



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

December 17, 2018

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

In Reply Refer To:
HSST-1/CC-141A

Mr. Gerrit A. Dyke
Lindsay Transportation Solutions, Inc.
180 River Road
Rio Vista, CA 94571

Dear Mr. Dyke:

This letter is in response to your November 9, 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-141A 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:

- MAX-Tension™ Median MASH16

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 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: MAX-Tension™ Median MASH16

Type of system: Terminal

Test Level: AASHTO MASH Test Level 3

Testing conducted by: Safe Technologies, Inc.

Date of request: October 30, 2018

Date initially acknowledged: November 1, 2018

Date of completed package: December 4, 2018

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within the attached form. This concurrence is only for as-tested device using a welded traffic side slider detail.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter and will need to be tested in accordance with all recommended tests in AASHTO's MASH as part of a new and separate submittal.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of AASHTO's MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number CC-141A 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
Safety Design

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	November 26, 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:	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	MAX-Tension Median	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 MAX-Tension™ Median Guardrail Terminal System (MAX-Median) is a re-directive gating end terminal for double sided corrugated W-beam barrier systems in median or roadside configurations. The MAX-Median system utilizes tensioned cables, telescoping panels, and a cutting tooth to absorb the kinetic energy and safely contain or redirect impacting vehicles. The system is comprised of a friction based energy absorbing impact head, two tension cables, two support cables, two releasable posts (post 1 and 2), a ground anchor assembly, a panel coupler, and an energy absorbing panel coupler with integrated cutting tooth used in conjunction with standard AASHTO 12 Gauge guardrail panels, posts, blockouts, and hardware. The system length is approximately 27ft [8.2m] and has an effective length of approximately 50 ft [15.25m], with the anchor assembly extending forward approximately 4 ft [1.2m]. The Length of Need is at Post 3, 9ft 4in [2.86m] downstream of the first post.

The MAX-Median can be applied directly to double sided W-Beam guardrail systems at, or transitioned to, 31" rail height with panels and post spacing configured at mid-span splice. Transitions to strong post W-beam guardrail systems or other barriers where the splice is not mid-span can be accomplished using 3ft 1 1/2in [0.95m], 9ft 4 1/2in [2.85m], or 15ft 7 1/2in [4.75m] panels after the MAX-Median system (minimum 50ft [15.25m] downstream of the first post) in accordance with Federal, State, and local standards. Transitions to other barrier systems such as thrie beam or rigid bridge or roadside barriers shall be in accordance with Federal, State, and local requirements and attached after the MAX-Median system (minimum 50ft [15.25m] downstream of the first post).

The MAX-Median can be applied with a 0 to 2 ft[610mm] offset in accordance with FHWA recommendations.

The MAX-Median may be configured using wood or composite blockouts with 8in [200mm] depth. Reference Enclosure A, "MAX-Tension Median Guardrail End Terminal System TL-3 Configurations Justifications".

The MAX-Median may utilize standard AASHTO 8.5lb/ft or 9lb/ft line posts after post number two. It may also utilize standard AASHTO M-180 12 Gauge panels in 12ft -6in [3.8m] or 25ft [7.6m] lengths within the system. Reference Enclosure A. The MAX-Median 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.

Any delineation pattern, tape, or decal may be placed on the Delineation Bracket attached to the MAX-Median impact head. In addition, variations of brackets may be utilized with the MAX-Median (Enclosure A).

The MAX-Median 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 MAX-Median. Reference Enclosure A.

A minor modification to a component is proposed in Enclosure A. The section titled "Stamped vs. Welded Traffic Side Slider" details an alternative manufacturing method for the coupler where it is stamped from a single sheet of steel instead of welding two components together. This component may be fabricated in either configuration with no effect on the capacity, function, or performance of the MAX-Median.

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: 2018.11.26 12:19:29 -08'00'
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)	<p>This testing as per eligibility letter CC-141 dated Jan 10, 2018.</p> <p>The MAX-Tension Median end terminal satisfied the MASH structural adequacy criteria for its intended function as an end terminal. 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 MAX-Tension Median end terminal. Theoretical occupant impact velocities in the longitudinal and lateral directions met the limit of 40.0 ft/s (12.2 m/s). Ridedown accelerations 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>Vehicle occupant compartment deformations were well below allowable limits. There were no intrusions into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The MAX-Tension Median end terminal was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> <p>The terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-30.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
3-31 (2270P)	<p>This testing as per eligibility letter CC-141 dated Jan 10, 2018.</p> <p>The MAX-Tension Median end terminal satisfied the MASH structural adequacy criteria for its intended function as an end terminal. The test article captured the 2270P vehicles in a controlled manner. The vehicles did not penetrate, underide, or override the installation. The test articles exhibited controlled permanent and dynamic deflection.</p> <p>All of the occupant risk criteria were satisfied. Theoretical occupant impact velocities in the longitudinal and lateral directions were well below the preferred limit of 30.0 ft/s (9.1 m/s). Ridedown accelerations in the longitudinal and lateral directions were well below the preferred limit of 15 G. There was no test article debris detached during the tests.</p> <p>Vehicle occupant compartment deformations were well below allowable limits. There were no intrusions into the occupant compartments. The test vehicles remained upright during and after the collision with minor roll and pitch. The vehicle did not intrude into adjacent lanes.</p> <p>The MAX-Tension Median end terminal was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> <p>The terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-31.</p>	PASS

