED module. Upon impact the CIS began to rotate in a counter clockwise direction and began fracturing the empty yellow module within the CIS. As the vehicle continued to move forward, the adjacent orange and white Sentry II barrier modules also rotated in a counterclockwise direction, were crushed, and ruptured dispersing the contained water. The yellow SLED modules and orange/white Sentry barrier modules remained tethered together via the steel t-pin between the module knuckles which connects directly to the internal molded in steel cables. The impacting vehicle was brought to a controlled stop 100.85 ft (30.74 m) forward and 89.8 ft (27.37 m) laterally 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 the deformation limits were not exceeded. The maximum roll and pitch angle did not exceed 75°.	PASS
3-45 (1500A)	The SLED to Sentry II 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:	Applus IDIADA 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: 2018.10.25 11:38:03 -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 :	TL-371 Valid until July 1, 2019	

Submitter Signature*: Felipe Almanza Digitally signed by Felipe Almanza DN: cn=Felipe Almanza, o=TraffFix Devices Inc., ou=Engineering, email=falmanza@traffixdevices.com, c=US Date: 2018.10.25 15:19:36 -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 3-40 Summary

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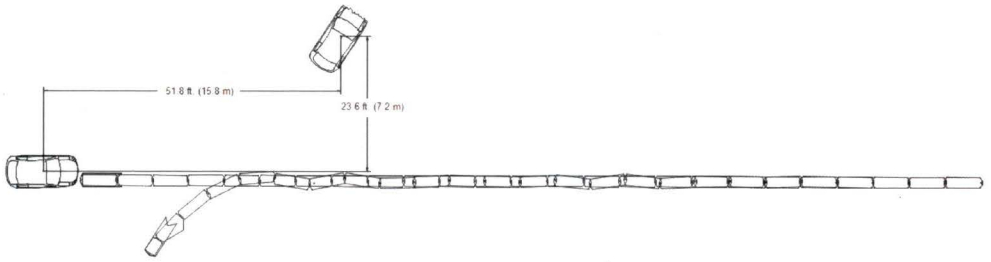


General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P36137-01
Test Designation	3-40
Test Date	11/14/16

Test Article

Name / Model	MASH SLED
Type	Crash Cushion
Installation Length	157.8 ft. (48.1 m)
Terminal Length	88.0 in. (2,235 mm)
Road Surface	Concrete

Test Vehicle

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,357.8 lbs (1,069.5 kg)
Test Inertial Mass	2,421.7 lbs (1,098.5 kg)
Gross Static Mass	2,589.3 lbs (1,174.5 kg)

Impact Conditions

Impact Velocity	64.99 mph (104.59 km/h)
Impact Angle	0.6°
Location / Orientation	16.7 in (423 mm) right of vehicle CL
Kinetic Energy	341.9 kip-ft (463.6 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	51.8 ft (15.8 m) downstream 23.6 ft. (7.2 m) left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	6.3°
Maximum Pitch Angle	10.8°
Maximum Yaw Angle	267.8°

Occupant Risk

Longitudinal OIV	35.8 ft/s (10.9 m/s)
Lateral OIV	2.6 ft/s (0.8 m/s)
Longitudinal RA	-18.0 g
Lateral RA	-2.1 g
THIV	36.1 ft/s (11.0 m/s)
PHD	16.6 g
ASI	1.14

Test Article Deflections

Static	13.5 ft. (4.1 m)
Dynamic	N/A
Working Width	14.4 ft. (4.4 m)

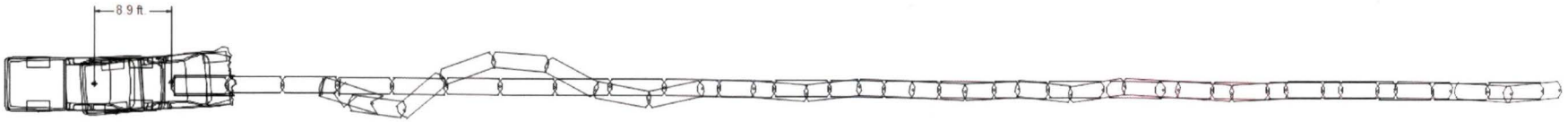
Vehicle Damage

Vehicle Damage Scale	12-FD-2
CDC	12FDEW2
Maximum Intrusion	0.4 in (10 mm)

