



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

January 30, 2023

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

In Reply Refer To:
HSST-1/CC-175

Bret R. Eckert
Trinity Highway Products, LLC
15601 Dallas Parkway, Suite 525
Addison, TX 75001
USA

Dear Mr. Eckert:

We received your correspondence of February 28, 2022 requesting issuance of a reimbursement eligibility letter under the Federal-aid highway program for the roadside safety system, device, design, product, or hardware (collectively “device”) described below. This letter is assigned Federal Highway Administration (FHWA) control number CC-175.

ELIGIBILITY LETTERS

The FHWA issues Federal-aid reimbursement eligibility letters for new roadside safety devices that are crash tested in accordance with the industry standard of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH).

FHWA, the Department of Transportation, and the United States (government) do not regulate roadside safety devices, crash test facilities, or the manufacturing industry. Issuance of eligibility letters is discretionary and provided only as a service to the states. FHWA may, at its discretion, decline to issue, revise, or rescind an eligibility letter. Eligibility letters are only issued by the FHWA headquarters Office of Safety.

Eligibility letters are issued only as notice to the states that a device is eligible for reimbursement under the Federal-aid highway program. They do not establish approval or certification for any other purpose. Issuance of an eligibility letter is not a prerequisite or requirement for state transportation agencies seeking to use Federal-aid funds for roadside safety devices. State agencies may use a device for which an eligibility letter has not been issued and seek Federal-aid reimbursement.

FEDERAL-AID REIMBURSEMENT

The request for issuance of this letter certified the device was crash tested in accordance with the industry standard of AASHTO’s MASH. This eligibility letter is based on that certification and the material offered in support of its issuance. The device described below is eligible for reimbursement under the Federal-aid highway program.

Name of system: Median Attenuating TREND Terminal (MATT) Type
of system: Crash Cushion
Test Level: Test Level 3
Testing conducted by: Applus IDIADA KARCO Engineering, LLC
Date of request: February 28, 2022

Information about the device, including material such as the eligibility request, crash test reports, drawings, or images are included in one or more attachment(s) to this letter.

Eligibility letter CC-175 is inapplicable to devices, optional equipment, alternate materials, or other features that were not crash tested in accordance with AASHTO's MASH.

This letter is issued only for the subject device as crash tested under AASHTO's MASH. Later modification(s) of the device are not eligible for Federal-aid reimbursement under this letter. Notice of later modification(s) should be given to transportation agencies, facility owners, and operators (collectively "agencies").

Agencies should be provided appropriate information about the device's design, installation, maintenance, materials, and mechanical properties.

Issuance of this letter is discretionary, and it may be revised or rescinded at FHWA's discretion. This letter is not a determination of compliance with the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) or ownership of any intellectual property rights.

This eligibility letter is not a determination by the government that a crash involving the subject device will result in any particular outcome. It is limited to only the device's eligibility for Federal-aid reimbursement.

INTELLECTUAL PROPERTY

Issuance of this eligibility letter does not convey property rights of any sort nor any exclusive privilege. This letter is not authorization or consent by the government for the use, manufacture, or sale of any patented or proprietary system, device, design, product, or hardware for which the requester is not the patent owner. Eligibility letters are not an expression of any view, position, or determination by the government as to the validity, scope, or ownership of any intellectual property rights to a specific device. These letters do not grant, impute, suggest, or otherwise establish any ownership, distribution, or licensing rights to the requester. The government expresses no opinion about the intellectual property rights relating to any device for which this or any other eligibility letter is issued.

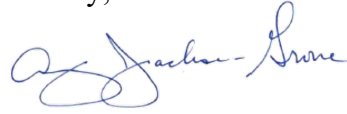
PUBLIC DISCLOSURE

To prevent any misunderstanding, and as discussed above, this eligibility letter is assigned FHWA control number CC-175. It should only be reproduced in full with its attachment(s). This letter and the material offered by the requester supporting its issuance is public information. All eligibility letters and supporting material are subject to public disclosure under the Freedom

of Information Act (FOIA). Eligibility letters are available to the public at https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/.

If you have any questions please contact Aimee Zhang at Aimee.Zhang@dot.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read "Amy Jackson-Grove". The signature is fluid and cursive, with the first name "Amy" being particularly prominent.

Amy Jackson-Grove
Acting Director, Office of Safety
Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	February 28, 2022	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Bret R. Eckert, P.E.	
	Company:	Trinity Highway Products, LLC	
	Address:	15601 Dallas Parkway, Suite 525, Addison, TX 75001	
	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	Median Attenuating TREND® Terminal (MATT™)	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:	Gregory A. Neece	Same as Submitter <input type="checkbox"/>
Company Name:	Trinity Highway Products, LLC	Same as Submitter <input type="checkbox"/>
Address:	15601 Dallas Parkway, Suite 525, Addison, TX 75001	Same as Submitter <input type="checkbox"/>
Country:	USA	Same as Submitter <input type="checkbox"/>

Enter below all disclosures of financial interests as required by the FHWA 'Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

The Median Attenuating TREND® Terminal ("MATT™") technology is the commercial embodiment of intellectual property that is owned by Trinity Highway Products, LLC ("THP"). THP does not pay royalties for sales of the MATT™ itself; however, royalties are paid for some specific components within the system. The MATT™ was designed and developed by engineers at THP.

Applus IDIADA KARCO Engineering, LLC ("KARCO") conducted the certification tests of the MATT™. KARCO is an internationally accredited third party crash testing laboratory. Physical crash testing of the MATT™ was performed in accordance with testing criteria, as set forth by the American Association of State Highway and Transportation Officials ("AASHTO") in the Manual for Assessing Safety Hardware ("MASH") (2016), with 2020 Errata. Other than fees paid to KARCO to conduct the tests and then analyze and report the test results, KARCO and THP do not share financial interests, nor are there any royalty payments made to KARCO. The fees paid to KARCO were not dependent or contingent on the results of the tests.

