



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

June 25, 2019

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

In Reply Refer To:
HSST-1/CC-153

Mr. Gerrit Dyke, P.E.
Lindsay Transportation Solutions
180 River Road
Rio Vista, CA 94571

Dear Mr. Dyke:

This letter is in response to your April 4, 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-153 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

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

- ABSORB-M

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: ABSORB-M
Type of system: Crash Cushion
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: Safety Technologies
Date of request: April 4, 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-153 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.
- 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,



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

Enclosures

FHWA Office of Safety

Form to Request for Federal Aid Reimbursement Eligibility of Safety Hardware Devices

This is the FHWA Office of Safety's instructions for the 'Form to Request Eligibility for Federal Aid Reimbursement' (Form).

The following steps serve as a guide to completing the Form.

Please contact FHWA's Office of Safety at 202-366-8568 with questions, comments or if experiencing difficulty. The Form requires Adobe® software (Full or Reader versions) to complete.

Essentials for getting started as follows:

1. Adobe® X Reader (minimum)
2. Active Outlook or a web-based email account
3. Copy Form to your C-Drive before getting started
4. Save-As using the following convention in naming your file:
i.e.; Business Name_System Type_Name of Product_Submission date}
key: ' _ ' = underscore

Steps for completion of the form to 'Request for Federal Aid Reimbursement Eligibility of Safety Hardware Devices as follows:

1. Enable Java Scripts
 2. Use 'tab' button to proceed to each succeeding required field
 3. All required fields are highlighted
 4. Some required fields have prescribed choices (via clicking the down '▼' arrow located at right hand side of the field). 'Click' on desired choice & then tab to next available required highlighted field.
 5. Spell out formal names, including safety hardware and devices. If an abbreviation (acronym) is desired and/or used, please indicate inside parenthesis after initial formal name.
 6. 'Help' buttons are provided for additional description for content clarity
 7. Product Description field shall be limited to total of 400 word count.
 8. Crash Testing Narrative Description shall be limited to 400 word total count.
 9. Upon completion of the Form and is prepared to send, click 'SUBMIT' button located at the end of form. This will prompt pop-up box that will request to select one of 2 email preference (i.e., Outlook or other web based email.)
 10. The default recipient of this email is the Office of Safety
 11. Attach additional documents required for submission (10 megabyte max.)
 12. If required attachment files exceed 10 megabyte max., forward to FHWA via mail carrier all excess files on compact disk or other memory access medium. For larger files, please provide file transfer protocol link within the body of email, or forward (via mail carrier) files stored on memory medium to FHWA Office of Safety. If using U.S. Mail, please be advised of package screening that may be harmful to contents of package.
 13. A signature is required by both the submitter and the crash test laboratory
- end*

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	April 4, 2019	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Gerrit A. Dyke, P.E.	
	Company:	Lindsay Transportation Solutions, Inc.	
	Address:	180 River Road, Rio Vista, CA 94571	
	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	ABSORB-M	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:	Gerrit A. Dyke, P.E.	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	Lindsay Transportation Solutions, Inc.	Same as Submitter <input checked="" type="checkbox"/>
Address:	180 River Road, Rio Vista, CA 94571	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.

Safe Technologies, Inc. (STI) performs testing and analysis services for Lindsay Transportation Solutions, Inc. (LTS). STI is a wholly owned subsidiary of LTS. STI is a fully accredited crash test facility to ISO 17025 by A2LA and is recognized by the US Federal Highway Administration (FHWA) to perform full scale crash tests per NCHRP Report 350 and MASH criteria.

The STI laboratory manager, technicians, and laborers are compensated by LTS for salaries and wages. STI and staff does not receive any incentives, compensation, commissions, or professional fees corresponding to the outcome of any testing or analysis.

STI or staff does not receive any research funding or other research support from LTS. STI and staff also do not have any financial interest in patents, copyrights, or other intellectual property associated with the products they test or analyze.

KARCO Engineering, LLC. was contracted by LTS to collaborate with STI for this testing program. KARCO provided guidance, recommendations, and suggestions for testing and reporting practices. KARCO reviewed test data and reports to ensure accuracy and correct representation of test parameters and results. KARCO nor any KARCO employee has any financial interest in LTS, STI, or the product being tested.

PRODUCT DESCRIPTION

- New Hardware or Significant Modification

 Modification to Existing Hardware

The ABSORB-M™ is a non-redirective, gating crash cushion designed to meet the latest test standards defined in the Manual for Assessing Safety Hardware (MASH), Second Edition, 2016. The ABSORB-M system utilizes water, thermoplastic elements (elements), tension straps, a midnose, and a transition to absorb kinetic energy and safely contain or control the trajectory of impacting vehicles. The MASH Test Level 3 system is comprised of a nose plate, three elements, ten pin assemblies, a midnose, a transition, and six mechanical anchors attaching to the barrier system. Of the three elements, the middle and rearmost are filled with water and the front element is empty. Each element is pre-assembled using four tension straps secured with eight bolts and thread locking compound. The system has a nominal 42" [1070mm] height, 24" [600mm] width, and an effective length of approximately 251 3/4" [6.4m]. The ABSORB-M is designed to attach directly to longitudinal roadside safety barrier systems and does not attach to a foundation.

