



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

October 15, 2018

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

In Reply Refer To:
HSST-1/CC-146

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 September 1, 2018 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-146 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

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

- Universal TAU-M Crash Cushion (TAU-M) TL2

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.

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: Universal TAU-M Crash Cushion (TAU-M) TL2

Type of system: Redirective, Non-Gating Crash Cushion

Test Level: MASH Test Level 2 (TL2)

Testing conducted by: Safe Technologies, Inc.

Date of request: September 1, 2018

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within the attached form for systems mounted on concrete only.

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

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.

Any user or agency relying on this eligibility letter is expected to use the same designs, specifications, drawings, installation and maintenance instructions as those submitted for review.

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.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number CC-146 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: | September 28, 2018 | <input type="radio"/> New <input checked="" type="radio"/> Resubmission |
| | Name: | Gerrit A. Dyke, P.E. | |
| | Company: | Lindsay Transportation Solutions, Inc. | |
| | Address: | 180 River Road, Rio Vista, CA 94571 | |
| | Country: | United States of America | |
| | 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 | Universal TAU-M Crash Cushion (TAU-M) | 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: | 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: | United States of America | 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 Universal TAU-M™ Parallel (TAU-M) is a redirective, non-gating crash cushion designed to meet the latest test standards defined in the Manual for Assessing Safety Hardware (MASH), Second Edition, 2016. The TAU-M system utilizes a cable anchoring system, telescoping three-beam panels, and energy absorbing cartridges (EAC) to absorb kinetic energy and safely contain or redirect impacting vehicles. The system is comprised of EACs, cables, a front cable anchor, a backstop, four end panel mounts, middle support assemblies (midsupports), cable guides, a front support, a front support leg kit, sliding panels, two end panels, slider kits, slider shims, a tether kit, four tow hooks, and a delineation bracket. The system has a nominal 32 5/8" height and 34 1/2" width. The test level 2 system measures approximately 185" (4 Bays) in length.

TAU-M has anchorage configurations for Concrete or Asphalt foundations or existing roadways. The hardware was full scale crash tested in the Test Level 3 configuration. Further details regarding TL-2 asphalt anchoring configurations are in Enclosure A.

TAU-M may be configured in part using some components of the TAU-II (NCHRP 350) system including the Compact Backstop and cable assemblies from the Wide TAU-II. Details of the conversion kit and component substitutions are in Enclosure A.

TAU-M utilizes standard corrugated three beam panels which enable the application of standard transition methods to various roadside hardware and barrier systems. Enclosure A details several standard transitions using AASHTO three beam panels and components. A proprietary transition using nested angled and standard end panels was tested and is available.

Any delineation pattern, tape, or decal may be placed on the Delineation Bracket attached to the TAU-M. In addition, variations of brackets may be utilized with the TAU-M. Reference Enclosure A.

TAU-M may display identification decals, tags, or stamps for product identification, component tracking and quality control. The identification method and location shall not effect the capacity, function, or performance of the TAU-M. Reference Enclosure A.

The TAU-M may be painted, stained, or powder coated on surfaces that do not effect the function of the system in place of or in addition to galvanizing. Reference Enclosure A for details regarding surfaces that may be coated and the components or surfaces that may not.

An alternative nut for the slider bolts may be used which limits the rotation of the nut during assembly and disassembly. The alternative nut does not effect the capacity of the joint, or the function or performance of the system. Details of the alternative nut are in Enclosure A.

The EACs used on the TAU-M have embossed lettering on their surfaces. The lettering may be changed and updated as required without effecting the function or performance of the component or 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: 2018.09.28 14:56:37 -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 |
|----------------------|---|--------------------|
| 2-30 (1100C) | <p>The TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-30 for non-gating crash cushions.</p> <p>The TAU-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a non-gating crash cushion. The test article captured the 1100C vehicle in a controlled manner. The vehicle did not penetrate, underide, or override the installation. The test article exhibited controlled permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied in testing the TAU-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. There was no test article debris detached during the test.</p> <p>There was no 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 TAU-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> | PASS |

| Required Test Number | Narrative Description | Evaluation Results |
|----------------------|---|--------------------|
| 2-31 (2270P) | <p>The TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-31 for non-gating crash cushions.</p> <p>The TAU-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a non-gating crash cushion. The test article captured the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underide, or override the installation. The test article exhibited controlled permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied in testing the TAU-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the preferred limit of 30.0 ft/s (9.1 m/s). ORAs in the longitudinal and lateral directions were below the limit of 20.49 G. There was no test article debris detached during the test.</p> <p>There was no deformation in 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 TAU-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> | PASS |

| | | |
|--------------|---|------|
| 2-32 (1100C) | <p>The TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-32 for non-gating crash cushions.</p> <p>The TAU-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a non-gating crash cushion. The test article captured the 1100C vehicle in a controlled manner. The vehicle did not penetrate, underide, or override the installation. The test article exhibited controlled permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied in testing the TAU-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. There was no test article debris detached during the test.</p> <p>There was no deformation in 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 TAU-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> | PASS |
|--------------|---|------|