PRODUCT DESCRIPTION

- New Hardware or Significant Modification
 Modification to Existing Hardware

MATT™ (“Median Attenuating TREND® Terminal”) is a tangent, double-sided, redirective/gating, energy-absorbing terminal for unidirectional or bidirectional applications, to include roadside, shoulder, median, and gore applications. It is also suitable for use as either an approach or departure terminal. MATT™ was tested to MASH-2nd Edition (2016), with 2020 Errata to Test Level 3 (“TL-3”) criteria. MATT™ can be connected directly to 8” [203 mm] blocked Midwest Guardrail System (“MGS”). No radiused or curved W-Beam guardrail is allowed within the System. MATT™ has a system length of 34’ 4-1/2” [10.48 m], which is measured from the center of Post 1 to the splice location directly behind Post 6. The impact head extends forward of the center of Post 1 by 2’ [610 mm], for an effective length of 36’ 4-1/2” [11.09 m].

The System utilizes an impact head, angle strut, tension cable, one (1) Controlled Release Post (“CRP”), four (4) Steel Yielding Terminal Posts (“SYTP”) and one (1) standard line post and various other fastener and hardware components. All system posts utilize below-grade soil plates for increased soil bearing resistance. Additionally, the System includes six (6) SETS of Proprietary W-Beam 10/12ga guardrail panels, of which three (3) SETS have an integrated shaper fin and three (3) SETS do not. Posts 1-5 uses 8” [203 mm] deep steel spacers (Double at Post 1-2, Singles at Posts 3-5) while Post 6 utilizes 8” [203 mm] deep guardrail composite block-out (s). System installation height, as tested, was 31” [787 mm] with a tolerance of +1” [25 mm], -0” and a width of 29” [737 mm]. Adhesive-backed delineation was attached to the impact head.

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:	Antonio Reyes	
Engineer Signature:	Antonio Reyes	Digitally signed by Antonio Reyes DN: cn=Antonio Reyes, o=Applus Idiada, ou, email=Antonio.Reyes@idiada.com, c=US Date: 2023.01.24 15:42:13 -08'00'
Address:	9270 Holly Road, Adelanto, CA 92301	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>Applus IDIADA KARCO Test No. P41061-01. Test Date April 9, 2021. Crash Test Report No. TR-P41061-01-A for MASH 2016 Test 3-30 Crash Test of Trinity Highway Products Median Attenuating TREND® Terminal (MATT™).</p> <p>The Median Attenuating TREND® Terminal (MATT™) terminal (P41061-01) was impacted by a 2015 Kia Rio 4-door sedan at a velocity of 63.14 mph (101.61 km/h) and a CIA of 0.7°. Upon impact, the terminal's post 1 released, post 2 yielded and partially uprooted as the rails translated rearward shearing the tabs through 1-1/2 panels. The vehicle yawed counter-clockwise and came to rest. There was no significant deformation or penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 32.5 ft/s (9.9 m/s) and a maximum ridedown acceleration (RA) of 19.0 g.</p> <p>The Trinity Highway Products Median Attenuating TREND® Terminal (MATT™) met all the requirements for MASH 2016 Test 3-30.</p>	PASS
3-31 (2270P)	<p>Applus IDIADA KARCO Test No. P41062-01. Test Date March 25, 2021. Crash Test Report No. TR-P41062-01-A for MASH 2016 Test 3-31 Crash Test of Trinity Highway Products Median Attenuating TREND® Terminal (MATT™).</p> <p>The Median Attenuating TREND® Terminal (MATT™) terminal (P41062-01) was impacted by a 2017 Ram 1500 pickup-truck at a velocity of 62.66 mph (100.84 km/h) and a CIA of 0.3°. Upon impact, the terminal's post 1 released and posts 2,3 and 4 yielded as the slotted rails translated rearward absorbing the energy of the impact. There was no significant deformation or penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 27.6 ft/s (8.4 m/s) and a maximum ridedown acceleration (RA) of 12.4 g.</p> <p>The Trinity Highway Products Median Attenuating TREND® Terminal (MATT™) met all the requirements for MASH 2016 Test 3-31.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
3-32 (1100C)	<p>Applus IDIADA KARCO Test No. P41295-01. Test Date October 8, 2021. Crash Test Report No. TR-P41295-01-A for MASH 2016 Test 3-32 Crash Test of Trinity Highway Products Median Attenuating TREND® Terminal (MATT™).</p> <p>The Median Attenuating TREND® Terminal (MATT™) terminal (P41295-01) was impacted by a 2015 Kia Rio 4-door sedan at a velocity of 62.44 mph (100.49 km/h) and a CIA of 4.8°. Upon impact, the terminal post 1 released, and post 2 yielded as the rails translated rearward shearing the tabs through 1-1/2 panels. The vehicle pitched and yawed and came to rest. There was no significant deformation or penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 35.4 ft/s (10.8 m/s) and a maximum ridedown acceleration (RA) of 19.0 g.</p> <p>The Trinity Highway Products Median Attenuating TREND® Terminal (MATT™) met all the requirements for MASH 2016 Test 3-32.</p>	PASS

