U.S. Department
of Transportation
**Federal Highway
Administration**

February 27, 2020

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

In Reply Refer To:
HSST-1/CC-158

Mr. Robby Ramirez
TrafFix Devices Inc.
160 Avenida La Pata
San Clemente California 92673

Dear Mr. Ramirez:

This letter is in response to your November 26, 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-158 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

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

- Scorpion II Metro

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 Metro
Type of system: Truck-Trailer Mounted Attenuator (TTMA)
Test Level: MASH Test Level 2 (TL2)
Testing conducted by: KARCO
Date of request: November 26, 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-158 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.

- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.

- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

Sincerely,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	November 15, 2019	◉ New ○ Resubmission
	Name:	Robby Ramirez	
	Company:	TrafFix Devices, Inc.	
	Address:	160 Avenida La Pata San Clemente CA, 92673	
	Country:	United States	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device & Testing Criterion - Enter from right to left starting with Test Level

!-!-!

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'CC': Truck-Mounted Attenuators (TMA)	◉ Physical Crash Testing ○ Engineering Analysis	Scorpion II Metro	AASHTO MASH	TL2

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	Robby Ramirez	Same as Submitter ☒
Company Name:	TrafFix Devices, Inc.	Same as Submitter ☒
Address:	160 Avenida La Pata San Clemente CA, 92673	Same as Submitter ☒
Country:	United States	Same as Submitter ☒
Enter below all disclosures of financial interests as required by the FHWA `Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.		
TrafFix Devices Inc. and Applus IDIADA KARCO Engineering LLC share no financial interests between the two organizations. This includes no shared financial interest but not limited to: i. Compensation including wages, salaries, commissions, professional fees, or fees for business referrals 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 II Metro Truck Mounted Attenuator (TMA) is a mobile crash cushion attached to the rear of a support vehicle's frame. The TMA may be used on shadow, stationary block vehicle, or on advanced warning vehicles upstream of a moving or stationary operation. The Scorpion II Metro TMA can be used on support vehicles with a minimum actual/curb weight of approximately 7,300 lbs. (3,300 kg) with no upper weight limit (infinite weight). The Scorpion II Metro was tested at a nominal speed of 50 mph (80 km/h) and can be used in lower speed applications.

The Scorpion II Metro TMA has overall dimensions of 7.7 ft. (2.3 m) long X 8.0 ft. (2.4 m) wide X 2.0 ft. (0.6 m) tall and has a ground clearance of 12 in ± 1 in (305 mm ± 25.4 mm) when deployed in the horizontal operating position. The Scorpion II Metro TMA consists of two main components: Cartridge and backup/diaphragm frames. The Cartridge is the energy attenuation component.

The Cartridge consists of four outboard convex aluminum tubes (two on each side) forming an aluminum structural weldment. The aluminum structural weldments bolt to a set of steel structural diaphragm frames. The structural assembly encompasses aluminum crush Module C and Module E. Attached to the rear most end of the Cartridge, is the single crush Module A. Crush Modules A, C, and E are made from an aluminum outer skin that contains expanded aluminum honeycomb. The energy absorbing modules A, C, and E are all approximately 2 ft. (0.6 m) tall and 5 ft. (1.5 m) wide and vary in depth. The approximate depth of Module A, C, and E are 1.0 ft. (0.3 m), 2.0 ft. (0.6 m), and 3.5 ft. (1.1 m), respectively. Module A, C, and E are designed to accommodate an assortment of rearward facing reflective sheeting and patterns that are visible in either the deployed or travel positions.

