U.S. Department of Transportation
Federal Highway Administration

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

December 19, 2011

In Reply Refer To:
HSST/CC-115

Mr. Brian Smith
Trinity Highway Products, LLC
2525 North Stemmons Freeway
Dallas, Texas 75207

Dear Mr. Smith:

This letter is in response to your request for the Federal Highway Administration (FHWA) to review a roadside safety system for eligibility for reimbursement under the Federal-aid highway program.

Name of system:	Trinity SOFT-STOP Terminal
Type of system:	W-Beam Guardrail Terminal
Test Level:	MASH Test Level 3 (TL-3)
Testing conducted by:	Texas Transportation Institute
Task Force 13 Designator:	SEW22
Date of request:	September 3, 2010
Date initially acknowledged:	September 30, 2010
Date of completed package:	September 3, 2010

Based on a review of crash test results submitted by the manufacturer certifying the device described herein meets the crashworthiness criteria of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH), the device is eligible for reimbursement under the Federal-aid highway program. Eligibility for reimbursement under the Federal-aid highway program does not establish approval or endorsement by FHWA for any particular purpose or use.

The FHWA, the Department of Transportation, and the United States Government do not endorse products or services and the issuance of a reimbursement eligibility letter is not an endorsement of any product or service

Decision:
The following device was found eligible, with details provided below:

- Trinity SOFT-STOP guardrail terminal.

FHWA: HSST: NArtimovicht: ms: x61331:2/10/11**UPDATED by SF 12/19/11**
File: s: //directory folder/HSST/Artimovich/CC115_Trinity_Soft_Stop.dotx
cc: HSST (NArtimovich; JDewar)

Requirements
Roadside safety devices should meet the guidelines contained in the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware. The FHWA memorandum "Identifying Acceptable Highway Safety Features" of July 25, 1997, and the FHWA/AASHTO MASH Implementation Plan provide further guidance on roadside hardware design.

Description and Crash Testing
Your letter of September 3, 2010, enclosed for reference, describes the Trinity SOFT-STOP in detail. Your letter also detailed the crash test matrix that was evaluated for the device. The MASH tests 3-30, 3-31, 3-33, 3-34, and 3-35 were conducted in reasonably close conformity with the guidelines. The test data summary sheets from the individual crash test reports are enclosed for reference.

We concur that MASH test 3-36 may be waived because the SOFT-STOP will not be connected to any stiffer device than W-beam guardrail, and test 3-35 showed that the performance of the system when impacted at an angle by the 2270P was satisfactory. We concur that the substitution of the 1100C vehicle to evaluate the reverse direction impact was appropriate. We concur that test 3-38 is not necessary because the SOFT-STOP is not a staged device and that your calculations predict crashworthy performance with the 1500A vehicle.

Findings
Therefore, the system described and detailed in the enclosed letter is eligible for reimbursement and should be installed under the range of conditions tested, when such use is acceptable to a highway agency.

Please note the following standard provisions that apply to FHWA eligibility letters:

- This finding of eligibility is limited to the crashworthiness characteristics of the systems and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the system will require a new letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke this letter.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the crashworthiness requirements of the FHWA and the MASH.
- To prevent misunderstanding by others, this letter of eligibility is designated as number CC-115 and 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 at our office upon request.

- The Trinity SOFT-STOP terminal is a patented product and considered 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.
- 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. The finding of eligibility is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely,

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

Enclosures

U.S. Department
of Transportation
Federal Highway Administration

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

December 19, 2011

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- Trinity SOFT-STOP guardrail terminal.

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Findings
Therefore, the system described and detailed in the enclosed letter is eligible for reimbursement and should be installed under the range of conditions tested, when such use is acceptable to a highway agency.

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- Any changes that may adversely influence the crashworthiness of the system will require a new letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke this letter.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the crashworthiness requirements of the FHWA and the MASH.
- To prevent misunderstanding by others, this letter of eligibility is designated as number CC-115 and 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 at our office upon request.

- The Trinity SOFT-STOP terminal is a patented product and considered 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.
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Sincerely,

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

Enclosures

TRINITY HIGHWAY PRODUCTS, LLC

September 3, 2010

Mr. Nicholas Artimovich, II
Highway Engineer, Office of Safety Design
Federal Highway Administration HSSD
1200 New Jersey Avenue SE, Room E-71-322
Washington, DC 20590
Tel: 202-366-1331
Fax: 202-366-2249
e-mail: nick.artimovich@fhwa.dot.gov

Re: Request for FHWA Acceptance of the Trinity SOFT-STOP Terminal

Dear Mr. Artimovich:

Trinity Highway Products, LLC is pleased to submit for your review and acceptance the Trinity SOFT-STOP Terminal, which performed acceptably according to the Test Level 3 (TL-3) evaluation criteria set out in the *Manual for Assessing Safety Hardware* (MASH) guidelines for terminals. Full-scale crash testing was conducted at the Texas Transportation Institute. Test reports and crash test videos are enclosed.

The SOFT-STOP is a proprietary terminal that includes a 12 gauge w-beam guardrail into which slots have been cut over the initial 81.75 inches. The slots allow the w-beam guardrail to be flattened into four strips which are fed through an extruder head and connected via a threaded rod assembly end attachment to an anchor post in advance of the terminal. Standard 12 gauge w-beam guardrail panels are used thereafter.

The top of the w-beam is 31 inches above grade, and guardrail splices are located at mid-span between posts. Post 1 is a W6x8.5 Steel Yielding Terminal Post (SYTP) and is placed under and attached to the extruding head 55 inches downstream of the anchor post. Post 2 is also a W6x8.5# SYTP. It is located 68 inches downstream of Post 1 and incorporates a 12-inch deep offset block (either routed or non-routed). Post 3 and beyond are spaced at 75 inches and are standard, non-weakened W6x8.5# line posts with 12-inch deep routed or non-routed offset blocks).

According to MASH, up to nine crash tests are recommended to evaluate terminals to TL-3. In the safety performance evaluation of the SOFT-STOP, seven full-scale crash tests were conducted. Trinity feels that safety performance verification of the proposed SOFT-STOP can be concluded, as summarized below.

***MASH* Test Designation 3-30:** An 1100C (2425 lb) passenger car impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 0 degree, respectively, with the quarter point of the vehicle aligned with the centerline of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.

Summary of results: The SOFT-STOP slowed and redirected the 1100C vehicle. No occupant compartment deformation occurred. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 25 degrees, and maximum pitch was 7 degrees. Occupant risk factors were within the limits specified for *MASH* test 3-30. The vehicle subsequently came to rest 27 feet downstream of impact and 34 feet toward traffic lanes. The SOFT-STOP performed acceptably according to the evaluation criteria of *MASH* test 3-30.

***MASH* Test Designation 3-31:** A 2270P (5000 lb) pickup truck impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 0 degree, respectively, with the centerline of the vehicle aligned with the centerline of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.