Figure 2 Summary of Test 3-40

MASH Test 3-41 Summary

0.000 s 0.200 s 0.400 s 0.600 s 0.800 s



General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P36283-01
Test Designation	3-41
Test Date	11/9/16

Test Article

Name / Model	MASH SLED
Type	Crash Cushion
Installation Length	157.8 ft. (48.1 m)
Terminal Length	88.0 in. (2,235 mm)
Road Surface	Concrete

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2012 RAM 1500
Curb Mass	4,920.6 lbs (2,232.0 kg)
Test Inertial Mass	4,983.5 lbs (2,260.5 kg)
Gross Static Mass	4,983.5 lbs (2,260.5 kg)

Impact Conditions

Impact Velocity	62.86 mph (101.17 km/h)
Impact Angle	0.1°
Location / Orientation	0.75 in. (19 mm) left of vehicle CL
Kinetic Energy	658.3 kip-ft (892.5 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	8.9 ft (2.7 m) downstream 2.9 in. (74 mm) left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-4.9°
Maximum Pitch Angle	1.3°
Maximum Yaw Angle	-4.5°

Occupant Risk

Longitudinal OIV	32.2 ft/s (9.8 m/s)
Lateral OIV	0.3 ft/s (0.1 m/s)
Longitudinal RA	-9.1 g
Lateral RA	-1.6 g
THIV	32.2 ft/s (9.8 m/s)
PHD	9.2 g
ASI	0.87

Test Article Deflections

Static	17.2 ft. (5.2 m)
Dynamic	21.7 ft. (6.6 m)
Working Width	5.5 ft. (1.7 m)

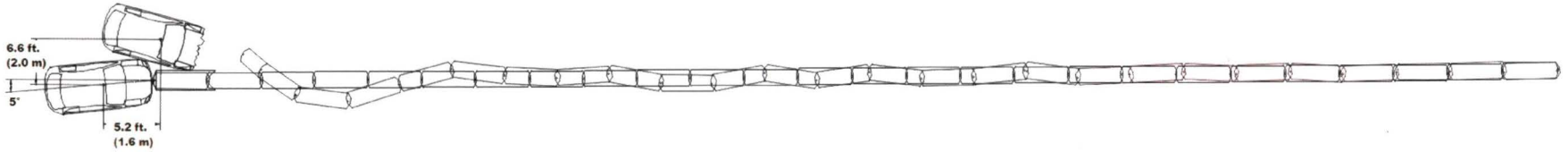
Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW3
Maximum Intrusion	0.3 in. (8 mm)

Figure 2 Summary of Test 3-41

MASH Test 3-42 Summary

0.000 s | 0.125 s | 0.230 s | 0.450 s | 1.400 s



General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P37264-01
Test Designation	3-42
Test Date	08/01/17

Test Article

Name / Model	MASH SLED
Type	Crash Cushion
Installation Length	164.1 ft. (50.0 m)
Terminal Length	88.0 in. (2,235 mm)
Road Surface	Concrete

Test Vehicle

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,435.0 lbs (1,104.5 kg)
Test Inertial Mass	2,433.9 lbs (1,104.0 kg)
Gross Static Mass	2,595.9 lbs (1,177.5 kg)

Impact Conditions

Impact Velocity	60.19 mph (96.86 km/h)
Impact Angle	5.4°
Location / Orientation	0.7 in (18 mm) right of vehicle CL
Kinetic Energy	294.8 kip-ft (399.7 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	5.2 ft (1.6 m) downstream 6.6 ft. (2.0 m) left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-4.2°
Maximum Pitch Angle	-2.3°
Maximum Yaw Angle	17°

Occupant Risk

Longitudinal OIV	34.4 ft/s (10.5 m/s)
Lateral OIV	2.6 ft/s (0.8 m/s)
Longitudinal RA	-17.8 g
Lateral RA	-4.4 g
THIV	34.1 ft/s (10.4 m/s)
PHD	16.6 g
ASI	1.13

Test Article Deflections

Static	10.5 ft. (3.2 m)
Dynamic	12.5 ft. (3.8 m)
Working Width	4.9 ft. (1.5 m)