The steel diaphragm and backup support the aluminum tubes and the crush modules. The framework structure also connects the TMA to the support vehicle. The structural mounting system incorporates extender frames to provide clearance for support vehicles with excess bed overhang when the TMA is in the stored position. The TMA can use either a low pivot mounting system to increase overhead clearance or the standard mounting system. Both high and low mounting systems were used in the course of the crash testing. The Scorpion II Metro TMA is rotated into the stored and deployed positions by an on board hydraulic system. An optional hydraulic powered vertical lift can be utilized to display an arrow board or variable message board when the TMA is in the deployed position. The vertical lift is powered by the same on board hydraulic system that rotates the TMA into the stored and deployed position. The vertical lift is sequenced to raise and lower a panel for displaying advanced messages, directional indicators, or other notifications. Lighting consists of LED, directional, and running lights meeting FMVSS requirements and optional strobe/flashing lights can be accommodated for enhancement of advanced warning to drivers.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Steven Matsusaka	
Engineer Signature:	Steven Matsusaka Digitally signed by Steven Matsusaka DN: cn=Steven Matsusaka, email=steven.matsusaka@idiada.com, c=US Date: 2019.11.25 17:28:55 -08'00'	
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
2-50 (1100C)	Test report number P39237-01, conducted on 08/01/19. The target test speed for this test was 50 mph (80 km/h). Test 2-50 involves an 1100C test vehicle impacting the system at an angle of 0° with centerline of the vehicle aligned with the centerline of the TMA. The test evaluates the impact performance of the TMA during small car impacts. The support vehicle was blocked against forward and lateral movement with no steering angle, parking brake set, and transmission placed in second gear. The test vehicle was a commercially available 2009 Kia Rio with a test inertial mass of 2,435.0 lbs (1104.5 kg). The test vehicle impacted the TMA at a speed and angle of 51.26 mph (82.49 km/h) and 0.4°, respectively. The TMA brought the test vehicle to a controlled stop and did not exceed Occupant Impact Velocity (OIV) or Occupant Ridedown Acceleration (ORA) limits in MASH. There were no detached fragment or debris that showed potential to penetrate the occupant compartment or present undue hazards to other traffic or work-zone personnel. The occupant compartment was not penetrated and there was negligible occupant compartment deformation. The Scorpion II Metro met all the requirements of MASH test 2-50.	PASS

Required Test Number	Narrative Description	Evaluation Results
2-51 (2270P)	Test report number P39238-02, conducted on 08/14/19. The target test speed for this test was 50 mph (80 km/h). Test 2-51 involves a 2270P test vehicle impacting the system at an angle of 0° with centerline of the vehicle aligned with the centerline of the TMA. The test evaluates the energy dissipation capacity of the TMA, structural adequacy, and occupant risk. The support vehicle was blocked against forward and lateral movement with no steering angle, parking brake set, and transmission placed in second gear. The test vehicle was a commercially available 2013 RAM 1500 with a test inertial mass of 5,007.7 lbs (2271.5 kg). The test vehicle impacted the TMA at a speed and angle of 51.23 mph (82.44 km/h) and 0.1°, respectively. The TMA brought the test vehicle to a controlled stop and did not exceed Occupant Impact Velocity (OIV) or Occupant Ridedown Acceleration (ORA) limits in MASH. There were no detached fragment or debris that showed potential to penetrate the occupant compartment or present undue hazards to other traffic or work-zone personnel. The occupant compartment was not penetrated and there was negligible occupant compartment deformation. The Scorpion II Metro met all the requirements of MASH test 2-51.	PASS

2-52 (2270P)	Test report number P39255-01, conducted on 08/15/19. The target test speed for this test was 50 mph (80 km/h). Test 2-52 involves a 2270P test vehicle impacting the system at an angle of 0° with centerline of the TMA offset 1/3 of the test vehicle's overall width. The test evaluates the capability of the TMA to safely attenuate off-center impacts from heavy passenger vehicles. The support vehicle was blocked against forward and lateral movement with no steering angle, parking brake set, and transmission placed in second gear. The test vehicle was a commercially available 2013 RAM 1500 with a test inertial mass of 5,027.6 lbs (2280.5 kg). The test vehicle impacted the TMA at a speed and angle of 49.77 mph (80.10 km/h) and 0.2°, respectively. The TMA brought the test vehicle to a controlled stop and did not exceed Occupant Impact Velocity (OIV) or Occupant Ridedown Acceleration (ORA) limits in MASH. There were no detached fragment or debris that showed potential to penetrate the occupant compartment or present undue hazards to other traffic or work-zone personnel. The occupant compartment was not penetrated and there was negligible occupant compartment deformation. The Scorpion II Metro met all the requirements of MASH test 2-52.	PASS