More details about the ABSORB-M are provided in Enclosure A titled "ABSORB-M MASH TL-3 Crash Cushion System".

Manufacturing drawings may be adjusted to ensure manufacturing capability and consistency with MASH tested and certified product.

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:	Joseph Nagy	
Engineer Signature:	Joseph Nagy	Digitally signed by Joseph Nagy Date: 2019.04.04 13:43:42 -07'00'
Address:	170 River Road, Rio Vista, CA 94571	Same as Submitter <input type="checkbox"/>
Country:	USA	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)	NA	Non-Relevant Test, not conducted
3-31 (2270P)	NA	Non-Relevant Test, not conducted
3-32 (1100C)	NA	Non-Relevant Test, not conducted
3-33 (2270P)	NA	Non-Relevant Test, not conducted
3-34 (1100C)	NA	Non-Relevant Test, not conducted
3-35 (2270P)	NA	Non-Relevant Test, not conducted
3-36 (2270P)	NA	Non-Relevant Test, not conducted
3-37 (2270P)	NA	Non-Relevant Test, not conducted
3-38 (1500A)	NA	Non-Relevant Test, not conducted

Required Test Number	Narrative Description	Evaluation Results
3-40 (1100C)	<p>The ABSORB-M was determined to have successfully met all of the evaluation criteria for MASH Test 3-40 for gating, non-redirective crash cushions.</p> <p>The ABSORB-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a gating, non-redirective crash cushion. The test article captured the 1100C vehicle in a controlled manner. The vehicle did not penetrate, underide, or override the installation.</p> <p>All of the occupant risk criteria were satisfied in testing the ABSORB-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the limit of 40.0 ft/s (12.2 m/s). ORAs in the longitudinal and lateral directions were below the preferred limit of 15.0 G. Some debris were propelled from the impacted system but due to their soft nature and light weight these fragments did not pose a threat to occupants of the vehicle, pedestrians or personnel in a work zone.</p> <p>There was minimal deformation to the occupant compartment of the 1100C test vehicle. There was no intrusion into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The ABSORB-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p>	PASS

3-41 (2270P)	<p>The ABSORB-M was determined to have successfully met all of the evaluation criteria for MASH Test 3-41 for gating, non-redirective crash cushions.</p> <p>The ABSORB-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a gating, non-redirective crash cushion. The test article captured the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underride, or override the installation.</p> <p>All of the occupant risk criteria were satisfied in testing the ABSORB-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the limit of 40.0 ft/s (12.2 m/s). ORAs in the longitudinal and lateral directions were below the preferred limit of 15.0 G. Some debris were propelled from the impacted system but due to their soft nature and light weight these fragments did not pose a threat to occupants of the vehicle, pedestrians or personnel in a work zone.</p> <p>There was minimal deformation to the occupant compartment of the 2270P test vehicle. There was no intrusion into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The ABSORB-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p>	PASS
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3-42 (1100C)	<p>The ABSORB-M was determined to have successfully met all of the evaluation criteria for MASH Test 3-42 for gating, non-redirective crash cushions.</p> <p>The ABSORB-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a gating, non-redirective crash cushion. The test article captured the 1100C vehicle in a controlled manner. The vehicle did not penetrate, underride, or override the installation.</p> <p>All of the occupant risk criteria were satisfied in testing the ABSORB-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the limit of 40.0 ft/s (12.2 m/s). ORAs in the longitudinal and lateral directions were below the preferred limit of 15.0 G. Some debris were propelled from the impacted system but due to their soft nature and light weight these fragments did not pose a threat to occupants of the vehicle, pedestrians or personnel in a work zone.</p> <p>There was minimal deformation to the occupant compartment of the 1100C test vehicle. There was no intrusion into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The ABSORB-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p>	PASS
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3-43 (2270P)	<p>The ABSORB-M was determined to have successfully met all of the evaluation criteria for MASH Test 3-43 for gating, non-redirective crash cushions.</p> <p>The ABSORB-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a gating, non-redirective crash cushion. The test article captured the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underride, or override the installation.</p> <p>All of the occupant risk criteria were satisfied in testing the ABSORB-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the limit of 40.0 ft/s (12.2 m/s). ORAs in the longitudinal and lateral directions were below the preferred limit of 15.0 G. Some debris were propelled from the impacted system but due to their soft nature and light weight these fragments did not pose a threat to occupants of the vehicle, pedestrians or personnel in a work zone.</p> <p>There was minimal deformation to the occupant compartment of the 2270P test vehicle. There was no intrusion into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The ABSORB-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p>	PASS
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3-44 (2270P)	<p>The ABSORB-M was determined to have successfully met all of the evaluation criteria for MASH Test 3-44 for gating, non-redirective crash cushions.</p> <p>The ABSORB-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a gating, non-redirective crash cushion. The test article captured the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underride, or override the installation.</p> <p>All of the occupant risk criteria were satisfied in testing the ABSORB-M crash cushion. Some debris were propelled from the impacted system but due to their soft nature and light weight these fragments did not pose a threat to occupants of the vehicle, pedestrians or personnel in a work zone.</p> <p>There was substantial deformation to the occupant compartment of the 2270P test vehicle. The deformation was measured to be within the allowable limits. There was no intrusion into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The ABSORB-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p>	PASS
3-45 (1500A)	<p>Calculations performed to demonstrate acceptable occupant risk values per MASH evaluation criteria. Reference Enclosure A, "ABSORB-M MASH TL-3 Crash Cushion System" section titled "1500A Vehicle (MASH Test 3-45)".</p>	PASS