3-33 (2270P)	<p>Applus IDIADA KARCO Test No. P41064-01. Test Date April 20, 2021. Crash Test Report No. TR-P41064-01-A for MASH 2016 Test 3-33 Crash Test of Trinity Highway Products Median Attenuating TREND® Terminal (MATT™).</p> <p>The Median Attenuating TREND® Terminal (MATT™) terminal (P41064-01) was impacted by a 2015 Ram 1500 pickup-truck at a velocity of 62.39 mph (100.41 km/h) and a CIA of 4.8°. Upon impact post 1 released, post 2 and 3 yielded flat to grade and the slotted rails translated rearward dissipating the energy of the impacting vehicle. The truck grazed post 4 and the slotted rails deformed as the vehicle slows to a stop adjacent to the system. There was no significant deformation or penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 25.9 ft/s (7.9 m/s) and a maximum ridedown acceleration (RA) of 10.8 g.</p> <p>The Trinity Highway Products Median Attenuating TREND® Terminal (MATT™) met all the requirements for MASH 2016 Test 3-33.</p>	PASS
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3-34 (1100C)	<p>Applus IDIADA KARCO Test No. P41065-01. Test Date March 11, 2021. Crash Test Report No. TR-P41065-01-NC for MASH 2016 Test 3-34 Crash Test of Trinity Highway Products Median Attenuating TREND® Terminal (MATT™).</p> <p>The Median Attenuating TREND® Terminal (MATT™) terminal (P41065-01) was impacted by a 2015 Kia Rio 4-door sedan at a velocity of 63.99 mph (102.98 km/h) and a CIA of 15.2°. Upon impact, the terminal deflected outward, releasing the upper portion of post 1. The vehicle continued redirecting off the terminal partially yielding post 2 through 4. The vehicle exited the system at post 5 and began yawing clockwise until it came to rest downstream in a controlled manner. There was no significant deformation or penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 16.4 ft/s (5.0 m/s) and a maximum ridedown acceleration (RA) of 15.3 g.</p> <p>The Trinity Highway Products Median Attenuating TREND® Terminal (MATT™) met all the requirements for MASH 2016 Test 3-34.</p>	PASS
3-35 (2270P)	<p>Applus IDIADA KARCO Test No. P41244-01. Test Date August 9, 2021. Crash Test Report No. TR-P41244-01-NC for MASH 2016 Test 3-35 Crash Test of Trinity Highway Products Median Attenuating TREND® Terminal (MATT™).</p> <p>The Median Attenuating TREND® Terminal (MATT™) terminal (P41244-01) was impacted by a 2015 Ram 1500 pickup-truck at a velocity of 62.53 mph (100.63 km/h) and a CIA of 26.3°. Upon impact, the vehicle made contact with the rail and caused posts 4 thru 8 to yield. The vehicle was redirected and came to rest in a controlled manner. There was no significant deformation or penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 21.7 ft/s (6.6 m/s) and a maximum ridedown acceleration (RA) of 14.3 g.</p> <p>The Trinity Highway Products Median Attenuating TREND® Terminal (MATT™) met all the requirements for MASH 2016 Test 3-35.</p>	PASS
3-36 (2270P)		Non-Relevant Test, not conducted

3-37 (2270P)	<p>Applus IDIADA KARCO Test No. P41228-01. Test Date July 22, 2021. Crash Test Report No. TR-P41228-01-A for MASH 2016 Test 3-37b Crash Test of Trinity Highway Products Median Attenuating TREND® Terminal (MATT™).</p> <p>The Median Attenuating TREND® Terminal (MATT™) terminal (P41228-01) was impacted by a 2015 Kia Rio 4-door sedan at a velocity of 63.58 mph (102.33 km/h) and a CIA of 25.2°. Upon impact, post 1 released, post 2 yielded and the car yawed 57 degrees before reaching its final resting position. The terminal caused no significant deformation or penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 38.4 ft/s (11.7 m/s) and a maximum ridedown acceleration (RA) of 17.8 g.</p> <p>The Trinity Highway Products Median Attenuating TREND® Terminal (MATT™) met all the requirements for MASH 2016 Test 3-37b.</p>	PASS
3-38 (1500A)		Non-Critical, not conducted
3-40 (1100C)		Non-Relevant Test, not conducted
3-41 (2270P)		Non-Relevant Test, not conducted
3-42 (1100C)		Non-Relevant Test, not conducted
3-43 (2270P)		Non-Relevant Test, not conducted
3-44 (2270P)		Non-Relevant Test, not conducted
3-45 (1500A)		Non-Relevant Test, not conducted

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	KARCO Engineering, INC	
Laboratory Signature:	Antonio Reyes	<small>Digitally signed by Antonio Reyes DN: cn=Antonio Reyes, o=Applus Idiada, ou, email=Antonio.Reyes@idiada.com, c=US Date: 2023.01.24 15:42:48 -08'00'</small>
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter <input type="checkbox"/>
Country:	USA	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	International Accreditation Services (IAS) ISO 17025 Accreditation Certificate #TL-371 Expires July 1, 2023	

Submitter Signature*: **Bret Eckert** Digitally signed by Bret Eckert
Date: 2023.01.25 06:50:37
-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

MASH 2016 Test 3-30 Summary



0.000 seconds 0.090 seconds 0.180 seconds 0.270 seconds 0.450 seconds



GENERAL INFORMATION	
Test Agency.....	Applus IDIADA KARCO
Test Number.....	P41061-01
Test Designation.....	3-30
Test Date.....	4/9/21
TEST ARTICLE	
Name / Model.....	MATT™
Type.....	Terminal
Installation Length.....	143.8 ft. (43.8 m) (Nominal)
Terminal Length.....	36.4 ft. (11.1 m)
Road Surface.....	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation.....	1100C
Year, Make, and Model....	2015 Kia Rio
Curb Mass.....	2,544.1 lbs (1,154.0 kg)
Test Inertial Mass.....	2,444.9 lbs (1,109.0 kg)
Gross Static Mass.....	2,610.2 lbs (1,184.0 kg)

Impact Conditions	
Impact Velocity.....	63.14 mph (101.61 km/h)
Impact Angle.....	0.7°
Location / Orientation.....	15.0 in. (382 mm) From Vehicle Centerline on Driver Side
Kinetic Energy.....	325.8 kip-feet (441.7 Kilojoules)
Minimum KE Required.....	288.0 kip-feet (390.0 Kilojoules)
Exit Conditions	
Exit Velocity.....	20.1 mph (32.4 km/h)
Exit Angle.....	88.5°
Final Vehicle Position.....	30.0 ft. (9.1 m) Traffic Side 27.7 ft. (8.4 m) Downstream
Vehicle Snagging.....	None
Vehicle Pocketing.....	None
Vehicle Stability.....	Satisfactory
Maximum Roll Angle.....	-13.0 °
Maximum Pitch Angle.....	19.8 °
Maximum Yaw Angle.....	127.1 °

Occupant Risk	
Longitudinal OIV.....	32.5 ft/s (9.9 m/s)
Lateral OIV.....	-2.6 ft/s (-0.8 m/s)
Longitudinal RA.....	-19.0 g
Lateral RA.....	3.1 g
THIV.....	32.8 ft/s (10.0 m/s)
PHD.....	19.0 g
ASI.....	1.35
Test Article Deflections	
Static.....	9.2 in. (234 mm)
Dynamic.....	18.7 in. (475 mm)
Working Width.....	18.7 in. (475 mm)
Vehicle Damage	
Vehicle Damage Scale.....	12-FD-6
CDC.....	12DEW3
Maximum Deformation....	0.4 in. (10 mm) Toe Pan