Summary of results: The SOFT-STOP brought the 2270P vehicle to a controlled stop. No occupant compartment deformation occurred. The 2270P vehicle remained upright during and after the collision event. Maximum roll was 4 degrees, and maximum pitch was -3 degrees. Occupant risk factors were within the limits specified for *MASH* test 3-31. The 2270P vehicle came to rest within the installation. The SOFT-STOP performed acceptably according to the evaluation criteria of *MASH* test 3-31.

***MASH* Test Designation 3-32:** An 1100C (2425 lb) passenger car impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 5/15 degrees, respectively, with the centerline of the vehicle aligned with the centerline of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.

Summary of results: The SOFT-STOP slowed and stopped the 1100C vehicle. No occupant compartment deformation occurred. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 28 degrees, and maximum pitch was -26 degrees. Occupant risk factors were within the limits specified for *MASH* test 3-32. The vehicle subsequently came to rest with the front of the vehicle adjacent to post 4 of the terminal, with most of the vehicle toward the field side. The SOFT-STOP performed acceptably according to the evaluation criteria of *MASH* test 3-32.

***MASH* Test Designation 3-33:** A 2270P (5000 lb) pickup truck impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 5/15 degrees, respectively, with the centerline of the vehicle aligned with the centerline of the nose of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.

Summary of results: The SOFT-STOP slowed the 2270P vehicle, redirected the vehicle toward the field side where the vehicle came to rest nearly adjacent to the field side of the installation. No occupant compartment deformation occurred. The 2270P vehicle remained upright during and after the collision event. Maximum roll was -21 degrees, and maximum pitch was 5 degrees. Occupant risk factors were within the limits specified for *MASH* test 3-31. The 2270P vehicle came to rest within the installation. The SOFT-STOP performed acceptably according to the evaluation criteria of *MASH* test 3-33.

***MASH* Test Designation 3-34:** An 1100C (2425 lb) passenger car impacting the terminal at a nominal impact speed and angle of 62 mi/h and 15 degrees, respectively, with the corner of the vehicle bumper aligned with the critical impact point (CIP) of the length of need (LON) of the terminal. This test is primarily intended to evaluate occupant risk and vehicle trajectory criteria.

Summary of results: The SOFT-STOP contained and redirected the 1100C vehicle. The vehicle did not penetrate or override the installation. Maximum dynamic deflection was 1.96 feet and the head fed through 6.2 feet of w-beam rail element. Maximum occupant compartment deformation was 1.0 inch inward in the area of the instrument panel on the left side. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 10 degrees, and maximum pitch was -4 degrees. Occupant risk factors were within the limits specified for *MASH* test 3-32. The vehicle subsequently came to rest 15 feet toward traffic lanes in front of post 8. The SOFT-STOP performed acceptably according to the evaluation criteria of *MASH* test 3-32.

***MASH* Test Designation 3-35:** A 2270P (5000 lb) pickup truck impacting the terminal at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively, with the corner of the vehicle bumper aligned with the beginning of the LON of the terminal. This test is primarily intended to evaluate structural adequacy and vehicle trajectory criteria.

Summary of results: The SOFT-STOP contained and redirected the 2270P. The vehicle did not underride or override the installation. Although the w-beam rail anchorage released late in the impact event, the vehicle did not penetrate the installation. While the vehicle was in contact with the w-beam, the maximum dynamic deflection was 10.4 feet. However, the upstream anchor released and as the vehicle lost contact with the w-beam, the w-beam continued to deflect, reaching a maximum displacement of 11.6 feet. The kickpanel of the left side was deformed inward 0.4 inch. The 2270P vehicle remained upright during and after the collision event. Maximum roll was -30 degrees, and maximum pitch was -12 degrees. Occupant risk factors were within the preferred limits specified for *MASH* test 3-31. The 2270P vehicle exited within the exit box. The SOFT-STOP performed acceptably according to the evaluation criteria of *MASH* test 3-35.

***MASH* Test Designation 3-36:** A 2270P (5000 lb) pickup truck impacting the terminal at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively, with the corner of the vehicle bumper aligned with the CIP with respect to the transition to the stiff barrier or backup structure.

As a w-beam guardrail terminal, the SOFT-STOP will never be attached directly to a backup structure, and the transition to a stiff barrier is basically at Post 3. Therefore, Trinity feels that Test 3-36 is irrelevant and was therefore not conducted.

***MASH* Test Designation 3-37:** A 2270P (5000 lb) pickup truck impacting the terminal at a nominal impact speed and angle of 62 mi/h and 25 degrees, respectively, mid-point between the nose and the end of the terminal in the reverse direction. This test is intended to evaluate the performance of a terminal for a "reverse" hit.

However, researchers at TTI believe that the reverse direction impact would be more critical for the 1100C (2425 lb) passenger car than for the 2270P pickup. Therefore, an 1100C (2425 lb) passenger car was used in Test 3-37.

Summary of results: The SOFT-STOP slowed the 1100C vehicle and allowed the 1100C (2425 lb) vehicle to gate through the end of the terminal. Maximum occupant compartment deformation was 0.75 inch in the floor to rood area on the left side. The 1100C vehicle remained upright during and after the collision event. Maximum roll was 8 degrees, and maximum pitch was 8 degrees. Occupant risk factors were within the preferred limits specified for *MASH* test 3-31. The 2270P vehicle exited toward the field side of the terminal. The SOFT-STOP performed acceptably according to the evaluation criteria of *MASH* test 3-37.

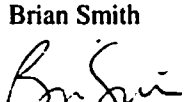
***MASH* Test Designation 3-38:** A 1500A (3307 lb) passenger car impacting the terminal end-on at a nominal impact speed and angle of 62 mi/h and 0 degree, respectively, with the centerline of the vehicle aligned with the centerline of the nose of the terminal. This test is primarily intended to evaluate the performance of the staged attenuator/terminal when impacted by a mid-size vehicle.

The SOFT-STOP is not a staged device. Therefore Test 3-38 was not conducted. However, as per Appendix G of MASH, calculations based on Test 3-31 have been performed to predict the occupant risk values for the 1500A (3307 lb) vehicle. The results of these calculations (shown on the enclosed document) predict that in crash testing with the 1500A (3307 lb) vehicle, the SOFT-STOP Terminal, would perform acceptably according to the Test Level 3 (TL-3) evaluation criteria set out in the MASH guidelines for terminals.

Trinity respectfully requests FHWA acceptance of the SOFT-STOP Terminal for use on the National Highway System (NHS) when such use is acceptable to the contracting agency as *MASH* Test Level 3 compliant.

Thank you for your consideration. Should you have questions, we will be pleased to furnish or secure answers promptly.

Sincerely,
Brian Smith



Trinity Highway Products, LLC.

