U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Avenue, SE.
Washington, DC 20590

February 8, 2008

In Reply Refer To: HSSD/CC-104

Barry D. Stephens, P.E.
Sr. Vice President Engineering
Energy Absorption Systems, Inc.
3617 Cincinnati Avenue
Rocklin, CA 95678

Dear Mr. Stephens:

Thank you for your January 3, 2008, letter requesting Federal Highway Administration (FHWA) review and acceptance of a new Trailer Truck-Mounted Attenuator (TMA), called the Vorteq[tm] TMA, for use on the National Highway System (NHS). You requested acceptance at the National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3). To support your request, you supplied a copy of the January 2008 E-TECH Testing Services, Inc. compliance Report No. 320 entitled "NCHRP Report 350 Crash Test Results for the Vorteq[TM] Trailer TMA." The report describes the new Vorteq Trailer TMA as well as the four full-scale crash tests you conducted on this safety device.

Introduction
The FHWA guidance on crash testing of roadside safety hardware is contained in a memorandum dated July 25, 1997, titled "INFORMATION: Identifying Acceptable Highway Safety Features."

The Vorteq Trailer TMA consists of six major assemblies: an Impact Head, Rear Collars, Frame Tubes, X-Brace, Tongue, and Suspension. The TMA is a nominal 6985 mm long by 2340 mm wide by 770 mm tall (22.9' x 7.6' x 2.5'). The 4980 mm (196") long Frame Tubes are the principle energy absorber in the system and are fabricated from 76 mm OD by 3 mm thick (3" x 0.120") ASTM A513 Type 1 HREW (Hot Rolled Electric Welded) low carbon steel tubing. The Frame Tubes absorb the energy of the crash as they tightly curl inward when the Impact Head is forced forward.

Testing
All four NCHRP Report 350 tests for TMAs were conducted: 3-50 and 3-51 (both required) and 3-52 and 3-53 (optional tests). In each of the four tests the support truck was blocked to prevent any roll ahead. The Test Data Summary Sheets from the E-TECH report are enclosed for reference, as is a drawing of the test article.

You noted that there were no TMA design changes during the certification test program; the same design was used in every test. The report shows that there were no fragments or other debris from the TMA that showed potential for penetrating the occupant compartment of either the impacting vehicle or host truck, or of presenting an undue hazard to other traffic, pedestrians, or personnel in a work zone. The Vorteq TMA did not swing significantly into adjacent traffic lanes during any of the tests. No debris of either the impacting vehicle or TMA ended up forward of the tailgate of the host vehicle. We also noted that the impacted TMA is capable of being safely transported a short distance off the road essentially intact after all test impacts.

Findings

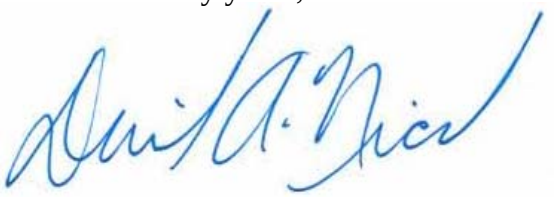
Based upon the successful completion of the aforementioned Report 350 tests, we agree that Energy's Vorteq Trailer TMA meets the NCHRP Report 350 criteria for the specified mandatory Tests 3-50 and 3-51 as well as optional Tests 3-52 and 3-53. The TMA was also restrained from forward and lateral movement in all of these tests, thus there is no upper limit to the weight of the support vehicle to which the Vorteq Trailer TMA can be attached. The system, as described above, may be used on the National Highway System (NHS) when such use is acceptable to the contracting authority.

