



Highway Attachment 8 – SCI Smart Cushion MASH Eligibility Letter

HWY18FH011

(37 pages)



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

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

August 16, 2016

In Reply Refer To:
HSST-CC-128

Mr. Jeffery D. Smith
Work Area Protection Corporation
2500 Production Drive
St. Charles, Missouri 60174

Dear Mr. Smith:

This letter is in response to your April 20, 2015, and July 28, 2016 requests 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-128 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:

- SCI SmartCushion® TL-3 SCI100GM Impact 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' 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.

FHWA: HSST: Artimovich: sf: x61331:8/8/16
File: s://directory folder/HSST/Artimovich/ CC128 SmartCushion.docx
cc: HSST (NArtimovich; BFouch)

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 American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (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:	SCI SmartCushion® SCI100GM
Type of system:	Permanent Crash Cushion for concrete or asphalt pavements.
Test Level:	MASH Test Level 3 (TL3)
Testing conducted by:	KARCO Engineering
Date of requests:	April 20, 2015, and May 18, 2016
Date of completed package:	July 28, 2016

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

If a manufacturer makes any modification to any of their roadside safety hardware that has an existing eligibility letter from FHWA, the manufacturer must notify FHWA of such modification with a request for continued eligibility for reimbursement. The notice of all modifications to a device must be accompanied by:

- Significant modifications – For these modifications, crash test results must be submitted with accompanying documentation and videos.
- Non-signification modifications – For these modifications, a statement from the crash test laboratory on the potential effect of the modification on the ability of the device to meet the relevant crash test criteria.

FHWA's determination of continued eligibility for the modified hardware will be based on whether the modified hardware will continue to meet the relevant crash test criteria.

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 the 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.

Supplemental Information

The SCI Smart Cushion® was developed by companies within the Stabler Companies Inc. family. Stabler Companies was purchased by New Enterprise Stone & Lime Co., Inc. in January of 2008. Stabler Companies Inc. was the parent company of SCI Products Inc. and Work Area Protection Corp. The first FHWA letter on the Smart Cushion®, CC-85, was issued to Stabler Companies Inc. while CC-85A and CC-85B were issued to SCI Products Inc. Although SCI Products Inc. is still in existence, it is not the manufacturing and marketing arm for the SCI Smart Cushion®. Work Area Protection Corp. which is a subsidiary of New Enterprise Stone & Lime Co., Inc. manufactures and markets the SCI Smart Cushion®.

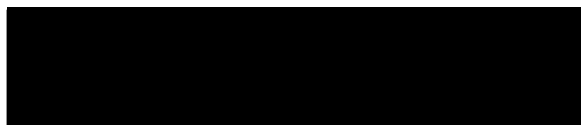
This letter acknowledges the Smart Cushion® is manufactured and marketed by Work Area Protection.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number CC-128 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 yours,



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:	May 18, 2016	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Jeffery D. Smith	
	Company:	Work Area Protection Corp.	
	Address:	2500 Production Drive, St. Charles, 60174	
	Country:	USA	
	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	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	SCI Smart Cushion-TL3 - SCI100GM- previously approved per NCHRP 350 under Approval HSA-10/CC-85 with no changes to the system.	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:	Jeffery D. Smith	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	Work Area Protection Corp.	Same as Submitter <input checked="" type="checkbox"/>
Address:	2500 Production Drive, St. Charles, 60174	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	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.

Subject: Disclosure of financial interest

KARCO Engineering, LLC is an independent research and testing laboratory having no affiliation with any other entity. The company is solely-owned and operated by Mr. Frank D. Richardson and Ms. Jennifer W. Peng (husband and wife) and was established on September 2, 1994. KARCO is actively involved in data acquisition and compliance/certification testing for a variety of government agencies and equipment manufacturers.

The principals and staff of KARCO Engineering have no past or present financial, contractual or organizational interest in any company or entity directly or indirectly related to the products that KARCO tests. If any financial interest should arise, other than receiving fees for testing, reporting, etc., with respect to any project, the company will provide, in writing, a full and immediate disclosure to the FHWA.

PRODUCT DESCRIPTION

New Hardware or Significant Modification
 Modification to Existing Hardware

The SCI Smart Cushion is a fully redirective crash cushion approved under NCHRP 350 and now tested to MASH criteria with no changes. It uses a hydraulic cylinder and cable assembly to provide a variable stopping force based on speed. It has 7 collapsible bays utilizing 3/16" tubular steel frames that support 10 gauge side panels that have 4 flutes. The dimensions are 258 inches (6556mm) long X 31.8 inches (808mm) wide at the rear X 33.4 inches (847 mm) high. The front sled structure is braced to minimize damage on angled or offset frontal impacts. This is a low maintenance system that requires very few repair parts.

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 crashworthiness

Engineer Name:	Balbino A. Beltran	
Engineer Signature:	Balbino A. Beltran	Digitally signed by Balbino A. Beltran DN: cn=Balbino A. Beltran, o=KARCO Engineering, LLC., ou, email=abeltran@karco.com, c=US Date: 2016.05.18 11:39:12 -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
3-30 (1100C)	<p>Test Date: 3-10-2016-KARCO Test TR-P36055-01-A Complete Report KARCO Test No. P36055-01. Test 3-30 involves a 1100C passenger car impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 0 degrees with the quarter point of the vehicle aligned with the center line of the crash cushion. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.</p> <p>For this test a 2010 Kia Rio weighing 2,453.6 lbs (1,113.0 kg) impacted the SCI Smart Cushion at a speed of 63.74 mph (102.67 km/h) and an angle of 0 degrees. Upon impact the vehicle forced the SCI Smart Cushion's sled rearward and began to collapse the sections in between the support frames. The crash cushion brought the vehicle to a controlled stop.</p> <p>The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-30.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
3-31 (2270P)	<p>Test Date 3-11-2015 - Karco Test #TR-P35022-01-B Complete Report.</p> <p>KARCO Test No. P35022-01. Test 3-31 involves a 2270P pickup truck impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 0 degrees with the centerline of the vehicle aligned with the center line of the crash cushion. This test is primarily intended to evaluate the capacity of the attenuator to stop the vehicle in a controlled manner. For this test, a 2009 Ram 1500 weighing 5,004.5 lbs (2,270.0 kg) impacted the SCI Smart Cushion at a speed of 60.70 mph (97.67 km/h) and an angle of .3 degrees. Upon impact the vehicle forced the SCI Smart Cushion's sled rearward and began to collapse the sections in between the support frames. The crash cushion brought the vehicle to a controlled stop. The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-31.</p>	PASS

