



U.S. Department
of Transportation
Federal Highway
Administration

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

September 15, 2017

In Reply Refer To:
HSST-1/CC-138

Mr. Felipe Almanza
TraFFix Devices Inc.
160 Avenida La Pata
San Clemente, CA 92673

Dear Mr. Almanza:

This letter is in response to your May 4, 2017 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-138 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

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

- Scorpion II Trailer Attenuator

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: Scorpion II Trailer Attenuator
Type of system: Trailer Mounted Attenuator (TMA)
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: KARCO
Date of request: May 1, 2017

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within 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 and will need to be tested in accordance with all recommended tests in AASHTO's MASH as part of a new and separate submittal.

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-138 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.

- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely,



Robert Ritter
Acting Director, Office of Safety
Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	May 01, 2017	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Felipe Almanza	
	Company:	TraFFix Devices Inc.	
	Address:	160 Avenida La Pata San Clemente CA 92672	
	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': Truck-Mounted Attenuators (TMA)	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	Scorpion II Trailer Attenuator	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 <input checked="" type="checkbox"/>
Company Name:	TraFFix Devices Inc.	Same as Submitter <input checked="" type="checkbox"/>
Address:	160 Avenida La Pata San Clemente CA 92672	Same as Submitter <input checked="" type="checkbox"/>
Country:	United States	Same as Submitter <input checked="" type="checkbox"/>
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 included 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 Scorpion Trailer Attenuator (TA) is a mobile crash cushion designed with a trailer tongue and axle/wheel assembly for towing by a support vehicle. The TA connects directly to the support vehicle's trailer connection and from a lunette eye on the attenuator. The TA may be used on shadow vehicle's, stationary block vehicle's, or on advanced warning vehicle's upstream of a moving or stationary operation. The Scorpion TA can be used on support vehicles with a min. actual/curb weight of 12,000 lbs with no upper weight limit (infinite weight). Lighting consists of LED or incandescent brake, directional, and running lights meeting FMVSS requirements and optional strobe/flashing lights can be accommodated for enhancement of advanced warning to drivers. The TA has overall dimensions of 17.8 ft (5.4 m) x 7.8 ft (2.4 m) x 4.3 ft (1.3 m) with ground clearance of 12.0 in \pm 1.0 in (305 mm \pm 25 mm). The Scorpion TA consists of three (3) main components: the trailer tongue, front Strut, and rear Cartridge. The Strut and Cartridge are the attenuation components, The trailer tongue is positioned nearest to the support vehicle, the Strut is bolted to the tongue and Cartridge. The Cartridge is the rear most component, furthest away from the support vehicle. The Cartridge is typically the first component impacted by an errant vehicle. The trailer tongue acts as a standard trailer single point connection under normal towing conditions by the support vehicle. The trailer tongue is designed with an integral Telescoping Anti-Rotation System (TARS) that is activated when the TA is impacted. The forward sliding action occurs during an impact, upon completion of the full telescoping action the outboard anti-rotation supports come into contact with the impact zone which in turn prevents angular rotation about the rear of the host vehicle. The TARS impact zone is a designated impact space on the rear of the host vehicle which the TARS anti-rotation support will come into contact when the TARS system engages in the designed forward action. The TARS impact zone is symmetrical left to right and is approximately 6" [152.4 mm] X 10" [254.0 mm] and 12" [304.8 mm] from the centerline of the support vehicle. The TARS tongue has overall dimensions of 4.8 ft. (1.5 m) X 6.3 ft. (1.9 m) X 2.2 ft. (0.7 m). The Strut consists of four (4) outboard convex aluminum tubes (two on each side) forming an aluminum structural weldment. The aluminum structural weldments bolt directly to the TARS tongue and the rear Cartridge. The structural assembly encompasses the aluminum crush Module D. The Module is made from an aluminum outer skin that contains expanded aluminum honeycomb and has overall dimensions of 4.0 ft. (1.2 m) x 6.7 ft. (2.0 m) x 2.0 ft. (0.6 m). The complete assembled Strut consists of two aluminum tube weldments and Module D. The Strut has overall dimensions of 4.8 ft. (1.5 m) x 7.8 ft. (2.4 m) x 2.2 ft. (0.7 m). The Cartridge consists of four (4) outboard convex aluminum tubes (two on each side) forming an aluminum structural weldment. The aluminum structural weldments bolt directly the Strut's steel angles and rear trailer diaphragm. The TA uses a Cartridge Trailer Diaphragm with an axle/wheel attachment for towing the TA. The structural assembly encompasses the two-aluminum crush Module C's. Attached to the rear most end of the Cartridge is the single crush Module A. The complete Cartridge consists of two aluminum tube weldments, axle diaphragm, mounting angles, one Module A, and two Module C's. The modules are made from an aluminum outer skin that contains expanded aluminum honeycomb. Module A has overall dimensions of 1.0 ft. (0.3 m) x 5.0 ft. (1.5 m) x 2.0 ft. (0.6 m) and each Module C has overall dimensions of 2.0 ft. (0.6 m) x 5.0 ft. (1.5 m) X 2.0 ft (0.6 m). The complete assembled Cartridge has overall dimensions of 8.3 ft. (2.5 m) x 7.8 ft. (2.4 m) x 3.0 ft. (0.9 m). An optional display panel lifting frame was utilized for all tests to validate the safe performance of a TA with the lifting frame and a mounted display panel. The lift frame rotates a display panel from a horizontal stored position to vertical deployed position with a manual or electrical power lift.