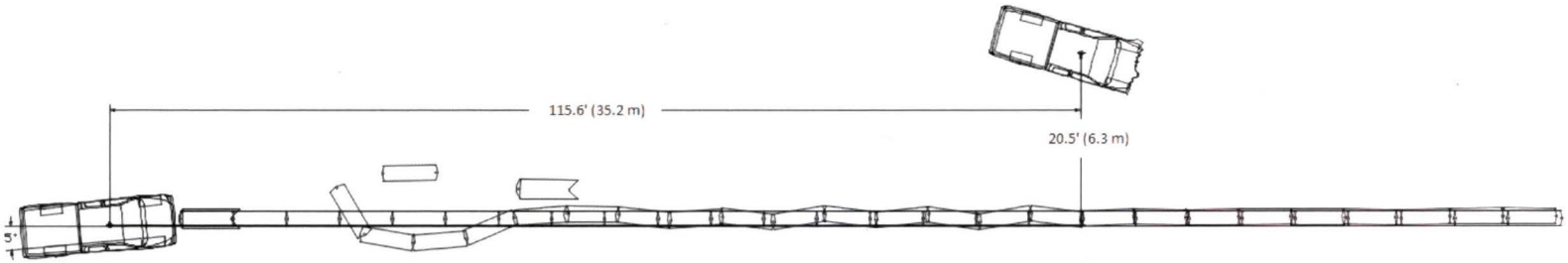
Vehicle Damage

Vehicle Damage Scale	12-FD-3
CDC	12FDEW2
Maximum Intrusion	0.22 in (6 mm)

Figure 2 Summary of Test 3-42

MASH Test 3-43 Summary

0.000 s | 0.180 s | 0.450 s | 0.810 s | 1.080 s



General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P37265-01
Test Designation	3-43
Test Date	08/03/17

Test Article

Name / Model	MASH SLED
Type	Crash Cushion
Installation Length	162.5 ft. (49.5 m)
Terminal Length	88.0 in. (2,235 mm)
Road Surface	Concrete

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2014 RAM 1500
Curb Mass	4,998.9 lbs (2,267.5 kg)
Test Inertial Mass	5,000.0 lbs (2,268.0 kg)
Gross Static Mass	5,000.0 lbs (2,268.0 kg)

Impact Conditions

Impact Velocity	65.47 mph (105.36 km/h)
Impact Angle	4.8°
Location / Orientation	0.5 in. (13 mm) right of vehicle CL
Kinetic Energy	716.4 kip-ft (971.4 kJ)

Exit Conditions

Exit Velocity	34.3 mph (55.2 km/h)
Exit Angle	20.6°
Final Vehicle Position	115.6 ft (35.2 m) downstream 20.5 ft. (6.3 m) left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-4.0°
Maximum Pitch Angle	-4.9°
Maximum Yaw Angle	-21.0°

Occupant Risk

Longitudinal OIV	30.8 ft/s (9.4 m/s)
Lateral OIV	5.2 ft/s (1.6 m/s)
Longitudinal RA	-6.4 g
Lateral RA	-3.4 g
THIV	31.2 ft/s (9.5 m/s)
PHD	6.4 g
ASI	0.82

Test Article Deflections

Static	18.8 ft. (5.7 m)
Dynamic	23.2 ft. (7.1 m)
Working Width	7.0 ft. (2.1 m)

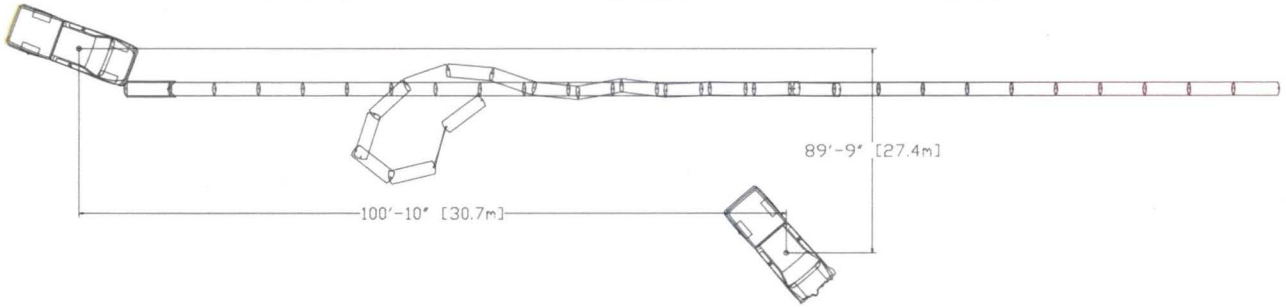
Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW3
Maximum Intrusion	0.3 in. (8 mm)