Please note also that the following provisions apply to FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the device and does not cover its structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any design changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, the in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- 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 acceptance, and that it will meet the crashworthiness requirements of NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number CC-104, shall not be reproduced except in full. This letter, and test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.
- The Vorteq^{tm} TMA is a patented product and is considered proprietary. If proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on

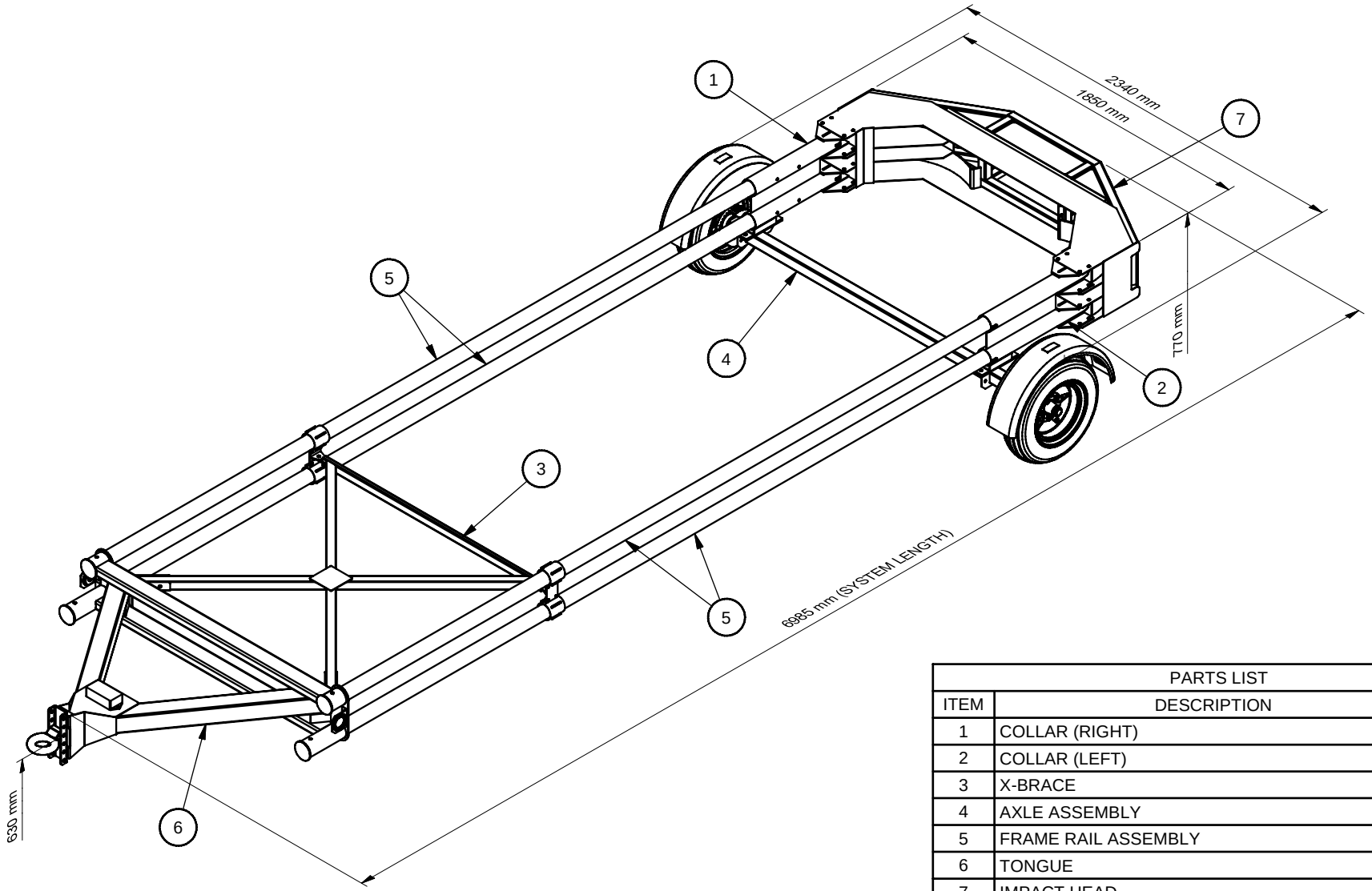
relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely yours,



David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

Enclosures



PARTS LIST		
ITEM	DESCRIPTION	QTY.
1	COLLAR (RIGHT)	1
2	COLLAR (LEFT)	1
3	X-BRACE	1
4	AXLE ASSEMBLY	1
5	FRAME RAIL ASSEMBLY	2
6	TONGUE	1
7	IMPACT HEAD	1