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 L. Ramirez	
Engineer Signature:	Robert Ramirez	Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=ramirez@karco.com, c=US Date: 2017.05.04 09:30:24 -0700
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter <input type="checkbox"/>
Country:	United States	Same as Submitter <input type="checkbox"/>

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-50 (1100C)	<p>The TA was positioned in line with the test vehicle's centerline. The inline centered position examines the TA's energy dissipation capacity, structural adequacy, occupant risk, with a rigidly blocked support vehicle for no upper support vehicle weight limit (infinite weight). The test was conducted using a commercially available 2012 Kia Rio 4-door sedan with test inertial mass of 2,458.1 lbs (1,115.0 kg). The vehicle was in good condition, was free of major body damage, and was not missing any structural components. The bumpers were standard equipment and were not modified for this test. Based on CarFax reporting there was no recorded history of major accidents, was not a salvage titled vehicle, not involved in flooding, or fire. The test vehicle impacted the TA at a velocity of 60.19 mph (96.87 km/hr) and at an impact angle of 0.8°.</p> <p>The vehicle made initial contact with the rear Cartridge crushing Module A upon impact and the outboard convex tube weldments began to collapse. After the convex tube weldments fully collapsed the two inboard Cartridge Modules C contacted each other and were crushed. The front Strut sustained moderate collapse of the outboard convex tube weldments and minimal crush of Module D.</p> <p>The TA system contained a display panel mounted to the lifting frame and was raised into the vertical deployed position. The display panel and lift frame did not pose or show potential to be a hazard in the impact event.</p> <p>The impacting vehicle was brought to a controlled stop and remained upright throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no measurable in cab deformation beyond the maximum allowable limits. The maximum roll and pitch did not exceed 75° and occupant risk values are within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
3-51 (2270P)	<p>The TA was positioned in line with the test vehicle's centerline. The inline centered position examines the TA'S energy dissipation capacity, structural adequacy, occupant risk, with a rigidly blocked support vehicle for no upper support vehicle weight limit (infinite weight). The test was conducted using a commercially available 2012 RAM 1500 4-door pickup truck with test inertial mass of 5,006.6 lbs (2,271.0 kg). The vehicle was in good condition, was free of major body damage, and was not missing any structural components. The bumpers were standard equipment and were not modified for this test. Based on CarFax reporting there was no recorded history of major accidents, was not a salvage titled vehicle, not involved in flooding, or fire. The test vehicle impacted the TMA at a velocity of 63.54 mph (103.25 km/hr) and at an impact angle of 0.4°.</p> <p>The vehicle made initial contact with the rear Cartridge crushing Module A upon impact and the outboard convex tube weldments began to collapse. After the convex tube weldments fully collapsed the two inboard Cartridge Modules C contacted each other and were crushed. The front Strut sets of outboard convex tube weldments fully collapsed and the inner Module D crushed to a near flattened state. The TA system contained a display panel mounted to the lifting frame and was raised into the vertical deployed position. The display panel and lift frame did not pose or show potential to be a hazard in the impact event.</p> <p>The impacting vehicle was brought to a controlled stop and remained upright throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no measurable in cab deformation beyond the maximum allowable limits. The maximum roll and pitch did not exceed 75° and occupant risk values are within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.</p>	PASS

3-52 (2270P)	<p>The TA was positioned offset 1/3 of the test vehicles width to the centerline of the test vehicle. The offset position examines the capability of a TA to safely attenuate off-center impacts, the TMA's structural adequacy, occupant risk, with a rigidly blocked support vehicle for no upper support vehicle weight limit (infinite weight). The test was conducted using a commercially available 2011 RAM 1500 4-door pickup truck with test inertial mass of 5,002.2 lbs (2,269.0 kg). The vehicle was in good condition, was free of major body damage, and was not missing any structural components. The bumpers were standard equipment and were not modified for this test. Based on CarFax reporting there was no recorded history of major accidents, was not a salvage titled vehicle, not involved in flooding, or fire. The test vehicle impacted the TA at a velocity of 60.60 mph (97.52 km/hr) and at an impact angle of 1.3°.</p> <p>The vehicle made initial contact with the rear Cartridge crushing Module A upon impact and the outboard convex tube weldments began to collapse. After the convex tube weldments fully collapsed the two inboard Cartridge Modules C contacted each other and were crushed. The front Strut sets of outboard convex tube weldments fully collapsed and the inner Module D crushed to a near flattened state. The TA system contained a display panel mounted to the lifting frame and was raised into the vertical deployed position. The display panel and lift frame did not pose or show potential to be a hazard in the impact event.</p> <p>The impacting vehicle was brought to a controlled stop and remained upright throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no measurable in cab deformation beyond the maximum allowable limits. The maximum roll and pitch did not exceed 75° and occupant risk values are within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration</p>	PASS
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3-53 (2270P)	<p>The TA was positioned offset ¼ of the test vehicles width and at a nominal angle of 10° with the center of the test vehicle. The offset and angular position impact examines the energy dissipation capacity of a TA, the TA's structural adequacy, occupant risk, and with a minimum support vehicle weight of 13,560.4 lbs (6,151.0 kg) with the parking brake engaged and the transmission in 2nd gear. The recorded roll ahead for the support vehicle was 20.3 ft (6.2 m). The test was conducted using a commercially available 2012 RAM 1500 4-door pickup truck with test inertial mass of 4,998.9 lbs (2,267.50 kg). The vehicle was in good condition, was free of major body damage, and was not missing any structural components. The bumpers were standard equipment and were not modified for this test. Based on CarFax reporting there was no recorded history of major accidents, was not a salvage titled vehicle, not involved in flooding, or fire. The test vehicle impacted the TMA at a velocity of 63.12 mph (101.58 km/hr) and at an impact angle of 9.8°. The vehicle made initial contact with the rear Cartridge crushing Module A upon impact and the outboard convex tube weldments began to collapse. After the convex tube weldments fully collapsed the two inboard Cartridge Modules C made contact with each other and were crushed. The front Strut sets of outboard convex tube weldments fully collapsed and the inner Module D crushed to near a near flattened state. The TA system contained a display panel mounted to the lifting frame and was raised into the vertical deployed position. The display panel and lift frame did not pose or show potential to be a hazard in the impact event.</p> <p>The impacting vehicle was brought to a controlled stop and remained upright throughout the impact event. The test vehicle's occupant compartment was not penetrated and there was no measurable in cab deformation beyond the maximum allowable. The maximum roll and pitch did not exceed 75° and occupant risk values are within limits per MASH specifications for Occupant Impact Velocity and Ridedown Acceleration.</p>	PASS
3-54 (1500A)	Per MASH Test is optional	Non-Critical, not conducted