Enclosures: 9

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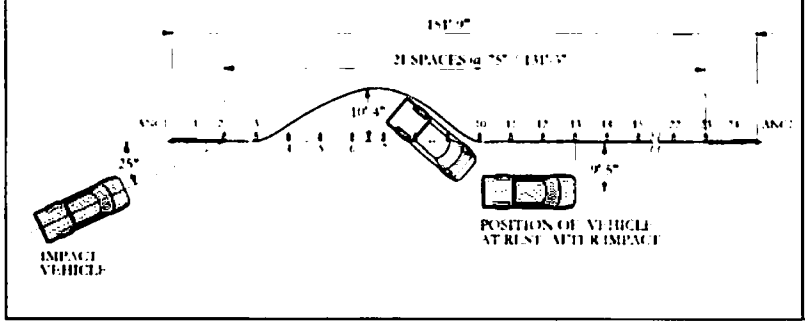
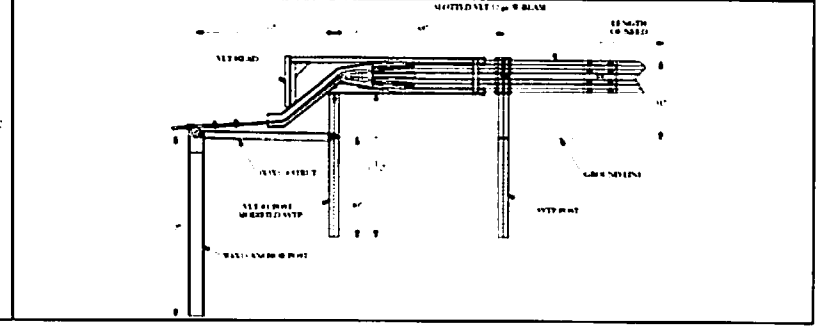
Tel: +1-214-589-8140 * Fax: +1-214-589-8423 * www.highwayguardrail.com





General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 400001-TSQ1
- Date 2009-10-01

Test Article
- Type ..... Terminal
- Name ..... Vertically Loading Terminal (VLT)
- Installation Length ..... 151.75 ft
- Material or Key Elements ..... 31 in tall 12 ga w-beam, steel posts

Soil Type and Condition ..... Standard Soil, Damp

Test Vehicle
- Type/Designation 2270P
- Make and Model ..... 2003 Dodge Ram 1500 quad-cab pickup
- Curb ..... 4708 lb
- Test Inertial ..... 5028 lb
- Dummy ..... No dummy
- Gross Static ..... 5028 lb

Impact Conditions
- Speed ..... 63.5 mi/h
- Angle ..... 26.4 degrees
- Location/Orientation ..... At Post 3

Exit Conditions
- Speed ..... Out of view
- Angle ..... Out of view

Occupant Risk Values
- Impact Velocity
  - Longitudinal ..... 15.8 ft/s
  - Lateral ..... 14.4 ft/s
- Ridedown Accelerations
  - Longitudinal ..... -11.0 G
  - Lateral ..... 7.9 G
- THIV ..... 21.0 km/h
- PHD ..... 11.6 G
- Max. 0.050-s Average
  - Longitudinal ..... -4.7 G
  - Lateral ..... 5.0 G
  - Vertical ..... 2.5 G

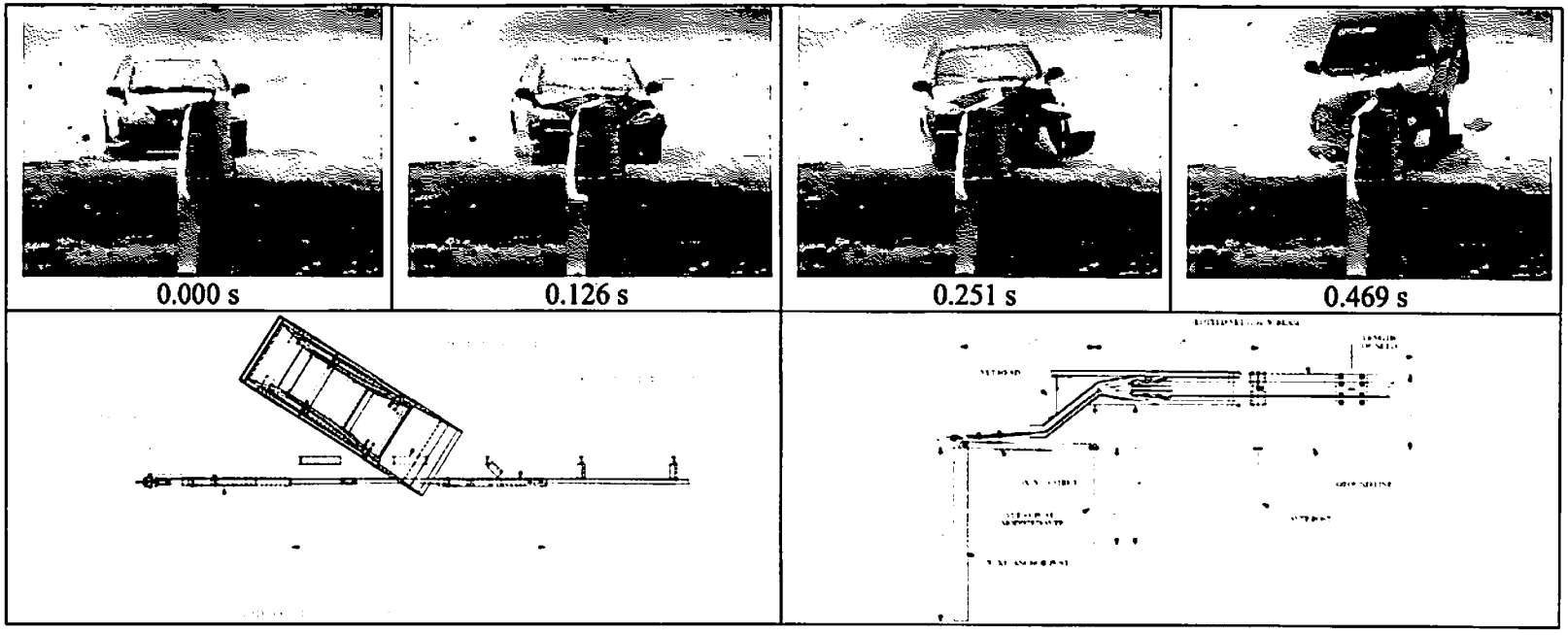
Post-Impact Trajectory
- Stopping Distance ..... 62.5 ft dwnstrm
  9.4 ft twd traffic

Vehicle Stability
- Maximum Yaw Angle ..... 74 degrees
- Maximum Pitch Angle ..... -12 degrees
- Maximum Roll Angle ..... -30 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 11.6 ft
- Permanent ..... 11.2 ft
- Working Width ..... 10.4 ft

Vehicle Damage
- VDS 11LFQ4
- CDC 11FDEW3
- Max. Exterior Deformation ..... 16.0 inches
- Max. Occupant Compartment Deformation ..... 0.4 inch

Summary of results for *MASH* test 3-35 on the VLT.