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:	Safe Technologies Inc.	
Laboratory Signature:	Joseph Nagy	Digitally signed by Joseph Nagy Date: 2019.04.04 14:18:31 -07'00'
Address:	170 River Road, Rio Vista, CA 94571	Same as Submitter <input type="checkbox"/>
Country:	United States of America	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	A2LA 1851.01 Valid through March 31, 2020	

Submitter Signature*: **Gerrit Dyke** Digitally signed by Gerrit Dyke
Date: 2019.04.04 14:19:07
-07'00'

Submit Form

ATTACHMENTS

Attach to this form:

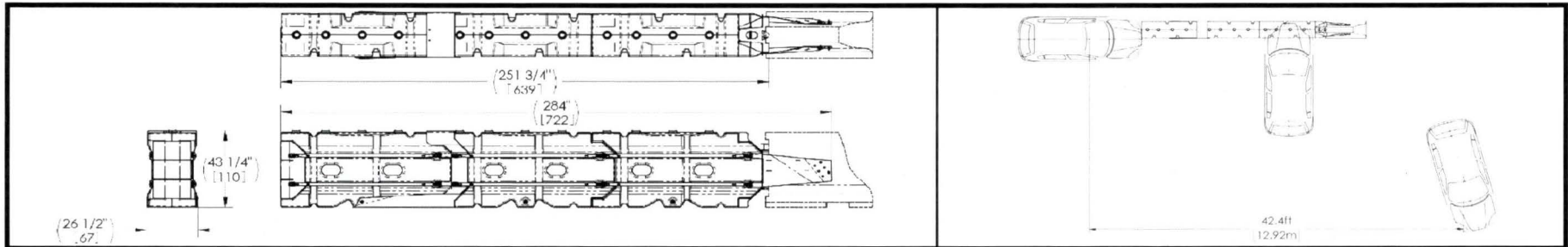
- 1) Additional disclosures of related financial interest as indicated above.
- 2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
- 3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications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

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words



t = 0.000 s t = 0.100 s t = 0.200 s t = 0.300 s t = 0.500 s t = 1.800 s



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MACC340A-C1
 Test Designation MASH 3-40
 Date..... 2/22/2019

Test Article

Name ABSORB-M, TL-3
 Type Non-redirective, Gating Crash Cushion
 Installation Length 284 in (722 cm)
 Width 26 1/2 in (67 cm)
 Height 43 1/4 in (110 cm)

Test Vehicle

Type / Designation 1100C
 Make and Model 2011 Hyundai Accent
 Curb Weight 2,478 lb (1,124 kg)
 Test Inertial Weight 2,425 lb (1,100 kg)
 Gross Static Weight 2,590 lb (1,175 kg)

Impact Conditions

Speed 61.9 mph (99.6 km/h)
 Angle 0 deg
 Location / Orientation 1/4 Offset, 16.75 in (42.5 m), driver's side

Exit Conditions

Speed..... N/A
 Angle..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 42.4 ft (12.9 m)
 Vehicle Snagging/Pocketing N/A

Occupant Risk Values

Longitudinal OIV 37.7 ft/s (11.5 m/s)
 Lateral OIV 0.98 ft/s (0.3 m/s)
 Longitudinal ORA 8.2 G
 Lateral ORA 2.6 G
 THIV 38.4 ft/s (11.7 m/s)
 PHD 8.4 G
 ASI 1.25

Test Article Damage:

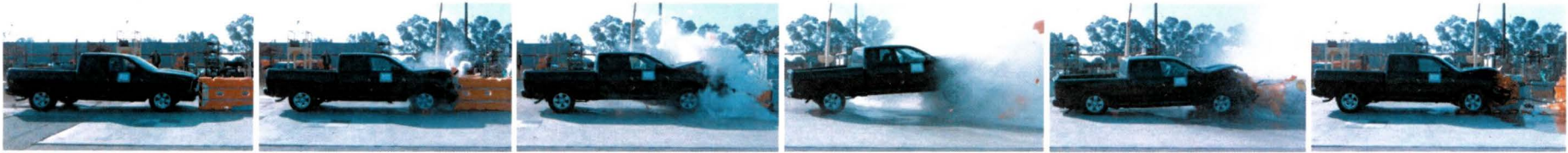
..... Substantial

Test Article Deflection

Longitudinal System Stroke 16.1 ft (4.90 m)
 Permanent Lateral Deflection N/A
 Dynamic Lateral Deflection N/A
 Debris Field
 Longitudinal from Nose Plate..... 79.7 ft (24.3 m)
 Lateral from System's Centerline..... 33.0 ft (10.1 m)

Vehicle Damage

VDS..... 12-FL-5
 CDC..... 12FDEW2
 Maximum Interior Deformation 3/4 in (19.1 mm) - driver's side dashboard



t = 0.000 s

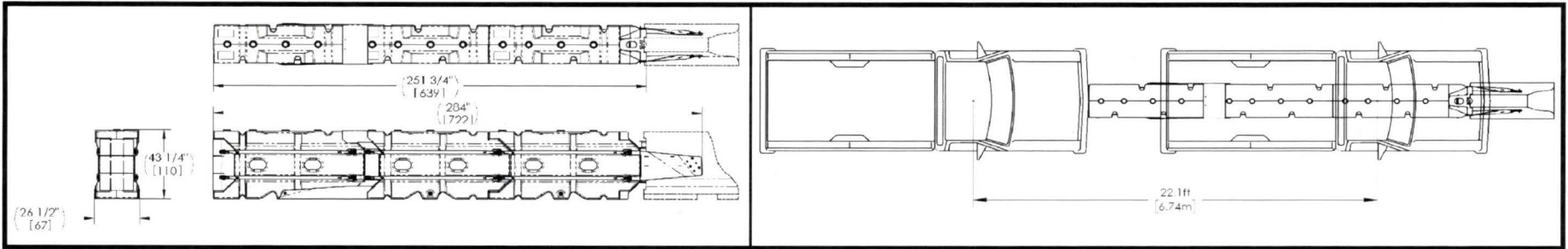
t = 0.100 s

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t = 0.400 s

t = 1.000 s

t = 4.150 s



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MACC341A-C3
 Test Designation MASH 3-41
 Date..... 12/13/2018

Test Article

Name ABSORB-M, TL-3
 Type Non-redirective, Gating Crash Cushion
 Installation Length 284 in (722 cm)
 Width 26 1/2 in (67 cm)
 Height 43 1/4 in (110 cm)

Test Vehicle

Type / Designation 2270P
 Make and Model 2014 Dodge Ram 1500
 Curb Weight 4,743 lb (2,151.5 kg)
 Test Inertial Weight 5,017 lb (2,275.5 kg)
 Gross Static Weight 5,017 lb (2,275.5 kg)

Impact Conditions

Speed 62.8 mph (101.0 km/h)
 Angle 0 deg
 Location / Orientation Front/Center

Exit Conditions

Speed..... N/A
 Angle..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 22.1 ft (6.74 m)
 Vehicle Snagging/Pocketing N/A

Occupant Risk Values

Longitudinal OIV 32.5 ft/s (9.9 m/s)
 Lateral OIV 0.66 ft/s (0.2 m/s)
 Longitudinal ORA 12.9 G
 Lateral ORA 1.3 G
 THIV 32.5 ft/s (9.9 m/s)
 PHD 12.9 G
 ASI 1.03

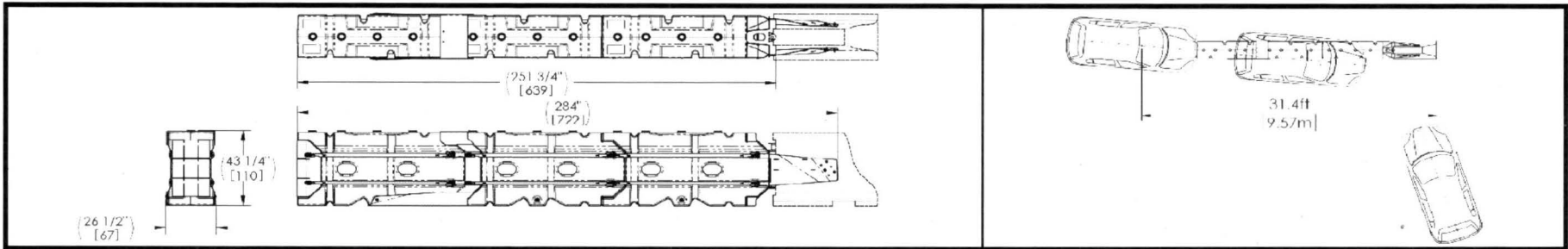
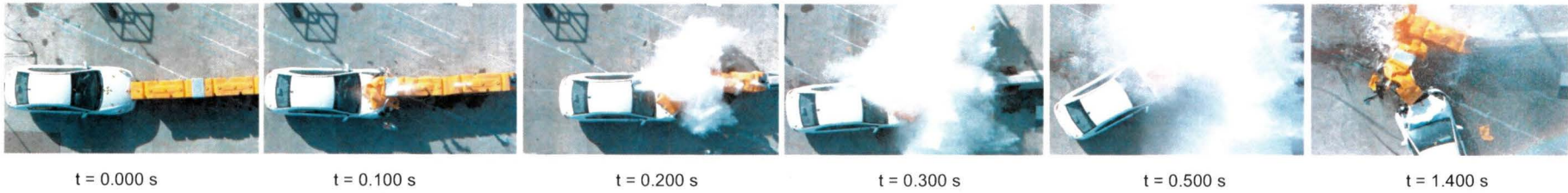
Test Article Damage:..... Substantial