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	KARCO Engineering, INC	
Laboratory Signature:	Robert Ramirez	<small>Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=r.ramirez@karco.com, c=US Date: 2017.05.04 09:31:54 -0700</small>
Address:	9270 Holly Rd.	Same as Submitter <input type="checkbox"/>
Country:	United States	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371; December 18, 2015 through December 18, 2017	

Submitter Signature*: *Felipe Almanza*

Digitally signed by Felipe Almanza,
DN: cn=Felipe Almanza, o=Test Devices
INC, ou
email=felipe.almanza@testdevices.com, c=US
Date: 2017.04.27 13:21:07-0600

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

SECTION 4

MASH TEST 3-50 SUMMARY

Test Article: TrafFix Devices Scorpion II TL3 TA

Project No. P36284-01

Test Program: MASH 3-50

Test Date: 11/10/16

SEQUENTIAL PHOTOGRAPHS



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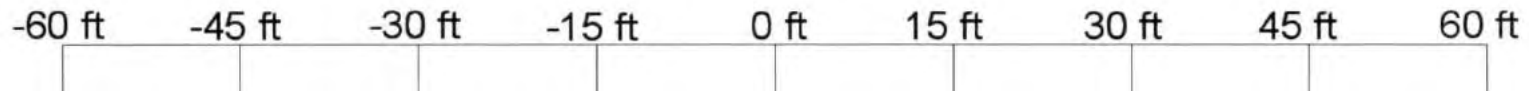
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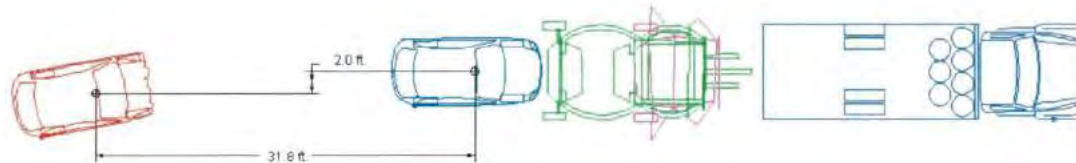
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PLAN VIEW



- Pre-Test**
- Article (green)
- Vehicle (blue)
- Post-Test**
- Article (pink)
- Vehicle (red)



SECTION 4 ... (CONTINUED)

MASH TEST 3-50 SUMMARY

Test Article: TraFFix Devices Scorpion II TL3 TA

Project No. P36284-01

Test Program: MASH 3-50

Test Date: 11/10/16

GENERAL INFORMATION		EXIT CONDITIONS	
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	
TEST NUMBER	P36284-01	EXIT ANGLE	
TEST DESIGNATION	3-50	VEHICLE STABILITY	Satisfactory
TEST DATE	11/10/16	FINAL VEHICLE POSITION	31.8 ft. (9.7 m) rearward and 2.0 ft. (0.6 m) right from its initial point on contact.
TEST ARTICLE		VEHICLE SNAGGING	None
NAME / MODEL	Scorpion II TL3 TA	VEHICLE POCKETING	None
TYPE	Trailer Mounted Attenuator	MAXIMUM ROLL ANGLE	1.5°
KEY ELEMENTS	Curved Tubes, Aluminum Honeycomb, Support Frame, Cartridge Section	MAXIMUM PITCH ANGLE	3.8°
ARTICLE LENGTH	17.8 ft. (5.4 m)	MAXIMUM YAW ANGLE	-2.9°
HEIGHT FROM GROUND	12.4 in. (315 mm)	KINETIC ENERGY	297.7 kip-ft (403.6 kJ)
MAXIMUM WIDTH	7.8 ft. (2.4 m)	OCCUPANT RISK VALUES	
ROAD SURFACE	Concrete	OCCUPANT IMPACT VELOCITY	Longitudinal 33.5 ft/s (10.2 m/s)
SUPPORT VEHICLE			Lateral 0.0 ft/s
TOTAL INSTALLATION LENGTH	45.2 ft (13.8 m)	RIDEDOWN ACCELERATION	Longitudinal -12.7 g
YEAR, MAKE AND MODEL	1991 Ford F700		Lateral 3.1 g
RESTRAINT	Blocked Against Roll Ahead	THIV	33.1 ft/s (10.1 m/s)
TEST VEHICLE		PHD	12.8 g
TYPE / DESIGNATION	1100C	ASI	1.68
YEAR, MAKE AND MODEL	2012 Kia Rio	TEST ARTICLE DEFLECTIONS	
CURB MASS	2,539.7 lbs (1,152.0 kg)	DYNAMIC DEFLECTION	8.92 ft. (2.72 m)
TEST INERTIAL MASS	2,458.1 lbs (1,115.0 kg)	STATIC DEFORMATION	7.48 ft. (2.28 m)
GROSS STATIC MASS	2,631.2 lbs (1,193.5 kg)	ARTICLE DAMAGE	Damage to cartridge, strut, and tongue sections.
IMPACT CONDITIONS		VEHICLE DAMAGE	
IMPACT VELOCITY	60.19 mph (96.87 km/h)	VEHICLE DAMAGE SCALE	12-FD-4
IMPACT ANGLE	0.8°	COLLISION DAMAGE CLASSIFICATION	12FDEW4
IMPACT LOCATION / ORIENTATION	0.5 in. (13 mm) right of TA centerline.		