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 400001-TSQ4
- Date 2009-12-15

Test Article
- Type ..... Terminal
- Name ..... Vertically Loading Terminal (VLT)
- Installation Length ..... 151.75 ft
- Material or Key Elements ..... 1 in tall 12 ga w-beam, steel posts

Soil Type and Condition ..... Standard Soil, Damp

Test Vehicle
- Type/Designation 1100C
- Make and Model ..... 2004 Kia Rio
- Curb ..... 2338 lb
- Test Inertial ..... 2419 lb
- Dummy ..... 171 lb
- Gross Static ..... 2590 lb

Impact Conditions
- Speed ..... 62.6 mi/h
- Angle ..... 6.3 degrees
- Location/Orientation ..... Cntrln on nose

Exit Conditions
- Speed ..... Stopped
- Angle ..... 4.5 degrees

Occupant Risk Values
- Impact Velocity
  - Longitudinal ..... 29.2 ft/s
  - Lateral ..... 0.0 ft/s
- Ridedown Accelerations
  - Longitudinal ..... -12.1 G
  - Lateral ..... 3.9 G
- THIV ..... 31.9 km/h
- PHD ..... 12.2 G
- Max. 0.050-s Average
  - Longitudinal ..... -9.4 G
  - Lateral ..... 1.3 G
  - Vertical ..... -4.3G

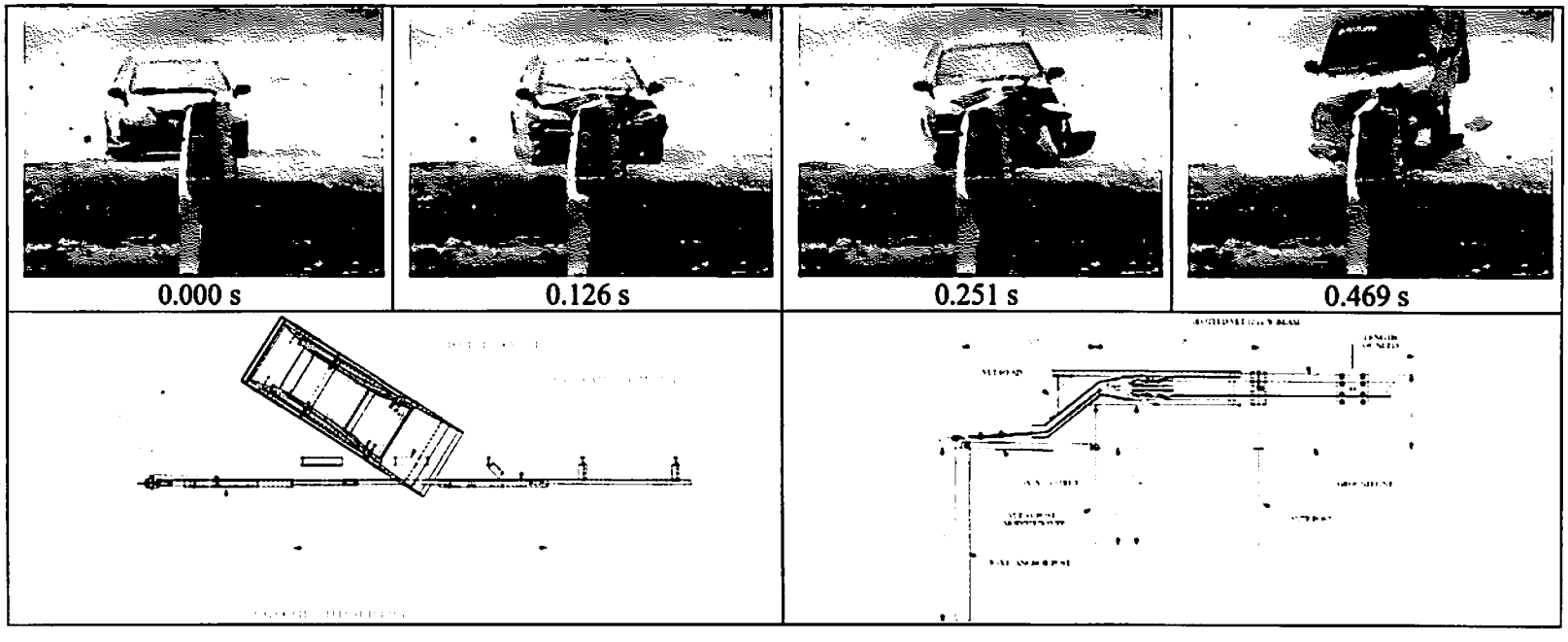
Post-Impact Trajectory
- Stopping Distance ..... Post 4 4 ft twd field side

Vehicle Stability
- Maximum Yaw Angle ..... 39 degrees
- Maximum Pitch Angle ..... -26 degrees
- Maximum Roll Angle ..... 28 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 17.7 ft
- Permanent ..... 17.1 ft
- Working Width ..... 10.2 ft

Vehicle Damage
- VDS 12FC3
- CDC 12FCEW3
- Max. Exterior Deformation ..... 9.25 inches
- Max. Occupant Compartment Deformation 0

Summary of results for *MASH* test 3-32 on the VLT.



General Information
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- Test No. 400001-TSQ4
- Date 2009-12-15

Test Article
- Type ..... Terminal
- Name ..... Vertically Loading Terminal (VLT)
- Installation Length ..... 151.75 ft
- Material or Key Elements ..... 1 in tall 12 ga w-beam, steel posts

Soil Type and Condition ..... Standard Soil, Damp

Test Vehicle
- Type/Designation 1100C
- Make and Model ..... 2004 Kia Rio
- Curb ..... 2338 lb
- Test Inertial ..... 2419 lb
- Dummy ..... 171 lb
- Gross Static ..... 2590 lb

Impact Conditions
- Speed ..... 62.6 mi/h
- Angle ..... 6.3 degrees
- Location/Orientation ..... Cntrln on nose

Exit Conditions
- Speed ..... Stopped
- Angle ..... 4.5 degrees

Occupant Risk Values
- Impact Velocity
  - Longitudinal ..... 29.2 ft/s
  - Lateral ..... 0.0 ft/s
- Ridedown Accelerations
  - Longitudinal ..... -12.1 G
  - Lateral ..... 3.9 G
- THIV ..... 31.9 km/h
- PHD ..... 12.2 G
- Max. 0.050-s Average
  - Longitudinal ..... -9.4 G
  - Lateral ..... 1.3 G
  - Vertical ..... -4.3G