2-53 (2270P)	Test report number P39268-01, conducted on 08/26/19. The target test speed for this test was 50 mph (80 km/h). Test 2-53 involves a 2270P test vehicle impacting the system at an angle of 10° with centerline of the TMA offset 1/4 of the test vehicles overall width. The test evaluates the capability of the TMA to safely attenuate off-center and angled impacts from heavy passenger vehicles. The lightest allowable support truck was used with a test inertial mass of 7231.0 lbs (3280 kg). The truck was set with no steering angle, parking brake set, and transmission placed in second gear. The test vehicle was a commercially available 2014 RAM 1500 with a test inertial mass of 5,029.8 lbs (2281.5 kg). The test vehicle impacted the TMA at a speed and angle of 50.70 mph (81.60 km/h) and 9.9°, respectively. The TMA brought the test vehicle to a controlled stop and did not exceed Occupant Impact Velocity (OIV) or Occupant Ridedown Acceleration (ORA) limits in MASH. There were no detached fragment or debris that showed potential to penetrate the occupant compartment or present undue hazards to other traffic or work-zone personnel. The occupant compartment was not penetrated and there was negligible occupant compartment deformation. The maximum forward roll of the support vehicle was 40.6 ft. (12.4 m). The Scorpion II Metro met all the requirements of MASH test 2-53.	PASS
2-54 (1500A)	Per MASH test 2-54 is optional	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, email=steven.matsusaka@idiada.com, c=US Date: 2019.11.26 09:01:55 -08'00'	
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, 2019 - July 1, 2022	

Submitter Signature*: Robert Ramirez Digitally signed by Robert Ramirez Date: 2019.11.26 09:20:17 -08'00'

