U.S. Department
of Transportation
Federal Highway Administration

January 6, 2020

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

In Reply Refer To:
HSST-1/CC-155

Mr. Felipe Almanza
TrafFix Devices Inc.
160 Avenida La Pata
San Clemente California 92673

Dear Mr. Almanza:

This letter is in response to your March 13, 2019 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-155 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 MGS Guardrail

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 MGS Guardrail
Type of system: Crash Cushion
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: KARCO
Date of request: March 13, 2019

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-155 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

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:	March 13, 2019	◉ New ○ Resubmission
	Name:	Robert 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, Attenuators, & Terminals	◉ Physical Crash Testing ○ Engineering Analysis	SLED to Guardrail	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:	Robert 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 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 free standing, non-redirective, gating crash cushion, designed to shield the end of guardrail. The SLED does not require anchoring to the road surface and can be used on concrete, asphalt, gravel, and dirt surfaces. The SLED was tested on a dirt surface. The SLED can be used in TL-1, TL-2, and TL-3 installations to treat the end of guardrail. The SLED attached to guardrail test series was conducted at TL-3 conditions. The SLED utilizes a transition that is mechanically attached to the guardrail it is shielding. The SLED system consists of four main components: three yellow water filled modules, one yellow empty module, one Containment Impact Sled (CIS), and one transition. The SLED's overall dimensions are 25.25 ft. (7.7 m) long (pin to pin) x 27.25 in. (0.7 m) wide x 45.875 in. (1.2 m) tall. The yellow modules are manufactured from polyethylene that is UV stabilized. The SLED system consists of three water filled modules with the front empty module connected to the steel CIS. The water filled modules weigh approx. 2,000 lbs. (907 kg) when filled. The SLED'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 four corrosion resistant cables. The modules are designed with knuckles at the ends which contains a series of vertically aligned concentric holes that allow a steel t-pin to be inserted to connect adjacent modules together. When modules are pinned together there are a total of eleven knuckles aligned with the steel t-pin inserted. At the front of the SLED system is the steel CIS that is connected to the front yellow empty module. The CIS is designed using a steel tube frame and sheet metal construction. The front yellow empty 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 three 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 is attached to the guardrail using a w-beam transition panel and a standard panel attached to the w-beam. The SLED transition is made of three components: one steel transition frame, one standard transition panel, and one w-beam transition panel. 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 drop pin. This is the same connection method used between the yellow water filled modules and between the CIS and the front yellow empty module. The transition panels are pinned to the transition frame using outboard alignment pins designed into the transition frame. The transition panel is attached to the guardrail panel using eight guardrail bolts. The standard transition panel and w-beam transition panels are also connected to the w-beam using one guardrail post bolt and two wooden blockouts.

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, o=Applus IDIADA KARCO Engineering, LLC., ou, email=Steven.Matsusaka@idiada.com, c=US Date: 2019.04.12 17:08:58 -07'00'	
Address:	9270 Holly Rd, Adelanto, CA 92301	Same as Submitter ☐
Country:	United States of America	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 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 2,471.3 lbs. (1,121.0 kg). The test vehicle impacted the SLED at a velocity of 62.78 mph (101.03 km/h) and at an impact angle of 0.5°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing and rupturing the yellow empty module within the CIS. As the vehicle continued downstream the three yellow water filled modules were crushed, ruptured, and dispersed the contained water. The vehicle rotated in a counter clockwise direction about its yaw axis before coming to a controlled stop 23.0 ft. (7.0 m) forward and 10.4 ft. (3.2 m) lateral from the initial point of impact. The yellow SLED modules remained tethered together and securely attached to the guardrail 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). The SLED attached to guardrail met all the requirements of MASH Test 3-40.	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, capacity to absorb sufficient kinetic energy, and the SLED's ability to bring the vehicle to a controlled stop. The test was conducted using a commercially available 2013 RAM 1500 4-door pickup truck with a test inertial mass of 4,986.8 lbs. (2,262.0 kg). The test vehicle impacted the SLED at a velocity of 62.75 mph (100.99 km/h) and at an impact angle of 0.6°. The test vehicle impacted the steel Containment Impact Sled (CIS), pushing it rearward crushing the yellow empty module within the CIS. As the vehicle continued downstream the three yellow water filled modules were crushed, ruptured, and dispersed the contained water. The yellow SLED modules remained tethered together and securely attached to the guardrail 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 stop 8.2 ft. (2.5 m) rearward and 5.6 ft. (1.7 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° and occupant risk values were within limits per MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SLED attached to guardrail met all the requirements of MASH Test 3-41.	PASS

3-42 (1100C)	The SLED was positioned at a nominal angle of 5° with the centerline of the test vehicle aligned with the nose of the system. The angled 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 2016 Hyundai Accent 4-door sedan with a test inertial mass of 2,426.1 lbs. (1,100.5 kg). The test vehicle impacted the SLED at a velocity of 61.99 mph (99.76 km/h) and at an impact angle of 4.2°. 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 three yellow water filled modules were crushed, ruptured, and dispersed the contained water. The vehicle rotated in a clockwise direction about its yaw axis before coming to a controlled stop 15.7 ft. (4.8 m) downstream and 5.8 ft. (1.8 m) lateral from the initial point of impact. The yellow SLED modules remained tethered together and securely attached to the guardrail 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). The SLED attached to guardrail met all the requirements of MASH Test 3-42.	PASS

3-43 (2270P)	The SLED was positioned at a nominal angle of 5° with the centerline of the test vehicle aligned with the nose of the system. The angled 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 RAM 1500 4-door pickup truck with a test inertial mass of 5,003.3 lbs. (2,269.5 kg). The test vehicle impacted the crash cushion at a velocity of 63.22 mph (101.75 km/h) 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 yellow empty module within the CIS. As the vehicle continued rearward the three yellow water filled modules were crushed, ruptured, and dispersed the contained water. The vehicle rotated in a clockwise direction about its yaw axis before coming to a controlled stop 97.4 ft. (29.7 m) forward and 10.8 ft. (3.3 m) lateral from the initial point of impact. The yellow SLED modules remained tethered together and securely attached to the guardrail 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). The SLED attached to guardrail met all the requirements of MASH Test 3-43.	PASS