3-32 (1100C)	<p>Test Date 3-8-2016 - Karco Test #TR-P36056-01-A Complete Report KARCO Test No. P36056-01. Test 3-32 involves a 1100C passenger car impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 15 degrees with the center point of the vehicle aligned with the center line of the crash cushion. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.</p> <p>For this test a 2010 Kia Rio weighing 2,444.9 lbs (1,109.0 kg) impacted the SCI Smart Cushion at a speed of 64.00 mph (103.00 km/h) and an angle of 15.3 degrees. Upon impact the vehicle forced the SCI Smart Cushion's sled rearward and began to collapse the sections in between the support frames. The crash cushion brought the vehicle to a controlled stop.</p> <p>The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-32.</p>	PASS
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3-33 (2270P)	<p>Test Date 3-7-2016 - Karco Test #TR-P36051-01-A Complete Report KARCO Test No. P36051-01. Test 3-33 involves a 2270P pickup impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 15 degrees with the centerline of the vehicle aligned with the center line of the crash cushion. This test is primarily intended to evaluate occupant risk, vehicle trajectory and the capacity of the attenuator to stop the vehicle in a controlled fashion on oblique impacts.</p> <p>For this test, a 2012 Ram 1500 weighing 4,998.9 lbs (2,267.5 kg) impacted the SCI Smart Cushion at a speed of 63.99 mph (102.98 km/h) and an angle of 14.9 degrees. Upon impact the vehicle forced the SCI Smart Cushion's sled rearward and began to collapse the sections in between the support frames. The crash cushion brought the vehicle to a controlled stop.</p> <p>The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-33.</p>	PASS
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3-34 (1100C)	<p>Test Date 3-9-2016 - Karco Test #TR-P36054-01-A Complete Report KARCO Test No. P36054-01. Test 3-34 involves a 1100C passenger car impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 15 degrees with the CIP at the point where the crash cushion behavior changes from gating to redirective. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.</p> <p>For this test a 2010 Kia Rio weighing 2,442.7 lbs (1,108.0 kg) impacted the SCI Smart Cushion at a speed of 60.17 mph (96.83 km/h) and an angle of 15.2 degrees. The impact point was 18.9" downstream of the front delineator plate. Upon impact the vehicle was smoothly redirected.</p> <p>The test vehicle sustained damage to its right front corner, doors and rear quarter panel. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-34.</p>	PASS
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3-35 (2270P)	<p>Test Date 3-8-2016 - Karco Test #TR-P36053-01-A Complete Report KARCO Test No. P36053-01. Test 3-35 involves a 2270P pickup impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 25 degrees with the CIP at the point where the crash cushion behavior changes from gating to redirective (beginning of length-of-need). This test is primarily intended to evaluate the capacity of the attenuator for redirection/containment of heavy vehicles at the front of the system.</p> <p>For this test a 2010 Ram 1500 weighing 5,009.9 lbs (2,272.5 kg) impacted the SCI Smart Cushion at a speed of 60.02 mph (96.59 km/h) and an angle of 25.9 degrees. The impact point was 19" downstream of the front delineator plate. Upon impact the vehicle was smoothly redirected without snagging.</p> <p>The test vehicle sustained damage to its right front corner, doors and rear quarter panel. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-35.</p>	PASS
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3-36 (2270P)	<p>Test Date 3-10-2016 - Karco Test #TR-P36052-01-A Complete Report KARCO Test No. P36052-01. Test 3-36 involves a 2270P pickup impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 25 degrees with the CIP at the point directed at the rear transition of a wide, rigid backup structure. This test is primarily intended to evaluate the capacity for redirection of heavy vehicles at the rear of the system where it protects wide rigid objects. For this test a 2011 Ram 1500 weighing 4,950.4 lbs (2,245.5 kg) impacted the SCI Smart Cushion at a speed of 62.08 mph (99.91 km/h) and an angle of 24.9 degrees. The impact point was 15' downstream of the front delineator plate. Upon impact the vehicle was smoothly redirected. The test vehicle sustained damage to its right front corner, doors and rear quarter panel. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-36.</p>	PASS
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3-37 (2270P)	<p>Test Date 3-11-2016 - Karco Test #TR-P36021-01-A Complete Report KARCO Test No. P36021-01. Test 3-37 involves a 2270P pickup impacting the crash cushion in the reverse direction at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 25 degrees with the CIP at the point directed at the beginning of the rear transition protecting a narrow concrete median barrier. This test is primarily intended to evaluate the potential for snagging and capacity for redirection of heavy vehicles at the rear of the system where vehicle can impact the rear of the attenuator.</p> <p>For this test a 2010 Ram 1500 weighing 4,976.9 lbs (2,257.5 kg) impacted the SCI Smart Cushion at a speed of 62.09 mph (99.92 km/h) and an angle of 24.5 degrees. The impact point was at the leading edge of the transition to the attenuator. Upon impact the vehicle was smoothly redirected with no snagging.</p> <p>The test vehicle sustained damage to its right front corner, doors and rear quarter panel. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-37.</p>	PASS
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Required Test Number	Narrative Description	Evaluation Results
3-38 (1500A)	<p>Test Date 5-9-2016 - Karco Test #TR-P36142-01 Complete Report KARCO Test No. P36142-01. Test 3-38 involves a 1500A sedan impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 0 degrees with the centerline of the vehicle aligned with the center line of the crash cushion. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria for a mid-size vehicle.</p> <p>For this test, a 2010 Chevrolet Malibu weighing 3,301.4 lbs (1,497.5 kg) impacted the SCI Smart Cushion at a speed of 60.57 mph (97.48 km/h) and an angle of .6 degrees. Upon impact the vehicle forced the SCI Smart Cushion's sled rearward and began to collapse the sections in between the support frames. The crash cushion brought the vehicle to a controlled stop. The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for Occupant Impact Velocity (OIV) and Ridedown Acceleration (RA). The SCI Smart Cushion redirective crash cushion passed all evaluation criteria for test 3-38.</p>	PASS
3-40 (1100C)	Test for non-redirective crash cushion is not applicable.	Non-Relevant Test, not conducted
3-41 (2270P)	Test for non-redirective crash cushion is not applicable.	Non-Relevant Test, not conducted
3-42 (1100C)	Test for non-redirective crash cushion is not applicable.	Non-Relevant Test, not conducted
3-43 (2270P)	Test for non-redirective crash cushion is not applicable.	Non-Relevant Test, not conducted
3-44 (2270P)	Test for non-redirective crash cushion is not applicable.	Non-Relevant Test, not conducted
3-45 (1500A)	Test for non-redirective crash cushion is not applicable.	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:	KARCO Engineering, INC	
Laboratory Signature:	Balbino A. Beltran	Digitally signed by Balbino A. Beltran DN: cn=Balbino A. Beltran, o=KARCO Engineering, LLC., ou, email=abeltran@karco.com, c=US Date: 2016.05.18 11:46:49 -07'00'
Address:	9270 Holly Road., Adelanto, Ca. 92301	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*: **Jeff Smith** Digitally signed by Jeff Smith
Date: 2016.05.18 12:39:49 -05'00'

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:

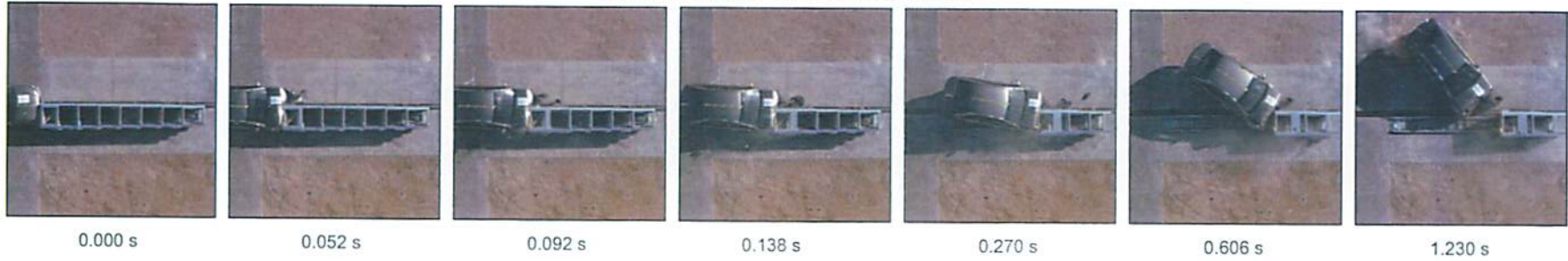
Eligibility Letter		
Number	Date	Key Words
CC-128	August 9, 2016	Crash Cushion Impact Attenuator SmartCushion Smart Cushion Low Maintenance

SECTION 4
MASH TEST 3-30 SUMMARY

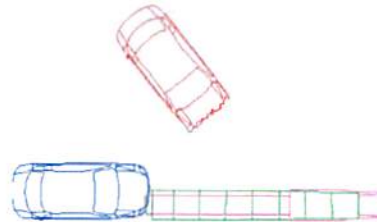
Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-30

Project No. P36055-01
Test Date: 03/10/16

SEQUENTIAL PHOTOGRAPHS



PLAN VIEW



Pre-Test
● Article
● Vehicle
Post-Test
● Article
● Vehicle

SECTION 4 ... (CONTINUED)

MASH TEST 3-30 SUMMARY

Test Article: Work Area Protection SCI Smart CushionProject No. P36055-01Test Program: MASH 3-30Test Date: 03/10/16

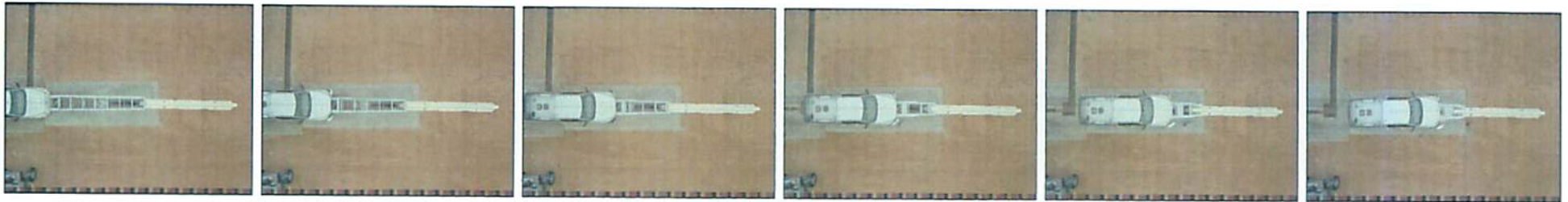
GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	N/A	
TEST NUMBER	P36055-01	EXIT ANGLE	N/A	
TEST DESIGNATION	3-30	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/10/16	FINAL VEHICLE POSITION	6.0 ft (1.8 m) downstream, 7.6 ft (2.3 m) left of barrier	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-11.1	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	8.4	
		MAXIMUM YAW ANGLE (°)	52.4	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	333.2 kip-ft (451.8 kJ)	
TOTAL INSTALLATION LENGTH	21.7 ft (6.6 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	34.1 ft/s (10.4 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	4.3 ft/s (1.3 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-11.9 g
TEST VEHICLE			Lateral	-3.6 g
TYPE / DESIGNATION	1100C	THIV	34.4 ft/s (10.5 m/s)	
YEAR, MAKE AND MODEL	2010 Kia Rio	PHD	12.2 g	
CURB MASS	2,480.2 lbs (1,125.0 kg)	ASI	1.60	
TEST INERTIAL MASS	2,453.8 lbs (1,113.0 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	2,613.5 lbs (1,185.5 kg)	STATIC	13.8 ft (4.2 m)	
IMPACT CONDITIONS		DYNAMIC	13.8 ft (4.2 m)	
IMPACT VELOCITY	63.74 mph (102.58 km/h)	ARTICLE DAMAGE	Minor	
IMPACT ANGLE (°)	0	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	0.6 in (16 mm) to the left of vehicle centerline	VEHICLE DAMAGE SCALE	12-FD-3	
		COLLISION DAMAGE CLASSIFICATION	12FDEW2	

SECTION 4
MASH TEST 3-31 SUMMARY

Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-31

Project No. P35022-01
Test Date: 03/11/15

SEQUENTIAL PHOTOGRAPHS



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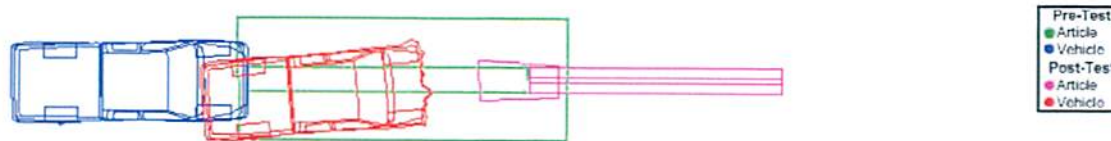
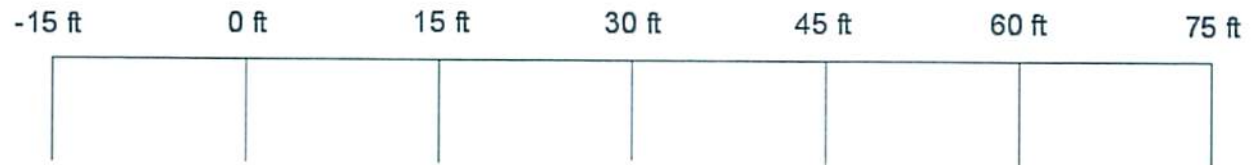
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PLAN VIEW



SECTION 4 ... (CONTINUED)

MASH TEST 3-31 SUMMARY

Test Article: Work Area Protection SCI Smart CushionProject No. P35022-01Test Program: MASH 3-31Test Date: 03/11/15

GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	N/A	
TEST NUMBER	P35022-01	EXIT ANGLE	N/A	
TEST DESIGNATION	3-31	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/11/15	FINAL VEHICLE POSITION	14.7 ft (4.5 m) downstream	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	3.4	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	3.7	
		MAXIMUM YAW ANGLE (°)		
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	616.4 kip-ft (835.7 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	25.6 ft/s (7.8 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	0.3 ft/s (0.1 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-20.3 g
TEST VEHICLE			Lateral	-2.4 g
TYPE / DESIGNATION	2270P	THIV		
YEAR, MAKE AND MODEL	2009 RAM 1500	PHD		
CURB MASS	4,866.7 lbs (2,207.5 kg)	ASI		1.41
TEST INERTIAL MASS	5,004.5 lbs (2,270.0 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	5,004.5 lbs (2,270.0 kg)	STATIC	17.1 ft (5.2 m)	
IMPACT CONDITIONS		DYNAMIC	17.1 ft (5.2 m)	
IMPACT VELOCITY	60.70 mph (97.67 km/h)	ARTICLE DAMAGE	Minor	
IMPACT ANGLE (°)	0.3	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	Centerline of crash cushion face	VEHICLE DAMAGE SCALE	12-FD-3	
		COLLISION DAMAGE CLASSIFICATION	12FDBW2	