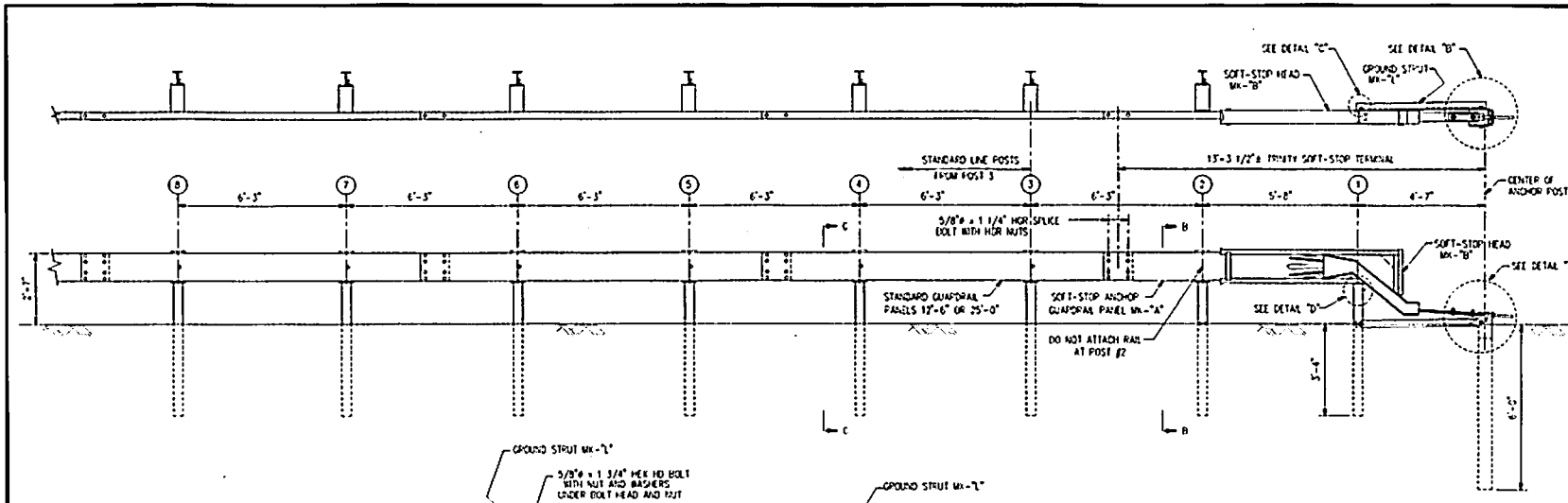
Post-Impact Trajectory
- Stopping Distance ..... Post 4 4 ft twd field side

Vehicle Stability
- Maximum Yaw Angle ..... 39 degrees
- Maximum Pitch Angle ..... -26 degrees
- Maximum Roll Angle ..... 28 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 17.7 ft
- Permanent ..... 17.1 ft
- Working Width ..... 10.2 ft

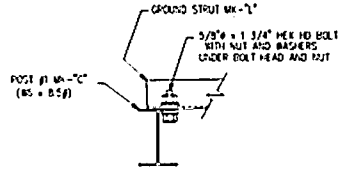
Vehicle Damage
- VDS 12FC3
- CDC 12FCEW3
- Max. Exterior Deformation ..... 9.25 inches
- Max. Occupant Compartment Deformation 0

Summary of results for *MASH* test 3-32 on the VLT.

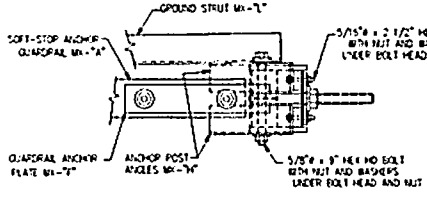


BILL OF MATERIAL

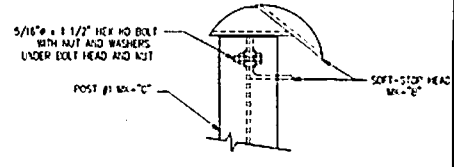
PIECE MARK	QTY	DESCRIPTION
A	1	SOFT-STOP ANCHOR GUARDRAIL (12'-6")
B	1	SOFT-STOP HEAD
C	1	POST #1 4'-9 1/2" (S3S7)
D	1	POST #2 6'-0" (S3S7)
E	1	OFFSET BLOCK 6 x 8 x 12 x 16
F	1	GUARDRAIL ANCHOR PLATE
G	1	ANCHOR POST
H	2	ANCHOR POST ANGLE 10" LG
J	1	ANCHOR KEEPER PLATE (24 GA)
K	1	ANCHOR PLATE WASHER (1/2" THK)
L	1	GROUND STRUT x 4'-8 1/4"
		HARDWARE
	1	1" WASHER
	1	1" HEX NUT
	2	3/4"ø x 2 1/2" HEX HD BOLT
	4	3/4" WASHER
	2	3/4" HEX NUT
	8	5/8"ø x 1 1/4" HOR SPLICE BOLT
	1	5/8"ø x 14" HOR POST BOLT
	1	5/8"ø x 1 3/4" HEX HD BOLT
	1	5/8"ø x 9" HEX HD BOLT
	5	5/8" WASHER
	2	5/8" HEX NUT
	9	5/8" HOR HEX NUT
	2	5/16"ø x 2 1/2" HEX HD BOLT
	1	5/16"ø x 1 1/2" HEX HD BOLT
	6	5/16" WASHER
	3	5/16" HEX NUT



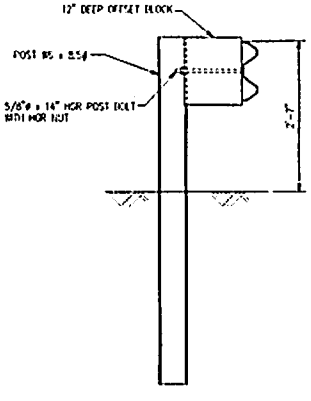
DETAIL "C"
(POST #1, SHOWN NEAR GROUND)



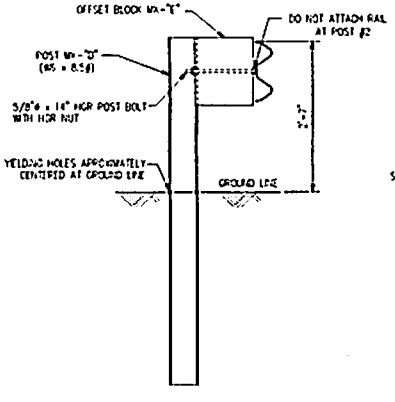
DETAIL "B"
(AT ANCHOR POST)



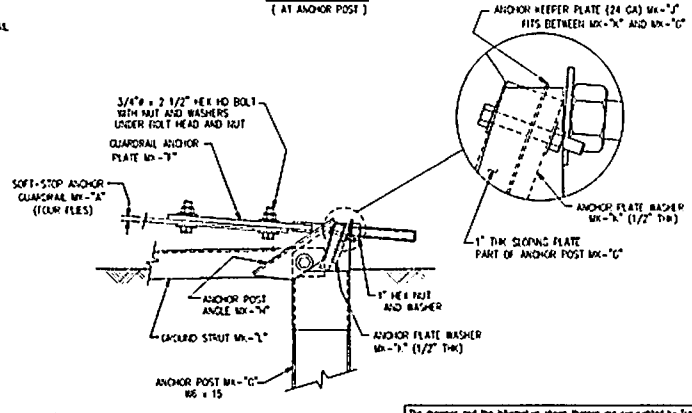
DETAIL "D"
(POST #1)



SECTION "C-C"
(POST #3 AND BEYOND)



SECTION "B-B"
(POST #2)



DETAIL "A"
(AT ANCHOR POST)