Figure 2 Summary of Test 3-43

MASH Test 3-44 Summary

0.000 s 0.100 s 0.180 s 0.325 s 0.625 s



General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P37266-01
Test Designation	3-44
Test Date	07/28/17

Test Article

Name / Model	MASH SLED
Type	Crash Cushion
Installation Length	162.5 ft. (49.5 m)
Terminal Length	88.0 in. (2,235 mm)
Road Surface	Concrete

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2012 RAM 1500
Curb Mass	4,960.3 lbs (2,250.0 kg)
Test Inertial Mass	5,011.0 lbs (2,273.0 kg)
Gross Static Mass	5,011.0 lbs (2,273.0 kg)

Impact Conditions

Impact Velocity	62.19 mph (100.08 km/h)
Impact Angle	20.9°
Location / Orientation	2.4 in. (62 mm) left of the vehicle CL
Kinetic Energy	647.9 kip-ft (878.4 kJ)

Exit Conditions

Exit Velocity	31.99 mph (51.48 km/h)
Exit Angle	39.4°
Final Vehicle Position	100.85 ft (30.74 m) downstream 89.80 ft. (27.37 m) right
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	5.7°
Maximum Pitch Angle	6.7°
Maximum Yaw Angle	27.2

Occupant Risk

Longitudinal OIV	28.5 ft/s (8.7 m/s)
Lateral OIV	2.0 ft/s (0.6 m/s)
Longitudinal RA	-10.4 g
Lateral RA	4.8 g
THIV	28.5 ft/s (8.7 m/s)
PHD	11.3 g
ASI	0.71

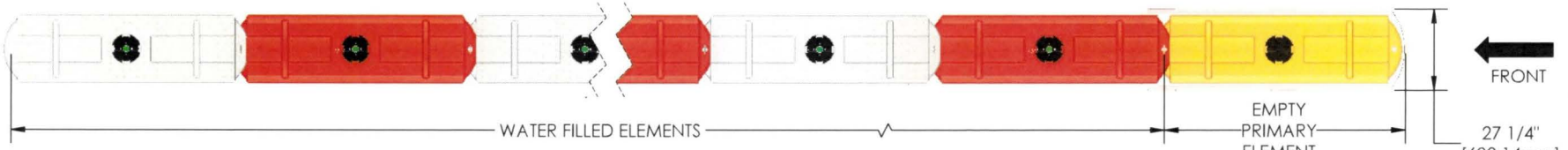
Test Article Deflections

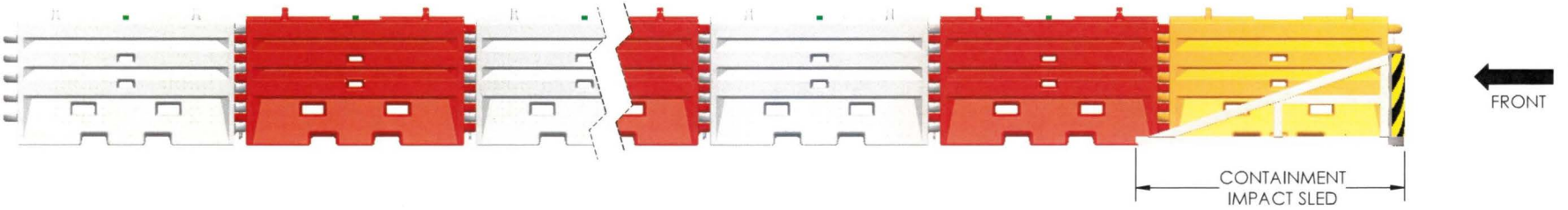
Static	13.9 ft. (4.2 m)
Dynamic	15.4 ft. (4.7 m)
Working Width	15.4 ft. (4.7 m)