SECTION 4

MASH TEST 3-51 SUMMARY

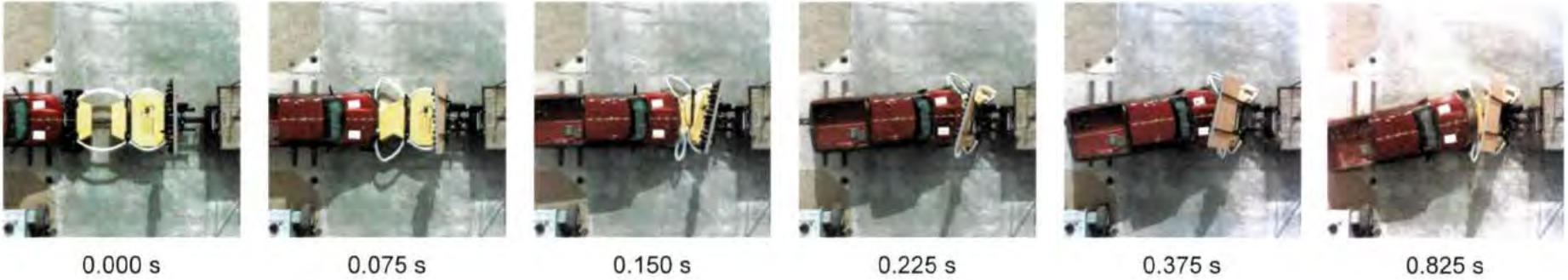
Test Article: TrafFix Devices Scorpion II TL3 TA

Project No. P36017-01

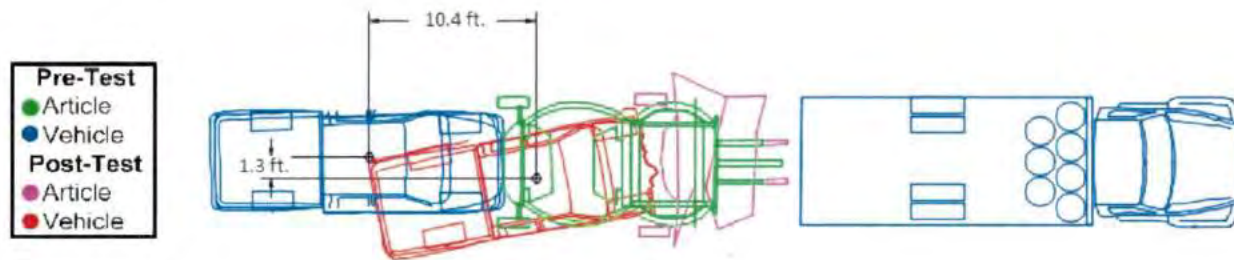
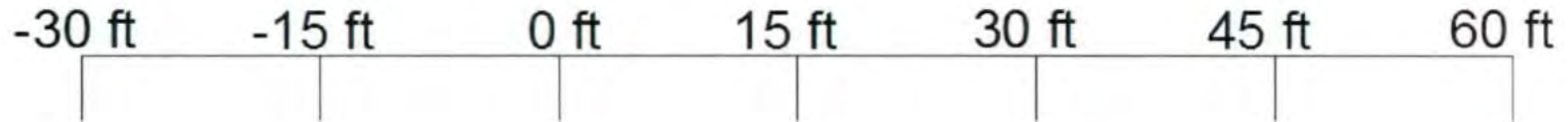
Test Program: MASH 3-51