| | | |
|--------------|---|------|
| 2-33 (2270P) | <p>The TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-33 for non-gating redirective crash cushions.</p> <p>The TAU-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a non-gating crash cushion. The test article captured the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underide, or override the installation. The test article exhibited controlled permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied in testing the TAU-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the preferred limit of 30.0 ft/s (9.1 m/s). ORAs in the longitudinal and lateral directions were below the limit of 20.49 G. There was no test article debris detached during the test.</p> <p>There was no deformation in 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 TAU-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> | PASS |
|--------------|---|------|

| | | |
|---------------------|---|-------------|
| <p>2-34 (1100C)</p> | <p>The TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-34 for non-gating crash cushions.</p> <p>The TAU-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a non-gating crash cushion. The test article first captured and later redirected the 1100C vehicle in a controlled manner. The vehicle did not penetrate, underride, or override the installation. The test article exhibited controlled permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied in testing the TAU-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the preferred limit of 30.0 ft/s (9.1 m/s). ORAs in the longitudinal and lateral directions were well below the preferred limit of 15.0 G. There was no test article debris detached during the test.</p> <p>There was no deformation in 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 TAU-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> | <p>PASS</p> |
|---------------------|---|-------------|

| | | |
|--------------|---|------|
| 2-35 (2270P) | <p>The TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-35 for non-gating crash cushions.</p> <p>The TAU-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a non-gating crash cushion. The test article redirected the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underride, or override the installation. The test article exhibited controlled permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied in testing the TAU-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the preferred limit of 30.0 ft/s (9.1 m/s). ORAs in the longitudinal and lateral directions were well below the preferred limit of 15.0 G. There was no test article debris detached during the test.</p> <p>There was no 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 moderate roll and minor pitch.</p> <p>The TAU-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> | PASS |
| 2-36 (2270P) | <p>By coincidence and due to the shorter length of the TAU-M, TL2 system (compared to the TAU-M, TL3), the critical impact point and the beginning of length of need for Tests 2-35 and Test 2-36 coincide. As a result, Test 2-35 and Test 2-36 are identical in all respects, having the same impact point, same impact angle, same impact velocity and using the same impacting vehicle.</p> <p>STI submits that the results of Test 2-35 satisfy the requirements for both tests, 2-35 and 2-36.</p> <p>As described in the test report for Test 2-35, the TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-35 and Test 2-36 for non-gating crash cushions.</p> | PASS |

| | | |
|--------------|---|----------------------------------|
| 2-37 (2270P) | <p>The TAU-M was determined to have successfully met all of the evaluation criteria for MASH Test 2-37a for non-gating crash cushions.</p> <p>The TAU-M crash cushion satisfied the MASH structural adequacy criteria for its intended function as a non-gating crash cushion. The test article redirected the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underide, or override the installation. The test article exhibited controlled permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied in testing the TAU-M crash cushion. Theoretical OIVs in the longitudinal and lateral directions were below the preferred limit of 30.0 ft/s (9.1 m/s). ORAs in the longitudinal and lateral directions were below the preferred limit of 15.0 G. There was no test article debris detached during the test.</p> <p>There was moderate 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 TAU-M crash cushion was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> | PASS |
| 2-38 (1500A) | Calculations performed to demonstrate acceptable occupant risk values per MASH evaluation criteria. Reference Enclosure A, "TAU-M Crash Cushion System MASH Configuration Justification" section titled "1500A Vehicle (MASH Test 2-38)". | PASS |
| 2-40 (1100C) | NA | Non-Relevant Test, not conducted |
| 2-41 (2270P) | NA | Non-Relevant Test, not conducted |
| 2-42 (1100C) | NA | Non-Relevant Test, not conducted |
| 2-43 (2270P) | NA | Non-Relevant Test, not conducted |
| 2-44 (2270P) | NA | Non-Relevant Test, not conducted |
| 2-45 (1500A) | NA | 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: | Safe Technologies Inc. | | |
| Laboratory Signature: | Joseph Nagy | | Digitally signed by Joseph Nagy Date: 2018.09.28 15:34:06 -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: 2018.09.28 15:35:38
-07'00'

Submit Form

ATTACHMENTS

Attach to this form:

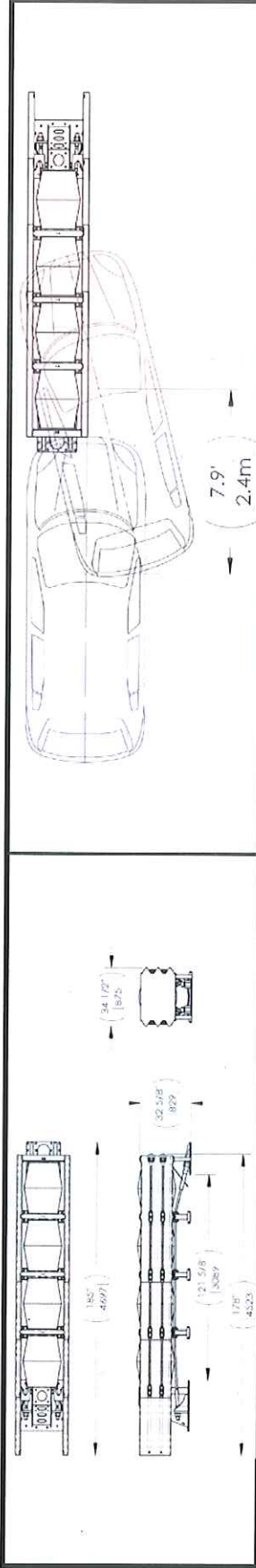
- 1) Additional disclosures of related financial interest as indicated above.
- 2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
- 3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [[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 |
| | | |



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General Information

Test Agency..... SAFE TECHNOLOGIES, INC.
 Test Number..... TAU230-C1
 Test Designation MASH 2-30
 Date..... 6/11/2018

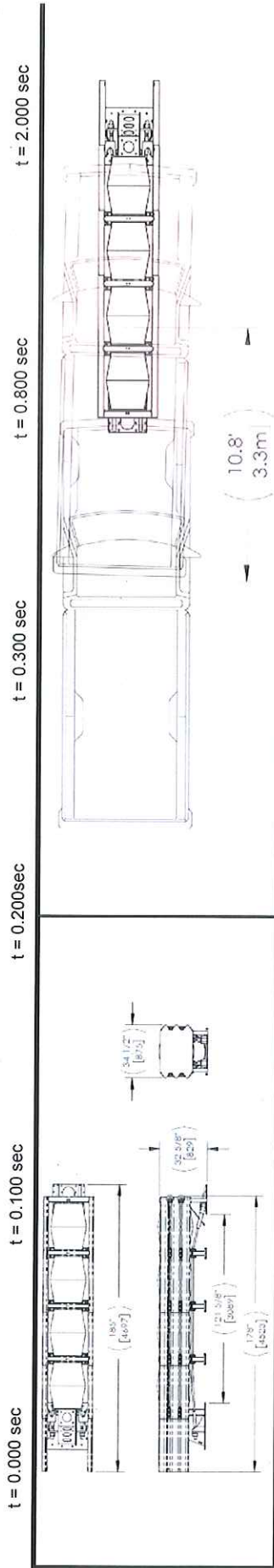
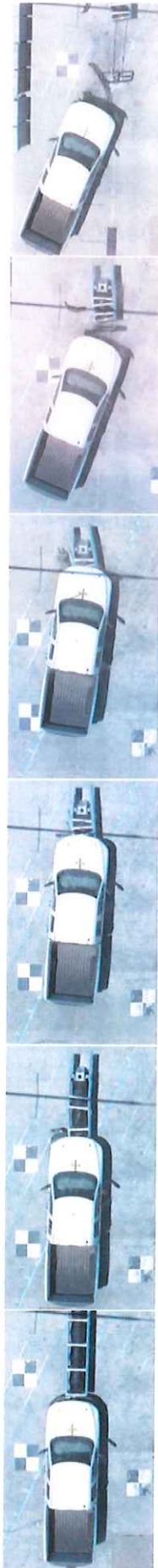
Test Article
 Name Universal TAU-M, TL-2
 Type Redirective, Non-gating Crash Cushion
 Installation Length 185 in (4.7 m)
 Width 34 1/2 in (875 mm)
 Height 32 5/8 in (829 mm)

Test Vehicle
 Type / Designation 1100C
 Make and Model 2011 Hyundai Accent
 Curb Weight 2,474 lb (1122 kg)
 Test Inertial Weight 2,426 lb (1,100.5 kg)
 Gross Static Weight 2,592 lb (1,175.5 kg)

Impact Conditions
 Speed 43.4 mph (69.8 km/h)
 Angle 0.0 deg
 Location / Orientation 1/4 Offset

Exit Conditions

Speed..... N/A
 Angle..... N/A
Post Impact Trajectory
 Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 7.9 ft (2.42 m)
 Vehicle Snagging/Pocketing N/A
Occupant risk Values
 Longitudinal OIV 31.5 ft/s (9.6 m/s)
 Lateral OIV 2.95 ft/s (0.9 m/s)
 Longitudinal ORA 11.2 G
 Lateral ORA 1.6 G
 THIV 31.8 ft/s (9.7 m/s)
 PHD 11.2 G
 ASI 0.84
Test Article Damage:..... Minimal
Test Article Deflection
 Longitudinal system stroke..... 5.9 ft (1.80 m)
 Permanent lateral deflection 4.1 in (10.5 cm)
 Dynamic lateral deflection 6.4 in (16.2 cm)
Vehicle Damage
 VDS..... 12-FL-3
 CDC..... 12FLEW1
 Maximum Interior Deformation No Deformation