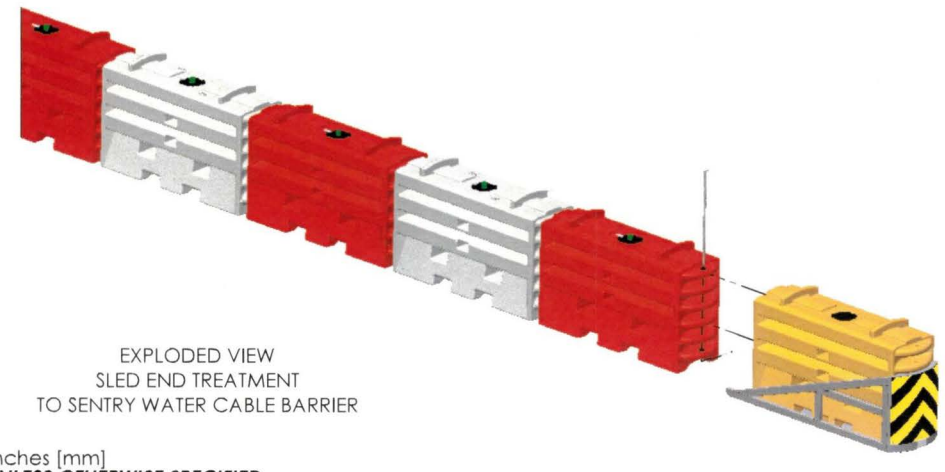
Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW3
Maximum Intrusion	1.9 in. (49 mm)

Figure 2 Summary of Test 3-44







EXPLODED VIEW
SLED END TREATMENT
TO SENTRY 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°

DRAWN BY: Christopher Jaime	DATE: 11/08/16	
CHECKED BY: FA	DATE: 11/08/16	
APPROVED BY: FA	DATE: 11/08/16	

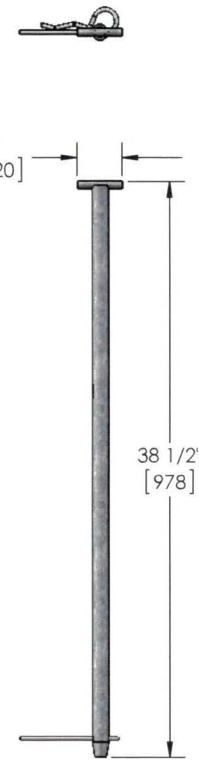
TrafFix Devices Inc.
160 Avenida La Pata
San Clemente, CA 92673
(949) 361-5663
FAX (949) 361-9205
www.traffixdevices.com

TITLE:

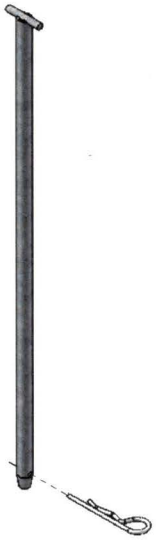
SLED End Treatment to Sentry Water Cable Barrier