DRAWN:	DATE:
DESIGNED:	DATE:
CHECKED:	DATE:
APPROVED:	DATE:
Q.C.	DATE:

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

Vorteq™ Trailer TMA

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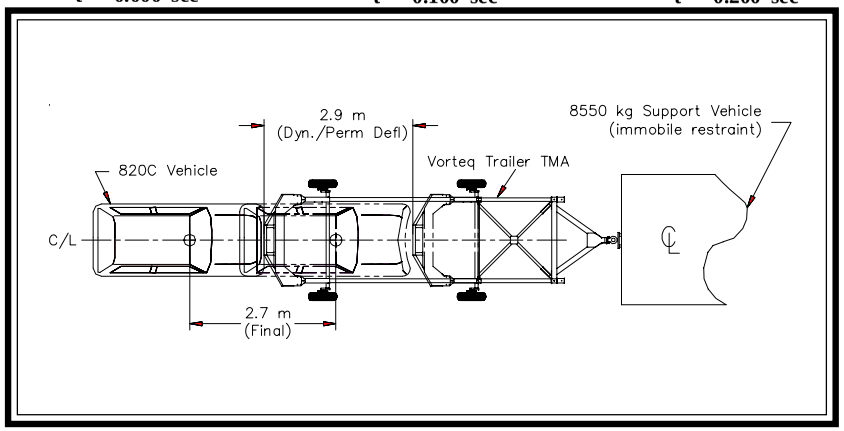
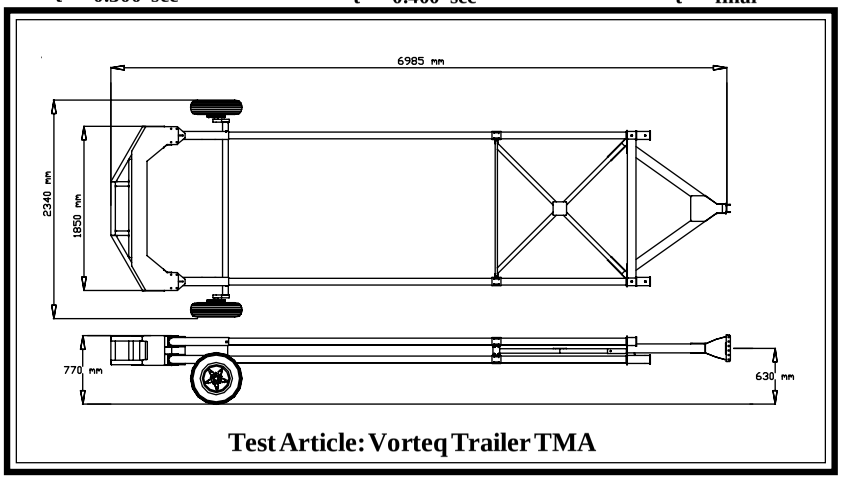




Test Article: Vorteq Trailer TMA

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-50
Test No.	01-4232-003
Date	12/7/07

Test Article

Type	Energy Absorption Systems, Inc.
	Vorteq™ Trailer TMA
Installation Length, (mm)	6985 (overall system)
Material and key elements	(4) 76 mm OD x 3 mm thick x
	4978 mm ASTM A513 Type 1 HREW
	low carbon steel Frame Tubes
Foundation Type and Condition	Concrete, clean and damp

Test Vehicle

Type	Production Model
Designation	820C Small Car
Model	1989 Ford Festiva
Mass (kg)	
Curb	775
Test inertial	810
Dummy	75
Gross Static	885

Support Vehicle

Model	1970 GMC 7500 T/A Dump
Test Inertial Mass (kg)	8550
Restraint	Immobile

Impact Conditions

Speed (km/h)	99.7
Angle (deg)	0
Impact Severity (kJ)	310.4

Exit conditions

Speed (km/h)	N/A
Angle (deg)	N/A

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	10.8
y-direction	0.0
Ridedown Acceleration (g's)	
x-direction	-14.5
y-direction	-2.5
Support Vehicle Acceleration (g's)	
x-direction	N/A (immobile)