General Information

Test Agency..... SAFE TECHNOLOGIES, INC.
 Test Number..... TAU231-C1
 Test Designation..... MASH 2-31
 Date..... 6/5/2018

Test Article
 Name..... Universal TAU-M, TL-2
 Type..... Redirective, Non-gating Crash Cushion
 Installation Length..... 185 in (4.7 m)
 Width..... 34 1/2 in (875 mm)
 Height..... 32 5/8 in (829 mm)

Test Vehicle
 Type / Designation..... 2270P
 Make and Model..... 2012 Dodge Ram 1500
 Curb Weight..... 4,885 lb (2,216 kg)
 Test Inertial Weight..... 5,017 lb (2,275.5 kg)
 Gross Static Weight..... 5,017 lb (2,275.5 kg)

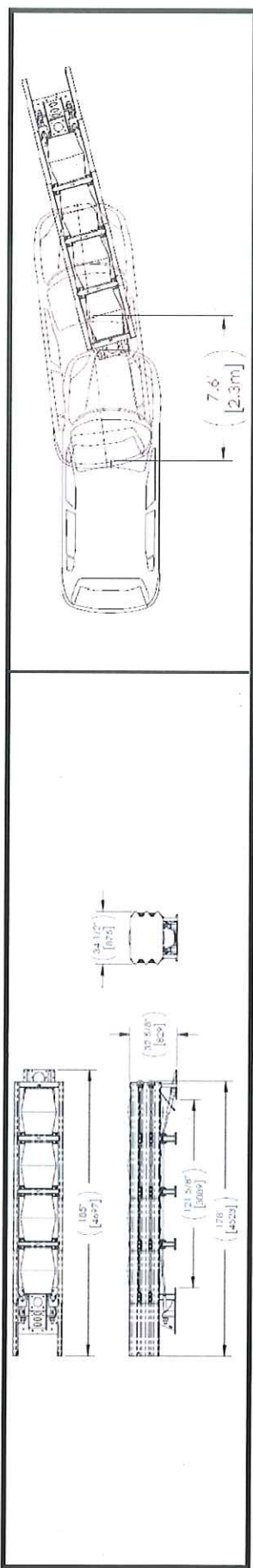
Impact Conditions
 Speed..... 43.6 mph (70.2 km/h)
 Angle..... 0.0 deg
 Location / Orientation..... Front/Center

Exit Conditions

Speed..... N/A
 Angle (deg)..... N/A
Post Impact Trajectory
 Vehicle Stability..... Satisfactory
 Longitudinal Stopping Distance (CG)..... 10.8 ft (3.29 m)
 Vehicle Snagging/Pocketing..... N/A
Occupant risk Values
 Longitudinal OIV..... 24.9 ft/s (7.6 m/s)
 Lateral OIV..... 2.30 ft/s (0.7 m/s)
 Longitudinal ORA..... 15.8 G
 Lateral ORA..... 3.1 G
 THIV..... 24.9 ft/s (7.6 m/s)
 PHD..... 15.8 G
 ASI..... 1.15
Test Article Damage:..... Minimal
Test Article Deflection
 Longitudinal System Stroke..... 9.08 ft (2.77 m)
 Permanent Lateral Deflection..... 3.3 in (8.4 cm)
 Dynamic Lateral Deflection..... 7.7 in (19.4 cm)
Vehicle Damage
 VDS..... 12-FC-3
 CDC..... 12FCEW1
 Maximum Interior Deformation..... No Deformation



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General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... TAU232-C1
 Test Designation..... MASH 2-32
 Date..... 6/7/2018
 Test Article

Name..... Universal TAU-M, TL-2
 Type..... Redirective, Non-gating Crash Cushion
 Installation Length..... 185 in (4.7 m)
 Width..... 34 1/2 in (875 mm)
 Height..... 32 5/8 in (829 mm)

Test Vehicle

Type / Designation..... 1100C
 Make and Model..... 2011 Hyundai Accent
 Curb Weight..... 2,496 lb (1,132 kg)
 Test Inertial Weight..... 2,425 lb (1,100 kg)
 Gross Static Weight..... 2,590 lb (1,175 kg)

Impact Conditions

Speed..... 44.0 mph (70.8 km/h)
 Angle..... 15 deg
 Location / Orientation..... Front/Center

Exit Conditions

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

Post Impact Trajectory

Vehicle Stability..... Satisfactory
 Longitudinal Stopping Distance (CG)..... 7.64 ft (2.33 m)
 Vehicle Snagging/Pocketing..... N/A

Occupant risk Values

Longitudinal OIV..... 36.4 ft/s (11.1 m/s)
 Lateral OIV..... 0.66 ft/s (0.2 m/s)
 Longitudinal ORA..... 11.5 G
 Lateral ORA..... 3.5 G
 THIV..... 36.4 ft/s (11.1 m/s)
 PHD..... 12.0 G
 ASI..... 1.08