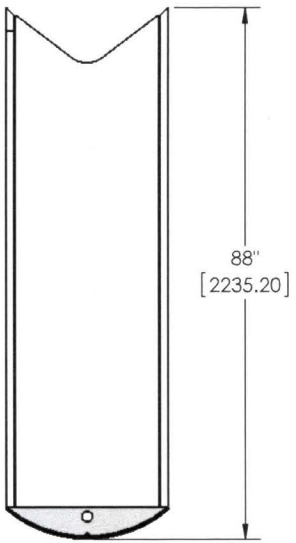
SIZE	DWG. NO.	REV
B	300-248	A

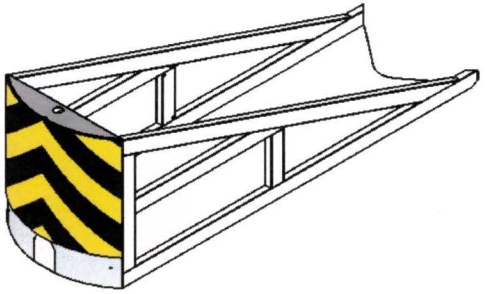
SHEET 1 OF 1

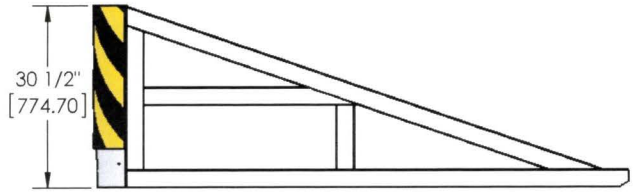


T PIN









FRONT STEEL CAP

UNITS: INCHES [mm]
MATERIAL: STEEL
NOTES: UNLESS OTHERWISE SPECIFIED

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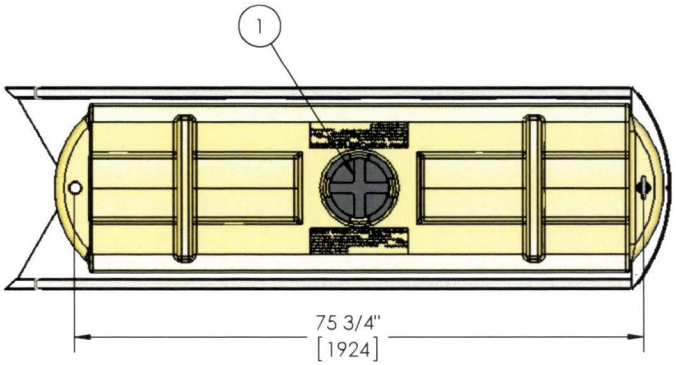
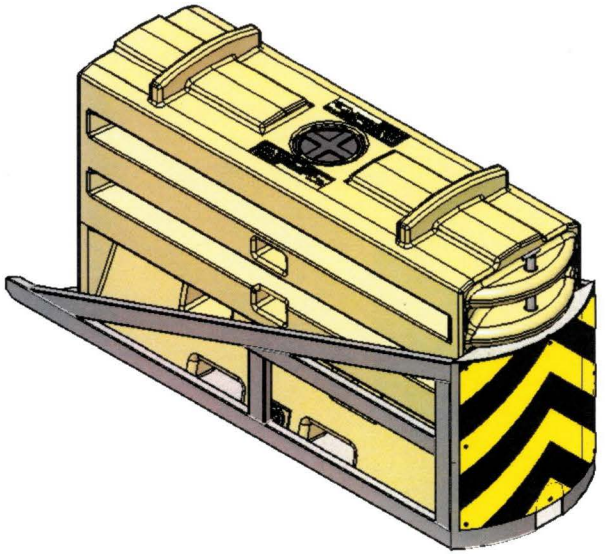
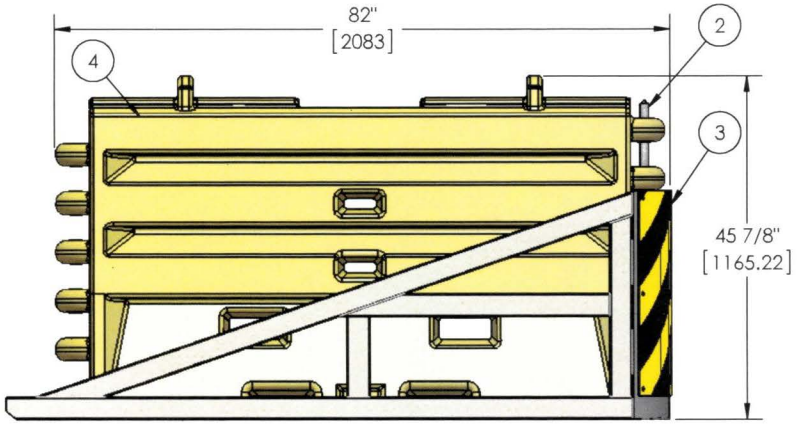
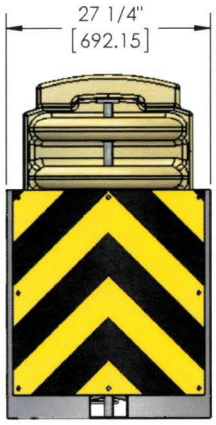
TITLE:
SLED END TREATMENT HARDWARE

DRAWN BY:	DATE:	SIZE	DWG. NO.	REV
JEREMY SMITH	02-09-10	B	300-106	H
CHECKED BY: FA	DATE: 10-16-09			
APPROVED BY: FA	DATE: 10-16-09			









ITEM NO.	DESCRIPTION
1	8" DIA FILL HOLE W/ TWIST LOCK LID
2	CONNECTION STEEL DROP PIN
3	FRONT STEEL SLED
4	SENTRY END TREATMENT

DRAWN BY: JEREMY SMITH DATE: 10-16-09
CHECKED BY: FA DATE: 10-16-09
APPROVED BY: FA DATE: 10-16-09

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160 Avenida La Pata
San Clemente, CA 92673
(949) 361-5663
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TITLE:
SLED END TREATMENT PRIMARY ELEMENT

SIZE B | DWG. NO. 326 | REV H

SHEET 1 OF 1