3-44 (2270P)	The SLED was positioned at a nominal angle of 20° with the center line of the test vehicle directed at the corner of the guardrail that is connected to the rearmost SLED yellow water filled module. The side angled impact test is to evaluate the SLED's ability to bring the vehicle to a controlled stop. This angle and intersection directed the test vehicle into the third module from the front of the system. The test was conducted using a commercially available 2012 RAM 1500 4-door pickup truck with a test inertial mass of 4,989.0 lbs. (2,263.0 kg). The test vehicle impacted the SLED at a velocity of 62.38 mph (100.39 km/h) and at an impact angle of 19.8°. The test vehicle impacted the third yellow water filled module, causing the vehicle to redirect slightly while crushing and rupturing the yellow filled module. As the vehicle continued forward the rearmost yellow water filled module was impacted and ruptured, which caused it to tear and disperse the contained water at the transition. The W-beam transition panel separated from the transition pin and allowed the vehicle to continue forward behind the crash cushion. The vehicle came to a controlled stop 117.8 ft. (35.9 m) downstream and 62.1 ft. (18.9 m) lateral from the initial point of impact. The yellow SLED modules remained tethered together but separated from the guardrail at the transition portion of the system. The steel t-pins between the module knuckles which connects directly to the internal molded in steel cables remained intact. 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°. The SLED attached to guardrail met all the requirements of MASH Test 3-44.	PASS
3-45 (1500A)	Test 3-45 is intended for the evaluation of staging devices. The SLED uses water to dissipate the impacting vehicle's kinetic energy. All water-filled modules are physically the same in composition and contain the same amount of water. The force to activate each module is the same throughout the system, making the activation force linear throughout the system. Therefore the SLED is not a staging devices and test 3-45 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 Digitally signed by Steven Matsusaka DN: cn=Steven Matsusaka, o=Applus IDIADA KARCO Engineering, LLC., ou, email=Steven.Matsusaka@idiada.com, c=US Date: 2019.04.12 17:10:17 -07'00'	
Address:	9270 Holly Rd, 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 1 2018 - July 1, 2019	

Submitter Signature*: Robert Ramirez Digitally signed by Robert Ramirez Date: 2019.04.15 09:22:44 -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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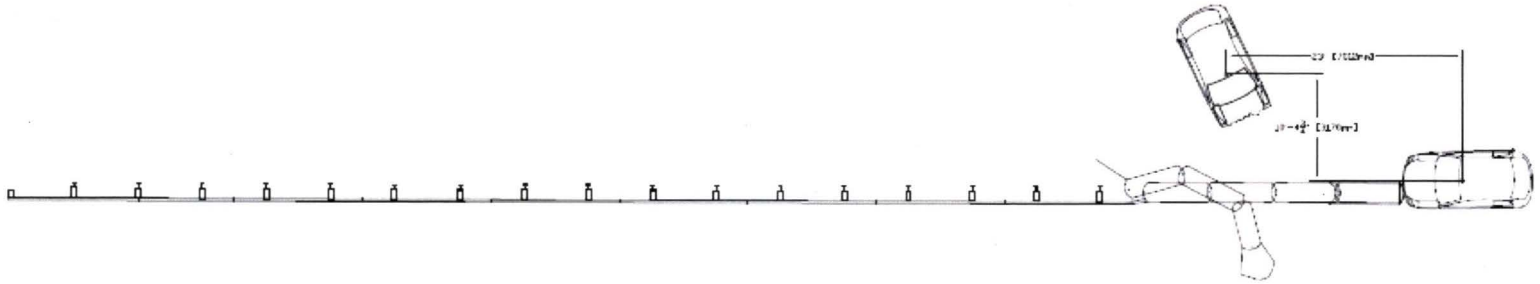


General Information

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P37262-01
Test Designation	3-40
Test Date	07/23/17

Test Article

Name / Model	SLED Attached to Guardrail
Type	Crash Cushion
Article Length	25.0 ft. (7.6 m)
Installation Length	136.1 ft. (41.5 m)
Road Surface	Medium to Fine Silty Soil

Test Vehicle

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,554.0 lbs (1,158.5 kg)
Test Inertial Mass	2,471.3 lbs (1,121.0 kg)
Gross Static Mass	2,627.9 lbs (1,192.0 kg)

Impact Conditions

Impact Velocity	62.78 mph (101.03 km/h)
Impact Angle	0.5°
Location / Orientation	Offset 16.8 in. (428 mm)
Kinetic Energy	325.6 kip-ft (441.5 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	23.0 ft. (7.0 m) downstream 10.4 ft. (3.2 m) right
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-8.1 °
Maximum Pitch Angle	5.2 °
Maximum Yaw Angle	-113.7 °

Occupant Risk

Longitudinal OIV	10.6 m/s (34.8 ft/s)
Lateral OIV	0.3 m/s (1.0 ft/s)
Longitudinal RA	-18.6 g
Lateral RA	-1.8 g
THIV	10.5 m/s (34.4 ft/s)
PHD	18.2 g
ASI	1.18

Test Article Deflections

Static	7.2 ft. (2.2 m)
Dynamic	7.2 ft. (2.2 m)
Working Width	9.4 ft. (2.9 m)
Debris Field	65.9 ft. (20.0 m) downstream 24.3 ft. (7.4 m) right