*Data Channel Failed

SECTION 4
MASH TEST 3-32 SUMMARY

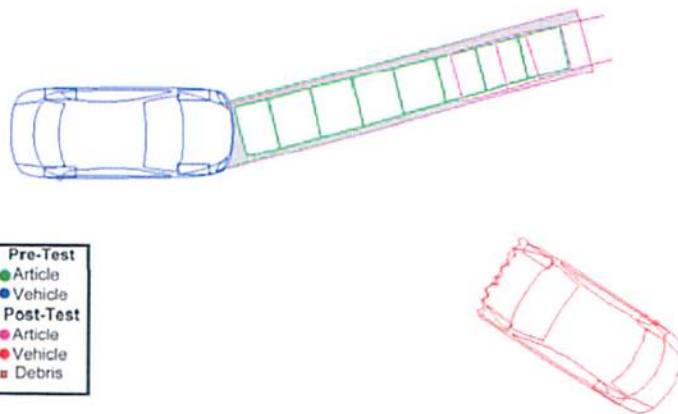
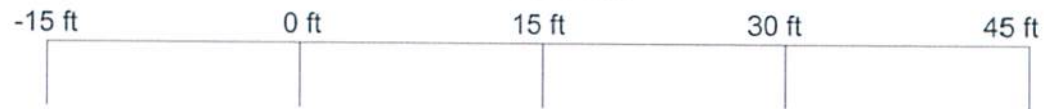
Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-32

Project No. P36056-01
Test Date: 03/08/16

SEQUENTIAL PHOTOGRAPHS



PLAN VIEW



SECTION 4 ... (CONTINUED)

MASH TEST 3-32 SUMMARY

Test Article: Work Area Protection SCI Smart Cushion
 Test Program: MASH 3-32

Project No. P36056-01
 Test Date: 03/08/16

GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	N/A	
TEST NUMBER	P36056-01	EXIT ANGLE	N/A	
TEST DESIGNATION	3-32	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/8/16	FINAL VEHICLE POSITION	21.5 ft (6.6 m) downstream, 20.0 ft (6.1 m) right	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-40.3	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	-39.6	
		MAXIMUM YAW ANGLE (°)	-104.5	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	334.6 kips-ft (453.7 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	35.1 ft/s (10.7 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	4.9 ft/s (1.5 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-8.1 g
TEST VEHICLE			Lateral	-2.5 g
TYPE / DESIGNATION	1100C	THIV	35.4 ft/s (10.8 m/s)	
YEAR, MAKE AND MODEL	2010 Kia Rio	PHD	18.4 g	
CURB MASS	2,490.2 lbs (1129.5 kg)	ASI	1.67	
TEST INERTIAL MASS	2444.9 lbs (1109.0 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	2618.0 lbs (1187.5 kg)	STATIC	13.7 ft. (4.2 m)	
IMPACT CONDITIONS		DYNAMIC	13.7 ft. (4.2 m)	
IMPACT VELOCITY	64.00 mph (103.00 km/h)	ARTICLE DAMAGE	Minor	
IMPACT ANGLE (°)	15.3	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	0.7 in (18 mm) right of crash cushion centerline	VEHICLE DAMAGE SCALE	12-FD-3	
		COLLISION DAMAGE CLASSIFICATION	12FDEW1	

SECTION 4
MASH TEST 3-33 SUMMARY

Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-33

Project No. P36051-01
Test Date: 03/07/16

SEQUENTIAL PHOTOGRAPHS



0.000 s

0.100 s

0.200 s

0.270 s

0.350 s

0.300 s

1.000 s

PLAN VIEW

-45 ft -30 ft -15 ft 0 ft 15 ft 30 ft 45 ft 60 ft 75 ft



- | | |
|-----------|-----------|
| Pre-Test | |
| ● Article | ● Article |
| ● Vehicle | ● Vehicle |
| Post-Test | |
| ● Article | ● Article |
| ● Vehicle | ● Vehicle |

SECTION 4 ... (CONTINUED)

MASH TEST 3-33 SUMMARY

Test Article: Work Area Protection SCI Smart Cushion
 Test Program: MASH 3-33

Project No. P36051-01
 Test Date: 03/07/16

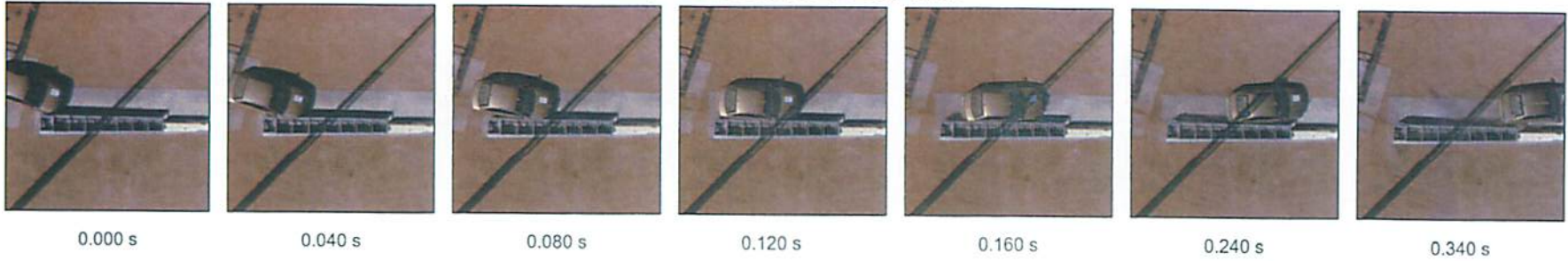
GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	N/A	
TEST NUMBER	P36051-01	EXIT ANGLE	N/A	
TEST DESIGNATION	3-33	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/7/16	FINAL VEHICLE POSITION	13.5 ft (4.1 m) downstream, 38.6 ft (11.8m) to the right side	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-7.7	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	-8.9	
		MAXIMUM YAW ANGLE (°)	-105.6	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	684.0 kips-ft (927.4 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	25.9 ft/s (7.9 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	6.6 ft/s (2.0 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-16.9 g
TEST VEHICLE			Lateral	-7.1 g
TYPE / DESIGNATION	2270P	THIV	26.9 ft/s (8.2 m/s)	
YEAR, MAKE AND MODEL	2012 RAM 1500	PHD	18.4 g	
CURB MASS	4,883.2 lbs (2,215.0 kg)	ASI	1.02	
TEST INERTIAL MASS	4,998.9 lbs (2,267.5 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	4,998.9 lbs (2,267.5 kg)	STATIC	17.0 ft (5.2 m)	
IMPACT CONDITIONS		DYNAMIC	17.0 ft (5.2 m)	
IMPACT VELOCITY	63.99 mph (102.98 km/h)	ARTICLE DAMAGE	Minor	
IMPACT ANGLE (°)	14.9	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	0.5 in (13 mm) right of the article centerline	VEHICLE DAMAGE SCALE	12-FD-3	
		COLLISION DAMAGE CLASSIFICATION	12FDEW2	