Figure 2 Summary of Test 3-30

MASH 2016 Test 3-31 Summary



0.000 seconds

0.100 seconds

0.200 seconds

0.300 seconds

0.400 seconds



GENERAL INFORMATION

Test Agency..... Applus IDIADA KARCO
 Test Number..... P41062-01
 Test Designation..... 3-31
 Test Date..... 3/25/21

TEST ARTICLE

Name / Model..... MATT™
 Type..... Terminal
 Installation Length..... 143.8 ft. (43.8 m) Nominal
 Terminal Length..... 36.4 ft. (11.1 m)
 Road Surface..... Smooth Concrete to Fine Silty Soil

TEST VEHICLE

Type / Designation..... 2270P
 Year, Make, and Model.... 2017 Ram 1500
 Curb Mass..... 5,055.1 lbs (2,293.0 kg)
 Test Inertial Mass..... 5,004.4 lbs (2270.0 kg)
 Gross Static Mass..... 5,004.4 lbs (2270.0 kg)

Impact Conditions

Impact Velocity..... 62.66 mph (100.84 km/h)
 Impact Angle..... 0.3°
 Location / Orientation..... 1.3 in. (33 mm) From Vehicle Centerline on Passenger Side
 Kinetic Energy..... 656.8 kip-feet (890.5 Kilojoules)
 Minimum KE Required..... 594.0 kip-feet (806.0 Kilojoules)

Exit Conditions

Exit Velocity..... Not Applicable
 Exit Angle..... Not Applicable
 Final Vehicle Position..... 22.2 ft. (6.8 m) Downstream
 0.5 ft. (0.2 m) Field Side
 Vehicle Snagging..... None
 Vehicle Pocketing..... None
 Vehicle Stability..... Satisfactory
 Maximum Roll Angle..... 1.5°
 Maximum Pitch Angle..... 5.3°
 Maximum Yaw Angle..... 4.8°

Occupant Risk

Longitudinal OIV..... 27.6 ft/s (8.4 m/s)
 Lateral OIV..... -0.0 ft/s (-0.0 m/s)
 Longitudinal RA..... -12.4 g
 Lateral RA..... -1.3 g
 THIV..... 27.6 ft/s (8.4 m/s)
 PHD..... 12.4 g
 ASI..... 0.65

Test Article Deflections

Static..... 9 in. (23 mm)
 Dynamic..... 1.2 in. (30 mm)
 Working Width..... Not Applicable

Vehicle Damage

Vehicle Damage Scale..... 12FDEW2
 CDC..... 12-FD-3
 Maximum Deformation.... 0.2 in (5 mm) Floor Pan/Toe pan

MASH 2016 Test 3-32 Summary



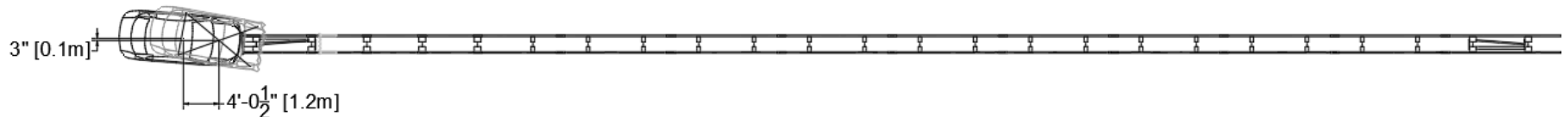
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GENERAL INFORMATION

Test Agency..... Applus IDIADA KARCO
 Test Number..... P41295-01
 Test Designation..... 3-32
 Test Date..... 10/8/21

TEST ARTICLE

Name / Model..... MATT™
 Type..... Terminal
 Installation Length..... 143.8 ft. (43.8 m) (Nominal)
 Terminal Length..... 36.4 ft. (11.1 m)
 Road Surface..... Smooth Concrete to Fine Silty Soil

TEST VEHICLE

Type / Designation..... 1100C
 Year, Make, and Model.... 2015 Kia Rio
 Curb Mass..... 2,550.7 lbs (1,157.0 kg)
 Test Inertial Mass..... 2,447.1 lbs (1,110.0 kg)
 Gross Static Mass..... 2,612.4 lbs (1,185.0 kg)

Impact Conditions

Impact Velocity..... 62.44 mph (100.49 km/h)
 Impact Angle..... 4.8°
 Location / Orientation..... 1.2 in. (31 mm) From Vehicle Centerline on the Driver Side
 Kinetic Energy..... 319.0 kip-feet (432.4 Kilojoules)
 Minimum KE..... 288.0 kip-feet (390.0 Kilojoules)

Exit Conditions

Exit Velocity..... 10.69 mph (17.20 km/h)
 Exit Angle..... 2.1°
 Final Vehicle Position..... 0.3 ft. (0.1 m) Field Side
 4.0 ft. (1.2 m) Downstream
 Vehicle Snagging..... None
 Vehicle Pocketing..... None
 Vehicle Stability..... Satisfactory
 Maximum Roll Angle..... 8.1 °
 Maximum Pitch Angle..... -14.4 °
 Maximum Yaw Angle..... 6.6 °

Occupant Risk

Longitudinal OIV..... 35.4 ft/s (10.8 m/s)
 Lateral OIV..... 2.3 ft/s (0.7 m/s)
 Longitudinal RA..... -19.0 g
 Lateral RA..... 3.5 g
 THIV..... 35.8 ft/s (10.9 m/s)
 PHD..... 19.1 g
 ASI..... 1.40

Test Article Deflections

Static..... 2.7 ft. (0.8 m)
 Dynamic..... 3.3 ft. (1.0 m)
 Working Width..... 3.6 ft. (1.1 m)