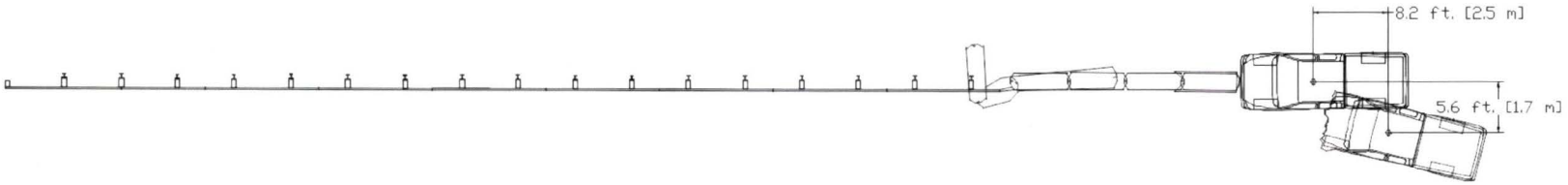
Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW4
Maximum Intrusion	0.8 in. (19 mm)

Figure 2 Summary of Test 3-40

MASH Test 3-41 Summary

0.000 s | 0.127 s | 0.381 s | 0.635 s | 1.143 s



General Information

Test Agency	IDIADA KARCO
KARCO Test No	P37165-01
Test Designation	3-41
Test Date	06/06/17

Test Article

Name / Model	SLED Attached to GR
Type	Non-redirective Crash Cushion
Article Length	25.3 ft. (7.7 m)
Installation Length	131.4 (40.1 m)
Road Surface	Medium to Fine Silty Soil

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2013 Ram 1500
Curb Mass	4,888.7 lbs (2,217.5 kg)
Test Inertial Mass	4,986.8 lbs (2,262.0 kg)
Gross Static Mass	4,986.8 lbs (2,262.0 kg)

Impact Conditions

Impact Velocity	62.75 mph (100.99 km/h)
Impact Angle	0.6°
Location / Orientation	Center vehicle to center of CC
Kinetic Energy	656.5 kip-ft (890.0 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	8.2 ft. (2.5 m) Rearward 5.6 ft. (1.7 m) Left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	20.8 °
Maximum Pitch Angle	-12.0 °
Maximum Yaw Angle	5.6 °

Occupant Risk

Longitudinal OIV	11.2 m/s (36.7 ft/s)
Lateral OIV	0.3 m/s (1.0 ft/s)
Longitudinal RA	-11.5 g
Lateral RA	1.2 g
THIV	11.2 m/s (36.7 ft/s)
PHD	10.8 g
ASI	1.13

Test Article Deflections

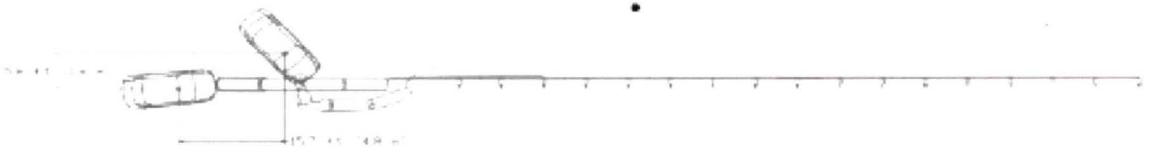
Static	1.6 ft. (0.5 m)
Dynamic	1.6 ft. (0.5 m)
Working Width	10.7 ft. (3.3 m)
Debris Field	N/A

Vehicle Damage

Vehicle Damage Scale	12-FC-6
CDC	12FDEW2
Maximum Intrusion	0.4 in. (10 mm)

Figure 2 Summary of Test 3-41

MASH Test 3-42 Summary



General Information	
Test Agency	IDIADA KARCO
Test No.	P38130-01
Test Designation	3-42
Test Date	05/18/18
Test Article	
Name / Model	SLED Attached to Guardrail
Type	Non-Redirective Crash Cushion
Article Length	25.0 ft (7.6 m)
Installation Length	136.1 ft (41.5 m)
Road Surface	Compacted Soil
Test Vehicle	
Type / Designation	1100C
Year, Make, and Model	2016 Hyundai Accent
Curb Mass	2,451.5 lbs (1,112.0 kg)
Test Inertial Mass	2,426.1 lbs (1,100.5 kg)
Gross Static Mass	2,588.2 lbs (1,174.0 kg)

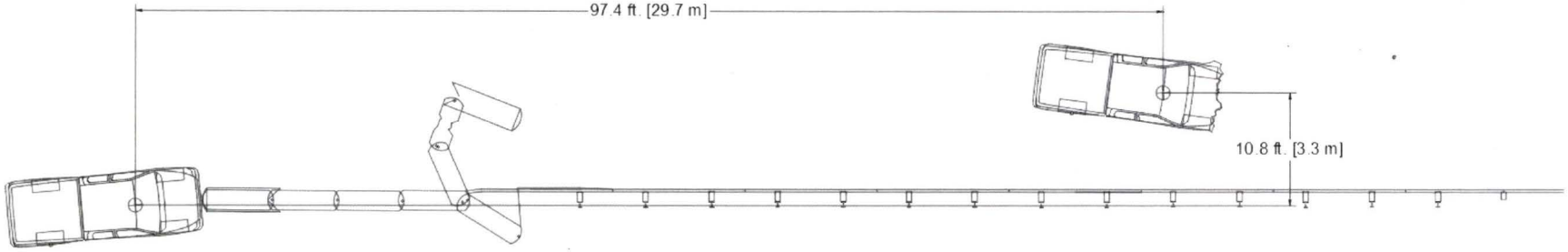
Impact Conditions	
Impact Velocity	61.99 mph (99.76 km/h)
Impact Angle	4.2°
Location / Orientation	Center of CIS
Kinetic Energy	311.7 kip-ft (422.6 kJ)
Exit Conditions	
Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	15.7 ft (4.8 m) downstream 5.8 ft (1.8 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	7.7 °
Maximum Pitch Angle	-5.0 °
Maximum Yaw Angle	51.3 °