Test Article Damage:

Test Article Deflection

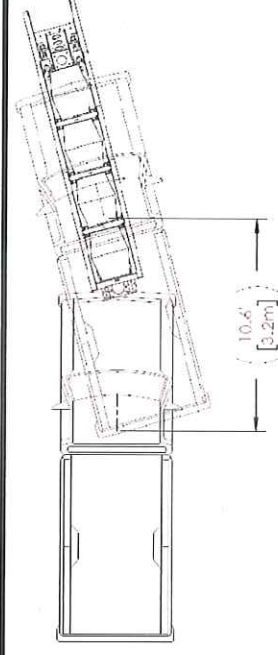
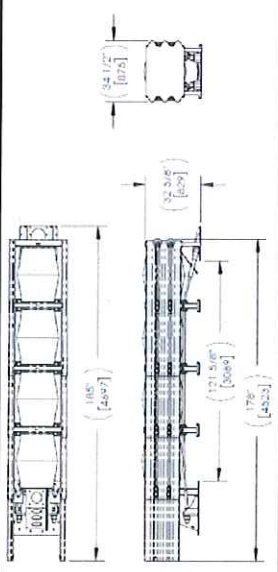
Longitudinal system stroke..... 4.82 ft (1.47 m)
 Permanent lateral deflection..... 9.8 in (25 cm)
 Dynamic lateral deflection..... 11.5 in (29.2 cm)

Vehicle Damage

VDS..... 12-FC-5
 CDC..... 12FDEW2
 Maximum Interior Deformation..... No Deformation



t = 0.000 sec t = 0.050 sec t = 0.100 sec t = 0.200 sec t = 0.300sec t = 0.600sec



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... TAU233-C1
 Test Designation..... MASH 2-33
 Date..... 6/7/2018

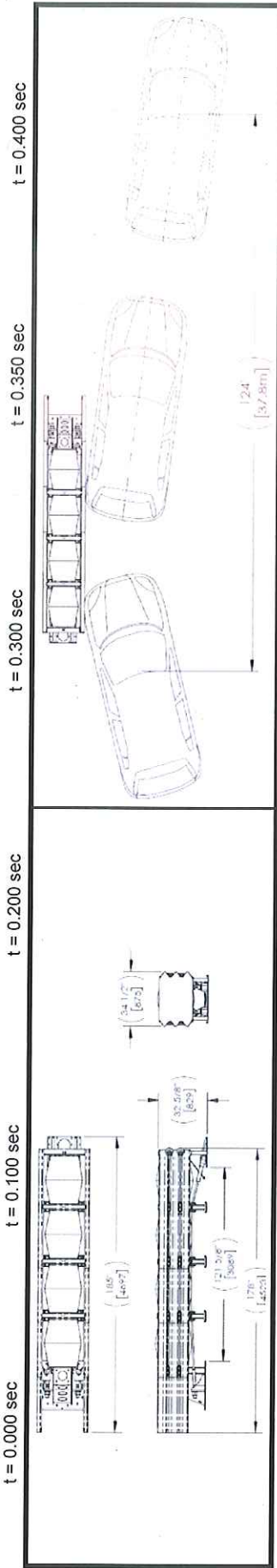
Test Article
 Name..... Universal TAU-M, TL-2
 Type..... Redirective, Non-gating Crash Cushion
 Installation Length..... 185 in (4.7 m)
 Width..... 34 1/2 in (875 mm)
 Height..... 32 5/8 in (829 mm)

Test Vehicle
 Type / Designation..... 2270P
 Make and Model..... 2012 Dodge Ram 1500
 Curb Weight..... 5,194 lb (2,356 kg)
 Test Inertial Weight..... 5,012 lb (2,273.5 kg)
 Gross Static Weight..... 5,012 lb (2,273.5 kg)

Impact Conditions
 Speed..... 42.9 mph (69.1 km/h)
 Angle..... 15 deg
 Location / Orientation..... Front/Center

Exit Conditions

Speed..... N/A
 Angle..... N/A
Post Impact Trajectory
 Vehicle Stability..... Satisfactory
 Longitudinal Stopping Distance (CG)..... 10.6 ft (3.22 m)
 Vehicle Snagging/Pocketing..... N/A
Occupant risk Values
 Longitudinal OIV..... 25.6 ft/s (7.8 m/s)
 Lateral OIV..... 3.28 ft/s (1.0 m/s)
 Longitudinal ORA..... 16.5 G
 Lateral ORA..... 2.9 G
 THIV..... 26.2 ft/s (8.0 m/s)
 PHD..... 16.8 G
 ASI..... 1.20
Test Article Damage:..... Minimal
Test Article Deflection
 Longitudinal system stroke..... 8.99 ft (2.74 m)
 Permanent lateral deflection..... 4.6 in (11.8 cm)
 Dynamic lateral deflection..... 11.7 in (29.8 cm)
Vehicle Damage
 VDS..... 12-FC-1
 CDC..... 12FCLW1
 Maximum Interior Deformation..... No Deformation