Submit Form

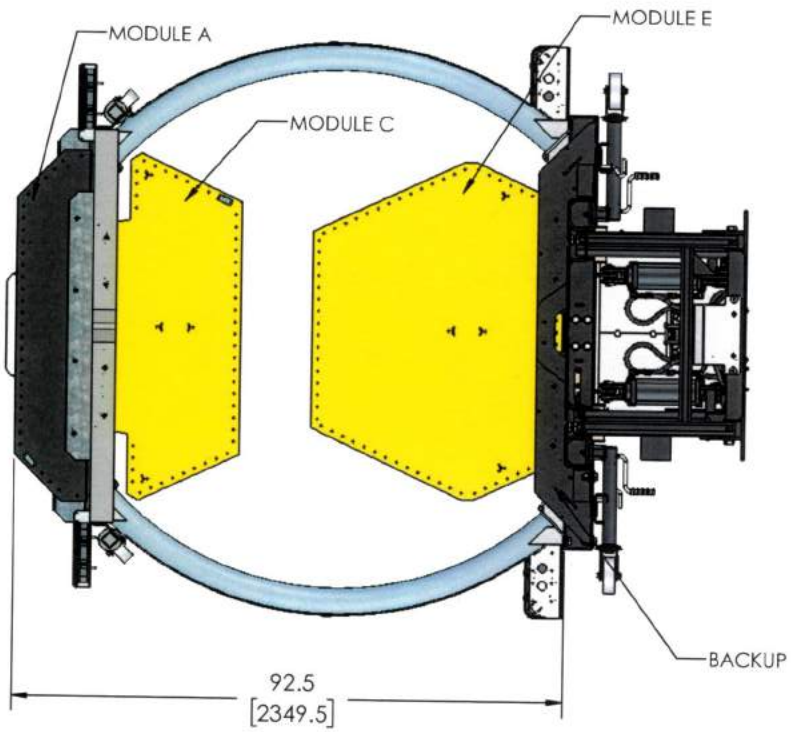
ATTACHMENTS

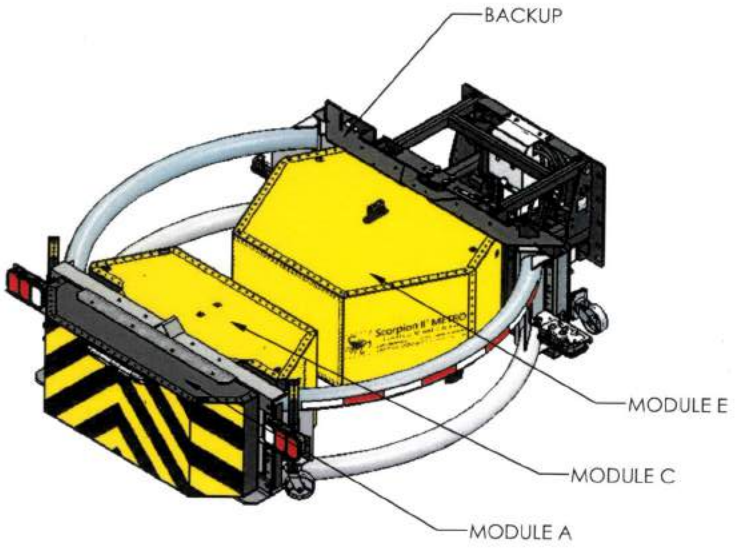
Attach to this form:

1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words





1. Units Inch [mm]
NOTES: Unless Otherwise Specified

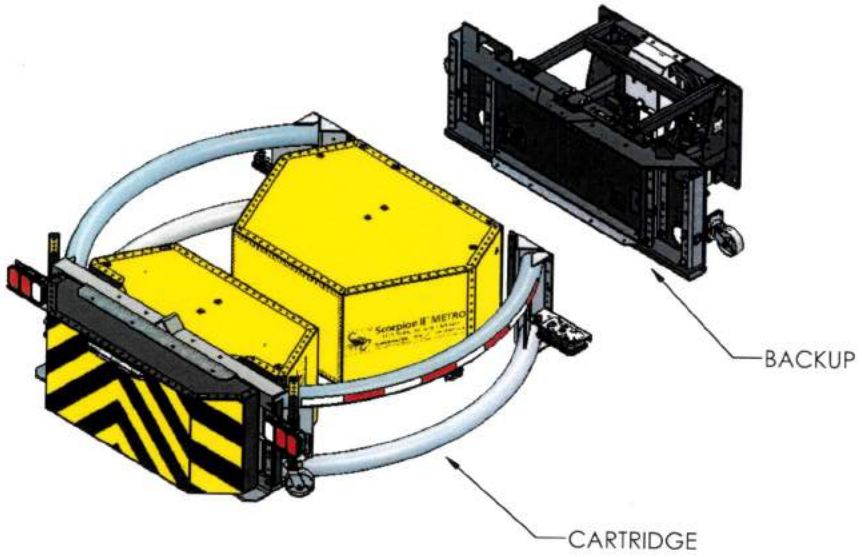
UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES [mm].
TOLERANCES:
FRACTIONAL: X/X ± 1/16" [1.6mm]
DECIMAL: X.X ± .062"
X.XX ± .032"
X.XXX ± .015"
DEGREES: ± 0.5°