European Committee for Normalization (CEN) Values

THIV (km/h)	38.8
PHD (g's)	14.5
ASI	1.4

Test Article Deflections (m)

Dynamic	2.9
Permanent	2.9

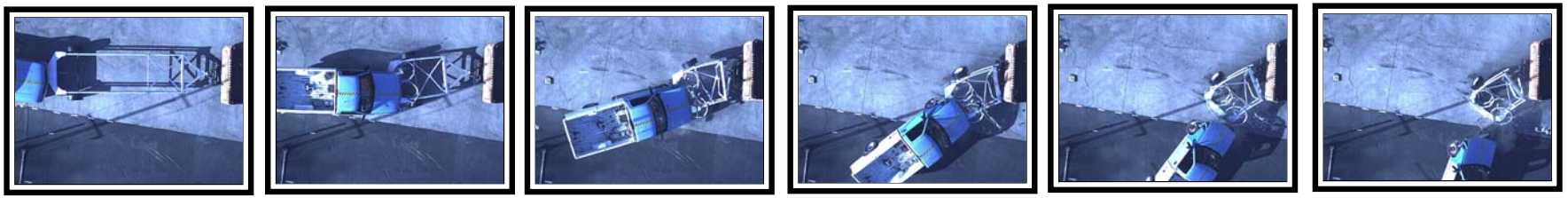
Vehicle Damage

Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
OCDI	AS0000000
Maximum Deformation (mm)	Negligible

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-0.9
Maximum Pitch Angle	-4.7
Maximum Yaw Angle	-4.9

Figure 1. Summary of Results - Vorteq Trailer TMA Test 01-4232-003



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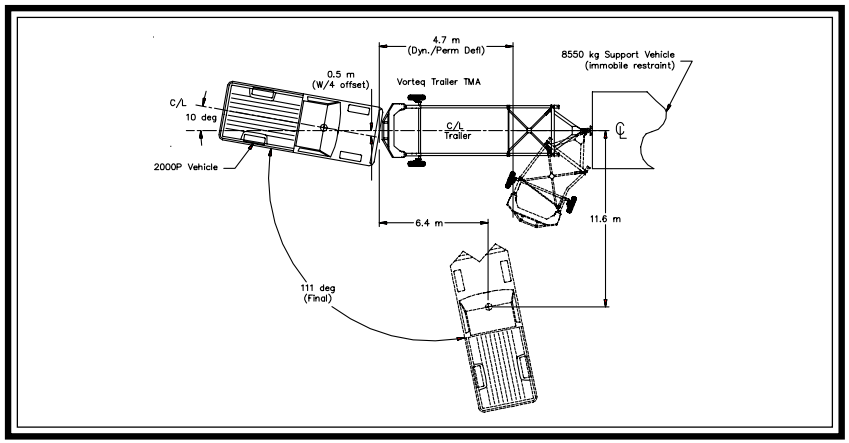

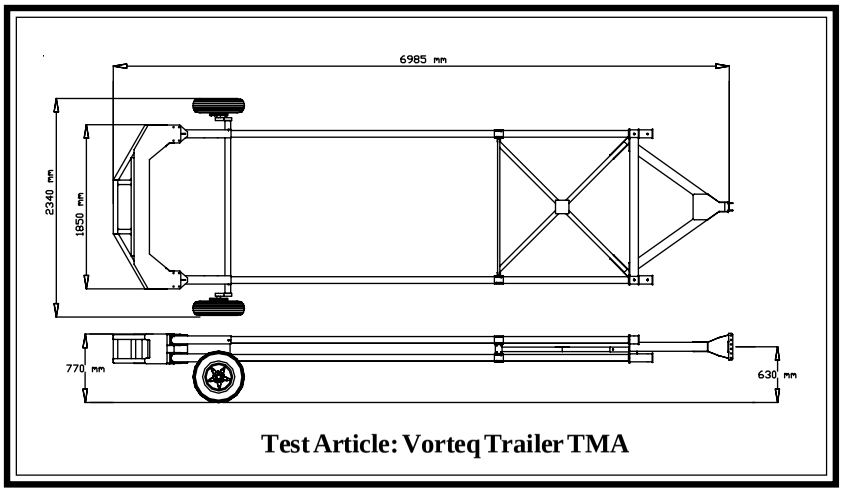

Test Article: Vorteq Trailer TMA

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-53
Test No.	01-4232-004
Date	12/13/07