Test Date: 12/09/16

SEQUENTIAL PHOTOGRAPHS



PLAN VIEW



SECTION 4 ... (CONTINUED)
MASH TEST 3-51 SUMMARY

Test Article: TrafFix Devices Scorpion II TL3 TA
 Test Program: MASH 3-51

Project No. P36017-01
 Test Date: 12/09/16

GENERAL INFORMATION		EXIT CONDITIONS	
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	
TEST NUMBER	P36017-01	EXIT ANGLE	
TEST DESIGNATION	3-51	VEHICLE STABILITY	Satisfactory
TEST DATE	12/09/16	FINAL VEHICLE POSITION	10.4 ft. (3.2 m) forward and 1.3 ft. (0.4 m) right from its initial point on contact.
TEST ARTICLE		VEHICLE SNAGGING	None
NAME / MODEL	Scorpion II TL3 TA	VEHICLE POCKETING	None
TYPE	Trailer Mounted Attenuator	MAXIMUM ROLL ANGLE	4.9°
KEY ELEMENTS	Curved Rails, Aluminum Honeycomb, Support Frame, Cartridge Section	MAXIMUM PITCH ANGLE	6.6°
ARTICLE LENGTH	17.8 ft. (5.4 m)	MAXIMUM YAW ANGLE	-14.7°
HEIGHT FROM GROUND	12.8 in. (325 mm)	KINETIC ENERGY	675.7 kip-ft (916.2 kJ)
MAXIMUM WIDTH	7.8 ft. (2.4 m)	OCCUPANT RISK VALUES	
ROAD SURFACE	Concrete	OCCUPANT IMPACT VELOCITY	Longitudinal 31.2 ft/s (9.5 m/s)
SUPPORT VEHICLE			Lateral 0.7 ft/s (0.2 m/s)
TOTAL INSTALLATION LENGTH	45.2 ft (13.8 m)	RIDEDOWN ACCELERATION	Longitudinal -19.3 g
YEAR, MAKE AND MODEL	1991 Ford F700		Lateral -2.5 g
RESTRAINT	Blocked Against Roll Ahead	THIV	31.2 ft/s (9.5 m/s)
TEST VEHICLE		PHD	12.8 g
TYPE / DESIGNATION	2270P	ASI	1.45
YEAR, MAKE AND MODEL	2012 RAM 1500	TEST ARTICLE DEFLECTIONS	
CURB MASS	4,935.0 lbs (2,238.5 kg)	DYNAMIC DEFLECTION	11.98 ft. (3.65 m)
TEST INERTIAL MASS	5,006.6 lbs (2,271.0 kg)	STATIC DEFORMATION	10.24 ft. (3.12 m)
GROSS STATIC MASS	5,006.6 lbs (2,271.0 kg)	ARTICLE DAMAGE	Damage to cartridge, strut, and tongue sections.
IMPACT CONDITIONS		VEHICLE DAMAGE	
IMPACT VELOCITY	63.54 mph (103.25 km/h)	VEHICLE DAMAGE SCALE	12-FD-3
IMPACT ANGLE	0.4°	COLLISION DAMAGE CLASSIFICATION	12FDEW2
IMPACT LOCATION / ORIENTATION	0.68 in. (17 mm) left of TMA centerline.		

SECTION 4

MASH TEST 3-52 SUMMARY

Test Article: TrafFix Devices Scorpion II TL3 TA

Project No. P36165-01

Test Program: MASH 3-52

Test Date: 12/20/16

SEQUENTIAL PHOTOGRAPHS



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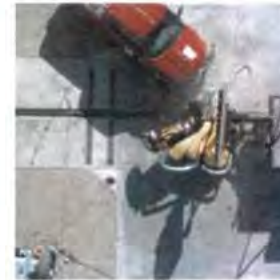
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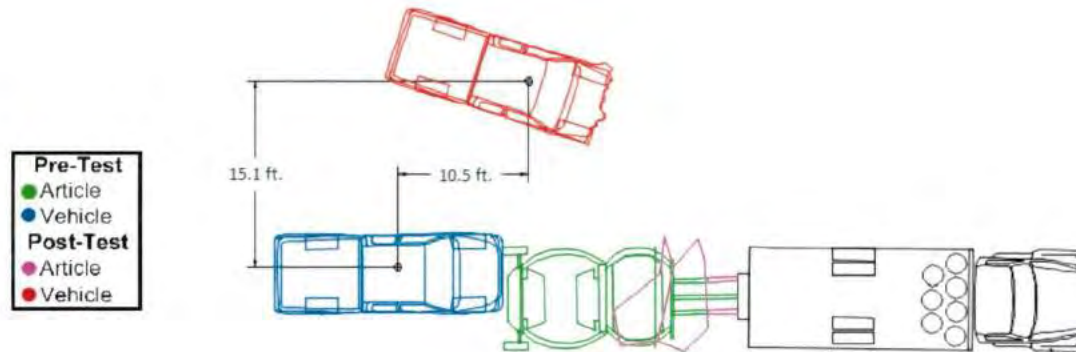
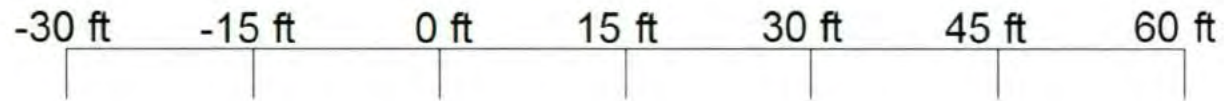