<p>3-32 (1100C)</p>	<p>This testing as per eligibility letter CC-141 dated Jan 10, 2018.</p> <p>The MAX-Tension Median end terminal satisfied the MASH structural adequacy criteria for its intended function as an end terminal. 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 MAX-Tension Median end terminal. Theoretical occupant impact velocities in the longitudinal and lateral directions were below the maximum limit of 40.0 ft/s (12 m/s). Ridedown accelerations 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>Vehicle occupant compartment deformations were well below allowable limits. There were no intrusions into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The MAX-Tension Median end terminal was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> <p>The terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-32.</p>	<p>PASS</p>
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<p>3-33 (2270P)</p>	<p>This testing as per eligibility letter CC-141 dated Jan 10, 2018.</p> <p>The MAX-Tension Median end terminal satisfied the MASH structural adequacy criteria for its intended function as an end terminal. The test article captured the 2270P vehicle in a controlled manner and brought the vehicle to a safe stop. The vehicle did not gate to the backside of the system. 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 . Theoretical occupant impact velocities in the longitudinal and lateral directions were well below the preferred limit of 30.0 ft/s (9.1 m/s). Ridedown accelerations in the longitudinal and lateral directions were well below the preferred limit of 15 G. There was minimal test article debris detached during the test.</p> <p>Vehicle occupant compartment deformations were well below allowable limits. There were no intrusions into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch. The vehicle did not intrude into adjacent lanes.</p> <p>The MAX-Tension Median end terminal was judged as satisfying the applicable MASH vehicle trajectory criteria.</p> <p>The terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-33.</p>	<p>PASS</p>
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3-34 (1100C)	<p>This testing as per eligibility letter CC-141 dated Jan 10, 2018.</p> <p>The MAX-Tension Median end terminal satisfied the MASH structural adequacy criteria for its intended function as an end terminal. The test article redirected the 1100C vehicle in a controlled manner. The vehicle did not penetrate, underide, or override the installation. The test article exhibited some permanent and dynamic deflection in the test.</p> <p>All of the occupant risk criteria were satisfied. Theoretical occupant impact velocities in the longitudinal and lateral directions were well below the preferred limit of 30.0 ft/s (9.1 m/s). Ridedown accelerations 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>Vehicle occupant compartment deformations were well below allowable limits. There were no intrusions into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The MAX-Tension Median end terminal was judged as satisfying the applicable vehicle trajectory criteria in MASH. There was no vehicle intrusion into adjacent lanes.</p> <p>The terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-34.</p>	PASS
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3-35 (2270P)	<p>This testing as per eligibility letter CC-141 dated Jan 10, 2018.</p> <p>The MAX-Tension Median end terminal satisfied the MASH structural adequacy criteria for its intended function as an end terminal. The test article contained and redirected the 2270P vehicle in a controlled manner. The vehicle did not penetrate, underride, override or gate the installation. The test article exhibited some permanent and dynamic deflection in the test. All of the occupant risk criteria were satisfied in testing the MAX-Tension Median end terminal. Theoretical occupant impact velocities in the longitudinal and lateral directions were well below the preferred limit of 30.0 ft/s (9.1 m/s). Ridedown accelerations 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 except for two blockouts that landed in the clear zone. Vehicle occupant compartment deformations were well below allowable limits. There were no intrusions into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch. The MAX-Tension Median end terminal was judged as satisfying the applicable vehicle trajectory criteria in MASH. There was no vehicle intrusion into adjacent lanes. The terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-35.</p>	PASS
3-36 (2270P)	<p>The MAX-Tension Median is applied only to corrugated W-profile guardrail barrier systems of equal lateral stiffness. Therefore this test is not relevant and was not conducted.</p>	Non-Relevant Test, not conducted

3-37b (1100C)	<p>The MAX-Tension Median end terminal satisfied the TL-3 MASH structural adequacy criteria for its intended function as a gating end terminal. The test article gated and partially redirected the 1100C vehicle in a controlled manner. 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 MAX-Tension Median end terminal. Theoretical occupant impact velocities in the longitudinal and lateral directions were below the limit of 40.0 ft/s (12.2 m/s). Ridedown accelerations 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 deformation to the passenger side toe pan area of the 1100C test vehicle was within acceptable limits. There were no intrusions into the occupant compartment. The test vehicle remained upright during and after the collision with minor roll and pitch.</p> <p>The MAX-Tension Median end terminal was judged as satisfying the applicable vehicle trajectory criteria in MASH.</p> <p>The Terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-37b.</p> <p>Additional testing, MASH Test 3-37a was also performed as per eligibility letter CC-141 dated Jan 10, 2018. The terminal was judged to have successfully met all of the evaluation criteria for MASH Test 3-37a.</p>	PASS
3-38 (1500A)	<p>These calculations as per eligibility letter CC-141 dated Jan 10, 2018.</p> <p>Calculations performed to demonstrate acceptable occupant risk values per MASH evaluation criteria. Reference Enclosure A, "MAX-Tension Median Guardrail End Terminal System TL-3 Configurations Justifications" section titled "1500A Vehicle (MASH Test 3-38)".</p>	PASS
3-40 (1100C)	Not applicable.	Non-Relevant Test, not conducted
3-41 (2270P)	Not applicable.	Non-Relevant Test, not conducted
3-42 (1100C)	Not applicable.	Non-Relevant Test, not conducted
3-43 (2270P)	Not applicable.	Non-Relevant Test, not conducted
3-44 (2270P)	Not applicable.	Non-Relevant Test, not conducted

3-45 (1500A)	Not applicable.	Non-Relevant Test, not conducted
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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: 2018.11.26 12:24:38 -08'00'
Address:	170 River Road, Rio Vista, CA 94571	Same as Submitter <input type="checkbox"/>	
Country:	USA	Same as Submitter <input type="checkbox"/>	
Accreditation Certificate Number and Dates of current Accreditation period :	1851.01, Valid through March 31, 2020		

Submitter Signature*: **Gerrit Dyke** Digitally signed by Gerrit Dyke
Date: 2018.11.26 12:25:11
08'00'