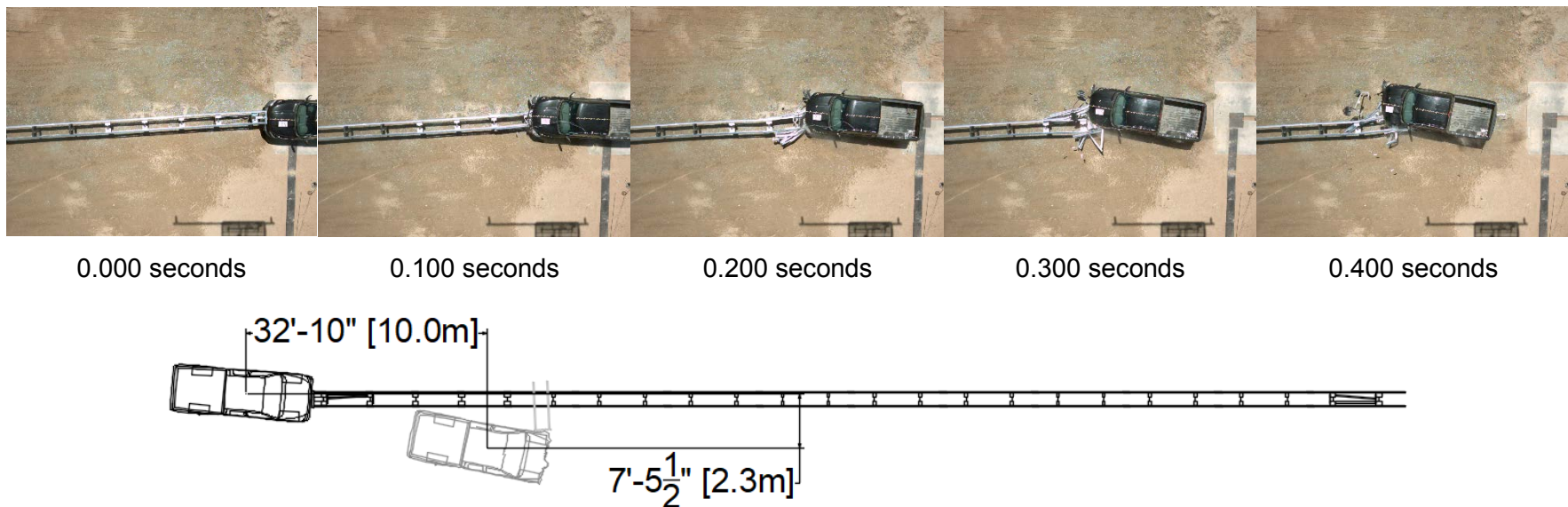
Vehicle Damage

Vehicle Damage Scale..... 12-FD-6
 CDC..... 12DEW3
 Maximum Deformation..... 2.6 in. (66 mm)*

* Caused by vehicle's hood, not the article.

Figure 2 Summary of Test 3-32

MASH 2016 Test 3-33 Summary



GENERAL INFORMATION	
Test Agency.....	Applus IDIADA KARCO
Test Number.....	P41064-01
Test Designation.....	3-33
Test Date.....	4/20/21
TEST ARTICLE	
Name / Model.....	MATT™
Type.....	Terminal
Installation Length.....	143.8 ft. (43.8 m) (Nominal)
Terminal Length.....	36.4 ft. (11.1 m)
Road Surface.....	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation.....	2270P
Year, Make, and Model....	2015 Ram 1500
Curb Mass.....	4,975.7 lbs (2,257.0 kg)
Test Inertial Mass.....	5,013.2 lbs (2274.0 kg)
Gross Static Mass.....	5,013.2 lbs (2274.0 kg)

Impact Conditions	
Impact Velocity.....	62.39 mph (100.41 km/h)
Impact Angle.....	4.8°
Location / Orientation.....	3.4 in. (86 mm) From Vehicle Centerline on Driver Side
Kinetic Energy.....	652.4 kip-feet (884.5 Kilojoules)
Minimum KE Required.....	594.0 kip-feet (806.0 Kilojoules)
Exit Conditions	
Exit Velocity.....	24.10 mph (38.79 km/h)
Exit Angle.....	11.2°
Final Vehicle Position.....	32.8 ft. (10.0 m) Downstream 7.5 ft. (2.3 m) Field side
Vehicle Snagging.....	None
Vehicle Pocketing.....	None
Vehicle Stability.....	Satisfactory
Maximum Roll Angle.....	-13.3°
Maximum Pitch Angle.....	-6.5°
Maximum Yaw Angle.....	-14.3°

Occupant Risk	
Longitudinal OIV.....	25.9 ft/s (7.9 m/s)
Lateral OIV.....	-3.6 ft/s (-1.1 m/s)
Longitudinal RA.....	-10.8 g
Lateral RA.....	4.3 g
THIV.....	25.9 ft/s (7.9 m/s)
PHD.....	11.4 g
ASI.....	0.80
Test Article Deflections	
Static.....	3.0 ft. (0.9 m)
Dynamic.....	3.7 ft. (1.1 m)
Working Width.....	10.7 ft. (3.3 m)
Vehicle Damage	
Vehicle Damage Scale.....	12FDEW3
CDC.....	12-FD-5
Maximum Deformation....	2.1 in (61 mm) Floor Pan

Figure 2 Summary of Test 3-33

MASH 2016 Test 3-34 Summary



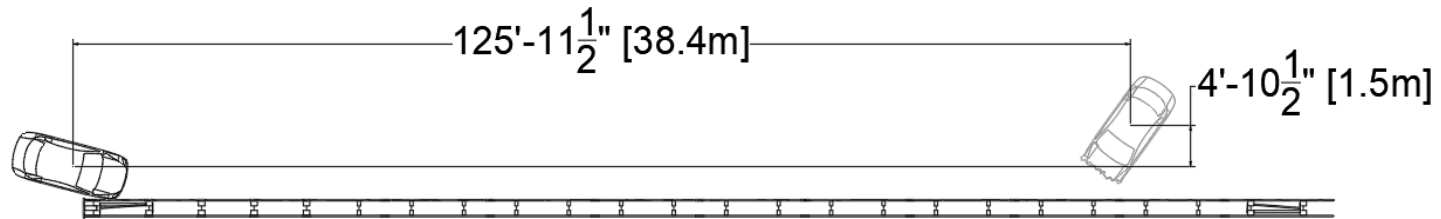
0.000 seconds

0.100 seconds

0.200 seconds

0.300 seconds

0.400 seconds



GENERAL INFORMATION

Test Agency..... Applus IDIADA KARCO
 Test Number..... P41065-01
 Test Designation..... 3-34
 Test Date..... 3/11/21