REV	CHK'D	BY	DATE	REMARKS

SOFT-STOP

TRINITY SOFT-STOP TERMINAL
PLAN, ELEVATION & SECTION
MASH TEST LEVEL 3

DRAWN	BT
CHECKED	BS
SCALE	N.T.S.
DATE	8-18-10
ENG. FILE #	17-128
SHT. No.	01 OF 1
DRAWING NO.	TSST-01
REV	0

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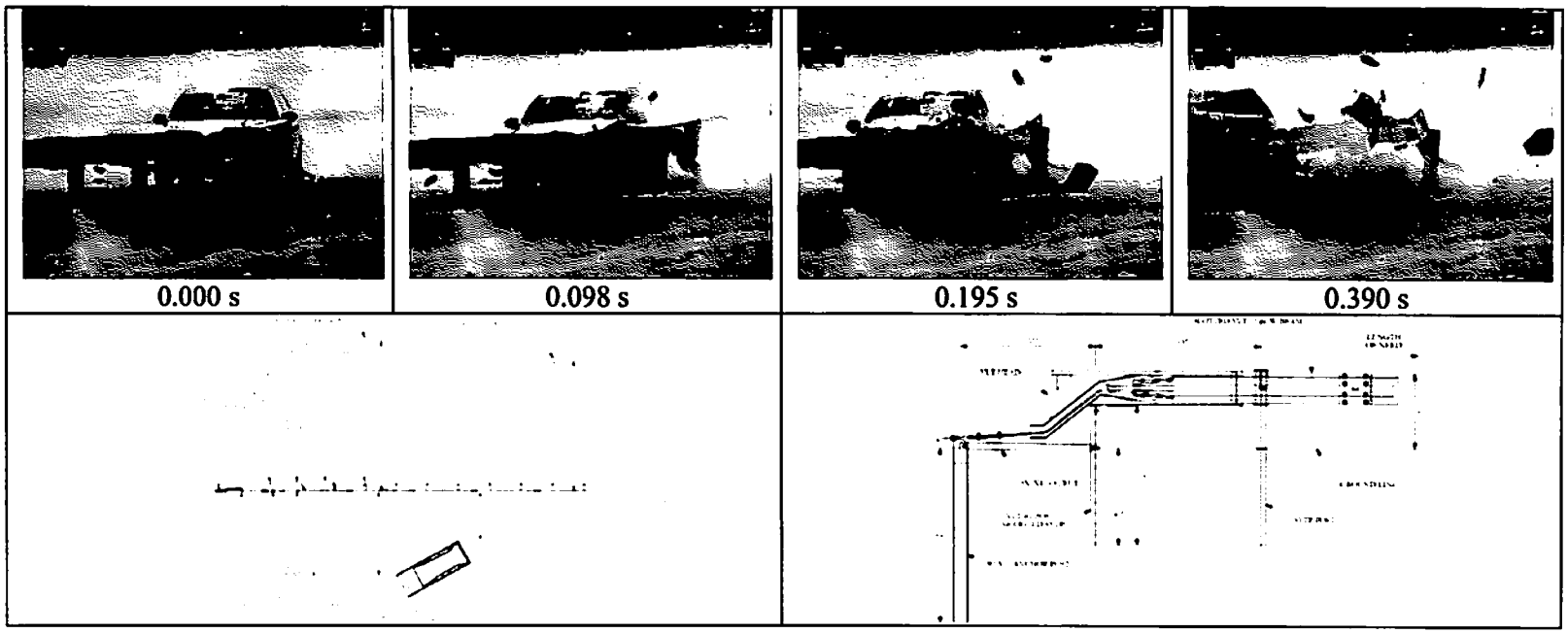
TRINITY HIGHWAY PRODUCTS, LLC.
2525 STEMMONS FREEWAY
DALLAS, TX 75207



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 400001-TSQ3
- Date 2009-11-24

Test Article
- Type ..... Terminal
- Name ..... Vertically Loading Terminal (VLT)
- Installation Length ..... 151.75 ft
- Material or Key Elements ..... 31 in tall 12 ga w-beam, steel posts

Soil Type and Condition ..... Standard Soil, Damp

Test Vehicle
- Type/Designation 1100C
- Make and Model ..... 2004 Kia Rio
- Curb ..... 2366 lb
- Test Inertial ..... 2425 lb
- Dummy ..... 174 lb
- Gross Static ..... 2599 lb

Impact Conditions
- Speed ..... 62.1 mi/h
- Angle ..... 14.3 degrees
- Location/Orientation ..... At Post 1

Exit Conditions
- Speed ..... 19.1 mi/h
- Angle ..... 78.8 degrees

Occupant Risk Values
- Impact Velocity
  - Longitudinal ..... 24.6 ft/s
  - Lateral ..... 11.2 ft/s
- Ridedown Accelerations
  - Longitudinal ..... -10.0 G
  - Lateral ..... 4.4 G
- THIV ..... 29.2 km/h
- PHD ..... 10.2 G
- Max. 0.050-s Average
  - Longitudinal ..... -7.8 G
  - Lateral ..... 3.2 G
  - Vertical ..... 2.0 G

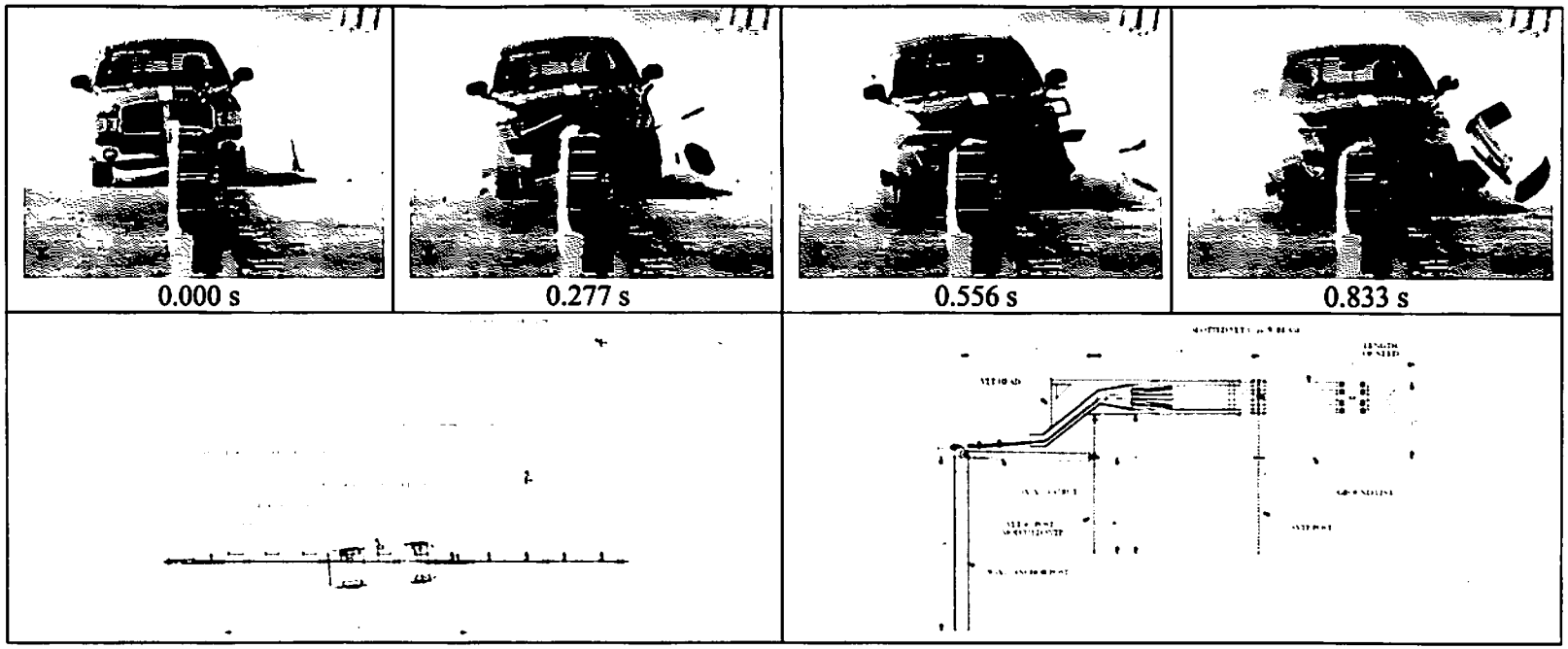
Post-Impact Trajectory
- Stopping Distance ..... 43.8 ft dwnstrm
  15.0 ft twd traffic