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PLAN VIEW



SECTION 4 ... (CONTINUED)
MASH TEST 3-52 SUMMARY

Test Article: TraFix Devices Scorpion II TL3 TA
 Test Program: MASH 3-52

Project No. P36165-01
 Test Date: 12/20/16

GENERAL INFORMATION		EXIT CONDITIONS	
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	
TEST NUMBER	P36165-01	EXIT ANGLE	
TEST DESIGNATION	3-52	VEHICLE STABILITY	Satisfactory
TEST DATE	12/20/16	FINAL VEHICLE POSITION	10.5 ft. (3.2 m) forward and 15.1 ft. (4.6 m) left from its initial point on contact.
TEST ARTICLE		VEHICLE SNAGGING	None
NAME / MODEL	Scorpion II TL3 TA	VEHICLE POCKETING	None
TYPE	Trailer Mounted Attenuator	MAXIMUM ROLL ANGLE	9.5°
KEY ELEMENTS	Curved Rails, Aluminum Honeycomb, Support Frame, Cartridge Section	MAXIMUM PITCH ANGLE	-19.8°
ARTICLE LENGTH	17.8 ft. (5.4 m)	MAXIMUM YAW ANGLE	36.3°
HEIGHT FROM GROUND	12.8 in. (325 mm)	KINETIC ENERGY	614.1 kip-ft (832.6 kJ)
MAXIMUM WIDTH	7.8 ft. (2.4 m)	OCCUPANT RISK VALUES	
ROAD SURFACE	Concrete	OCCUPANT IMPACT VELOCITY	Longitudinal 30.2 ft/s (9.2 m/s)
SUPPORT VEHICLE			Lateral 1.6 ft/s (0.5 m/s)
TOTAL INSTALLATION LENGTH	45.2 ft (13.8 m)	RIDEDOWN ACCELERATION	Longitudinal -10.0 g
YEAR, MAKE AND MODEL	1991 Ford F700		Lateral -2.4 g
RESTRAINT	Blocked Against Roll Ahead	THV	30.2 ft/s (9.2 m/s)
TEST VEHICLE		PHD	10.1 g
TYPE / DESIGNATION	2270P	ASI	0.88
YEAR, MAKE AND MODEL	2011 RAM 1500	TEST ARTICLE DEFLECTIONS	
CURB MASS	4,985.7 lbs (2,261.5 kg)	DYNAMIC DEFLECTION	11.32 ft. (3.45 m)
TEST INERTIAL MASS	5,002.2 lbs (2,269.0 kg)	STATIC DEFORMATION	10.56 ft. (3.22 m)
GROSS STATIC MASS	5,002.2 lbs (2,269.0 kg)	ARTICLE DAMAGE	Damage to cartridge, strut, and tongue sections.
IMPACT CONDITIONS		VEHICLE DAMAGE	
IMPACT VELOCITY	60.60 mph (97.52 km/h)	VEHICLE DAMAGE SCALE	12-FD-4
IMPACT ANGLE	1.3°	COLLISION DAMAGE CLASSIFICATION	12FDEW3
TARGET OFFSET/ ACTUAL OFFSET	26.5 in. (674 mm) / 25.8 in. (655 mm)		