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

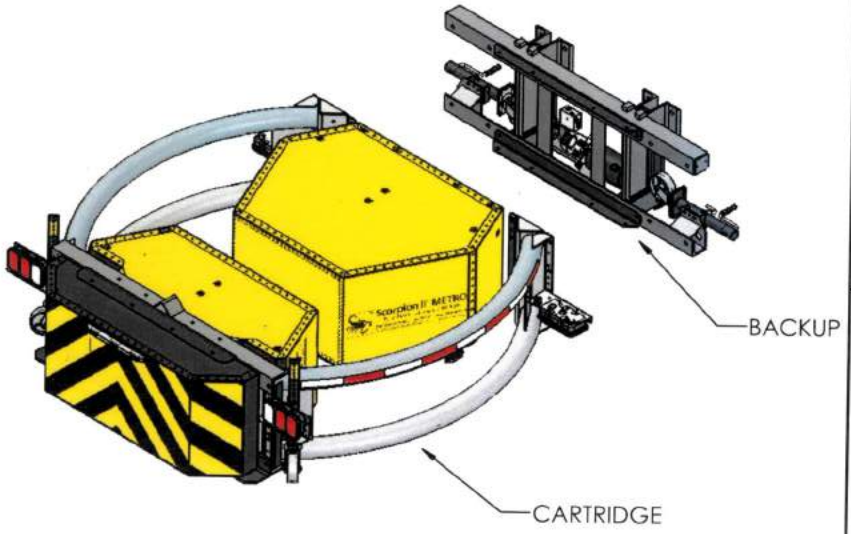
TITLE:
SCORPION II METRO

DRAWN BY: Robby Ramirez	DATE: 09/12/19	SIZE B	DRAWING NO. 1000-217
CHECKED BY: GM	DATE: 09/12/19		REV A
APPROVED BY: GM	DATE: 09/12/19		SHEET 1 OF 2

LOW PIVOT BACKUP



HIGH PIVOT BACKUP



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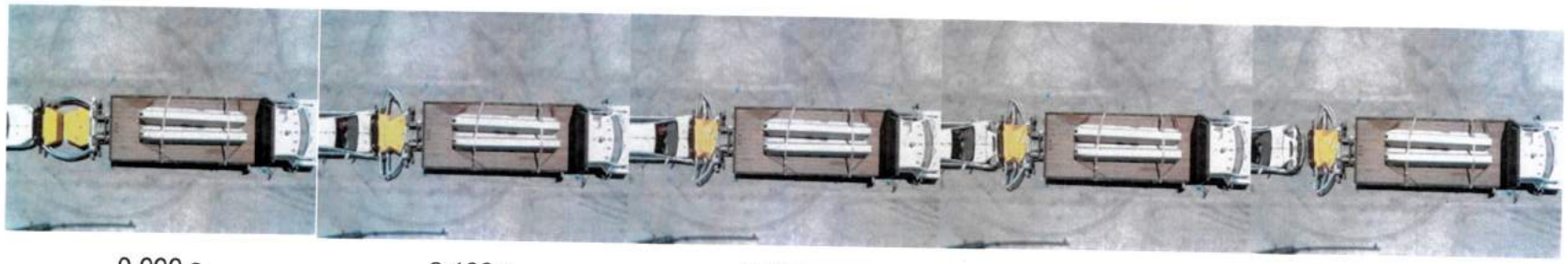
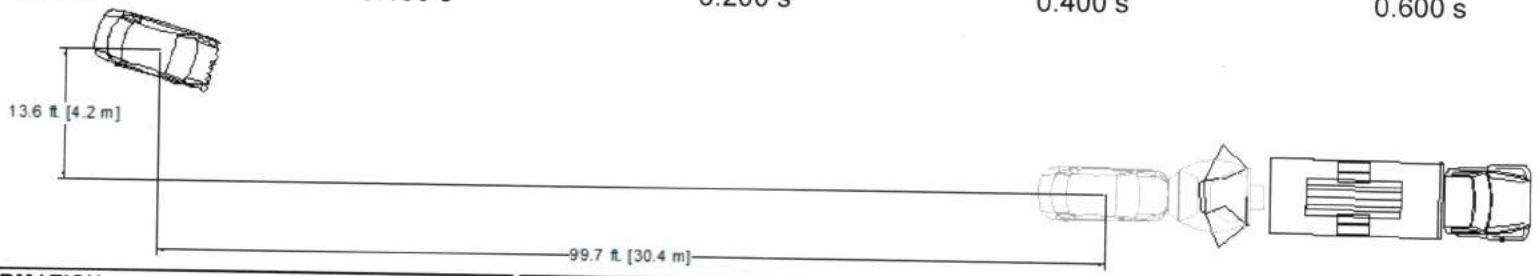
TITLE: SCORPION II METRO