Occupant Risk	
Longitudinal OIV	33.8 ft/s (10.3 m/s)
Lateral OIV	1.0 ft/s (0.3 m/s)
Longitudinal RA	-19.5 g
Lateral RA	-4.8 g
THIV	33.8 ft/s (10.3 m/s)
PHD	18.9 g
ASI	1.20
Test Article Deflections	
Static	0.7 ft (0.2 m)
Dynamic	5.4 ft. (1.6 m)
Working Width	11.1 ft (3.4 m)
Debris Field	85.5 ft (26.0 m) downstream 34.8 ft. (10.6 m) Left
Vehicle Damage	
Vehicle Damage Scale	12-FD-4
CDC	12FDEW4
Maximum Intrusion	0.1 in. (3 mm)

Figure 2 Summary of Test 3-42

MASH Test 3-43 Summary

0.000 s 0.100 s 0.200 s 0.600 s 1.00 s



General Information

Test Agency	IDIADA KARCO
Test No	P38132-01
Test Designation	3-43
Test Date	05/24/18

Test Article

Name / Model	SLED Attached to GR
Type	Non-Redirective Crash Cushion
Article Length	25.3 ft. (7.7 m)
Installation Length	131.4 ft. (40.1 m)
Road Surface	Compacted Soil

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2013 RAM 1500
Curb Mass	4,883.2 lbs (2,215.0 kg)
Test Inertial Mass	5,003.3 lbs (2,269.5 kg)
Gross Static Mass	5,003.3 lbs (2,269.5 kg)

Impact Conditions

Impact Velocity	63.22 mph (101.75 km/h)
Impact Angle	5.4°
Location / Orientation	Center of CIS
Kinetic Energy	668.5 kip-ft (906.4 kJ)

Exit Conditions

Exit Velocity	14.04 mph (22.60 km/h)
Exit Angle	11.2°
Final Vehicle Position	97.4 ft. (29.7 m) dw 10.8 ft. (3.3 m) Left
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	8.8 °
Maximum Pitch Angle	23.8 °
Maximum Yaw Angle	-22.9 °

Occupant Risk

Longitudinal OIV	32.2 ft/s (9.8 m/s)
Lateral OIV	2.6 ft/s (0.8 m/s)
Longitudinal RA	-12.8 g
Lateral RA	-3.9 g
THIV	32.2 ft/s (9.8 m/s)
PHD	12.0 g
ASI	0.88

Test Article Deflections

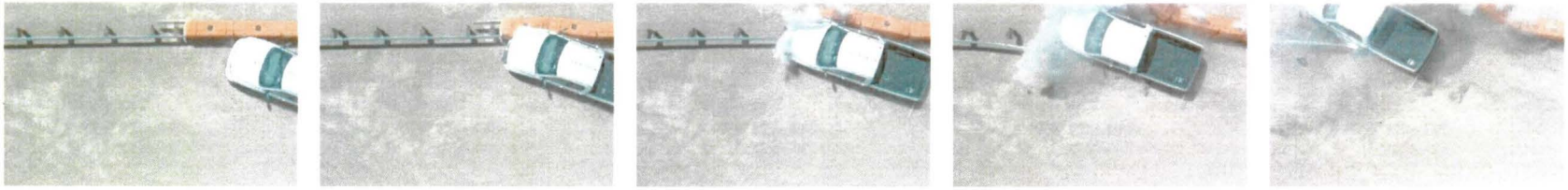
Static	7.8 ft. (2.4 m)
Dynamic	8.2 ft. (2.5 m)
Working Width	16.4 ft. (5.0 m)
Debris Field	110.9 ft. (33.8 m) downstream 29.8 ft. (9.1 m) Left

Vehicle Damage

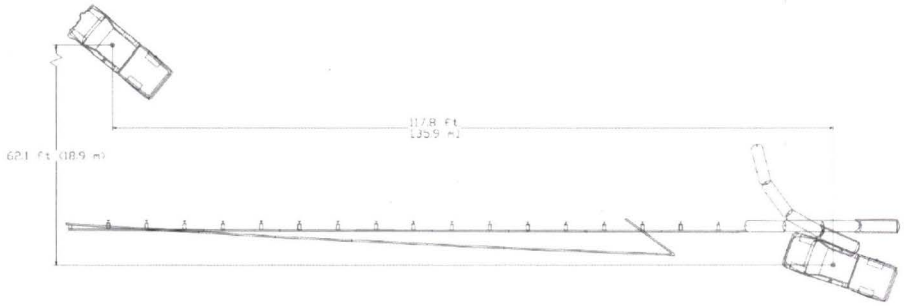
Vehicle Damage Scale	12-FD-4
CDC	12FDEW4
Maximum Intrusion	0.2 in. (6 mm)

Figure 2 Summary of Test 3-43

MASH Test 3-44 Summary



0.000 s 0.060 s 0.120 s 0.220 s 0.420 s



General Information

Test Agency	IDIADA KARCO
Test No	P37261-01
Test Designation	3-44
Test Date	07/26/17

Test Article

Name / Model	SLED Attached to GR
Type	Non-Redirective Crash Cushion
Article Length	25.3 ft. (7.7 m)
Installation Length	131.4 ft. (40.1 m)
Road Surface	Compacted Soil

Test Vehicle

Type / Designation	2270P
Year, Make, and Model	2012 RAM 1500
Curb Mass	4,990.1 lbs (2,263.5 kg)
Test Inertial Mass	4,989.0 lbs (2,263.0 kg)
Gross Static Mass	4,989.0 lbs (2,263.0 kg)

Impact Conditions

Impact Velocity	62.38 mph (100.39 km/h)
Impact Angle	19.8°
Location / Orientation	Veh. CL to W-Beam Leading
Kinetic Energy	649.0 kip-ft (879.9 kJ)