SECTION 4

MASH TEST 3-53 SUMMARY

Test Article: TrafFix Devices Scorpion II TL3 TA

Project No. P36177-01

Test Program: MASH 3-53

Test Date: 12/21/16

SEQUENTIAL PHOTOGRAPHS



0.000 s



0.075 s



0.225 s



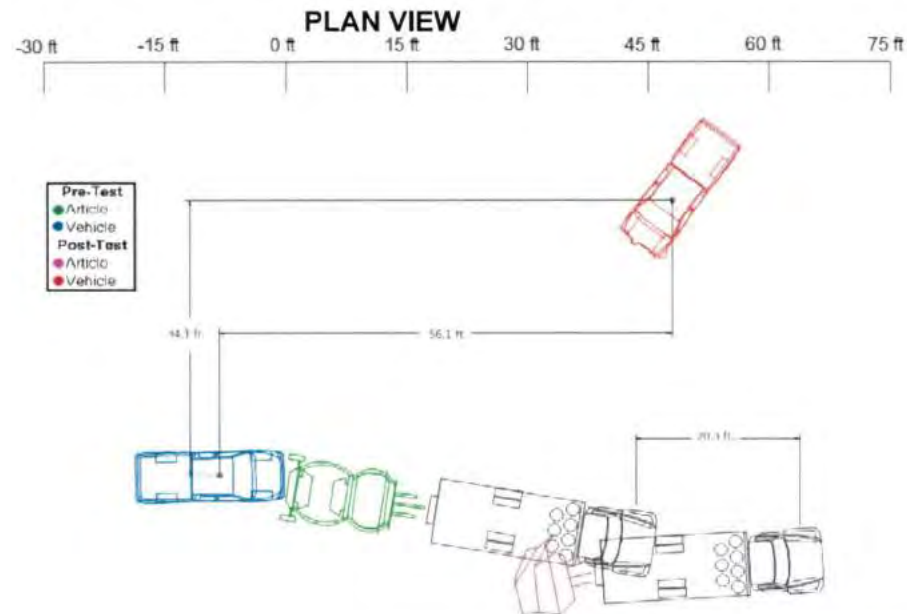
0.375 s



0.525 s



0.675 s

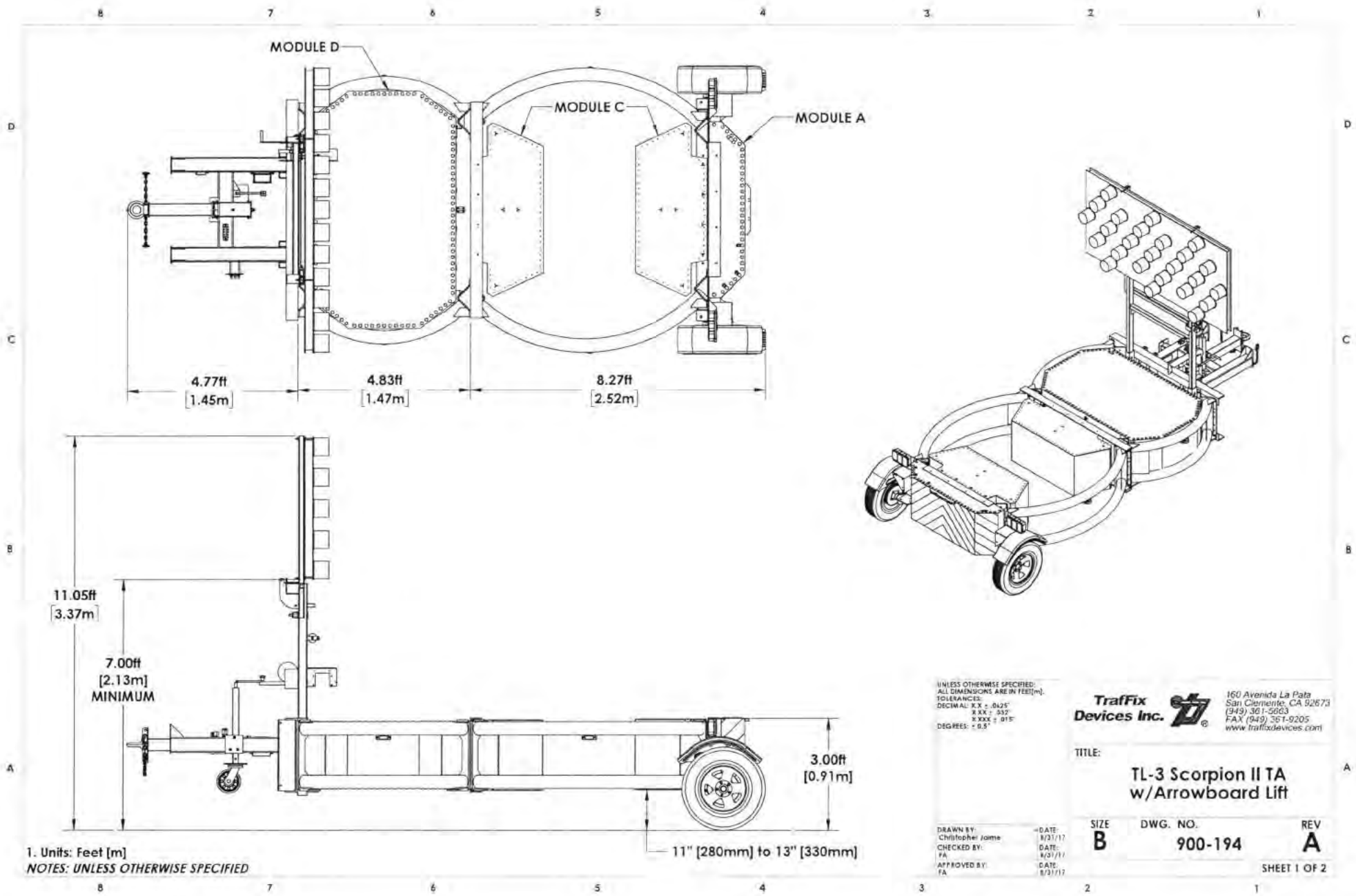


SECTION 4 ... (CONTINUED)
MASH TEST 3-53 SUMMARY

Test Article: TraFFix Devices Scorpion II TL3 TA
 Test Program: MASH 3-53

Project No. P36177-01
 Test Date: 12/21/16

GENERAL INFORMATION		EXIT CONDITIONS	
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	
TEST NUMBER	P36177-01	EXIT ANGLE	
TEST DESIGNATION	3-53	VEHICLE STABILITY	Satisfactory
TEST DATE	12/21/16	FINAL VEHICLE POSITION	56.1 ft. (17.1 m) forward and 34.1 ft. (10.4 m) left from its initial point on contact.
TEST ARTICLE		VEHICLE SNAGGING	None
NAME / MODEL	Scorpion II TL3 TA	VEHICLE POCKETING	None
TYPE	Trailer Mounted Attenuator	MAXIMUM ROLL ANGLE	10.9°
KEY ELEMENTS	Curved Rails, Aluminum Honeycomb, Support Frame, Cartridge Section	MAXIMUM PITCH ANGLE	5.7°
ARTICLE LENGTH	17.8 ft. (5.4 m)	MAXIMUM YAW ANGLE	133°
HEIGHT FROM GROUND	12.75 in. (324 mm)	KINETIC ENERGY	665.8 kip-ft (902.7 kJ)
MAXIMUM WIDTH	7.8 ft. (2.4 m)	OCCUPANT RISK VALUES	
ROAD SURFACE	Concrete	OCCUPANT IMPACT VELOCITY	Longitudinal 27.9 ft/s (8.5 m/s)
SUPPORT VEHICLE			Lateral 3.9 ft/s (1.2 m/s)
TOTAL INSTALLATION LENGTH	45.2 ft (13.8 m)	RIDEDOWN ACCELERATION	Longitudinal -12.6 g
YEAR, MAKE AND MODEL	1991 Ford F700		Lateral -3.9 g
RESTRAINT	2nd Gear, Parking Brake Engaged	THIV	28.2 ft/s (8.6 m/s)
TEST VEHICLE		PHD	13.2 g
TYPE / DESIGNATION	2270P	ASI	1.08
YEAR, MAKE AND MODEL	2012 RAM 1500	TEST ARTICLE DEFLECTIONS	
CURB MASS	4,986.8 lbs (2,262.0 kg)	DYNAMIC DEFLECTION	9.83 ft. (3.00 m)
TEST INERTIAL MASS	4,998.9 lbs (2,267.5 kg)	STATIC DEFORMATION	9.10 ft. (2.77 m)
GROSS STATIC MASS	4,998.9 lbs (2,267.5 kg)	ARTICLE DAMAGE	Damage to cartridge, strut, and tongue sections.
IMPACT CONDITIONS		VEHICLE DAMAGE	
IMPACT VELOCITY	63.12 mph (101.58 km/h)	VEHICLE DAMAGE SCALE	12-FD-4
IMPACT ANGLE	3.8°	COLLISION DAMAGE CLASSIFICATION	12FDEW3
TARGET OFFSET/ ACTUAL OFFSET	19.9 in. (505 mm) / 19.4 in. (493 mm)		