SIZE	DRAWING NO.	REV
B	1000-217	A

SHEET 2 OF 2

MASH 2016 Test 2-50 Summary





GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test No	P39237-01
Test Designation	2-50
Test Date	08/01/19

TEST ARTICLE

Name / Model	Scorpion II Metro
Type	Truck Mounted Attenuator
Support Vehicle Length	27.3 ft (8.3 m)
TMA Length	7.7 ft. (2.4 m)
Road Surface	Smooth, clean concrete
Support Vehicle Restraint	Blocked Against Roll Ahead

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2009 Kia Rio
Curb Mass	2,442.7 lbs (1,108.0 kg)
Test Inertial Mass	2,435.0 lbs (1,104.5 kg)
Gross Static Mass	2,601.4 lbs (1,180.0 kg)

Impact Conditions

Impact Velocity	51.26 mph (82.49 km/h)
Impact Angle	0.4°
Location / Orientation	0.5" / Right
Kinetic Energy	213.9 kip-ft (290.0 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	99.7 ft. (30.4 m) Upstream 13.6 ft. (4.2 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-4.6 °
Maximum Pitch Angle	-4.1 °
Maximum Yaw Angle	-2.5 °

Occupant Risk

Longitudinal OIV	39.7 ft/s (12.1 m/s)
Lateral OIV	-1.0 ft/s (-0.3 m/s)
Longitudinal RA	-12.9 g
Lateral RA	2.2 g
THIV	39.7 ft/s (12.1 m/s)
PHD	12.9 g
ASI	1.31

Test Article Deflections

Static	3.8 ft. (1.1 m)
Dynamic	4.1 ft. (1.2 m)
Working Width	N/A
Debris Field	N/A

Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FCDW2
Maximum Intrusion	0.2 in. (4 mm)

Figure 3 Summary of Test 2-50

MASH 2016 Test 2-51 Summary

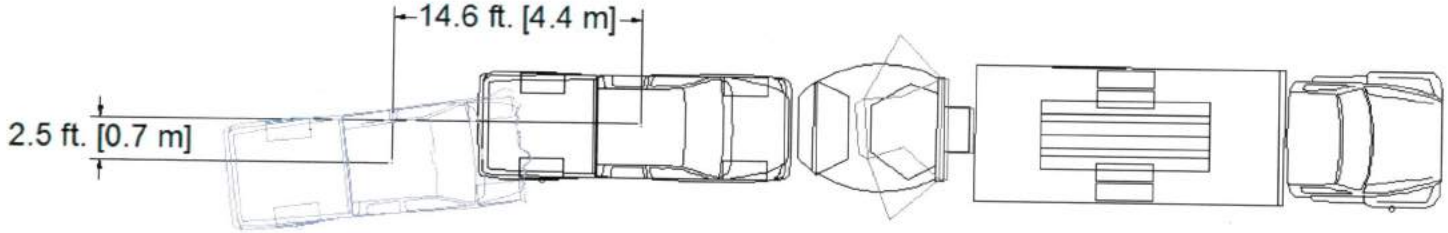

0.000 s


0.150 s


0.450 s


0.750 s


1.650 s



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test No	P39238-02
Test Designation	2-51
Test Date	08/14/19

TEST ARTICLE

Name / Model	Scorpion II Metro
Type	Truck Mounted Attenuator
Support Vehicle Length	
TMA Length	7.7 ft. (2.3 m)
Road Surface	Smooth, clean concrete
Support Vehicle Restraint	Blocked Against Roll Ahead

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2013 RAM 1500
Curb Mass	4,829.1 lbs (2,190.5 kg)
Test Inertial Mass	5,007.7 lbs (2,271.5 kg)
Gross Static Mass	5,007.7 lbs (2,271.5 kg)