General Information

Test Agency..... SAFE TECHNOLOGIES, INC.
 Test Number..... TAU234-C1
 Test Designation..... MASH 2-34
 Date..... 6/20/2018
 Test Article

Name..... Universal TAU-M, TL-2
 Type..... Redirective, Non-gating Crash Cushion
 Installation Length..... 185 in (4.7 m)
 Width..... 34 1/2 in (875 mm)
 Height..... 32 5/8 in (829 mm)

Test Vehicle

Type / Designation..... 1100C
 Make and Model..... 2011 Kia Rio
 Curb Weight..... 2,446 lb (1,109.5 kg)
 Test Inertial Weight..... 2,436 lb (1,105 kg)
 Gross Static Weight..... 2,601 lb (1,180 kg)

Impact Conditions

Speed..... 44.2 mph (71.1 km/h)
 Angle..... 15 deg
 Location / Orientation..... CIP, 2.39 ft (72.9 cm) downstream from upstream end

Exit Conditions

Speed..... 41.5 mph (66.8 km/h)
 Angle..... 8 deg

Post Impact Trajectory

Vehicle Stability..... Satisfactory
 Longitudinal Stopping Distance (CG)..... 124 ft (37.8 m)
 Vehicle Snagging/Pocketing..... None

Occupant risk Values

Longitudinal OIV..... 7.23 ft/s (2.2 m/s)
 Lateral OIV..... 17.4 ft/s (5.3 m/s)
 Longitudinal ORA..... 1.1 G
 Lateral ORA..... 3.4 G
 THIV..... 18.4 ft/s (5.6 m/s)
 PHD..... 3.5 G
 ASI..... 0.61

Test Article Damage:

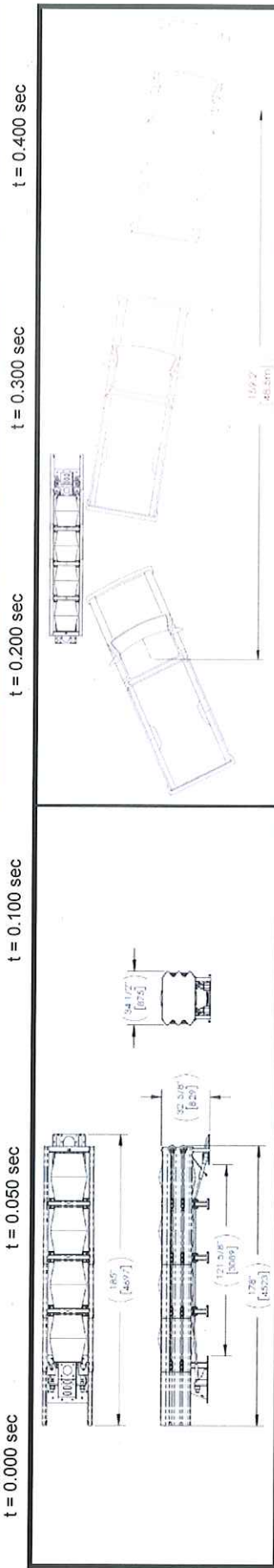
Minimal Cosmetic Damage

Test Article Deflection

Longitudinal System Stroke..... N/A
 Permanent Lateral Deflection..... 1.2 in (3 cm)
 Dynamic Lateral Deflection..... 7.4 in (18 cm)

Vehicle Damage

VDS..... 11-LFQ-1
 CDC..... 11LDEW1
 Maximum Interior Deformation..... No Deformation



General Information

Test Agency..... SAFE TECHNOLOGIES, INC.
 Test Number..... TAU235-C1
 Test Designation..... MASH 2-35 & MASH 2-36
 Date..... 6/14/2018

Test Article
 Name..... Universal TAU-M, TL-2
 Type..... Redirective, Non-gating Crash Cushion
 Installation Length..... 185 in (4.7 m)
 Width..... 34 1/2 in (875 mm)
 Height..... 32 5/8 in (829 mm)

Test Vehicle
 Type / Designation..... 2270P
 Make and Model..... 2012 Dodge Ram 1500
 Curb Weight..... 4,896 lb (2,221 kg)
 Test Inertial Weight..... 5,034 lb (2,283.5 kg)
 Gross Static Weight..... 5,034 lb (2,283.5 kg)

Impact Conditions
 Speed..... 43.1 mph (69.4 km/h)
 Angle..... 25 deg
 Location / Orientation..... BLON at 2.99 ft (0.91 m) downstream from upstream end of right panel 1