Submit Form

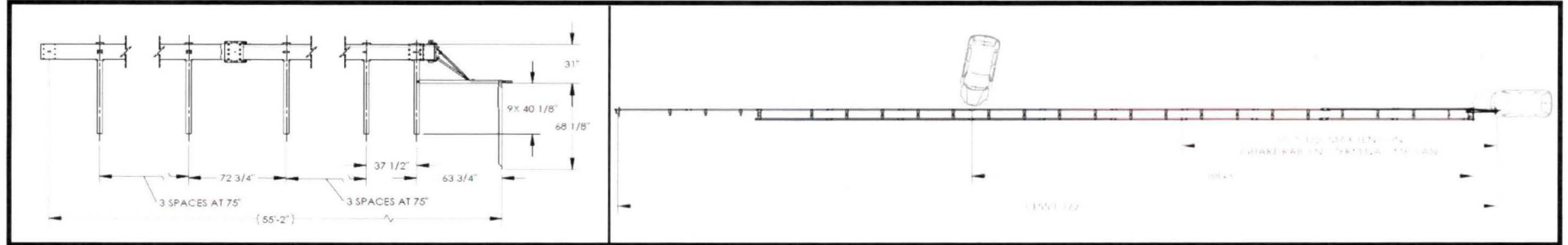
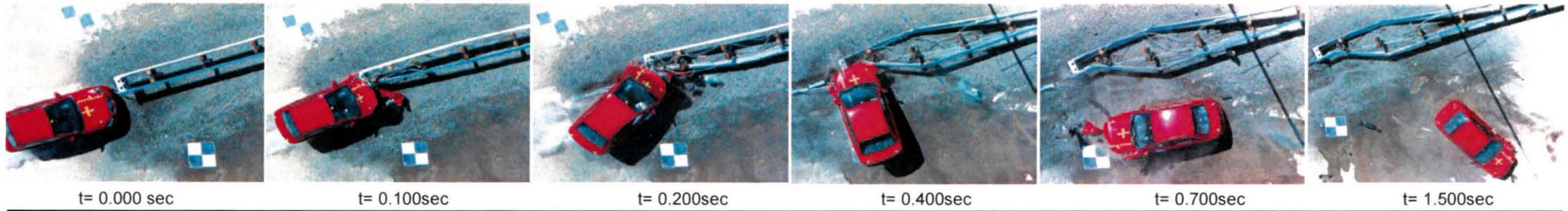
ATTACHMENTS

Attach to this form:

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

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MMT330-C3
 Test Designation MASH 3-30
 Date..... 7/14/2017

Test Article

Name LTS, MAX-Tension Median
 Type Guardrail End Terminal, Median
 Installation Length 155.1 ft (47.3 m)
 Width 28.4 in (721.4 mm)
 Height 31 in (787 mm)

Soil Conditions

Type of soil..... AASHTO Grade A/B Soil-Aggregate
 Soil strength..... 19,115 lb (85.0 kN)

Test Vehicle

Type / Designation 1100C
 Make and Model 2011 Kia Rio
 Curb Weight 2458.2 lb (1115.0 kg)
 Test Inertial Weight 2447.1 lb (1110.0 kg)
 Gross Static Weight 2612.5 lb (1185.0 kg)

Impact Conditions

Speed 62.0 mph (99.8 kph)
 Angle 0.0 deg
 Location / Orientation 1/4 Offset

Exit Conditions

Speed (mph)..... N/A
 Angle (deg)..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance..... 88.25 ft (26.9 m)
 Vehicle Snagging/Pocketing None

Occupant risk Values

Longitudinal OIV 40.0 ft/s (12.2 m/s)
 Lateral OIV 1.6 ft/s (0.5 m/s)
 Longitudinal ORA 9.3 g's
 Lateral ORA 7.5 g's
 THIV 41.0 ft/s (12.5 m/s)
 PHD 10.0 g's
 ASI 1.84

Test Article Deformation..... Moderate

Test Article Deflections

Longitudinal system stroke..... 6.92 ft (2.11 m)
 Permanent lateral deflection 23.4 in (0.595 m)
 Dynamic lateral deflection 26.0 in (0.660 m)

Vehicle Damage

VDS..... 11-FL-5
 CDC..... 11FLEW3
 Interior Deformation Minimal



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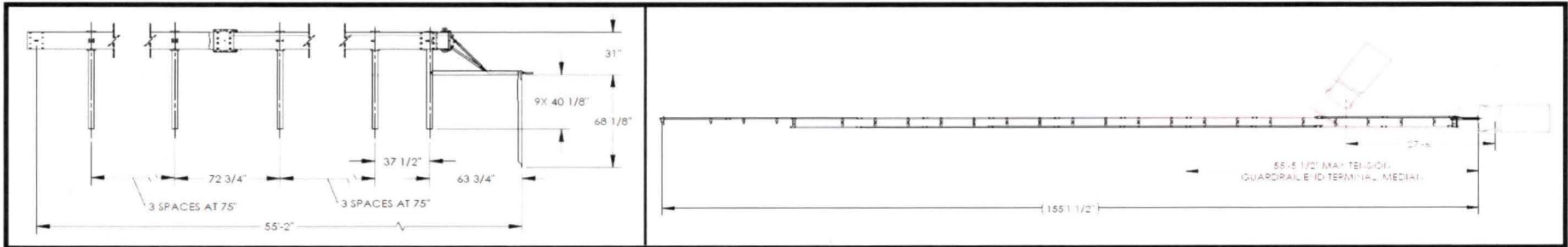
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General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MMT331-C1
 Test Designation MASH 3-31
 Date..... 8/1/2017

Test Article

Name LTS, MAX-Tension Median
 Type Guardrail End Terminal, Median
 Installation Length 155.1 ft (47.3 m)
 Width 28.4 in (721.4 mm)
 Height 31 in (787 mm)