Impact Conditions

Impact Velocity	51.23 mph (82.44 km/h)
Impact Angle	0.1°
Location / Orientation	Centerline TMA
Kinetic Energy	439.3 kip-ft (595.6 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	14.6 ft. (4.4 m) 2.5 ft. (0.7 m)
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	8.2 °
Maximum Pitch Angle	4.4 °
Maximum Yaw Angle	2.2 °

Occupant Risk

Longitudinal OIV	37.7 ft/s (11.5 m/s)
Lateral OIV	0.0 ft/s (0.0 m/s)
Longitudinal RA	-19.8 g
Lateral RA	-1.6 g
THIV	37.7 ft/s (11.5 m/s)
PHD	19.8 g
ASI	1.57

Test Article Deflections

Static	5.4 ft. (1.6 m)
Dynamic	6.3 ft. (1.9 m)
Working Width	N/A
Debris Field	N/A

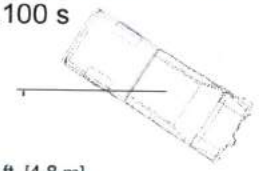
Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW2
Maximum Intrusion	0.1 in. (2 mm) floor pan

Figure 3 Summary of Test 2-51

MASH 2016 Test 2-52 Summary

0.000 s 0.100 s 0.200 s 0.400 s 0.600 s



15.8 ft. [4.8 m]

1.2 ft. [0.4 m]

GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test No	P39255-01
Test Designation	2-52
Test Date	08/15/2019

TEST ARTICLE

Name / Model	Scorpion II Metro
Type	Truck-Mounted Attenuator
Support Vehicle Length	27.3 ft. (8.3 m)
TMA Length	7.7 ft. (2.3 m)
Road Surface	Smooth, clean concrete
Support Vehicle Restraint	Blocked Against Roll Ahead

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2013 RAM 1500
Curb Mass	5,011.0 lbs (2,273.0 kg)
Test Inertial Mass	5,027.6 lbs (2,280.5 kg)
Gross Static Mass	5,027.6 lbs (2,280.5 kg)

Impact Conditions

Impact Velocity	49.77 mph (80.10 km/h)
Impact Angle	0.2°
Location / Orientation	27.4 in. (697 mm) left of TMA centerline
Kinetic Energy	416.3 kip-ft (564.5 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	1.2 ft. (0.4 m) Upstream 15.8 ft. (4.8 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	9.9 °
Maximum Pitch Angle	8.4 °
Maximum Yaw Angle	-55.5 °

Occupant Risk

Longitudinal OIV	36.4 ft/s (11.1 m/s)
Lateral OIV	4.9 ft/s (1.5 m/s)
Longitudinal RA	-16.1 g
Lateral RA	-4.7 g
THIV	36.7 ft/s (11.2 m/s)
PHD	16.8 g
ASI	1.28