Test Article Deflection

Longitudinal System Stroke..... 19.6 ft (5.97 m)
 Permanent Lateral Deflection N/A
 Dynamic Lateral Deflection N/A
 Debris Field
 Longitudinal from Nose Plate..... 109 ft (33.4 m)
 Lateral from System's Centerline..... 66.0 ft (20.1 m)

Vehicle Damage

VDS..... 12-FC-5
 CDC..... 12FDEW2
 Maximum Interior Deformation 3/8 in (9.53 mm) - floor pan area



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MACC342A-C1
 Test Designation MASH 3-42
 Date..... 12/18/2018

Test Article

Name ABSORB-M, TL-3
 Type Non-redirective, Gating Crash Cushion
 Installation Length 284 in (722 cm)
 Width 26 1/2 in (67 cm)
 Height 43 1/4 in (110 cm)

Test Vehicle

Type / Designation 1100C
 Make and Model 2010 Hyundai Accent
 Curb Weight 2,477 lb (1,123.5 kg)
 Test Inertial Weight 2,425 lb (1,100 kg)
 Gross Static Weight 2,590 lb (1,175 kg)

Impact Conditions

Speed 61.1 mph (98.4 km/h)
 Angle 5 deg
 Location / Orientation Front/Center

Exit Conditions

Speed..... N/A
 Angle..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 31.4 ft (9.57 m)
 Vehicle Snagging/Pocketing N/A

Occupant Risk Values

Longitudinal OIV 39.4 ft/s (12.0 m/s)
 Lateral OIV 4.27 ft/s (1.3 m/s)
 Longitudinal ORA 11.5 G
 Lateral ORA 2.4 G
 THIV 39.7 ft/s (12.1 m/s)
 PHD 11.5 G
 ASI 1.39

Test Article Damage:..... Substantial

Test Article Deflection

Longitudinal System Stroke..... 17.2 ft (5.26 m)
 Permanent Lateral Deflection N/A
 Dynamic Lateral Deflection N/A
 Debris Field

 Longitudinal from Nose Plate..... 86.9 ft (26.5 m)
 Lateral from System's Centerline..... 39.8 ft (12.1 m)

Vehicle Damage

VDS..... 12-FC-5
 CDC..... 12FDEW2*
 Maximum Interior Deformation 5/8 in (15.9 mm) - driver's side floor pan area



t = 0.000 s

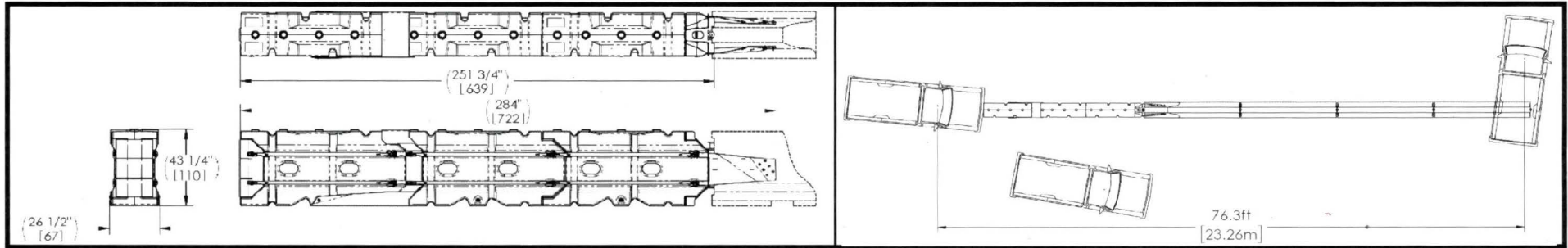
t = 0.100 s

t = 0.200 s

t = 0.400 s

t = 0.600 s

t = 1.000 s



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MACC343A-C2
 Test Designation MASH 3-43
 Date..... 2/21/2019

Test Article

Name ABSORB-M, TL-3
 Type Non-redirective, Gating Crash Cushion
 Installation Length 284 in (722 cm)
 Width 26 1/2 in (67 cm)
 Height 43 1/4 in (110 cm)