Soil Conditions

Type of soil..... AASHTO Grade A/B Soil-Aggregate
 Soil strength..... 19,661 lb (87.4 kN)

Test Vehicle

Type / Designation 2270P
 Make and Model 2012 Dodge Ram 1500
 Curb Weight 4873.3 lb (2210.5 kg)
 Test Inertial Weight 5058.5 lb (2294.5 kg)
 Gross Static Weight 5058.5 lb (2294.5 kg)

Impact Conditions

Speed 62.7 mph (100.9 kph)
 Angle 0.0 deg
 Location / Orientation Front/Center

Exit Conditions

Speed (mph)..... N/A
 Angle (deg)..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 27.5 ft (8.38m)
 Vehicle Snagging/Pocketing N/A

Occupant risk Values

Longitudinal OIV 24.3 ft/s (7.4 m/s)
 Lateral OIV 1.64 ft/s (0.5 m/s)
 Longitudinal ORA 10.6 g's
 Lateral ORA 3.1 g's
 THIV 24.3 ft/s (7.4 m/s)
 PHD 10.6 g's
 ASI 0.84

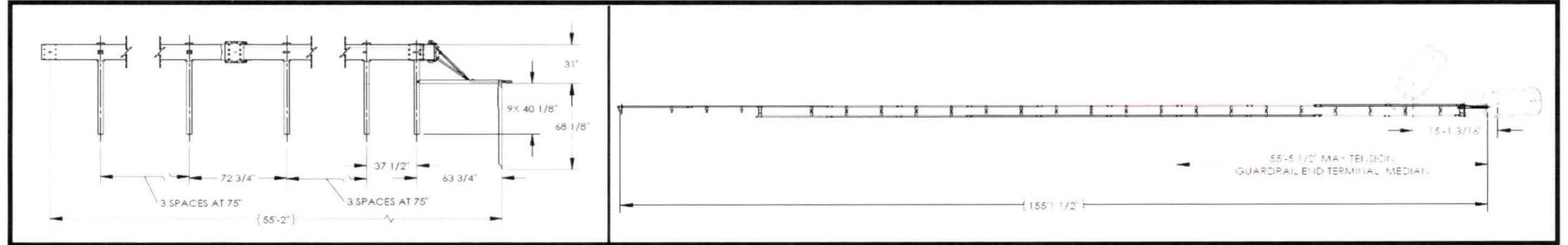
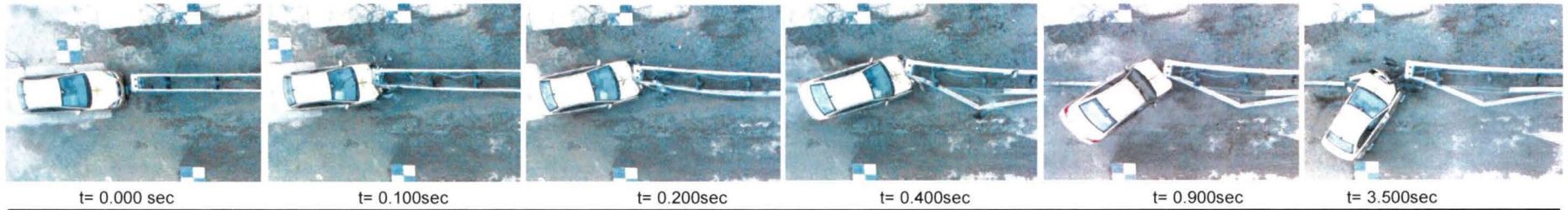
Test Article Damage:..... Substantial

Test Article Deflection

Longitudinal system stroke..... 24.1 ft (7.34 m)
 Permanent lateral deflection 5.9 ft (1.81 m)
 Dynamic lateral deflection 5.9 ft (1.81 m)

Vehicle Damage

VDS..... 12-FC-5
 CDC..... 12FCEW2
 Maximum Interior Deformation 1.25 in (32 mm) in the ceiling.



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MMT332-C1
 Test Designation MASH 3-32
 Date..... 8/3/2017

Test Article

Name LTS, MAX-Tension Median
 Type Guardrail End Terminal, Median
 Installation Length 155.1 ft (47.3 m)
 Width 28.4 in (721.4 mm)
 Height 31 in (787 mm)

Soil Conditions

Type of soil..... AASHTO Grade A/B Soil-Aggregate
 Soil strength..... 12,590 lb (56.0 kN)

Test Vehicle

Type / Designation 1100C
 Make and Model 2011 Kia Rio
 Curb Weight 2429.5 lb (1102.0 kg)
 Test Inertial Weight 2451.5 lb (1112.0 kg)
 Gross Static Weight 2616.9 lb (1187.0 kg)

Impact Conditions

Speed 62.2 mph (100.1 kph)
 Angle 5.0 deg
 Location / Orientation Front/Center

Exit Conditions

Speed (mph)..... N/A
 Angle (deg)..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 15.1 ft (4.61 m)
 Vehicle Snagging/Pocketing None

Occupant risk Values

Longitudinal OIV 37.7 ft/s (11.5 m/s)
 Lateral OIV 0.33 ft/s (0.1 m/s)
 Longitudinal ORA 7.8 g's
 Lateral ORA 2.5 g's
 THIV 37.7 ft/s (11.5 m/s)
 PHD 8.1 g's
 ASI 1.87

Test Article Deformation

..... Moderate

Test Article Deflections

Longitudinal system stroke..... 13.1 ft (3.99 m)
 Permanent lateral deflection 29.6 in (0.752 m)
 Dynamic lateral deflection 33.0 in (0.837 m)

Vehicle Damage

VDS..... 12-FC-6
 CDC..... 12FZEW3
 Maximum Interior Deformation 2.31 in (57 mm) in the floor pan.