SECTION 4
MASH TEST 3-34 SUMMARY

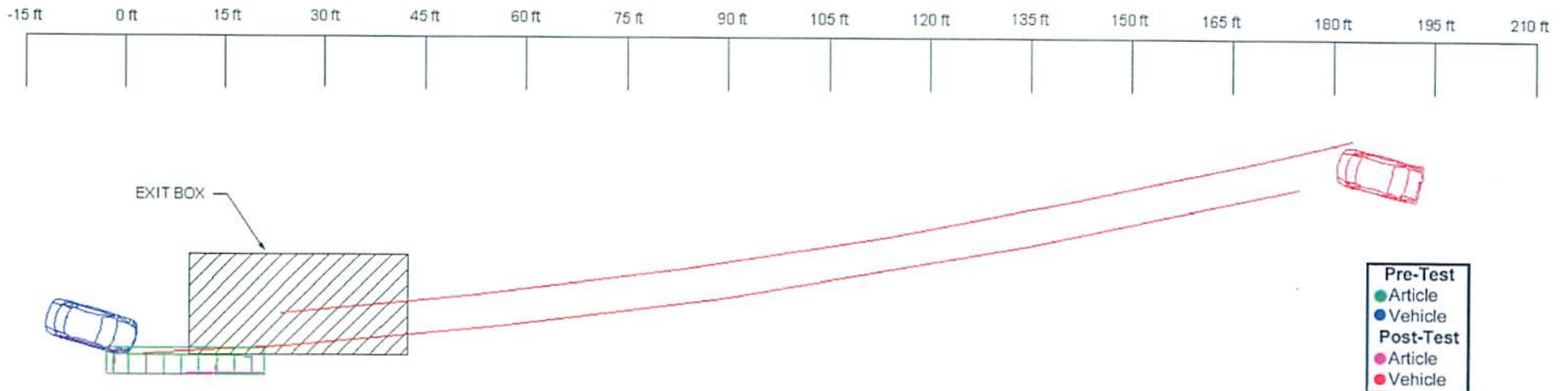
Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-34

Project No. P36054-01
Test Date: 03/09/16

SEQUENTIAL PHOTOGRAPHS



PLAN VIEW



SECTION 4 ... (CONTINUED)

MASH TEST 3-34 SUMMARY

Test Article: Work Area Protection SCI Smart CushionProject No. P36054-01Test Program: MASH 3-34Test Date: 03/09/16

GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	50.28 mph (80.92 km/h)	
TEST NUMBER	P36054-01	EXIT ANGLE (°)	4.3	
TEST DESIGNATION	3-34	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/9/16	FINAL VEHICLE POSITION	190.6 ft (58.1 m) downstream, 25.8 ft (7.8 m) to the left side	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-3.8	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	4.1	
		MAXIMUM YAW ANGLE (°)	-22.0	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	19.8 kip-ft (26.8 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	7.5 ft/s (2.3 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	19.0 ft/s (5.8 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-2.0 g
TEST VEHICLE			Lateral	-9.7 g
TYPE / DESIGNATION	1100C	THIV		20.7 ft/s (6.3 m/s)
YEAR, MAKE AND MODEL	2010 Kia Rio	PHD		9.7 g
CURB MASS	2,503.3 lbs (1,135.5 kg)	ASI		1.28
TEST INERTIAL MASS	2,442.7 lbs (1,108.0 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	2,610.3 lbs (1,184.0 kg)	STATIC		0.9 in (23 mm)
IMPACT CONDITIONS		DYNAMIC		2.0 in (51 mm)
IMPACT VELOCITY	60.17 mph (96.83 km/h)	ARTICLE DAMAGE		Minor
IMPACT ANGLE (°)	15.2	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	18.9 in (480 mm) downstream from crash cushion front face	VEHICLE DAMAGE SCALE		1-RD-1
		COLLISION DAMAGE CLASSIFICATION		01RDES1

SECTION 4
MASH TEST 3-35 SUMMARY

Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-35

Project No. P36053-01
Test Date: 03/08/16

SEQUENTIAL PHOTOGRAPHS



0.000 s

0.050 s

0.090 s

0.175 s

0.220 s

0.300 s

0.500 s

PLAN VIEW



SECTION 4 ... (CONTINUED)

MASH TEST 3-35 SUMMARY

Test Article: Work Area Protection SCI Smart Cushion
 Test Program: MASH 3-35

Project No. P36053-01
 Test Date: 03/08/16

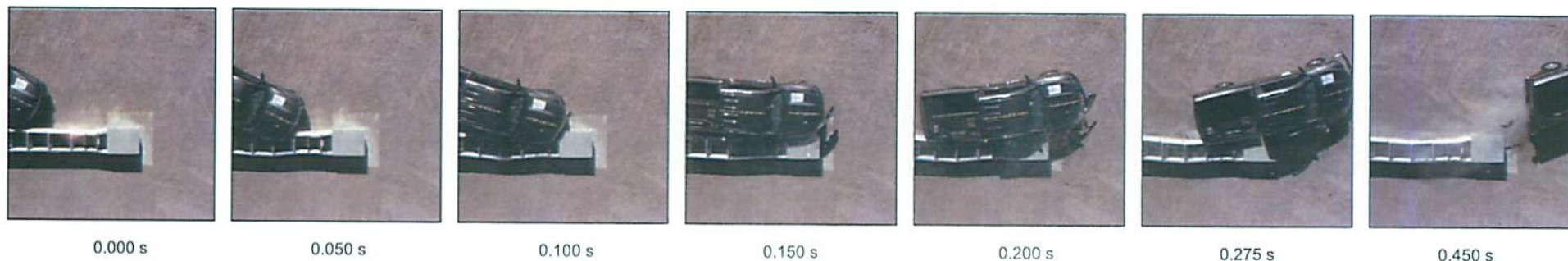
GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	52.55 mph (84.58 km/h)	
TEST NUMBER	P36053-01	EXIT ANGLE (°)	9.2	
TEST DESIGNATION	3-35	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/8/16	FINAL VEHICLE POSITION	225.4 ft (68.9 m) downstream, 76.2 ft (23.2 m) left side	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-10.7	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	22.0	
		MAXIMUM YAW ANGLE (°)	-33.2	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	115.7 kip-ft (156.1 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	15.7 ft/s (4.8 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	29.5 ft/s (9.0 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-2.6 g
TEST VEHICLE			Lateral	-13.2 g
TYPE / DESIGNATION	2270P	THIV	33.1 ft/s (10.1 m/s)	
YEAR, MAKE AND MODEL	2010 Ram 1500	PHD	13.2 g	
CURB MASS	4822.5 lbs (2187.5 kg)	ASI	1.81	
TEST INERTIAL MASS	5009.9 lbs (2272.5 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	5009.9 lbs (2272.5 kg)	STATIC	0.7 in (17 mm)	
IMPACT CONDITIONS		DYNAMIC	2.6 in (66 mm)	
IMPACT VELOCITY	60.02 mph (96.59 km/h)	ARTICLE DAMAGE	Minor	
IMPACT ANGLE (°)	25.9	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	19.0 in (483 mm) downstream of crash cushion front face	VEHICLE DAMAGE SCALE	01-RFQ-3	
		COLLISION DAMAGE CLASSIFICATION	01RDEW2	