Exit Conditions

Exit Velocity	25.34 mph (40.78 km/h)
Exit Angle	29.5°
Final Vehicle Position	117.8 ft. (35.9 m) downstream 62.1 ft. (18.9 m) Right
Vehicle Snagging	Minor
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-4.7 °
Maximum Pitch Angle	9.8 °
Maximum Yaw Angle	13.0 °

Occupant Risk

Longitudinal OIV	26.6 ft/s (8.1 m/s)
Lateral OIV	6.9 ft/s (2.1 m/s)
Longitudinal RA	-10.0 g
Lateral RA	4.1 g
THIV	27.6 ft/s (8.4 m/s)
PHD	10.1 g
ASI	0.82

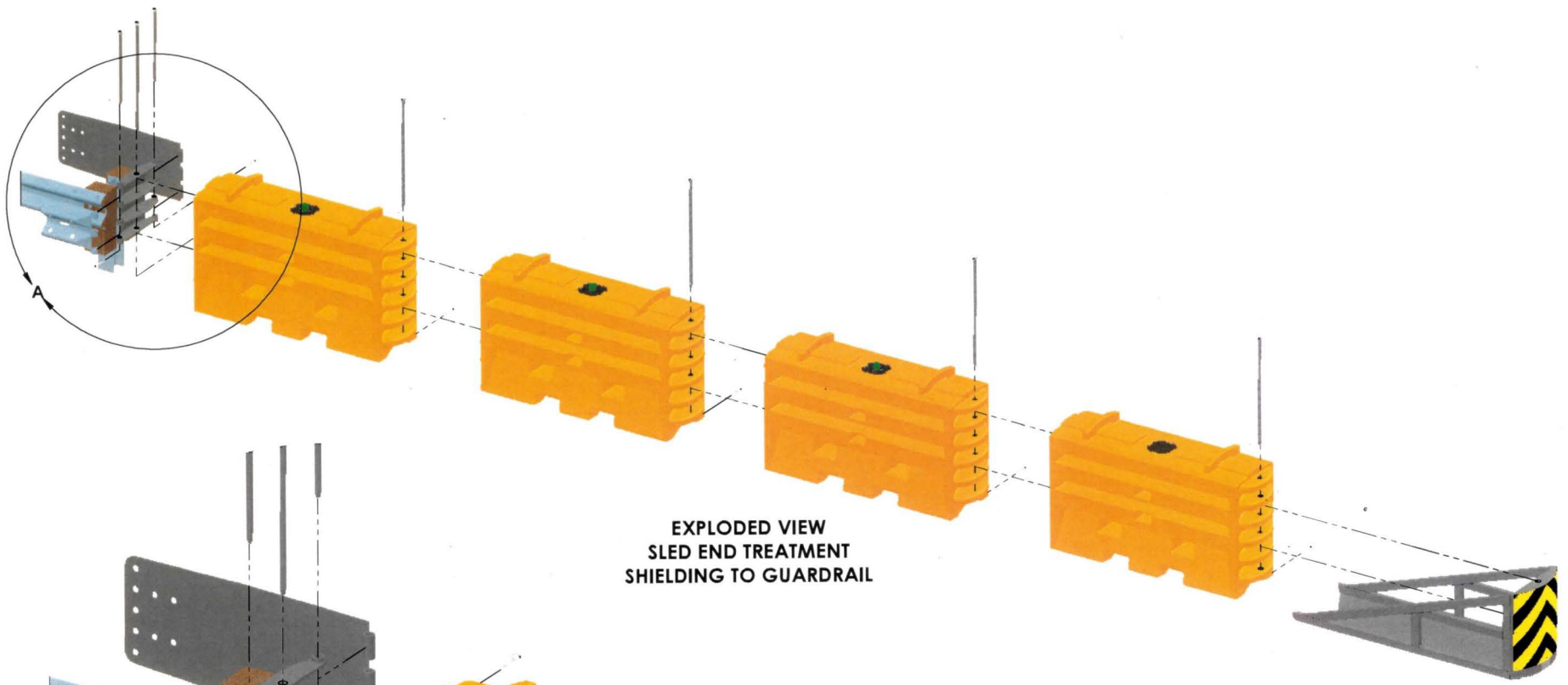
Test Article Deflections

Static	14.3 ft. (4.4 m)
Dynamic	N/A
Working Width	18.1 ft (5.5 m)
Article Debris Field	105.9 ft. (32.3 m) downstream 45.9 ft. (14.0 m) right

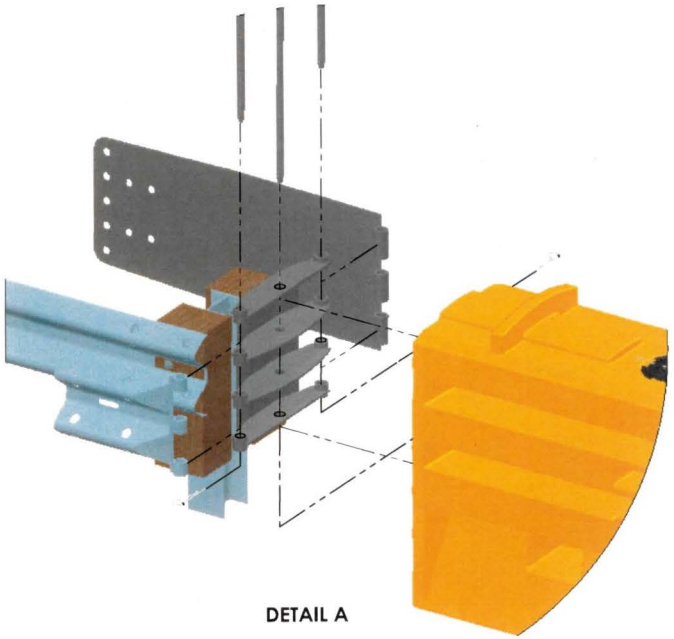
Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW4
Maximum Intrusion	1.3 in. (33 mm)