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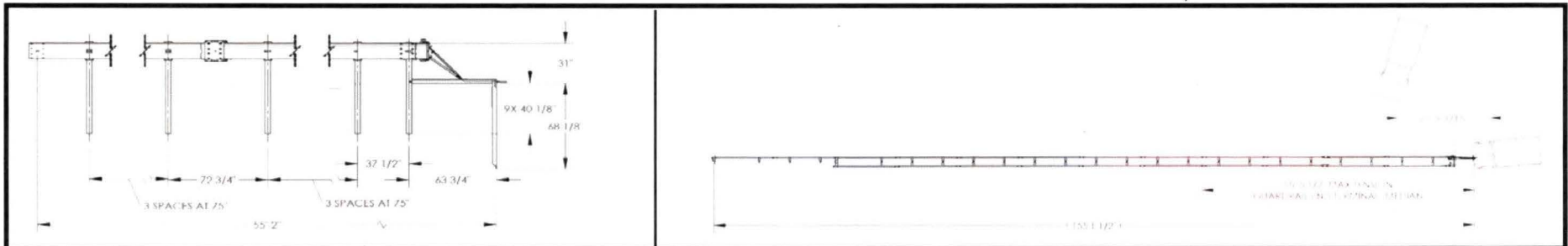
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General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MMT333-C1
 Test Designation MASH 3-33
 Date..... 8/7/2017

Test Article

Name LTS, MAX-Tension Median
 Type Guardrail End Terminal, Median
 Installation Length 155.1 ft (47.3 m)
 Width 28.4 in (721.4 mm)
 Height 31 in (787 mm)

Soil Conditions

Type of soil..... AASHTO Grade A/B Soil-Aggregate
 Soil strength..... 11,498 lb (51.1 kN)

Test Vehicle

Type / Designation 2270P
 Make and Model 2011 Dodge Ram 1500
 Curb Weight 4835.8 lb (2193.5 kg)
 Test Inertial Weight 5008.9 lb (2272.0 kg)
 Gross Static Weight 5008.9 lb (2272.0 kg)

Impact Conditions

Speed 63.2 mph (101.7 kph)
 Angle 5 deg
 Location / Orientation Front/Center

Exit Conditions

Speed (mph)..... N/A
 Angle (deg)..... N/A

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 23.8 ft (7.26 m)
 Vehicle Snagging/Pocketing N/A

Occupant risk Values

Longitudinal OIV 24.3 ft/s (7.4 m/s)
 Lateral OIV 1.64 ft/s (0.5 m/s)
 Longitudinal ORA 11.4 g's
 Lateral ORA 4.1g's
 THIV 24.3 ft/s (7.4 m/s)
 PHD 11.4 g's
 ASI 0.95

Test Article Damage:

Substantial

Test Article Deflection

Longitudinal system stroke..... 18.2 ft (5.54 m)
 Permanent lateral deflection 5.0 ft (1.52 m)
 Dynamic lateral deflection 5.2 ft (1.58 m)

Vehicle Damage

VDS..... 12-FC-5
 CDC..... 12FCEW2
 Maximum Interior Deformation 1 in (25.4 mm) in the floor pan



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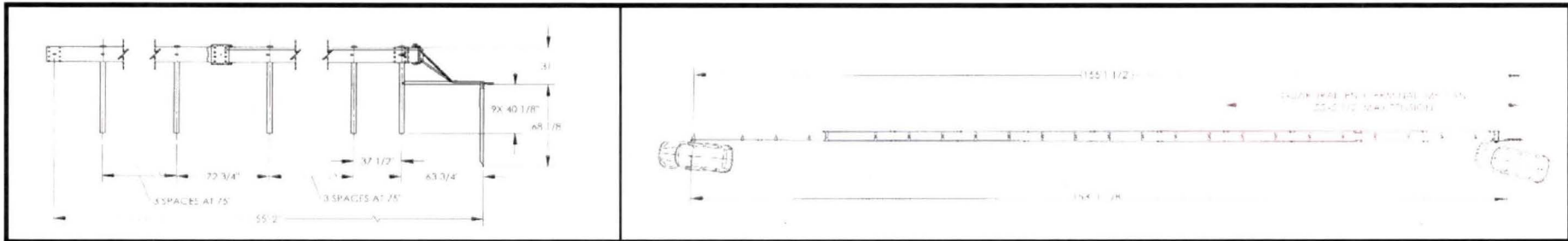
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General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MMT334-C1
 Test Designation MASH 3-34
 Date..... 8/10/2017

Test Article

Name LTS, MAX-Tension Median
 Type Guardrail End Terminal, Median
 Installation Length 155.1 ft (47.3 m)
 Width 28.4 in (721.4 mm)
 Height 31 in (787 mm)

Soil Conditions

Type of soil..... AASHTO Grade A/B Soil-Aggregate
 Soil strength..... 16,977 lb (75.5 kN)

Test Vehicle

Type / Designation 1100C
 Make and Model 2011 Hyundai Accent
 Curb Weight 2467.0 lb (1119 kg)
 Test Inertial Weight 2446.0 lb (1109.5 kg)
 Gross Static Weight 2611.4 lb (1184.5 kg)

Impact Conditions

Speed 61.5 mph (99.0 kph)
 Angle 15.0 deg
 Location / Orientation 1.94 ft (0.59 m) from post 1

Exit Conditions

Speed (mph)..... 55.8 mph (89.9 kph)
 Angle (deg)..... 9.1 degrees

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) Approximately 138.8 ft (42.3 m),
 stopped by containment barrier
 Vehicle Snagging/Pocketing N/A

Occupant risk Values

Longitudinal OIV 11.2 ft/s (3.4 m/s)
 Lateral OIV 20.0 ft/s (6.1 m/s)
 Longitudinal ORA 9.4 g's
 Lateral ORA 7.8 g's
 THIV 22.6 ft/s (6.9 m/s)
 PHD 9.8 g's
 ASI 0.82