SECTION 4
MASH TEST 3-36 SUMMARY

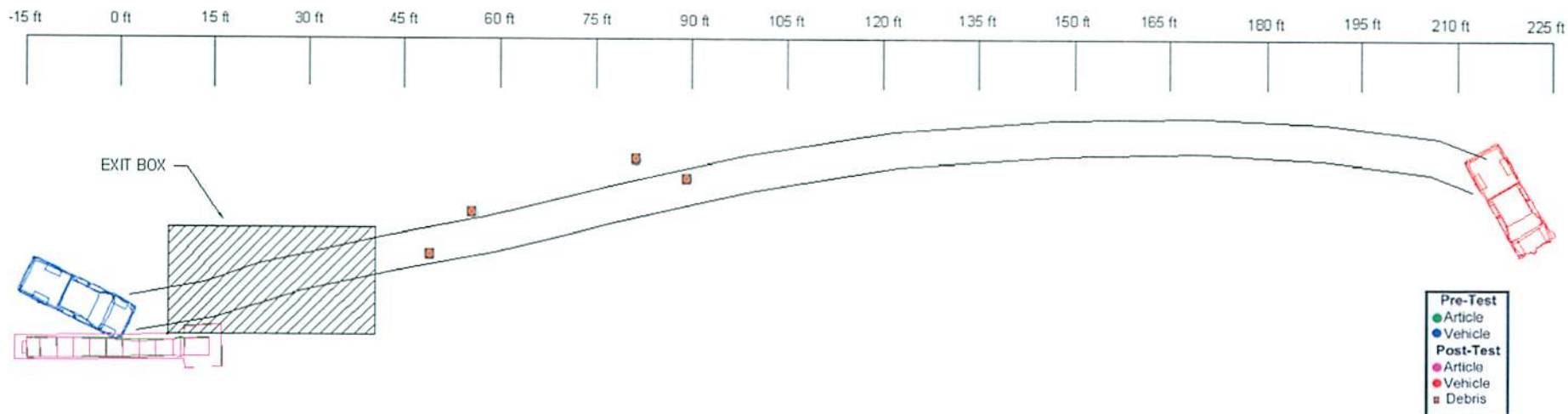
Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-36

Project No. P36052-01
Test Date: 03/10/16

SEQUENTIAL PHOTOGRAPHS



PLAN VIEW



SECTION 4 ... (CONTINUED)

MASH TEST 3-36 SUMMARY

Test Article: Work Area Protection SCI Smart CushionProject No. P36052-01Test Program: MASH 3-36Test Date: 03/10/16

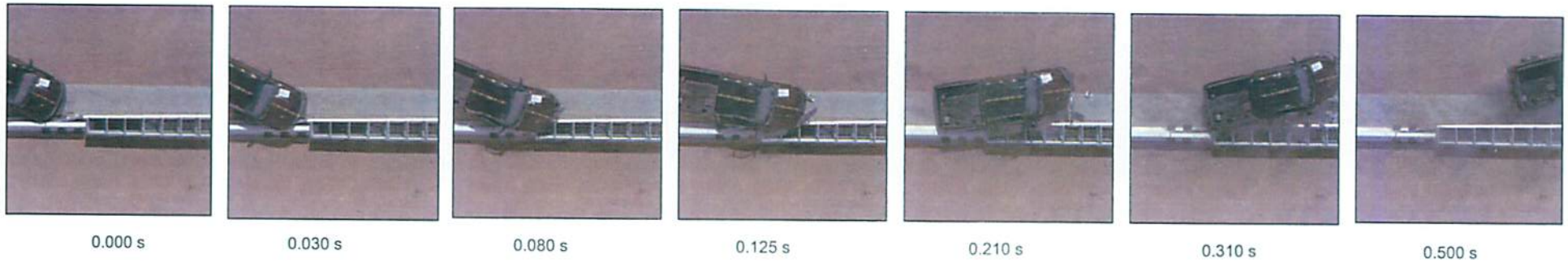
GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	52.95 mph (85.21 km/h)	
TEST NUMBER	P36052-01	EXIT ANGLE (°)	15.3	
TEST DESIGNATION	3-36	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/10/16	FINAL VEHICLE POSITION	221.3 ft (67.4 m) downstream, 13.3 ft. (4.1 m) left side	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-14.5	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	26.4	
		MAXIMUM YAW ANGLE (°)	-38.5	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	113.1 kips-ft (153.3 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	18.0 ft/s (5.5 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	29.5 ft/s (9.0 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-10.5 g
TEST VEHICLE			Lateral	-12.3 g
TYPE / DESIGNATION	2270P	THIV	33.5 ft/s (10.2 m/s)	
YEAR, MAKE AND MODEL	2011 RAM 1500	PHD	12.3 g	
CURB MASS	4877.6 lbs (2212.5 kg)	ASI	1.76	
TEST INERTIAL MASS	4950.4 lbs (2245.5 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	4950.4 lbs (2245.5 kg)	STATIC	4.3 in (108 mm)	
IMPACT CONDITIONS		DYNAMIC	4.5 in (114 mm)	
IMPACT VELOCITY	62.08 mph (99.91 km/h)	ARTICLE DAMAGE	Moderate	
IMPACT ANGLE (°)	24.9	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	15.0 ft (4.6 m) downstream from crash cushion front face	VEHICLE DAMAGE SCALE	1-RFQ-3	
		COLLISION DAMAGE CLASSIFICATION	01RDEW3	