Figure 2 Summary of Test 3-44



EXPLODED VIEW
SLED END TREATMENT
SHIELDING TO GUARDRAIL



DETAIL A

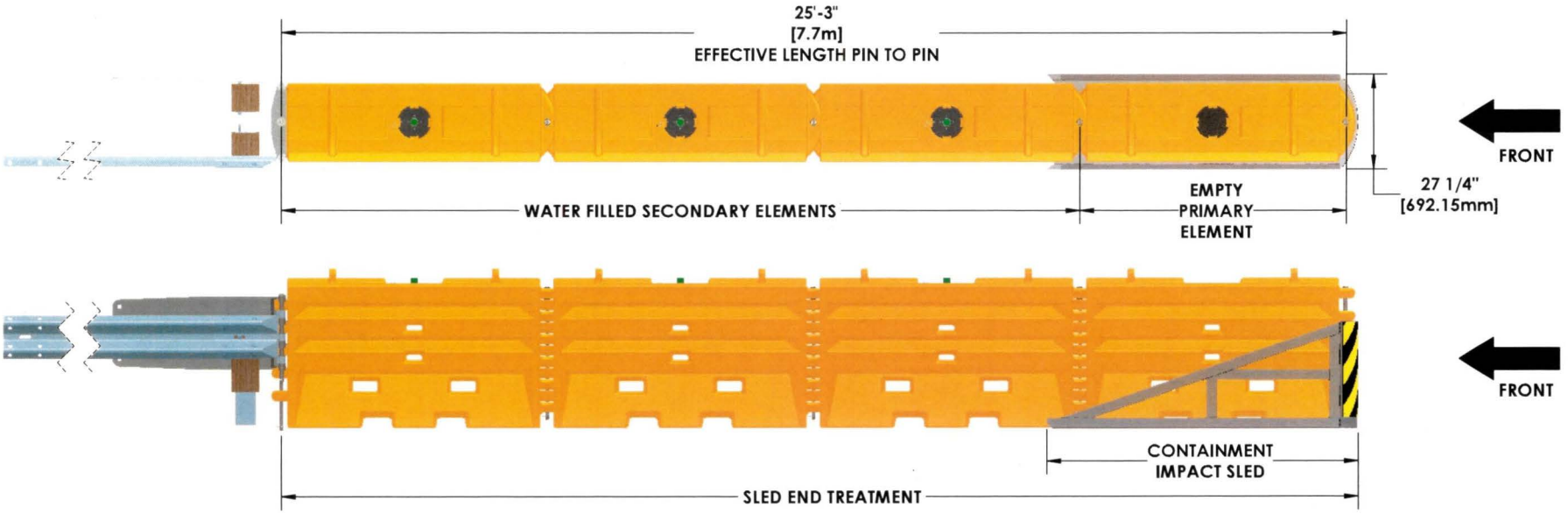
UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES[mm].

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 W/ GUARDRAIL

DRAWN BY: Christopher Jaime	DATE: 5/17/17	SIZE B	DWG. NO. 300-262
CHECKED BY: FA	DATE: 5/17/17		REV A
APPROVED BY: FA	DATE: 5/17/17		SHEET 2 OF 2



CUT AWAY SLED END TREATMENT
ALL SECTIONS CONTAIN INTERNAL MOLDED-IN CABLES

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
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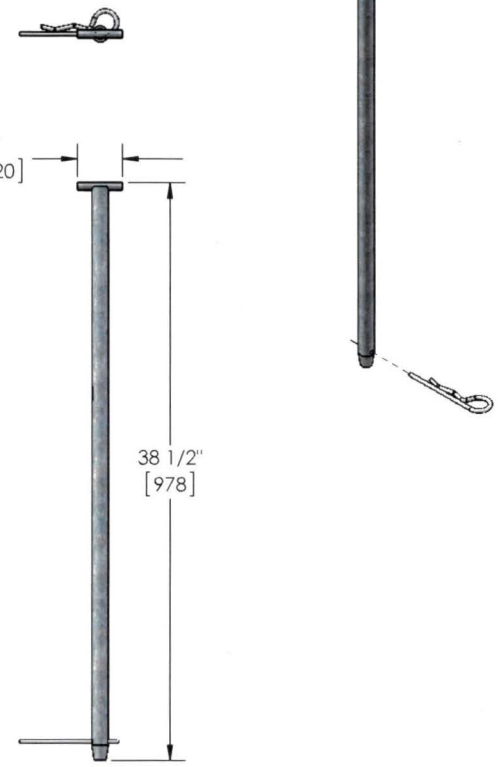
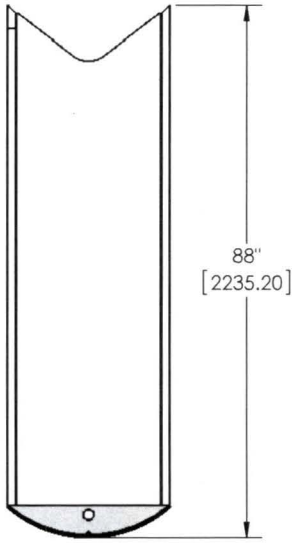
TITLE:

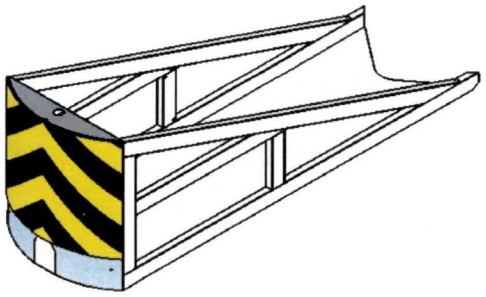
SLED END TREATMENT W/ GUARDRAIL

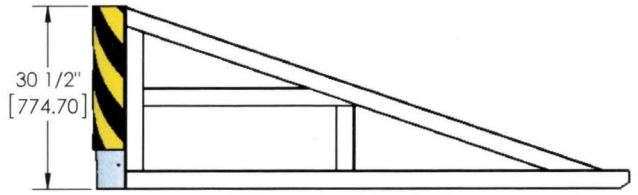
DRAWN BY: Christopher Jaime	DATE: 5/17/17	SIZE B	DWG. NO. 300-262
CHECKED BY: FA	DATE: 5/17/17		REV A
APPROVED BY: FA	DATE: 5/17/17		SHEET 1 OF 2



T PIN







FRONT STEEL CAP

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

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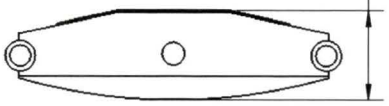
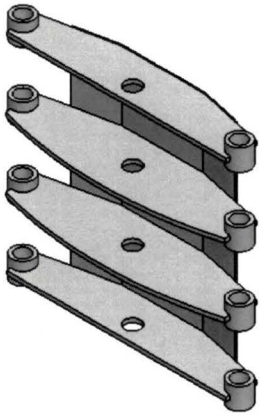
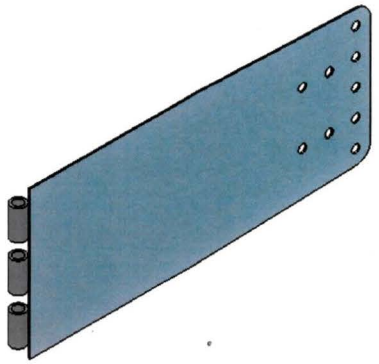
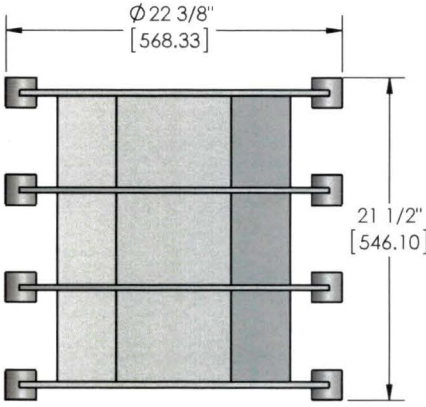
TITLE:
SLED END TREATMENT HARDWARE

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			

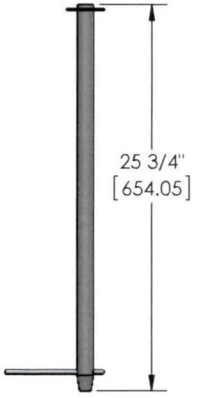




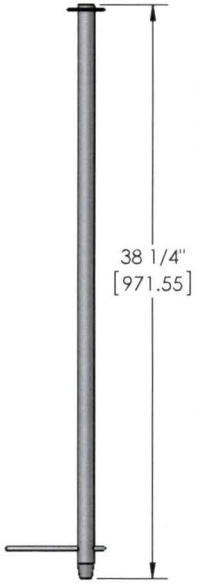




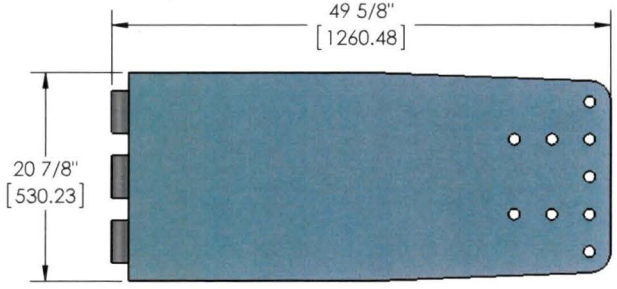
SLED END TREATMENT
TRANSITION FRAME



SHORT
OUTSIDE
TRANSITION PIN
W/ KEEPER PIN



LONG
CENTER
TRANSITION PIN
W/ KEEPER PIN



SLED END TREATMENT
TRANSITION PANEL

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

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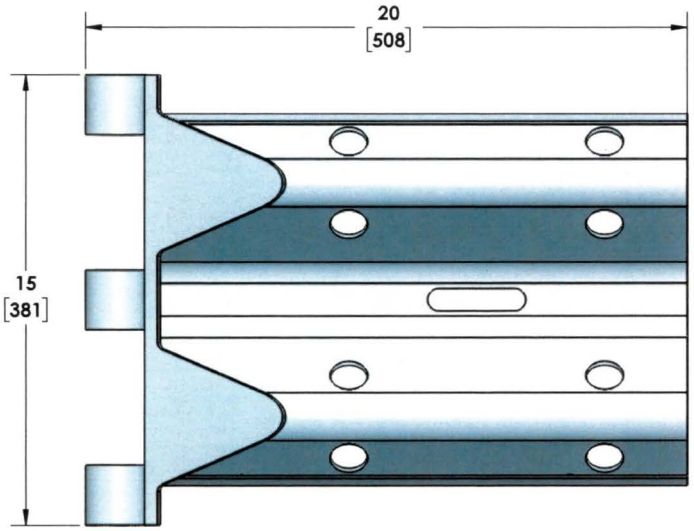
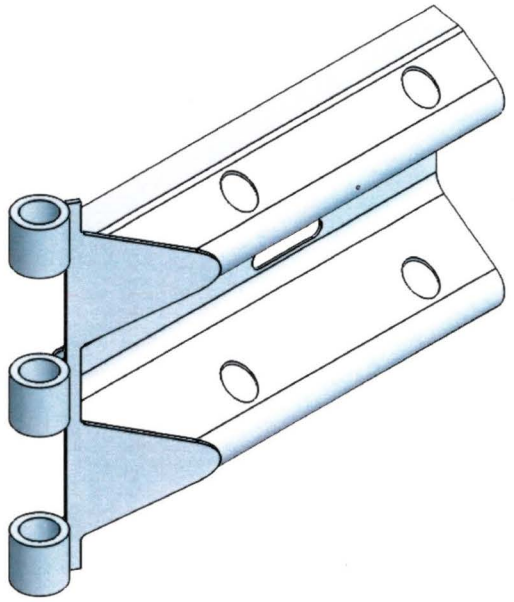
TITLE:
SLED END TREATMENT HARDWARE