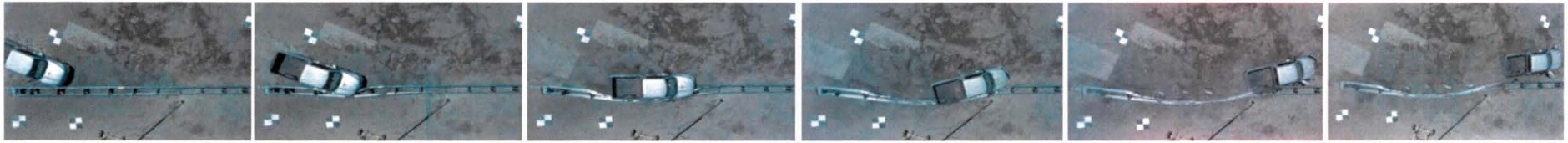
Test Article Damage:..... Minimal

Test Article Deflection

Longitudinal system stroke..... N/A
 Permanent lateral deflection 0.29 ft (0.09 m)
 Dynamic lateral deflection 0.57 ft (0.17 m)

Vehicle Damage

VDS..... 1-FR-2
 CDC..... 01FREE2
 Maximum Interior Deformation 1.0 in (25.4 mm) in the ceiling



t= 0.000 sec

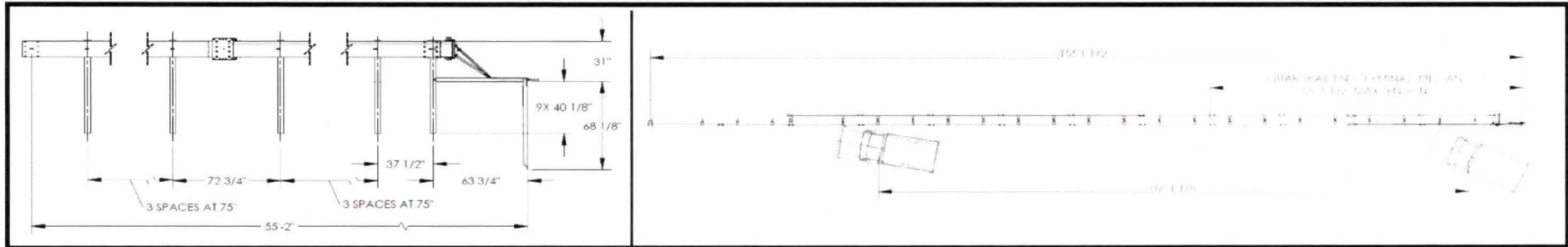
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t= 1.00sec



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MMT335-C1
 Test Designation MASH 3-35
 Date..... 7/21/2017

Test Article

Name LTS, MAX-Tension Median
 Type Guardrail End Terminal, Median
 Installation Length 155.1 ft (47.3 m)
 Width 28.4 in (721.4 mm)
 Height 31 in (787 mm)

Soil Conditions

Type of soil..... AASHTO Grade A/B Soil-Aggregate
 Soil strength..... 19213 lb (85.5 kN)

Test Vehicle

Type / Designation 2270P
 Make and Model 2011 Dodge Ram 1500
 Curb Weight 4578 lb (2,076.5 kg)
 Test Inertial Weight 5,012 lb (2,273.5 kg)
 Gross Static Weight 5,012 lb (2,273.5 kg)

Impact Conditions

Speed 63 mph (101.4 kph)
 Angle 25 deg
 Location / Orientation 3.0 m downstream from middle of post 1

Exit Conditions

Speed..... 24 mph (38.5 kph)
 Angle (deg)..... 12

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 109.1 ft (33.3 m)
 Vehicle Snagging/Pocketing N/A

Occupant risk Values

Longitudinal OIV 17.1 ft/s (5.2 m/s)
 Lateral OIV 14.4 ft/s (4.4 m/s)
 Longitudinal ORA 7.2 g's
 Lateral ORA 7.8 g's
 THIV 21.7 ft/s (6.6 m/s)
 PHD 9.3 g's
 ASI 0.63

Test Article Damage:..... Substantial

Test Article Deflection

Longitudinal system stroke..... N/A
 Permanent lateral deflection 2.1 ft (0.64 m)
 Dynamic lateral deflection 2.7 ft (0.83 m)

Vehicle Damage

VDS..... 01-RP-4
 CDC..... 01RDEW2
 Maximum Interior Deformation 0.88 in (22.2 mm) in the floor pan



t= 0.000 sec

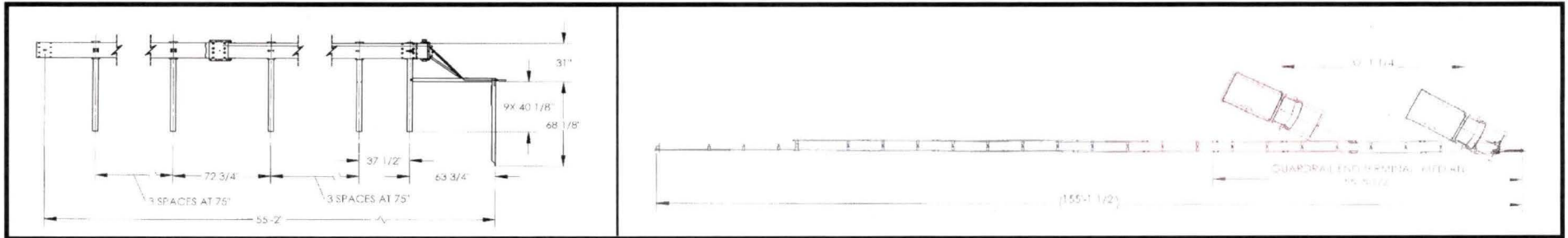
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General Information