TEST ARTICLE

Name / Model..... MATT™
 Type..... Terminal
 Installation Length..... 143.8 ft. (43.8 m) (Nominal)
 Terminal Length..... 36.4 ft. (11.1 m)
 Road Surface..... Smooth Concrete to Fine Silty Soil

TEST VEHICLE

Type / Designation..... 1100C
 Year, Make, and Model.... 2015 Kia Rio
 Curb Mass..... 2,561.7 lbs (1,162.0 kg)
 Test Inertial Mass..... 2,442.7 lbs (1,108.0 kg)
 Gross Static Mass..... 2,612.4 lbs (1,185.0 kg)

Impact Conditions

Impact Velocity..... 63.99 mph (102.98 km/h)
 Impact Angle..... 15.2°
 Location / Orientation..... 18" Downstream of Post 1
 Impact Severity..... 22.4 kip-ft (30.4 kJ)
 Minimum IS Required..... 19 kip-ft. (26 kJ)

Exit Conditions

Exit Velocity..... 61.45 mph (98.93 km/h)
 Exit Angle..... 3.1°
 Final Vehicle Position..... 126.0 ft. (38.4 m) Downstream
 4.9 ft. (1.5 m) Impact side
 Vehicle Snagging..... None
 Vehicle Pocketing..... None
 Vehicle Stability..... Satisfactory
 Maximum Roll Angle..... 16.4 °
 Maximum Pitch Angle..... -10.4 °
 Maximum Yaw Angle..... -147.5 °

Occupant Risk

Longitudinal OIV..... 9.8 ft/s (3.0 m/s)
 Lateral OIV..... 16.4 ft/s (5.0 m/s)
 Longitudinal RA..... -15.3 g
 Lateral RA..... -9.4 g
 THIV..... 21.3 ft/s (6.5 m/s)
 PHD..... 15.3 g
 ASI..... 0.71

Test Article Deflections

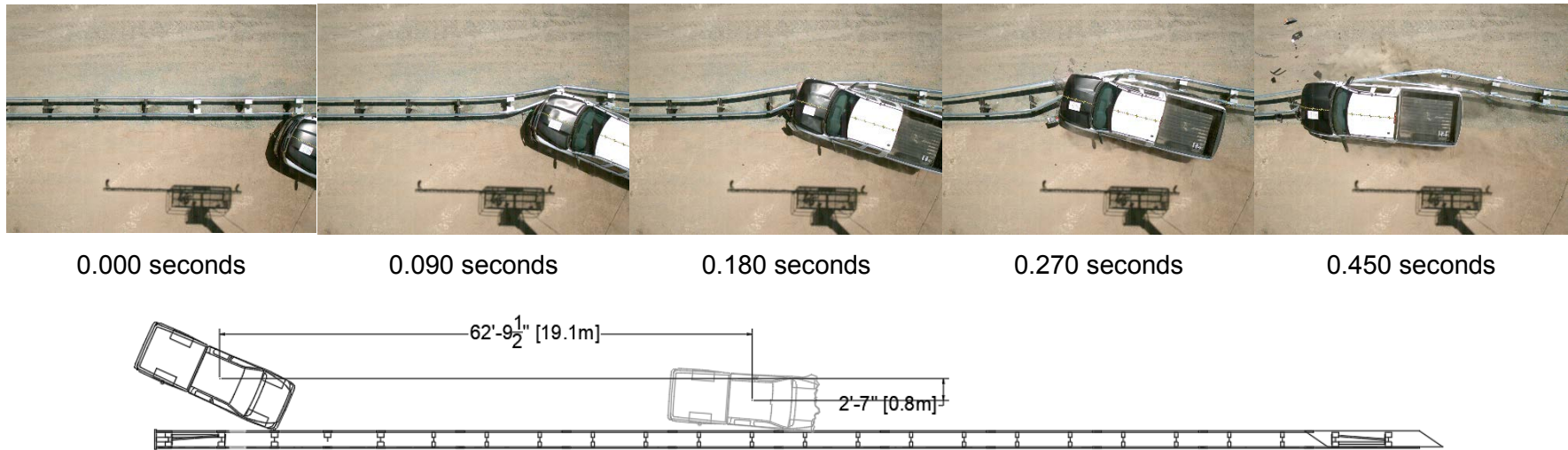
Static..... 15.6 in. (396 mm)
 Dynamic..... 19.9 in. (505 mm)
 Working Width..... 36.9 in. (937mm)

Vehicle Damage

Vehicle Damage Scale..... 12FR-3
 CDC..... 12FRES7
 Maximum Deformation..... 2.7 in. (69 mm) Side Front Panel

Figure 2 Summary of Test 3-34

MASH 2016 Test 3-35 Summary



GENERAL INFORMATION	
Test Agency.....	Applus IDIADA KARCO
Test Number.....	P41244-01
Test Designation.....	3-35
Test Date.....	8/9/21
TEST ARTICLE	
Name / Model.....	MATT™
Type.....	Terminal
Installation Length.....	143.8 ft. (43.8 m) (Nominal)
Terminal Length.....	36.4 ft. (11.1 m)
Road Surface.....	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation.....	2270P
Year, Make, and Model....	2015 Ram 1500
Curb Mass.....	5,112.4 lbs (2,319.0 kg)
Test Inertial Mass.....	5,011.0 lbs (2,273.0 kg)
Gross Static Mass.....	5,011.0 lbs (2,273.0 kg)

Impact Conditions	
Impact Velocity.....	62.53 mph (100.63 km/h)
Impact Angle.....	26.3°
Location / Orientation.....	Post 3 - Beginning of the Length of Need
Impact Severity.....	128.6 kip-feet (174.3 Kilojoules)
Minimum IS Required.....	106.0 kip-feet (144.0 Kilojoules)
Exit Conditions	
Exit Velocity.....	10.81 mph (17.40 km/h)
Exit Angle.....	6.3°
Final Vehicle Position.....	2.6 ft. (0.8 m) Impact Side 62.8 ft. (19.1 m) Downstream
Vehicle Snagging.....	None
Vehicle Pocketing.....	None
Vehicle Stability.....	Satisfactory
Maximum Roll Angle.....	-6.4°
Maximum Pitch Angle.....	-8.3°
Maximum Yaw Angle.....	-27.5°