Exit Conditions

Speed..... 38 mph (61.8 km/h)
 Angle..... 10 deg

Post Impact Trajectory
 Vehicle Stability..... Satisfactory
 Longitudinal Stopping Distance (CG)..... 159.2 ft (48.5 m)
 Vehicle Snagging/Pocketing..... Minimal

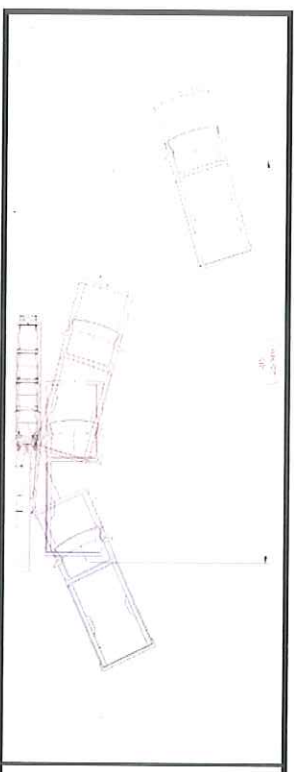
Occupant risk Values
 Longitudinal OIV..... 26.9 f/s (8.2 m/s)
 Lateral OIV..... 13.1 f/s (4.0 m/s)
 Longitudinal ORA..... 5.7 G
 Lateral ORA..... 5.5 G
 THIV..... 28.9 f/s (8.8 m/s)
 PHD..... 6.9 G
 ASI..... 0.97

Test Article Damage: Minimal
Test Article Deflection
 Longitudinal system stroke..... N/A
 Permanent lateral deflection..... 3.6 in (9.2 cm)
 Dynamic lateral deflection..... 10.6 in (26.8 cm)

Vehicle Damage
 VDS..... 11-LFQ-2
 CDC..... 11LDEW1
 Maximum Interior Deformation..... No Deformation



t = 0.000 sec t = 0.050 sec t = 0.100 sec t = 0.200 sec t = 0.300 sec t = 0.600 sec



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... TAU237a-C1
 Test Designation MASH 2-37a
 Date..... 6/27/2018

Test Article

Name Universal TAU-M, TL-2
 Type Redirective, Non-gating Crash Cushion
 Installation Length 242 in (6.15 m)
 Width 34 1/2 in (875 mm)
 Height 32 5/8 in (829 mm)

Test Vehicle

Type / Designation 2270P
 Make and Model 2012 Dodge Ram 1500
 Curb Weight 5,003 lb (2,269.5 kg)
 Test Inertial Weight 5,003 lb (2,269.5 kg)
 Gross Static Weight 5,003 lb (2,269.5 kg)

Impact Conditions

Speed 43.4 mph (69.9 km/h)
 Angle 25 deg
 Location / Orientation Reverse CIP at 6.67 ft (2.03 m) upstream from downstream end of backstop

Exit Conditions

Speed..... 30.7 mph (49.4 km/h)
 Angle..... 16 deg

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 85 ft (25.9 m)
 Vehicle Snagging/Pocketing Minimal

Occupant risk Values

Longitudinal OIV 20.3 ft/s (6.2 m/s)
 Lateral OIV 19.7 ft/s (6.0 m/s)
 Longitudinal ORA 8.6 G
 Lateral ORA 9.4 G
 THIV 27.9 ft/s (8.5 m/s)
 PHD 10.9 G
 ASI 1.15

Test Article Damage:

..... Minimal

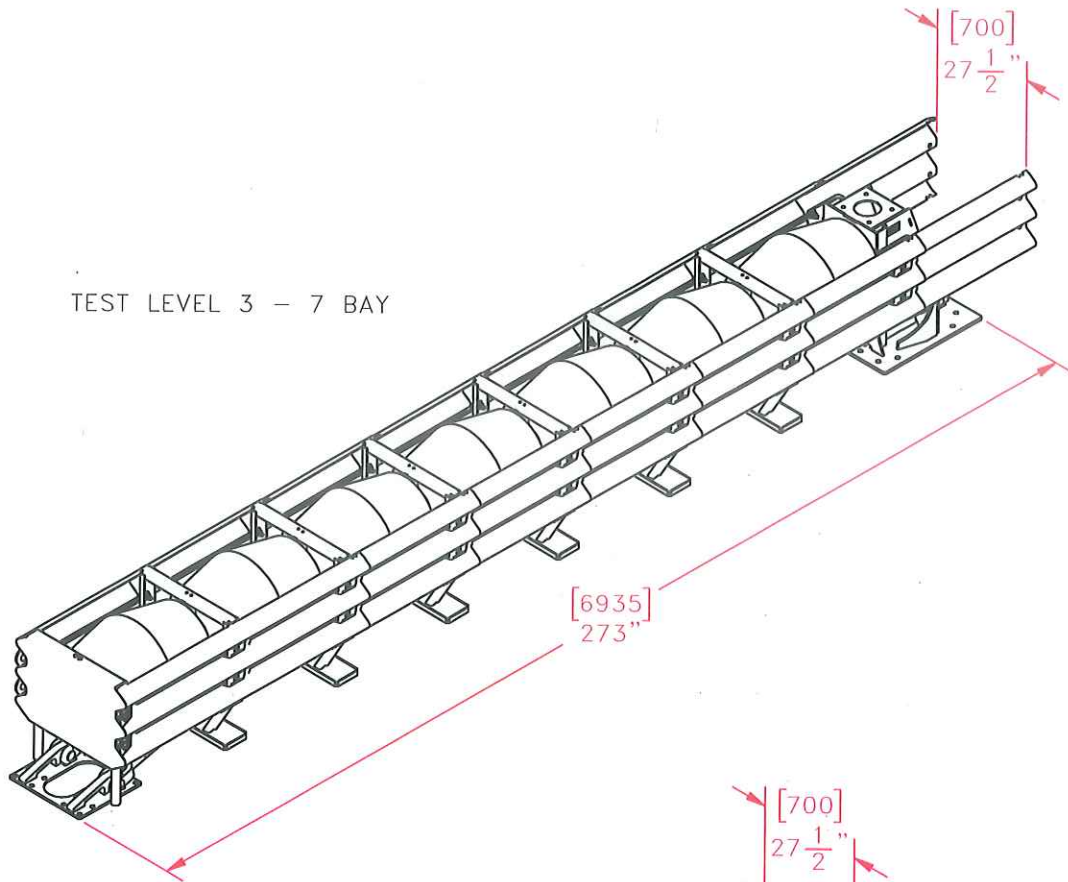
Test Article Deflection

Longitudinal system stroke..... N/A
 Permanent lateral deflection 3.6 in (9.2 cm)
 Dynamic lateral deflection 10 in (25.8 cm)

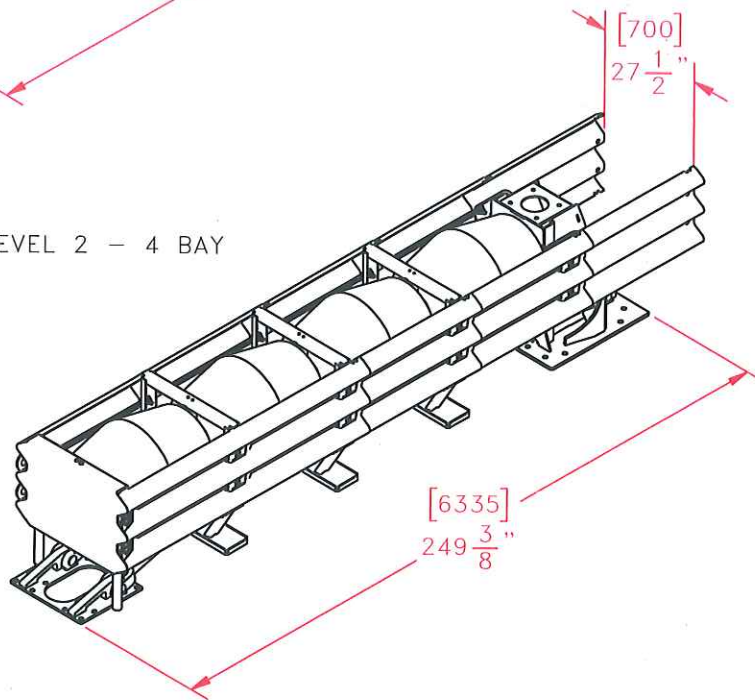
Vehicle Damage

VDS..... 11-LFQ-5
 CDC..... 11LDEW2
 Maximum Interior Deformation 4.25 in (108 mm) in the

TEST LEVEL 3 - 7 BAY



TEST LEVEL 2 - 4 BAY



Universal TAU-M™



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

SHEET NO.

DATE:

1 OF 2

08/24/18

INTENDED USE

The Universal TAU-M™ system is a re-directive non-gating crash cushion and is ideally suited for hazards such as the ends of rigid barriers, tollbooths, utility poles, and more. This system is designed to reduce severity of an errant vehicle impact and to safely stop or redirect an errant vehicle away from roadside or median hazards. These types of systems are typically applied to locations where head-on and angled impacts are likely to occur and it is desirable to have the majority of post impact trajectories on the impact side of the system.

The Universal TAU-M™ parallel crash cushions can protect hazards up to 30" [762] and offers a variety of anchoring options to fit many applications. Standard non-proprietary three-beam transitions may enable protecting much wider hazards. Test Level 2 systems are 4 Bays and Test Level 3 systems are 7 Bays.

The TAU-II™ (SCT01a-b) may be converted to a TAU-M.

APPROVALS

The Universal TAU-M™ system has been fully tested in conformance with MASH Test Level 2 and Test Level 3 and is determined eligible for Federal reimbursement by FHWA.

FHWA Eligibility Letters: XXXXXXXX

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

Universal TAU-M™



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