Test Article Deflections

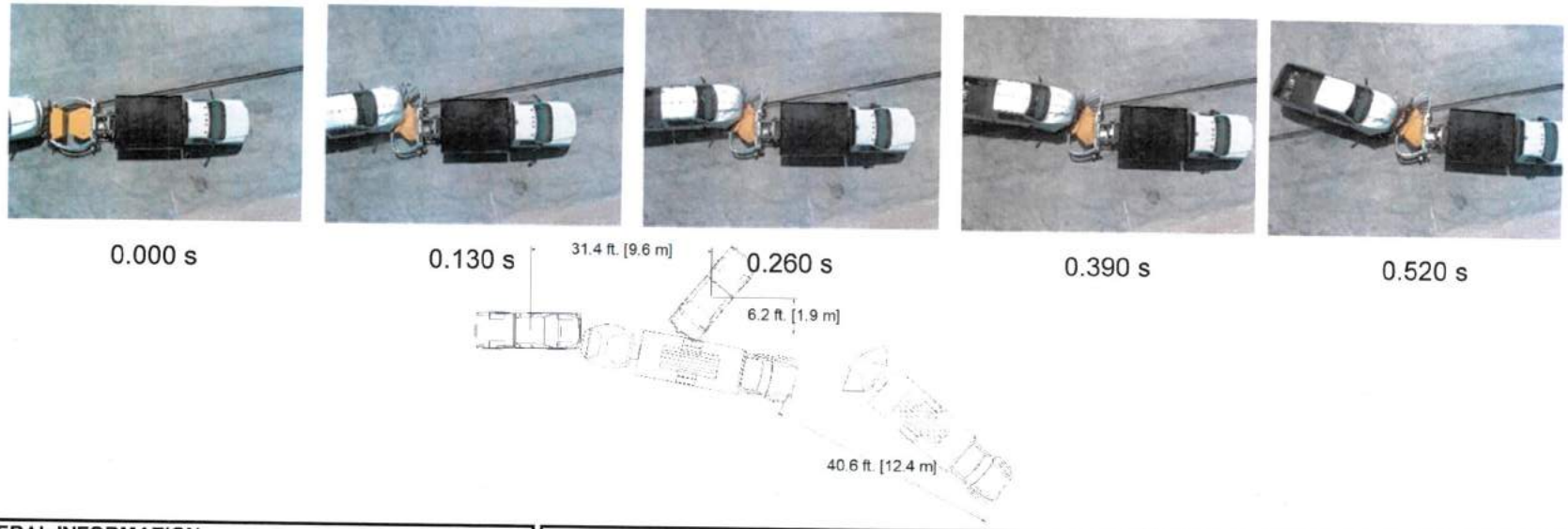
Static	5.5 ft. (1.7 m)
Dynamic	6.1 ft. (1.9 m)
Working Width	N/A
Debris Field	N/A

Vehicle Damage

Vehicle Damage Scale	12-FD-4
CDC	12FDEW3
Maximum Intrusion	0.2 in. (5 mm) at floor pan

Figure 3 Summary of Test 2-52

MASH 2016 Test 2-53 Summary



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test No	P39268-01
Test Designation	2-53
Test Date	08/26/19
TEST ARTICLE	
Name / Model	Scorpion II Metro
Type	Truck Mounted Attenuator
Support Vehicle Length	28.2 ft. (8.6 m)
TMA Length	7.7 ft. (2.3 m)
Road Surface	Smooth, clean concrete
Support Vehicle Restraint	2nd Gear, Parking Brake Engaged
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2014 RAM 1500
Curb Mass	5,060.6 lbs (2,295.5 kg)
Test Inertial Mass	5,029.8 lbs (2,281.5 kg)
Gross Static Mass	5,029.8 lbs (2,281.5 kg)

Impact Conditions	
Impact Velocity	50.70 mph (81.60 km/h)
Impact Angle	9.9°
Location / Orientation	19.2 in. (488 mm) left of TMA centerline
Kinetic Energy	432.2 kip-ft (586.0 kJ)
Exit Conditions	
Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	31.4 ft. (9.6 m) downstream 6.2 ft. (1.9 m) Left
Support Vehicle Roll-Ahead	40.6 ft. (12.4 m)
Vehicle Snagging	None
Vehicle Pocketing	None
Vehicle Stability	Satisfactory
Maximum Roll Angle	-3.9 °
Maximum Pitch Angle	-5.4 °
Maximum Yaw Angle	-69.2 °

Occupant Risk	
Longitudinal OIV	33.1 ft/s (10.1 m/s)
Lateral OIV	7.5 ft/s (2.3 m/s)
Longitudinal RA	-8.8 g
Lateral RA	-2.0 g
THIV	33.8 ft/s (10.3 m/s)
PHD	8.8 g
ASI	0.89
Test Article Deflections	
Static	4.7 ft. (1.4 m)
Dynamic	5.1 ft. (1.5 m)
Working Width	N/A
Debris Field	N/A
Vehicle Damage	
Vehicle Damage Scale	12-FR-4
CDC	12FZEW2
Maximum Intrusion	0.1 in. (4 mm) Floor Pan

Figure 3 Summary of Test 2-53