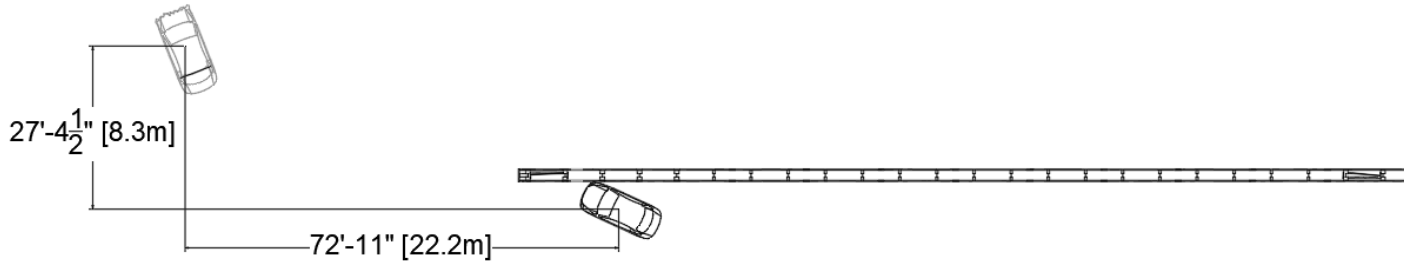
Occupant Risk	
Longitudinal OIV.....	21.7 ft/s (6.6 m/s)
Lateral OIV.....	13.1 ft/s (4.0 m/s)
Longitudinal RA.....	-14.3 g
Lateral RA.....	-5.9 g
THIV.....	23.3 ft/s (7.1 m/s)
PHD.....	14.9 g
ASI.....	0.64
Test Article Deflections	
Static.....	4.5 ft. (1.4 m)
Dynamic.....	5.3 ft. (1.6 m)
Working Width.....	5.8 ft. (1.8 m)
Vehicle Damage	
Vehicle Damage Scale.....	12-FD-6
CDC.....	12DEW3
Maximum Deformation.....	2.2 in. (56 mm) Toe Pan

Figure 2 Summary of Test 3-35

MASH 2016 Test 3-37b Summary



0.000 seconds 0.065 seconds 0.130 seconds 0.260 seconds 0.325 seconds



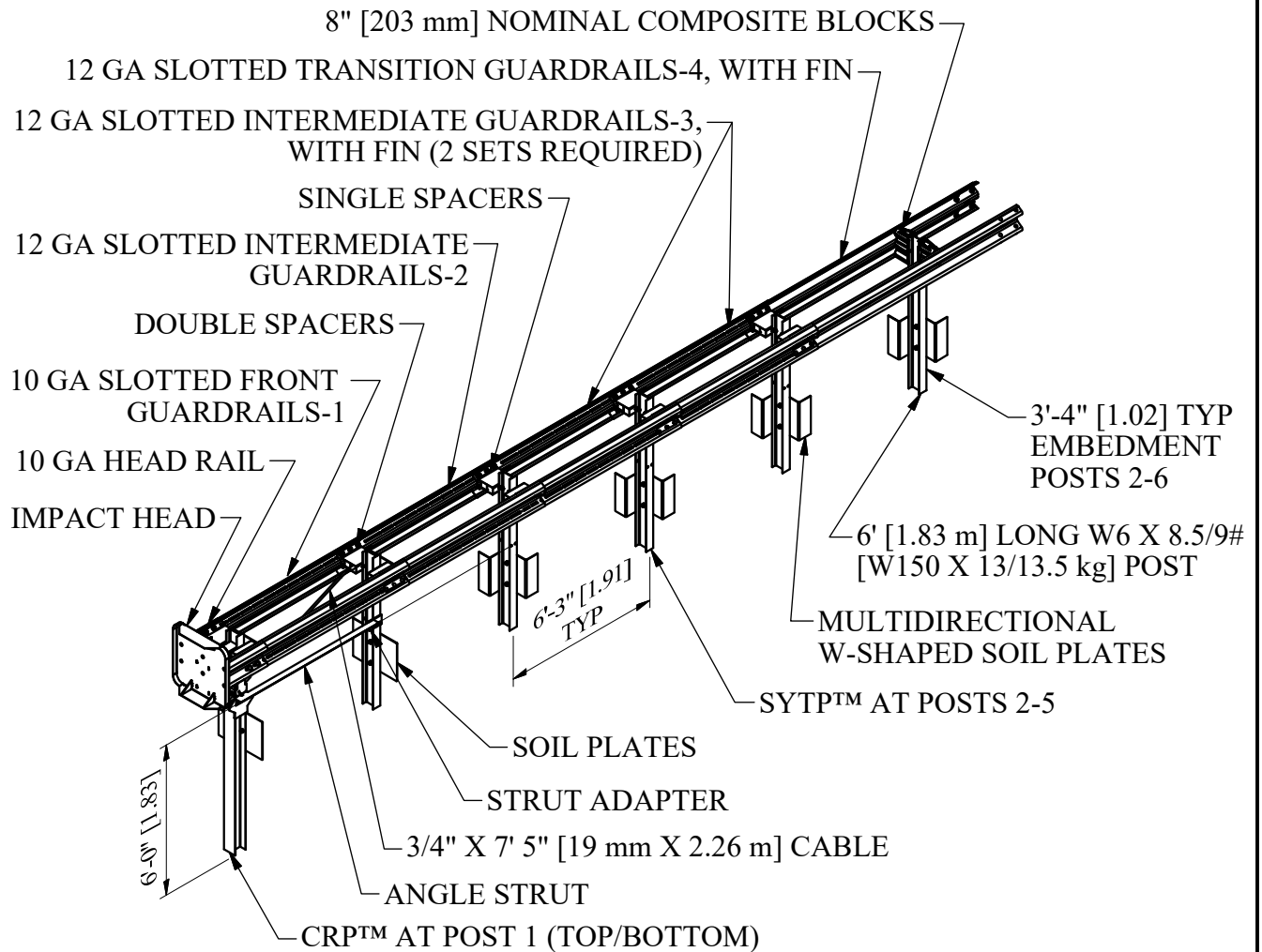
GENERAL INFORMATION	
Test Agency.....	Applus IDIADA KARCO
Test Number.....	P41228-01
Test Designation.....	3-37b
Test Date.....	7/22/21
TEST ARTICLE	
Name / Model.....	MATT™
Type.....	Terminal
Installation Length.....	143.8 ft. (43.8 m) (Nominal)
Terminal Length.....	36.4 ft. (11.1 m)
Road Surface.....	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation.....	1100C
Year, Make, and Model....	2015 Kia Rio
Curb Mass.....	2,431.7 lbs (1,103.0 kg)
Test Inertial Mass.....	2,431.7 lbs (1,103.0 kg)
Gross Static Mass.....	2,575.0 lbs (1,168.0 kg)