Vehicle Stability
- Maximum Yaw Angle ..... -216 degrees
- Maximum Pitch Angle ..... -4 degrees
- Maximum Roll Angle ..... 10 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 1.96 ft
- Permanent ..... 1.58 ft
- Working Width ..... 2.66 ft

Vehicle Damage
- VDS 11LFQ5
- CDC 11FDEW4
- Max. Exterior Deformation ..... 18.0 inches
- Max. Occupant Compartment Deformation ..... 1.0 inches

Summary of results for *MASH* test 3-34 on the VLT.



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 400001-TSQ7
- Date 2010-01-12

Test Article
- Type ..... Terminal
- Name ..... Vertically Loading Terminal (VLT)
- Installation Length ..... 151.75 ft
- Material or Key Elements ..... 31 in tall 12 ga w-beam, steel posts

Soil Type and Condition ..... Standard Soil, Damp

Test Vehicle
- Type/Designation 2270P
- Make and Model ..... 2002 Dodge Ram 1500 quad-cab pickup
- Curb ..... 5024 lb
- Test Inertial ..... 5084 lb
- Dummy ..... No dummy
- Gross Static ..... 5084 lb

Impact Conditions
- Speed ..... 61.1 mi/h
- Angle ..... 1.4 degrees
- Location/Orientation ..... End-on

Exit Conditions
- Speed ..... Out of view
- Angle ..... 5.0 degrees

Occupant Risk Values
- Impact Velocity
  - Longitudinal ..... 20.0 ft/s
  - Lateral ..... 0.0 ft/s
- Ridedown Accelerations
  - Longitudinal ..... -8.6 G
  - Lateral ..... -2.3 G
- THIV ..... 21.8 km/h
- PHD ..... 8.6 G
- Max. 0.050-s Average
  - Longitudinal ..... -5.0 G
  - Lateral ..... -0.8 G
  - Vertical ..... 2.3 G

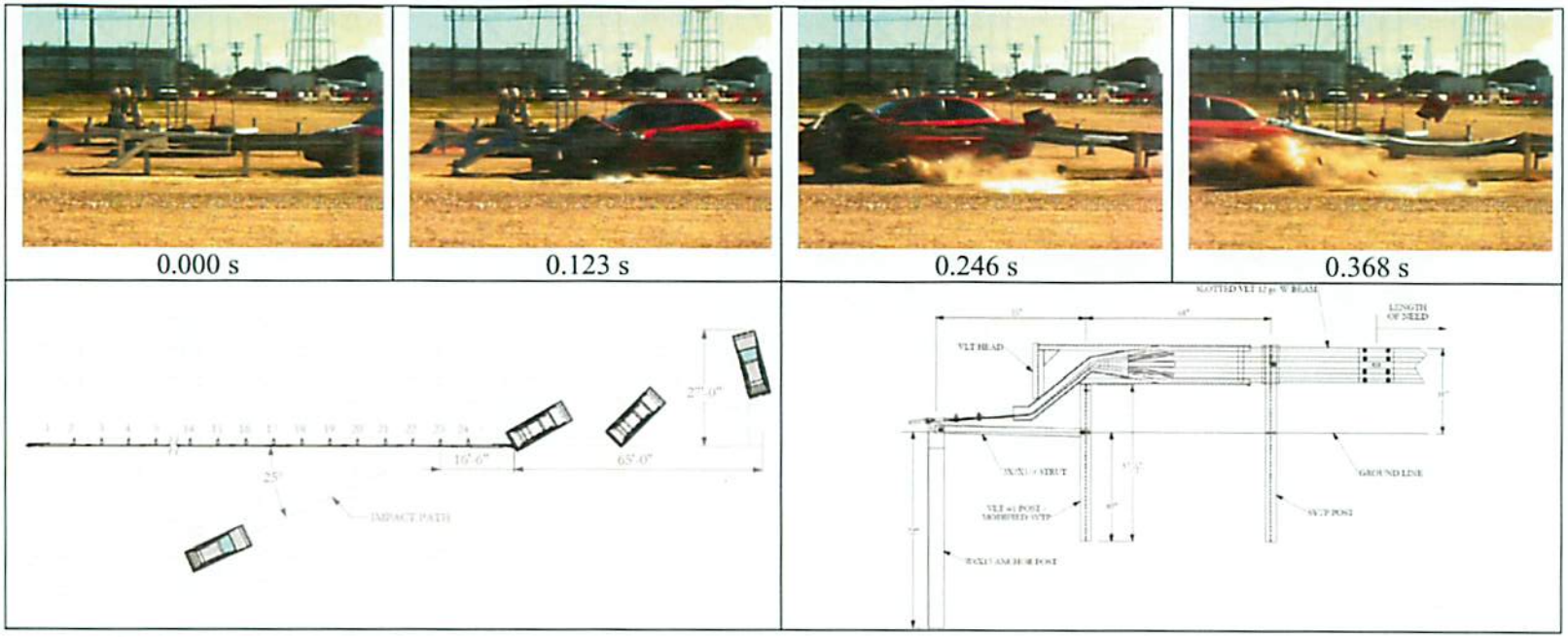
Post-Impact Trajectory
- Stopping Distance ..... 37.5 ft dwnstrm
  Over posts 6-7

Vehicle Stability
- Maximum Yaw Angle ..... 3 degrees
- Maximum Pitch Angle ..... -3 degrees
- Maximum Roll Angle ..... 4 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 45.7 ft
- Permanent ..... 45.7 ft
- Working Width ..... 4.4 ft

Vehicle Damage
- VDS 12FC5
- CDC 12FCEN4
- Max. Exterior Deformation ..... 17.0 inches
- Max. Occupant Compartment Deformation 0

Summary of results for *MASH* test 3-31 on the VLT.