SECTION 4
MASH TEST 3-37 SUMMARY

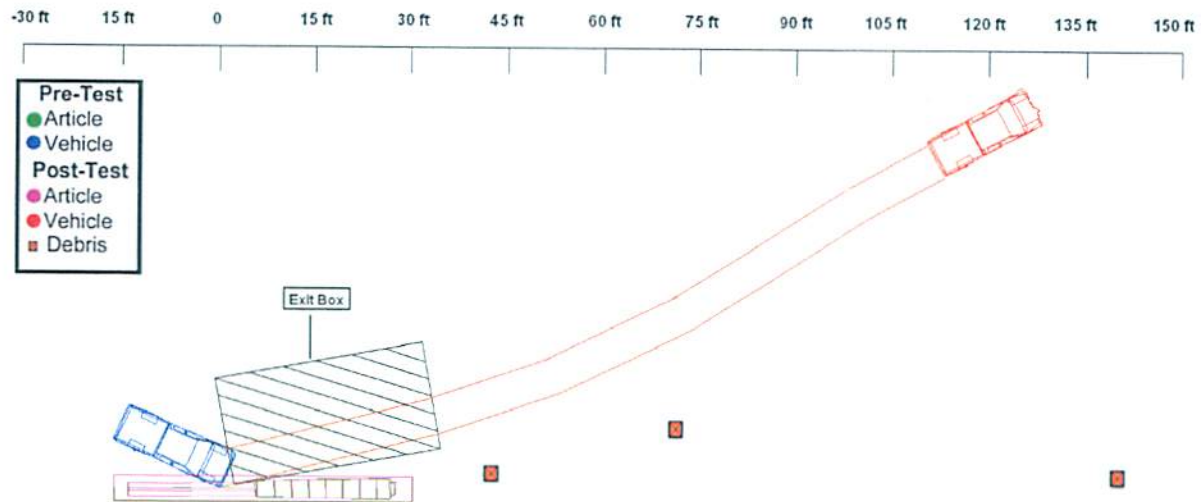
Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-37

Project No. P36021-01
Test Date: 03/11/16

SEQUENTIAL PHOTOGRAPHS



PLAN VIEW



SECTION 4 ... (CONTINUED)

MASH TEST 3-37 SUMMARY

Test Article: Work Area Protection SCI Smart CushionProject No. P36021-01Test Program: MASH 3-37Test Date: 03/11/16

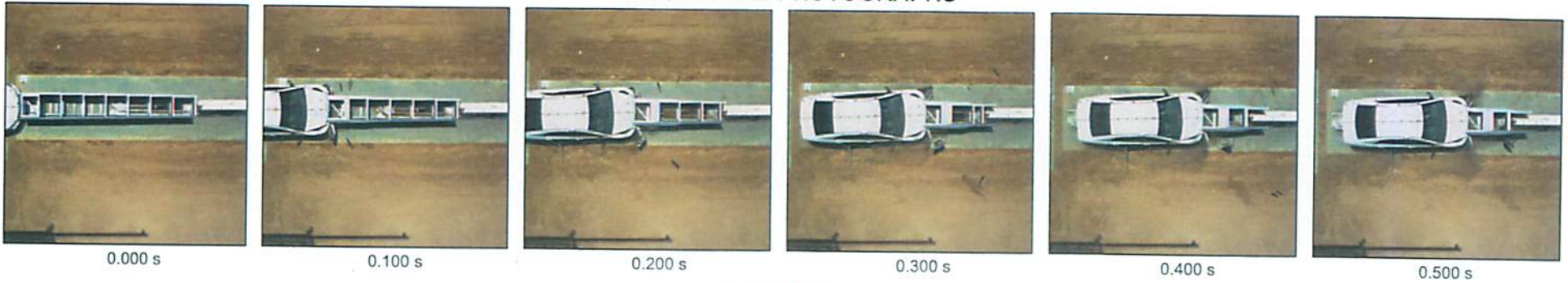
GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	42.80 mph (68.88 km/h)	
TEST NUMBER	P36021-01	EXIT ANGLE (°)	14.3	
TEST DESIGNATION	3-37	VEHICLE STABILITY	Satisfactory	
TEST DATE	3/11/16	FINAL VEHICLE POSITION	124.6 ft (38.0 m) downstream, 57.7 ft (17.6 m) left side	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-11.8	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	19.3	
		MAXIMUM YAW ANGLE (°)	-41.9	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	110.3 kips-ft (149.5 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	26.2 ft/s (8.0 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	32.2 ft/s (9.8 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-11.3 g
TEST VEHICLE			Lateral	-11.4 g
TYPE / DESIGNATION	2270P	THIV	40.7 ft/s (12.4 m/s)	
YEAR, MAKE AND MODEL	2010 RAM 1500	PHD	13.4 g	
CURB MASS	5017.6 lbs (2276.0 kg)	ASI	2.18	
TEST INERTIAL MASS	4,976.9 lbs (2,257.5 kg)	TEST ARTICLE DEFLECTIONS		
GROSS STATIC MASS	4,976.9 lbs (2,257.5 kg)	STATIC	0.6 in (16 mm)	
IMPACT CONDITIONS		DYNAMIC	3.4 in (86 mm)	
IMPACT VELOCITY	62.09 mph (99.92 km/h)	ARTICLE DAMAGE	Moderate	
IMPACT ANGLE (°)	24.5	VEHICLE DAMAGE		
IMPACT LOCATION / ORIENTATION	13.7 ft (4.2 m) downstream of concrete barrier	VEHICLE DAMAGE SCALE	1-RFQ-5	
		COLLISION DAMAGE CLASSIFICATION	01RDEW4	