Impact Conditions	
Impact Velocity.....	63.58 mph (102.33 km/h)
Impact Angle.....	25.2°
Location / Orientation.....	6.9 in. (176 mm) Downstream from Midpoint of Post 3
Impact Severity.....	59.6 kip-feet (80.8 Kilojoules)
Minimum IS Required.....	51.0 kip-feet (69.7 Kilojoules)
Exit Conditions	
Exit Velocity.....	50.37 mph (81.06 km/h)
Exit Angle.....	-31.8°
Final Vehicle Position.....	27.4 ft. (8.3 m) Field Side 72.9 ft. (22.2 m) Downstream
Vehicle Snagging.....	None
Vehicle Pocketing.....	None
Vehicle Stability.....	Satisfactory
Maximum Roll Angle.....	10.7
Maximum Pitch Angle.....	16.8
Maximum Yaw Angle.....	57.1

Occupant Risk	
Longitudinal OIV.....	38.4 ft/s (11.7 m/s)
Lateral OIV.....	10.5 ft/s (3.23 m/s)
Longitudinal RA.....	-17.8 g
Lateral RA.....	6.3 g
THIV.....	39.7 ft/s (12.1 m/s)
PHD.....	17.8 g
ASI.....	1.19
Test Article Deflections	
Static.....	14.8 ft. (4.5 m)
Dynamic.....	15.0 ft. (4.6 m)
Working Width.....	15.3 ft. (4.7 m)
Vehicle Damage	
Vehicle Damage Scale.....	12-FD-6
CDC.....	12DEW4
Maximum Deformation.....	3.0 in. (76 mm) Windshield

* Caused by vehicle's hood, not the article.

Figure 2 Summary of Test 3-37b



NOTES:

1. VARIOUS DELINEATION OPTIONS ARE AVAILABLE.
2. MATT™ TO BE INSTALLED TANGENT, WITH NO RADII OR CURVING OF SYSTEM GUARDRAIL WITHIN SYSTEM.
3. SYSTEM REQUIRES SPECIFIC ASTM A325 BOLT/NUT COMBINATIONS TO BE TORQUED TO 65 lb-ft [88 Nm], ALL OTHER FASTENERS TO BE TIGHTENED SNUG.
4. REFER TO MATT™ ASSEMBLY MANUAL (628155) AND DWG SS-6288 FOR FULL DETAILS OF ASSEMBLY AND INSTALLATION.
5. PROPER SITE GRADING IS REQUIRED.

2023

MATT™ (Median Attenuating TREND® Terminal)



TRINITY
HIGHWAY

SEW_{xx}

SHEET NO.

DATE

1 of 2

1/24/2023

INTENDED USE

The MATT™ ("Median Attenuating TREND® Terminal") is a tangent, double-sided, redirective/gating, energy-absorbing terminal for use with various longitudinal highway barriers, in either unidirectional or bidirectional applications, to include roadside, shoulder, median, and gore applications. It is also suitable for use as an approach or departure terminal.

FEATURES

The MATT™ has a system length of 34' 4-1/2" [10.48 m], which is measured from the center of Post 1 to the splice location directly behind Post 6. The impact head extends forward of the center of Post 1 by 2' [610 mm], for an effective length of 36' 4-1/2" [11.09 m].

The MATT™ consists of an impact head, angle strut, tension cable, one (1) Controlled Release Post ("CRP"), four (4) Steel Yielding Terminal Posts ("SYTP") and one (1) standard line post. All system posts utilize below-grade soil plates for increased soil bearing resistance.

The system includes six (6) sets (Left/Right) of proprietary W-beam 10/12 ga guardrail, of which three (3) sets feature an integrated shaper fin and three (3) sets do not. Posts 1-5 use 8" [203 mm] deep steel spacers (double at Post 1-2, single at Posts 3-5) while Post 6 utilizes 8" [203 mm] deep guardrail composite blockouts. System installation height, as tested, was 31" [787 mm] with a tolerance of +1" [25 mm], -0".

During redirective impacts within MASH 2016 Test Level 3 ("TL-3") criteria, the MATT™ is designed to redirect vehicles, starting at the beginning length of need ("BLON") at Post 3 - which is located 12' 6" [3.81 m] from Post 1. During end-on impacts within MASH 2016 TL-3 criteria, the MATT™ is designed to absorb a vehicle's impacting energy by the tearing of metal tabs between each slot combined with the friction developed between each sliding rail at each post connection and also by the deformation of steel components as each W-beam guardrail slides rearward over each subsequent W-beam guardrail with integrated shaper fins. MATT™ can be connected directly to 8" [203 mm] blocked Midwest Guardrail System ("MGS").

SPECIFICATIONS

System Length: 34'-4 1/2" [10.48 m]
System Width: 29" [737 mm]
System Height: 31", +1"/-0" [787 mm, +25 mm/-0 mm]
System Weight: ~1,525 lbs [692 kg]

ELIGIBILITY

The MATT™ has been tested in conformance to MASH 2nd Edition (2016) with 2020 Errata Test Level 3 specifications and is eligible for Federal reimbursement by FHWA. FHWA Eligibility Letter(s): [Report #] dated [Month Day, Year] for MASH 2nd Edition (2016) Test Level 3.

REFERENCES

American Association of State Highway and Transportation Officials (AASHTO), *Manual for Assessing Safety Hardware (MASH) 2nd Edition* (2016) with 2020 Errata.

CONTACT INFORMATION

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MATT™ (Median Attenuating TREND® Terminal)

SEW_{xx}

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DATE

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TRINITY
HIGHWAY