TTest Article

Type	Energy Absorption Systems, Inc.
	Vorteq™ Trailer TMA
Installation Length, (mm)	6985 (overall system)
Material and key elements	(4) 76 mm OD x 3 mm thick x
	4978 mm ASTM A513 Type 1 HREW
	low carbon steel Frame Tubes
Foundation Type and Condition	Concrete, clean and dry

Test Vehicle

Type	Production Model
Designation	2000P Pickup
Model	1996 GMC C2500
Mass (kg)	
Curb	1933
Test inertial	1998
Dummy	N/A
Gross Static	1998

Support Vehicle

Model	1970 GMC 7500 T/A Dump
Test Inertial Mass (kg)	8550
Restraint	Immobile

Impact Conditions

Speed (km/h)	101.1
Angle (deg)	10
Impact Severity (kJ)	787.1

NCHRP 350 Occupant Risk Values

Impact Velocity (m/s)	
x-direction	8.6
y-direction	0.2
Ridedown Acceleration (g's)	
x-direction	-15.9
y-direction	6.7
Support Vehicle Acceleration (g's)	
x-direction	N/A (immobile)

European Committee for Normalization (CEN) Values

THIV (km/h)	30.8
PHD (g's)	17.1
ASI	1.2

Test Article Deflections (m)

Dynamic	4.7
Permanent	4.7

Vehicle Damage

Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
OCDI	AS0000000
Maximum Deformation (mm)	Negligible

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-24.2
Maximum Pitch Angle	-24.6
Maximum Yaw Angle	-110.7

Figure 16. Summary of Results - Vorteq Trailer TMA Test 01-4232-004

E-TECH Testing Services, Inc.
A Qinetiq Company
3617 B Cincinnatti Avenue
Rocklin, CA 95765
PHONE (916) 645-8188
FAX (916) 645-3653


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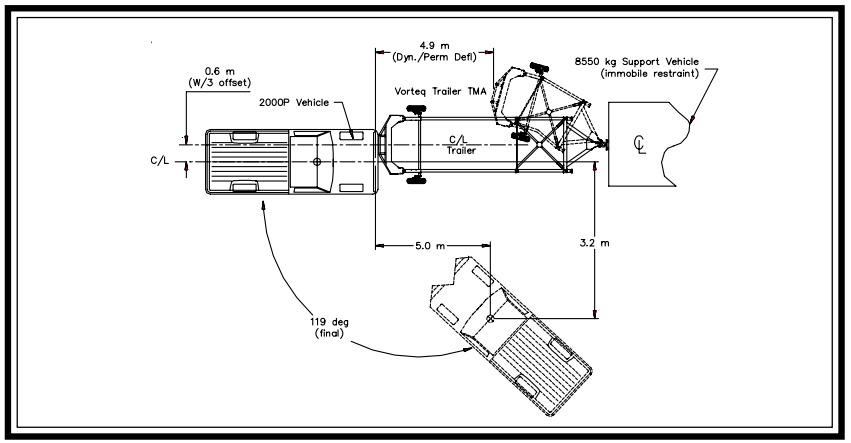