Test Agency.....SAFE TECHNOLOGIES, INC.
 Test Number.....MMT337-C1
 Test DesignationMASH 3-37a
 Date.....7/27/2017

Test Article

NameLTS, MAX-Tension Median
 TypeGuardrail End Terminal, Median
 Installation Length155.1 ft (47.3 m)
 Width28.4 in (721.4 mm)
 Height31 in (787 mm)

Soil Conditions

Type of soil.....AASHTO Grade A/B Soil-Aggregate
 Soil strength.....15,550 lb (69.2 kN)

Test Vehicle

Type / Designation2270P
 Make and Model2011 Dodge Ram 1500
 Curb Weight5006.7 lb (2271 kg)
 Test Inertial Weight5054.1 lb (2292.5 kg)
 Gross Static Weight5054.1 lb (2292.5 kg)

Impact Conditions

Speed62.5 mph (100.6 kph)
 Angle25.0 deg
 Location / Orientation29.5 ft (9.0 m) from post 1

Exit Conditions

Speed (mph).....N/A
 Angle (deg).....N/A

Post Impact Trajectory

Vehicle StabilitySatisfactory
 Longitudinal Stopping Distance (CG)32.1 ft (9.8 m)
 Vehicle Snagging/PocketingMedium

Occupant risk Values

Longitudinal OIV24.3 ft/s (7.4 m/s)
 Lateral OIV12.1 ft/s (3.7 m/s)
 Longitudinal ORA8.2 g's
 Lateral ORA5.6 g's
 THIV24.6 ft/s (7.5 m/s)
 PHD8.9 g's
 ASI0.79

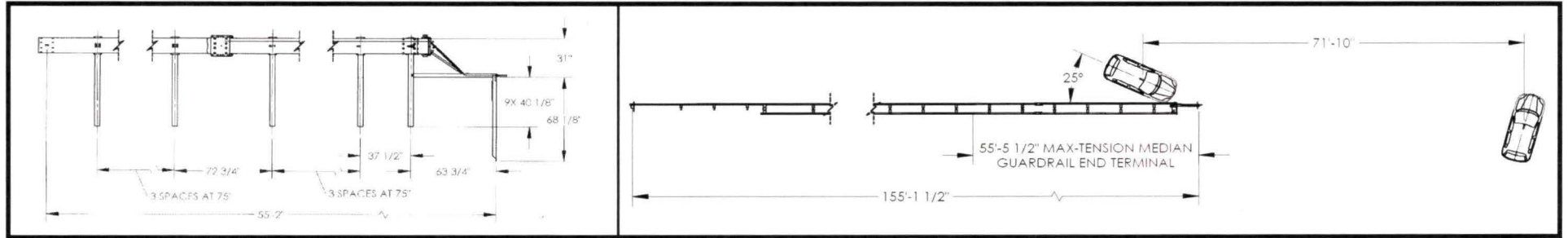
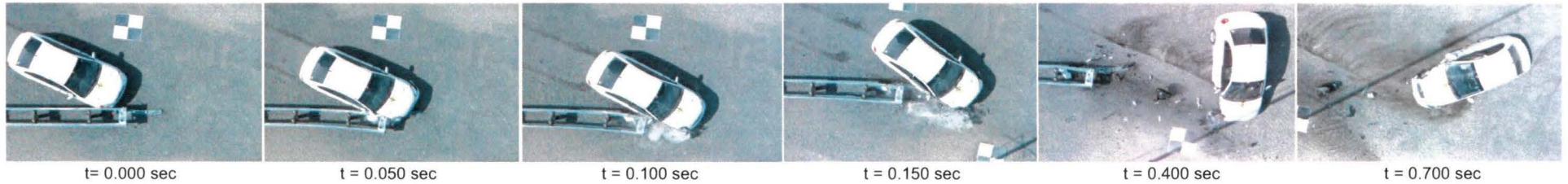
Test Article Damage:.....Substantial

Test Article Deflection

Longitudinal system stroke.....N/A
 Permanent lateral deflection1.5 ft (0.46 m)
 Dynamic lateral deflection2.8 ft (0.85 m)

Vehicle Damage

VDS.....01-FR-5
 CDC.....01FZEW4
 Maximum Interior Deformation2.75 in (69.85 mm) - dashboard



General Information

Test Agency..... **SAFE TECHNOLOGIES, INC.**
 Test Number..... MMT337b-C1
 Test Designation MASH 3-37b
 Date..... 9/12/2018

Test Article

Name MAX-Tension Median, TL-3
 Type Guardrail End Terminal, Median
 Installation Length 155.1 ft (47.3 m)
 Width 29 7/8 in (759 mm)
 Height 31 in (787 mm)

Soil Conditions

Type of soil..... AASHTO Grade A/B Soil-Aggregate
 Soil strength..... 10,648 lb (47.4 kN)

Test Vehicle

Type / Designation 1100C
 Make and Model 2011 Hyundai Accent
 Curb Weight 2,421 lb (1,098 kg)
 Test Inertial Weight 2,425 lb (1,100 kg)
 Gross Static Weight 2,590 lb (1,175 kg)

Impact Conditions

Speed 62.7 mph (100.9 km/h)
 Angle 25 deg
 Location / Orientation 27.0 in (68.6 cm) from post 2
 towards the Impact Head

Exit Conditions

Speed 38.4 mph (61.8 km/h)
 Angle 11 deg

Post Impact Trajectory

Vehicle Stability Satisfactory
 Longitudinal Stopping Distance (CG) 71.8 ft (21.8 m)
 Vehicle Snagging/Pocketing Minimal

Occupant Risk Values

Longitudinal OIV 34.8 ft/s (10.6 m/s)
 Lateral OIV 8.2 ft/s (2.5 m/s)
 Longitudinal ORA 7.7 G
 Lateral ORA 7.4 G
 THIV 36.4 ft/s (11.1 m/s)
 PHD 11.0 G
 ASI 1.36