1. Units: Feet [m]
 NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
 ALL DIMENSIONS ARE IN FEET (m).
 TOLERANCES:
 DECIMAL: X.X = .0425"
 X.XX = .007"
 X.XXX = .015"
 DEGREES = 0.5°

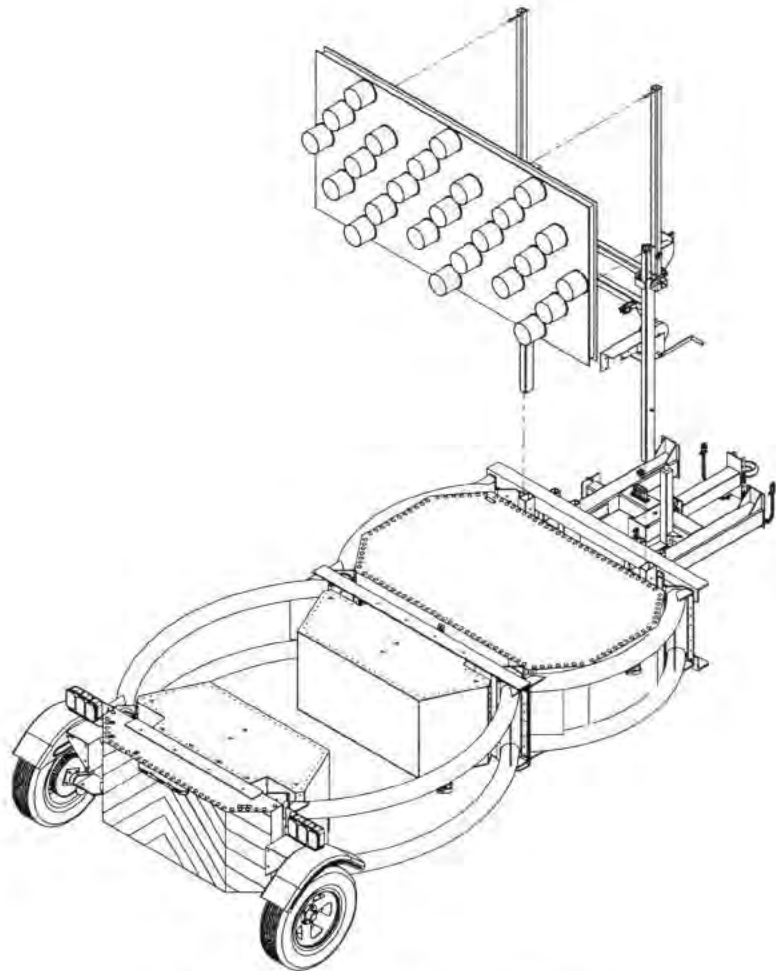
TrafFix Devices Inc.  160 Avenida La Pata
 San Clemente, CA 92673
 (949) 361-5663
 FAX (949) 361-9205
 www.traffixdevices.com

TITLE:
**TL-3 Scorpion II TA
 w/Arrowboard Lift**

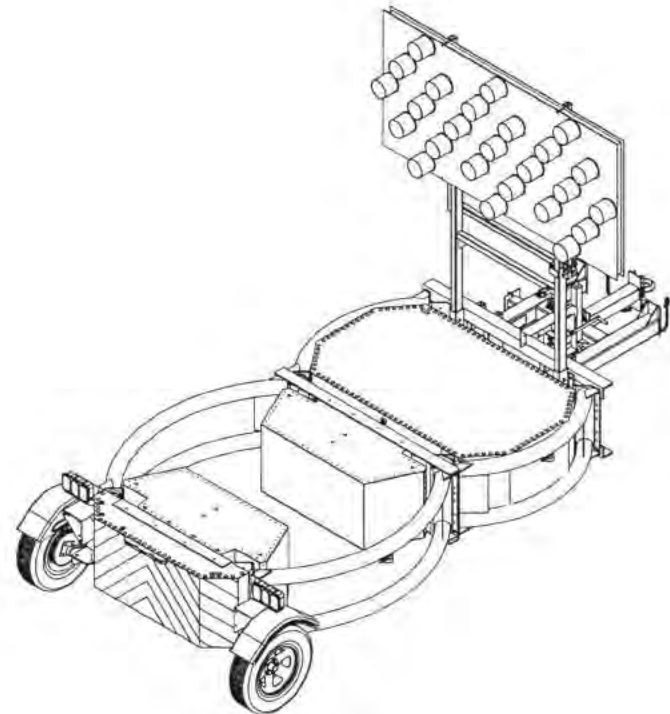
DRAWN BY: Christopher Jaime
 CHECKED BY: FA
 APPROVED BY: FA
 DATE: 8/31/17
 DATE: 8/31/17
 DATE: 8/31/17

SIZE **B** DWG. NO. **900-194** REV **A**

SHEET 1 OF 2



Exploded View of Arrowboard Lift Install to Scorpion II TA



Assembled View of Arrowboard Lift Install to Scorpion II TA

UNLESS OTHERWISE SPECIFIED:
 ALL DIMENSIONS ARE IN FEET(IN).
 TOLERANCES:
 DECIMAL XX ± .0425"
 XXX ± .030"
 XXXX ± .015"
 DEGREES ± 0.5°

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TITLE:

**TL-3 Scorpion II TA
 w/Arrowboard Lift**

DRAWN BY:
 Christopher Jaime
 CHECKED BY:
 FA
 APPROVED BY:
 FA

DATE:
 8/31/17
 DATE:
 8/31/17
 DATE:
 8/31/17

SIZE
B

DWG. NO.
900-194

REV
A

SHEET 2 OF 2

NOTES: UNLESS OTHERWISE SPECIFIED