Test Vehicle

Type / Designation 2270P
 Make and Model 2012 Dodge Ram 1500
 Curb Weight 4,830 lb (2,191 kg)
 Test Inertial Weight 5,009 lb (2,272 kg)
 Gross Static Weight 5,009 lb (2,272 kg)

Impact Conditions

Speed 62.3 mph (100.3 km/h)
 Angle 5 deg
 Location / Orientation Front/Center

Exit Conditions

Speed..... N/A
 Angle..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 76.3 ft (23.3 m)
 Vehicle Snagging/Pocketing N/A

Occupant Risk Values

Longitudinal OIV 31.2 ft/s (9.5 m/s)
 Lateral OIV 4.59 ft/s (1.4 m/s)
 Longitudinal ORA 6.6 G
 Lateral ORA 2.2 G
 THIV 31.5 ft/s (9.6 m/s)
 PHD 6.6 G
 ASI 0.94

Test Article Damage:..... Substantial

Test Article Deflection

Longitudinal System Stroke..... 19.2 ft (5.85 m)
 Permanent Lateral Deflection N/A
 Dynamic Lateral Deflection N/A
 Debris Field
 Longitudinal from Nose Plate..... 82.8 ft (25.2 m)
 Lateral from System's Centerline..... 40.0 ft (12.2 m)

Vehicle Damage

VDS..... 12-FC-4
 CDC..... 12FDEW1
 Maximum Interior Deformation 7/8 in (22.2 mm) - passenger's side roof area



t = 0.000 s

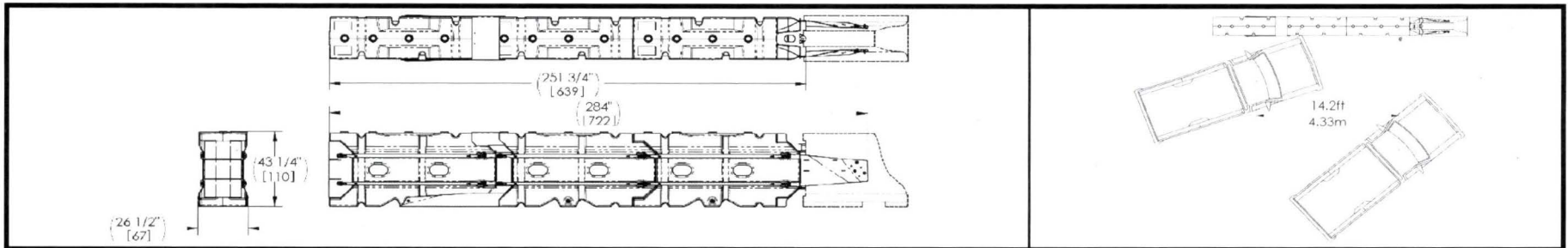
t = 0.100 s

t = 0.200 s

t = 0.300 s

t = 0.500 s

t = 1.200 s



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MACC344A-C1
 Test Designation MASH 3-44
 Date..... 12/20/2018

Test Article

Name ABSORB-M, TL-3
 Type Non-redirective, Gating Crash Cushion
 Installation Length 284 in (722 cm)
 Width 26 1/2 in (67 cm)
 Height 43 1/4 in (110 cm)

Test Vehicle

Type / Designation 2270P
 Make and Model 2012 Dodge Ram 1500
 Curb Weight 4,785 lb (2,170.5 kg)
 Test Inertial Weight 5,018 lb (2,276 kg)
 Gross Static Weight 5,018 lb (2,276 kg)

Impact Conditions

Speed 62.4 mph (100.4 km/h)
 Angle 20 deg
 Location / Orientation CIP, 9.91 ft (3.02 m) downstream
 from upstream end

Exit Conditions

Speed..... N/A
 Angle..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 14.2 ft (4.33 m)
 Vehicle Snagging/Pocketing Substantial

Occupant Risk Values (Shown for Reference)

Longitudinal OIV 43.6 ft/s (13.3 m/s)
 Lateral OIV 8.53 ft/s (2.6 m/s)
 Longitudinal ORA 36.1 G
 Lateral ORA 8.5 G
 THIV 45.3 ft/s (13.8 m/s)
 PHD 36.3 G
 ASI 2.45