Test Article Damage:..... Minimal

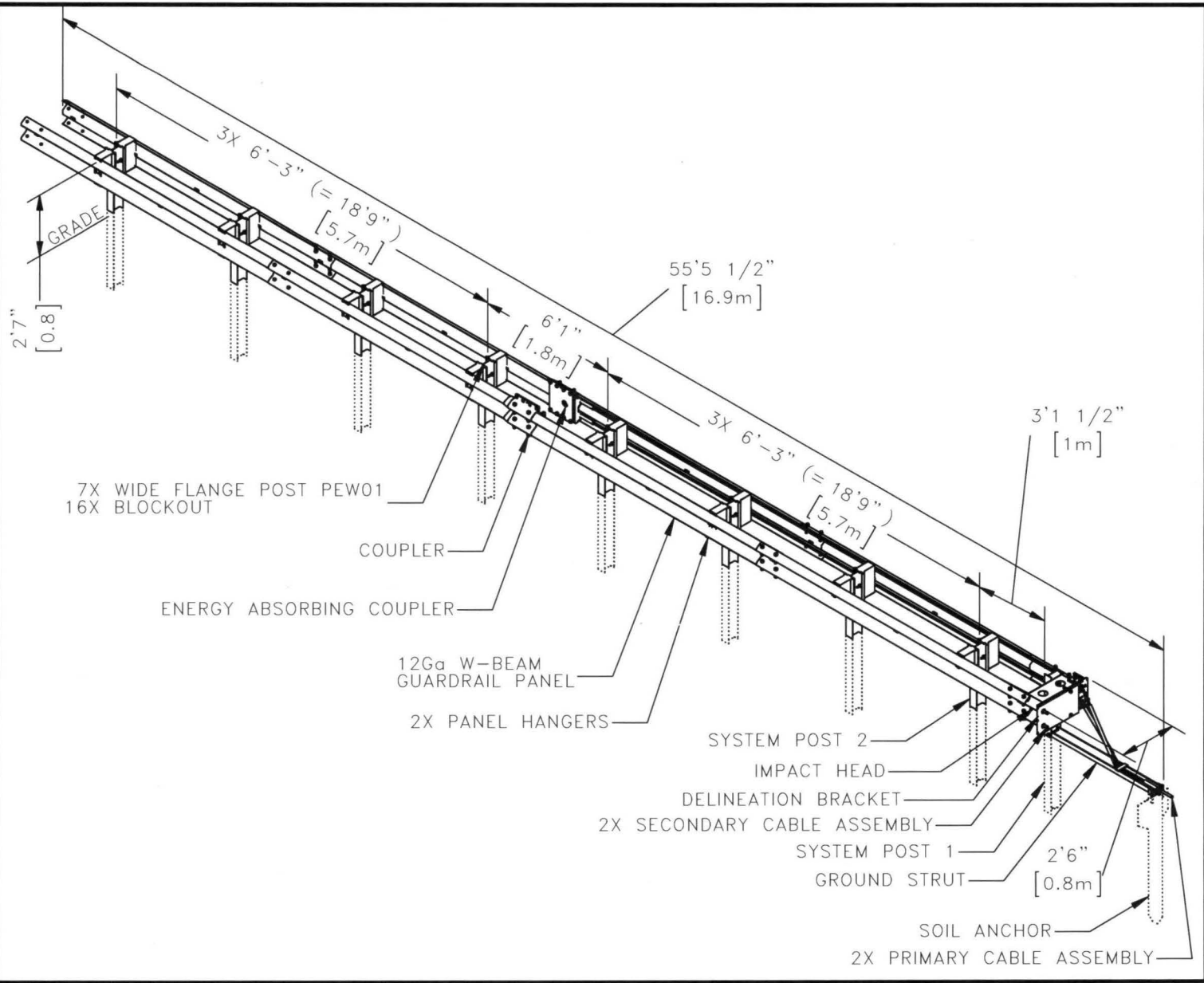
Test Article Deflection

Longitudinal system stroke..... N/A
 Permanent lateral deflection 7.8 in (19.8 cm)
 Dynamic lateral deflection 13.4 in (34.0 cm)

Vehicle Damage

VDS..... 1-RFQ-5
 CDC 01RFEW2
 Maximum Interior Deformation 8.75 in (222 mm) - toe pan

MAX-TENSION MEDIAN GUARDRAIL END TERMINAL



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

SHEET NO.	DATE:
1 OF 2	

INTENDED USE

The MAX-Tension™ Median Guardrail End Terminal (MAX-Median) is a re-directive, gating tension-based end terminal for double sided corrugated W-Beam barrier systems in median or roadside configurations. It can be used to protect motorists from unforgiving terminations of longitudinal barriers. The MAX-Median system absorbs the energy and gradually decelerates an impacting vehicle when impacted head-on and contains and redirects a vehicle during side impacts. The beginning of length of need is at post 3. The MAX-Median system intergrates directly into a corrugated W-Beam guardrail system.

The system consists of a friction based energy absorbing impact head, two tension cables and two support cables, releasable post 1 and 2, a ground anchor assembly, a panel coupler, and an energy absorbing panel coupler with integrated cutting tooth used in conjunction with standard AASHTO 12 gauge guardrail panels, posts, blockouts, and hardware. The system can be installed on any guardrail system at or transitioned to a rail height of 31" [787] with mid-span splices. Contact the manufacturer for further information and installation instructions.

APPROVALS

The MAX-Tension Median system has been fully tested in conformance with MASH Test Level 3 and is eligible for Federal reimbursement.

FHWA Eligibility Letters: CC-141, January 10, 2018

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

MAX-TENSION MEDIAN GUARDRAIL END TERMINAL

			
SHEET NO.	DATE:		
2 OF 2			