DRAWN BY:	DATE:
JEREMY SMITH	02-09-10
CHECKED BY: FA	DATE: 10-16-09
APPROVED BY: FA	DATE: 10-16-09

SIZE	DWG. NO.	REV
B	300-106	H





2. Units: Inches [mm]
1. Material: Steel
NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES[mm].

DRAWN BY: Christopher Jaime	DATE: 5/18/17	
CHECKED BY: FA	DATE: 5/18/17	
APPROVED BY: FA	DATE: 5/18/17	

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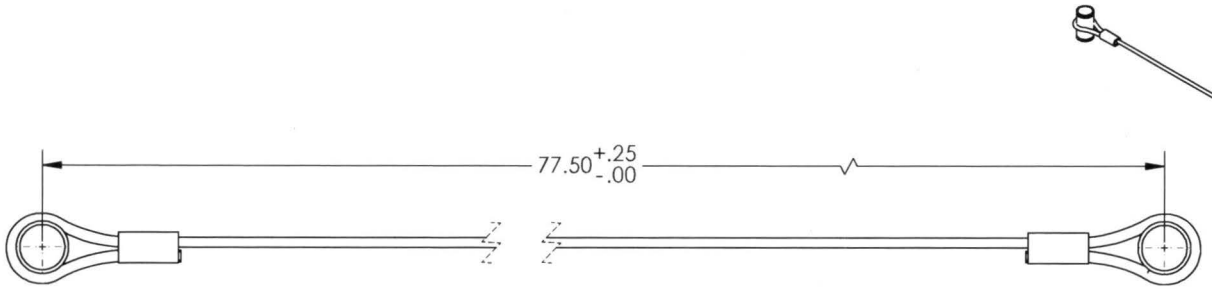
TITLE:

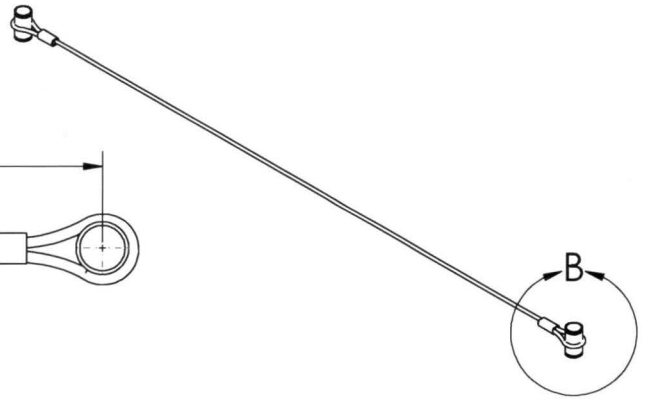
W-Beam Guardrail Transition Panel

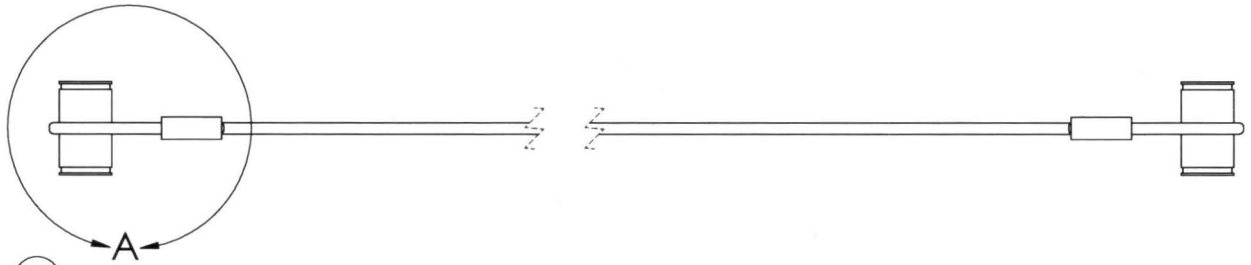
SIZE	DWG. NO.	REV
B	300-263	A

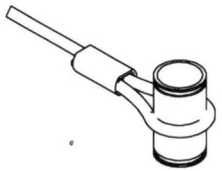
SHEET 1 OF 1

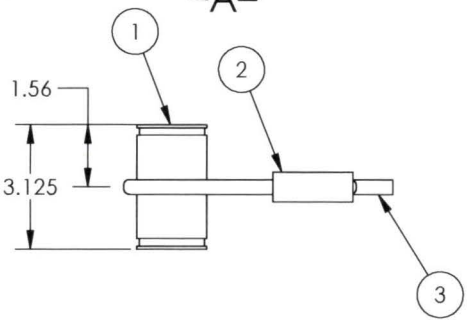
CABLE SPEC
3/8" DIA WIRE ROPE
CORROSION RESISTANT











ITEM NO.	DESCRIPTION	QTY
1	BUSHING	2
2	SWAGE	2
3	CABLE	1

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES[mm].
TOLERANCES:
DECIMAL: .000 ± .0625

DRAWN BY: DATE: 12-29-08
CHECKED BY: DATE:
APPROVED BY: DATE:

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TITLE: WATER WALL WIRE ROPE

SIZE B | DWG. NO. 323 | REV A

SHEET 1 OF 1