Test Article Damage:..... Substantial

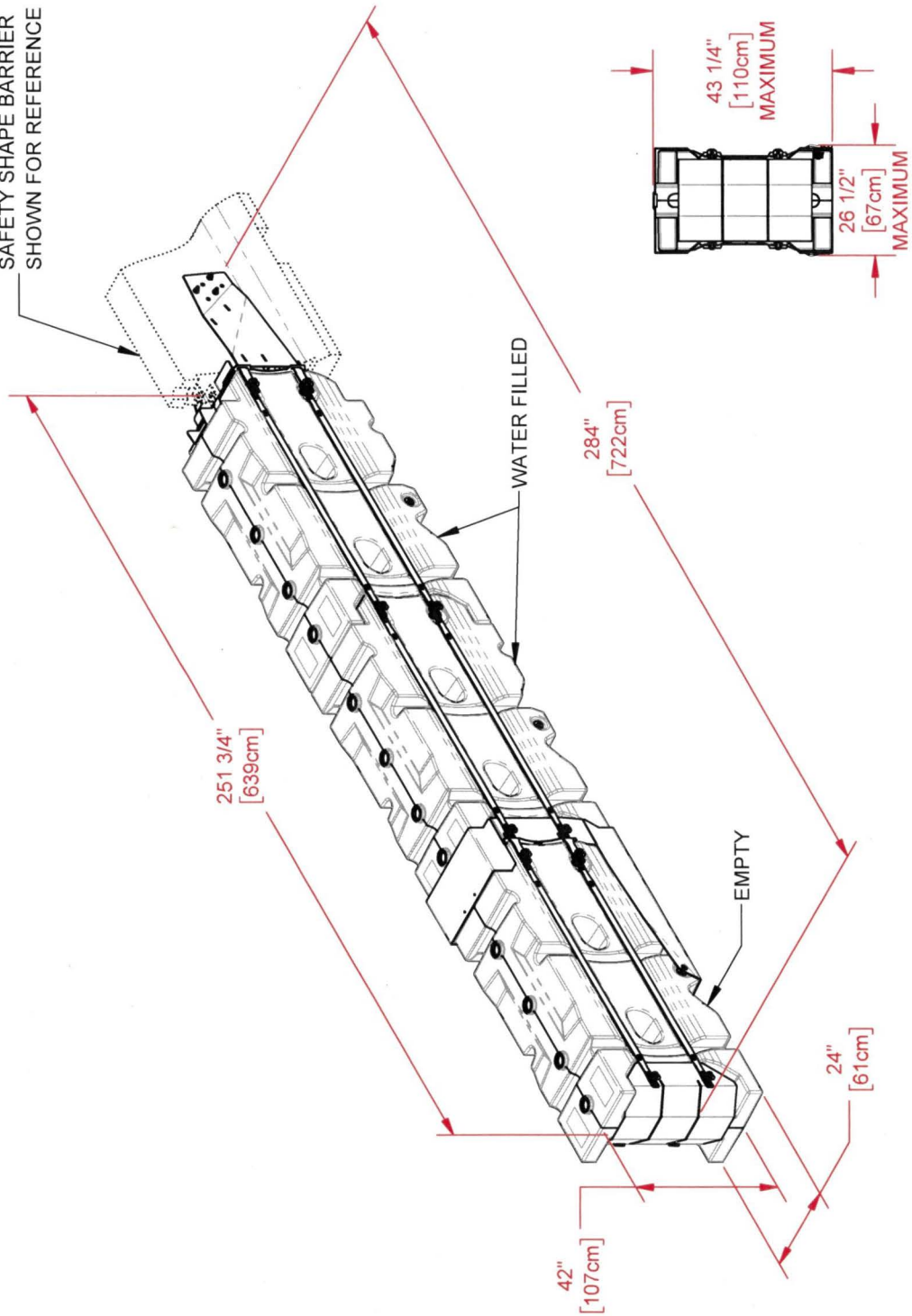
Test Article Deflection

Longitudinal System Stroke..... N/A
 Permanent Lateral Deflection N/A
 Dynamic Lateral Deflection N/A
 Debris Field
 Longitudinal from Nose Plate..... 60.7 ft (18.5 m)
 Lateral from System's Centerline..... 46.5 ft (14.2 m)

Vehicle Damage

VDS..... 11-FL-7
 CDC..... 11FDEW5
 Maximum Interior Deformation 8 1/8 in (206 mm) - driver's side
 toe pan area

SAFETY SHAPE BARRIER
SHOWN FOR REFERENCE



ABSORB-M™ TL-3



Lindsay Transportation Solutions, 180 River Rd., Rio Vista CA. 94571, 888-800-3691
www.theroadzipper.com

SHEET NO.
1 OF 2

DATE:
03/26/19

INTENDED USE

The ABSORB-M™ is a non-redirective, gating crash cushion designed to meet the latest test standards defined in the Manual for Assessing Safety Hardware (MASH), Second Edition, 2016. The ABSORB-M system utilizes water, thermoplastic elements (elements), tension straps, a midnose, and a transition to absorb kinetic energy and safely contain or control the trajectory of impacting vehicles. The MASH Test Level 3 system is comprised of a nose plate, three elements, ten pin assemblies, a midnose, a transition, and six mechanical anchors attaching to the barrier system. Of the three elements, the middle and rearmost are filled with water and the front element is empty. Each element is pre-assembled using four tension straps secured with eight bolts and thread locking compound. The system has a nominal 42" [1070mm] height, 24" [610mm] width, and an effective length of approximately 251 3/4" [6.39m]. The ABSORB-M is designed to attach directly to longitudinal roadside safety barrier systems and does not attach to a foundation.