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 400001-TSQ2
- Date 2009-11-05

Test Article
- Type ..... Terminal
- Name ..... Vertically Loading Terminal (VLT)
- Installation Length ..... 151.75 ft
- Material or Key Elements ..... 31 in tall 12 ga w-beam, steel posts

Soil Type and Condition ..... Standard Soil, Damp

Test Vehicle
- Type/Designation 1100C
- Make and Model ..... 2003 Kia Rio
- Curb ..... 2401 lb
- Test Inertial ..... 2413 lb
- Dummy ..... 175 lb
- Gross Static ..... 2588 lb

Impact Conditions
- Speed ..... 63.2 mi/h
- Angle ..... 25.2 degrees
- Location/Orientation ..... At Post 22

Exit Conditions
- Speed ..... 40.2 mi/h
- Angle ..... 28.6 degrees

Occupant Risk Values
- Impact Velocity
  - Longitudinal ..... 29.8 ft/s
  - Lateral ..... 7.2 ft/s
- Ridedown Accelerations
  - Longitudinal ..... -2.5 G
  - Lateral ..... -3.4 G
- THIV ..... 34.1 km/h
- PHD ..... 4.0 G
- Max. 0.050-s Average
  - Longitudinal ..... -10.9 G
  - Lateral ..... 3.4 G
  - Vertical ..... -4.4 G

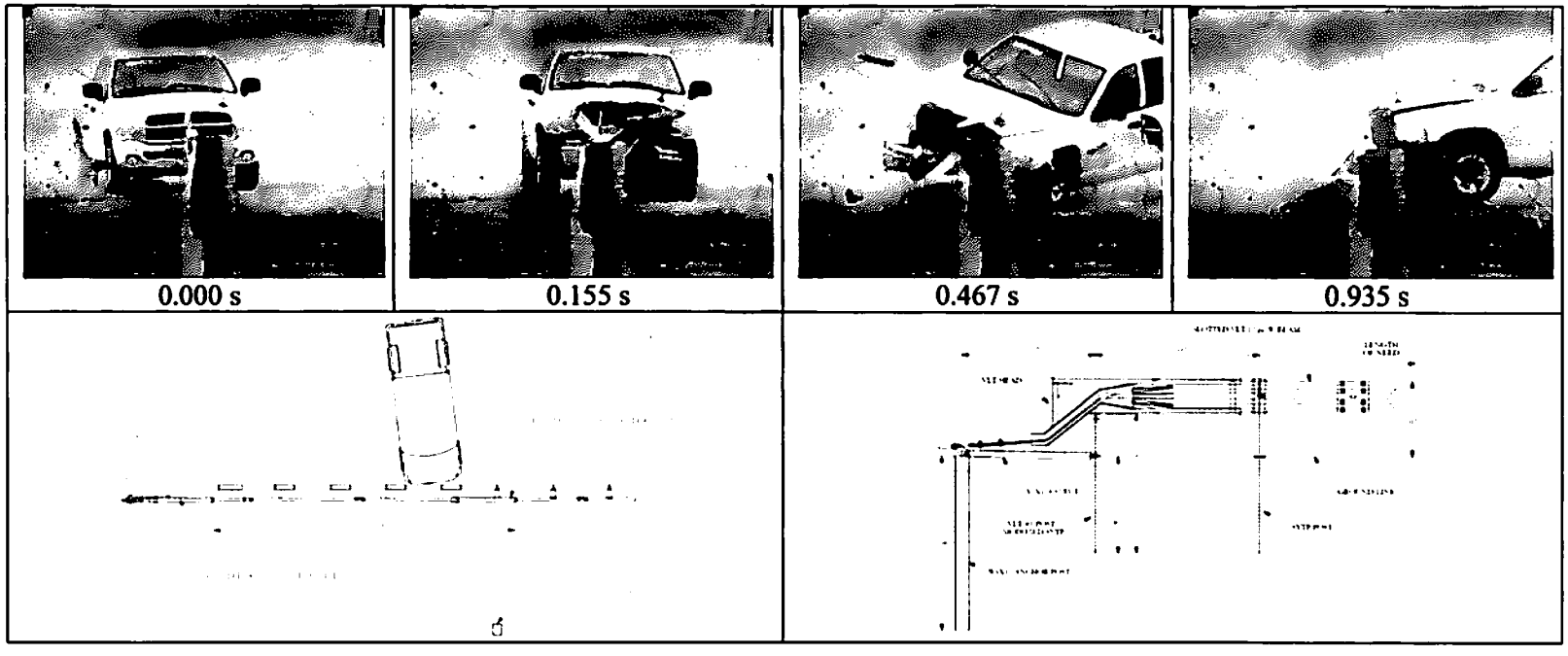
Post-Impact Trajectory
- Stopping Distance ..... 62.5 ft dwnstrm
  9.4 ft twd traffic

Vehicle Stability
- Maximum Yaw Angle ..... -20 degrees
- Maximum Pitch Angle ..... 8 degrees
- Maximum Roll Angle ..... 8 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 8.5 ft
- Permanent ..... 2.5 ft
- Working Width ..... 27 ft

Vehicle Damage
- VDS 11LFQ4
- CDC 11FDEW3
- Max. Exterior Deformation ..... 14.0 inches
- Max. Occupant Compartment Deformation ..... 0.75 inch

Summary of results for *MASH* test 3-37 (modified) on the VLT.



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 400001-TSQ6
- Date 2010-01-06

Test Article
- Type ..... Terminal
- Name ..... Vertically Loading Terminal (VLT)
- Installation Length ..... 151.75 ft
- Material or Key Elements ..... 31 in tall 12 ga w-beam, steel posts

Soil Type and Condition ..... Standard Soil, Damp

Test Vehicle
- Type/Designation 2270P
- Make and Model ..... 2003 Dodge Ram 1500 quad-cab pickup
- Curb ..... 4695 lb
- Test Inertial ..... 4958 lb
- Dummy ..... No dummy
- Gross Static ..... 4958 lb

Impact Conditions
- Speed ..... 60.9 mi/h
- Angle ..... 7.3 degrees
- Location/Orientation ..... End-on

Exit Conditions
- Speed ..... Out of view
- Angle ..... Out of view

Occupant Risk Values
- Impact Velocity
  - Longitudinal ..... 21.0 ft/s
  - Lateral ..... 3.0 ft/s
- Ridedown Accelerations
  - Longitudinal ..... -9.5 G
  - Lateral ..... 3.8 G
- THIV ..... 23.3 km/h
- PHD ..... 9.7 G
- Max. 0.050-s Average
  - Longitudinal ..... -7.3 G
  - Lateral ..... 2.8 G
  - Vertical ..... -3.1 G

Post-Impact Trajectory
- Stopping Distance ..... 28 ft dwnstrm, Adjcnt to field side

Vehicle Stability
- Maximum Yaw Angle ..... 85 degrees
- Maximum Pitch Angle ..... 5 degrees
- Maximum Roll Angle ..... -21 degrees
- Vehicle Snagging ..... No
- Vehicle Pocketing ..... No

Test Article Deflections
- Dynamic ..... 2.0 ft
- Permanent ..... 2.0 ft
- Working Width ..... 14.7 ft

Vehicle Damage
- VDS 12FC5
- CDC 12FCEN4
- Max. Exterior Deformation ..... 17.75 inches
- Max. Occupant Compartment Deformation 0

Summary of results for *MASH* test 3-33 on the VLT.