SECTION 4
MASH TEST 3-38 SUMMARY

Test Article: Work Area Protection SCI Smart Cushion
Test Program: MASH 3-38

Project No. P36142-01
Test Date: 05/09/16

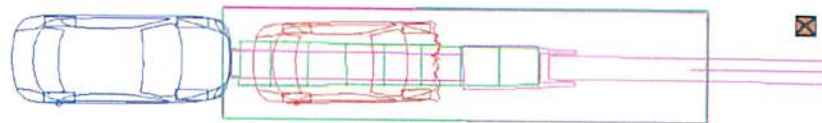
SEQUENTIAL PHOTOGRAPHS



PLAN VIEW



- Pre-Test
 - Article
 - Vehicle
- Post-Test
 - Article
 - Vehicle
 - Debris

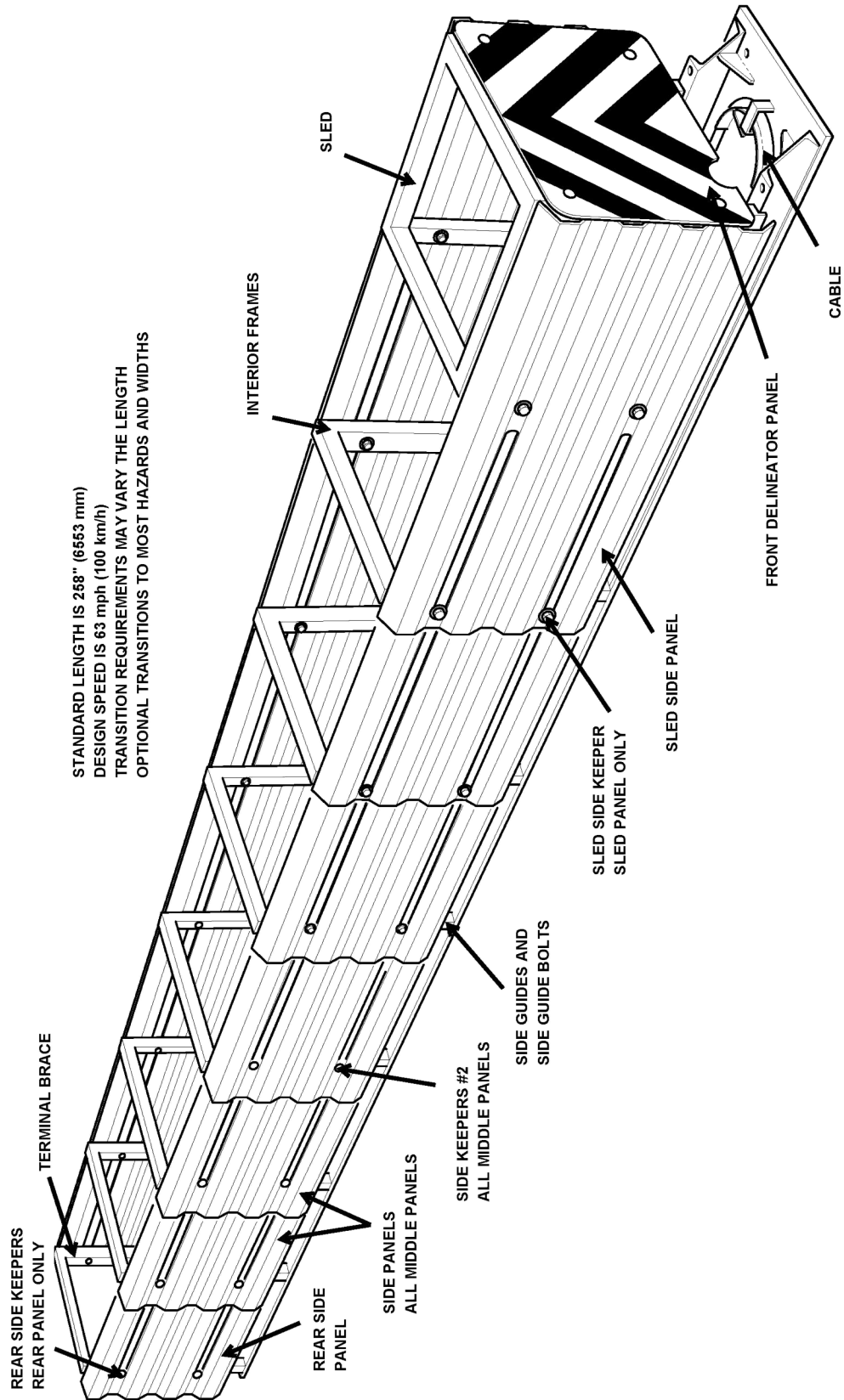


SECTION 4 ... (CONTINUED)

MASH TEST 3-38 SUMMARY

Test Article: Work Area Protection SCI Smart CushionProject No. P36142-01Test Program: MASH 3-38Test Date: 05/09/16

GENERAL INFORMATION		EXIT CONDITIONS		
TEST AGENCY	KARCO Engineering, LLC.	EXIT VELOCITY	N/A	
TEST NUMBER	P36142-01	EXIT ANGLE	N/A	
TEST DESIGNATION	3-38	VEHICLE STABILITY	Satisfactory	
TEST DATE	5/9/16	FINAL VEHICLE POSITION	15.7 ft (4.8 m) downstream	
TEST ARTICLE		VEHICLE SNAGGING	None	
NAME / MODEL	SCI Smart Cushion	VEHICLE POCKETING	None	
TYPE	Redirective Crash Cushion	MAXIMUM ROLL ANGLE (°)	-1.1	
KEY ELEMENTS	Base Structure, Sled, Wire Rope Cable, Sheaves, Shock Arresting Cylinder	MAXIMUM PITCH ANGLE (°)	-2.3	
		MAXIMUM YAW ANGLE (°)	2.1	
ARTICLE LENGTH	21.7 ft (6.6 m)	KINETIC ENERGY	404.9 kip-ft (549.0 kJ)	
TOTAL INSTALLATION LENGTH	41.5 ft (12.7 m)	OCCUPANT RISK VALUES		
HEIGHT	33.5 in (851 mm)	OCCUPANT IMPACT VELOCITY	Longitudinal	28.9 ft/s (8.8 m/s)
MAXIMUM WIDTH	37.4 in (951 mm)		Lateral	0.3 ft/s (0.1 m/s)
ROAD SURFACE	Concrete	RIDEDOWN ACCELERATION	Longitudinal	-11.3 g
			Lateral	-1.6 g
TEST VEHICLE		THIV		28.9 ft/s (8.8 m/s)
TYPE / DESIGNATION	1500A	PHD		11.4 g
YEAR, MAKE AND MODEL	2010 Chevrolet Malibu	ASI		1.37
CURB MASS	3,392.9 lbs (1,539.0 kg)	TEST ARTICLE DEFLECTIONS		
TEST INERTIAL MASS	3,301.4 lbs (1,497.5 kg)	STATIC		15.7 ft (4.8 m)
GROSS STATIC MASS	3,301.4 lbs (1,497.5 kg)	DYNAMIC		15.7 ft (4.8 m)
IMPACT CONDITIONS		ARTICLE DAMAGE		Minor
IMPACT VELOCITY	60.57 mph (97.48 km/h)	VEHICLE DAMAGE		
IMPACT ANGLE (°)	0.6	VEHICLE DAMAGE SCALE		12-FD-3
IMPACT LOCATION / ORIENTATION	Centerline of crash cushion sled	COLLISION DAMAGE CLASSIFICATION		12FDEW2



SCI100GM IMPACT ATTENUATOR



Work Area Protection Corp.

SCI17a

SHEET NO.

DATE

1 OF 2

5/19/16

DESCRIPTION

The SCI100GM impact attenuator was designed to provide a variable stopping force based on speed to give a smooth ridedown for a wide variety of speeds and masses. It passed all MASH tests including optional test #3-38 setting record ridedown G forces for small vehicles. This system was first tested to NCHRP 350 and passed all MASH tests with no changes.

The SCI100GM uses a hydraulic shock-absorbing cylinder to give a speed dependent, smooth ridedown. The telescoping fender panels are slightly tapered to allow a smooth stress-free nesting during collapse. The SCI100GM uses a 1.125" (29mm) IWRC galvanized cable to control the front sled's rearward travel. Galvanizing and Welding meet standards ASTM A123 and AWS D1.1, respectively.

The SCI100GM only requires the replacement of two 1/4" (6mm) x 1.75" (44mm) grade 8 shear bolts after a frontal impact within MASH design criteria. A reset can be performed in less than 30 minutes by an experienced repair crew.

The SCI100GM has transitions to 24" (610mm), 30" (762mm) and 36" (914mm) obstacles as well as gore area configurations. Wider width may affect the length of the system.

SPECIFICATIONS

Non-Gating	Length	21.5' (6.55m)
Redirectional	Width	24" (610mm)
Non-Pocketing	Height	2.75' (840mm)
Bidirectional	Weight	3450 lb (1,565kg)
Fully Reusable		

APPROVAL

The SCI100GM impact attenuator was tested to the MASH Test Level 3 criteria and was approved in the FHWA NCHRP 350 acceptance letter CC-85 and MASH acceptance letter CC-128.

SCI100GM IMPACT ATTENUATOR

SCI17a



Work Area Protection Corp.

SHEET NO.

DATE

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5/19/16