APPROVALS

The ABSORB-M™ system has been fully tested in conformance with MASH, 2016 Test Level 3 and is determined eligible for Federal reimbursement by FHWA.

FHWA Eligibility Letter:CC-XXX

CONTACT INFORMATION

Lindsay Transportation Solutions
180 River Rd.
Rio Vista, CA 94571
www.barriersystemsinc.com
Phone: 888-800-3691 or 707-374-6800
Fax: 707-374-6801
Email: info@barriersystemsinc.com

ABSORB-M™ TL-3



SHEET NO.
2 OF 2

DATE:
03/26/19

Lindsay Transportation Solutions, 180 River Rd., Rio Vista CA. 94571, 888-800-3691
www.theroadzipper.com

Appendix A: Cold Weather Tech Brief TB 1903328

TB 1903328 Rev. 1
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PRELIMINARY



TECHNICAL BRIEF

180 River Road • Rio Vista, CA 94571 • +1 707-374-6800 • US Toll Free 888-800-3691
www.lindsaytransportationsolutions.com

ABSORB-M™ Anti-Freeze Solutions

In regions where the water filled ABSORB-M™ elements could become frozen, proper antifreeze agents should be used. Care should be taken to ensure that proper antifreeze agents are used in accordance with local regulations, environmental concerns and ensuring that any post impact liquid on the road surface does not constitute an undue hazard to adjacent motorists.

The information outlined in this document is intended to provide a general guide to ABSORB-M™ users for choosing, calculating, and applying anti-freeze solutions. The actual method and implementation of an anti-freezing solution should be determined by state and local standards and in accordance with the specific manufacturers' instructions.

Possible Anti-Freeze compounds include:

- Calcium Chloride, CaCl₂
- Calcium Magnesium Acetate, CMA
- Magnesium Chloride, MgCl₂
- Sodium Chloride, NaCl
- Potassium Acetate, KAc

Considerations for choosing an Anti-Freeze should include environmental impact on local vegetation and waterways, corrosion of existing structures, and the effect on concrete or asphalt roadways. Transportation, installation, and handling of the material should also be considered. The examples listed above are products commonly used on highways as de-icing road and bridge conditioners and for dust control. Specific information pertaining to these products regarding said considerations should be readily available from the product supplier or manufacturer.

The correct mixture of Anti-Freeze and water is critical to insure proper ice protection and performance of the ABSORB-M™ crash cushion. The freezing capacity depends on the particular chemical and the solution concentrate by percent weight of the solution. Both too little and too much solution will result in diminished freezing capacity. The ideal solution concentration for maximum capacity is specific to the chemical chosen. It may be desirable to reduce the concentration for cost savings if the maximum capacity is not necessary.

Depending on the form the chemical is provided; such as a fluid, powder, or pellet; the actual amount of the desired chemical may not constitute 100 % of the material by weight. It is important to account for the actual weight of the deicing chemical when mixing the solution.

03/28/19

A typical solution recommended by some customers is Calcium Chloride. The ideal solution for maximum capacity is 29% by weight Calcium Chloride providing a freezing temperature of -53°F (-47°C). This solution is commonly used as a road-deicing agent, thus satisfying particular environmental regulations. It is available as a fluid solution of definite concentration or pellets and flakes in various sized bags. If purchased in flake or pellet form, care must be taken in dissolving it in water. Also, the concentrate must be calculated from the actual Calcium Chloride content. For example, if the flake/pellet agent purchased has a Calcium Chloride content of 80% and a 29% solution by weight is desired, the quantity added must account for the impurity of the agent. These principles apply to many various anti-freezing chemicals. Refer to the manufacturer or supplier for how to calculate the quantity of agent to add to the ABSORB-M™ element based on the actual chemical and agent used, given the ABSORB-M™ Data shown below.

ABSORB-M™ Data

Fluid Capacity of (1) ABSORB-M™ Element: **250 Gallons** (947 Liters), **33.4 ft³** (.947 m³)
Weight of Water at 30° F (0° C): **62.4 lb/ft³** (999.6 kg/m³) ≈ **2086 lb** (947 kg) **H₂O/Element**

Anti-Freeze Chemical Companies

The following Companies are manufacturers of deicing chemicals. These are just a few examples. These companies or their local distributors should be able to supply further information and options for your application.

Dow Chemical Company
USA or Canada (800)-447-4369
Worldwide (989)-832-1466
www.dow.com
Contact for local Distributor, or find on Web Site

Cargill Salt
(888)-385-7258
Highway and Specialty Deicing Customer Service (800)-600-7258
www.cargillsalt.com
Contact for information and distribution

Cryotech Deicing Technology
Main Office and Plant – Iowa (800)-346-7237
www.cryotech.com
Contact for information, Branch Offices, and distribution

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