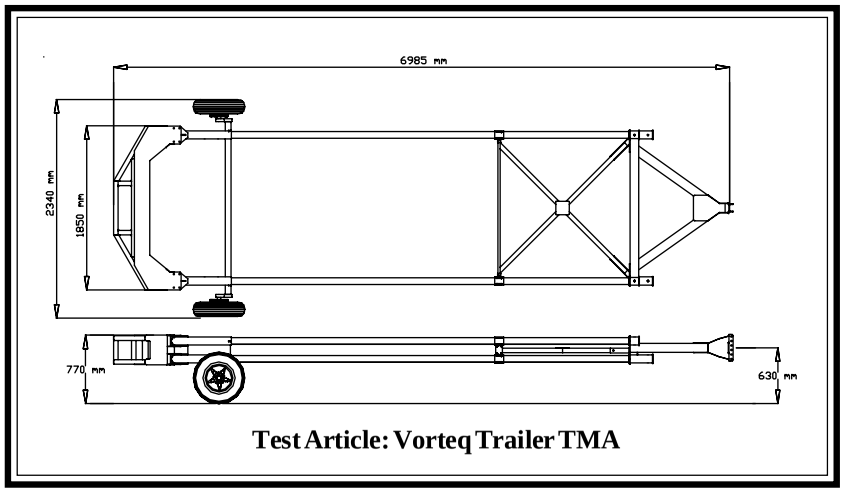

Test Article: Vorteq Trailer TMA

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-52
Test No.	01-4232-002
Date	12/4/07

Test Article

Type	Energy Absorption Systems, Inc.
	Vorteq™ Trailer TMA
Installation Length, (mm)	6985 (overall system)
Material and key elements	(4) 76 mm OD x 3 mm thick x
	4978 mm ASTM A513 Type 1 HREW
	low carbon steel Frame Tubes
Foundation Type and Condition	Concrete, clean and dry

Test Vehicle

Type	Production Model
Designation	2000P Pickup
Model	1990 GMC
Mass (kg)	
Curb	1916
Test inertial	1985
Dummy	N/A
Gross Static	1985

Support Vehicle

Model	1970 GMC 7500 T/A Dump
Test Inertial Mass (kg)	8550
Restraint	Immobile

Impact Conditions

Speed (km/h)	99.7
Angle (deg)	0
Impact Severity (kJ)	760.7

NCHRP 350 Occupant Risk Values

Impact Velocity (m/s)	
x-direction	9.2
y-direction	-0.2
Ridedown Acceleration (g's)	
x-direction	-18.3
y-direction	-12.4
Support Vehicle Acceleration (g's)	
x-direction	N/A (immobile)

European Committee for Normalization (CEN) Values

THIV (km/h)	33.1
PHD (g's)	18.9
ASI	1.2

Test Article Deflections (m)

Dynamic	4.9
Permanent	4.9

Vehicle Damage

Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
OCDI	AS0000000
Maximum Deformation (mm)	20

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-20.5
Maximum Pitch Angle	21.1
Maximum Yaw Angle	-118.8

Figure 11. Summary of Results - Vorteq Trailer TMA Test 01-4232-001

E-TECH Testing Services, Inc.
A Qualspec Company
3617 B Cincinnatti Avenue
Rocklin, CA 95765
PHONE (916) 645-8188
FAX (916) 645-3653






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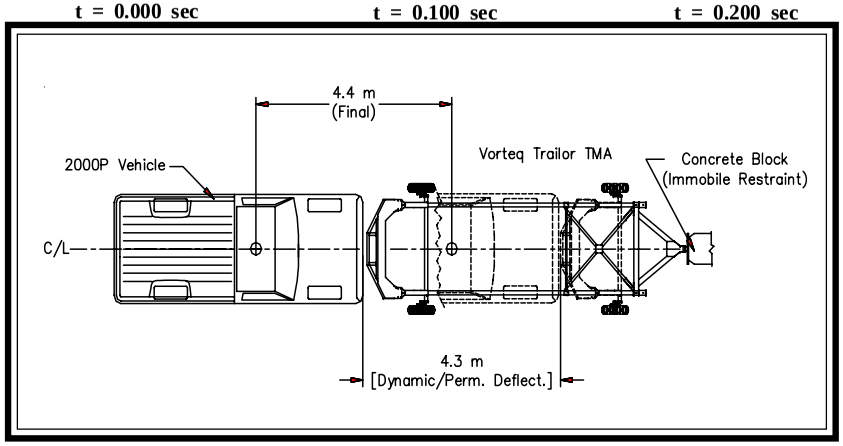

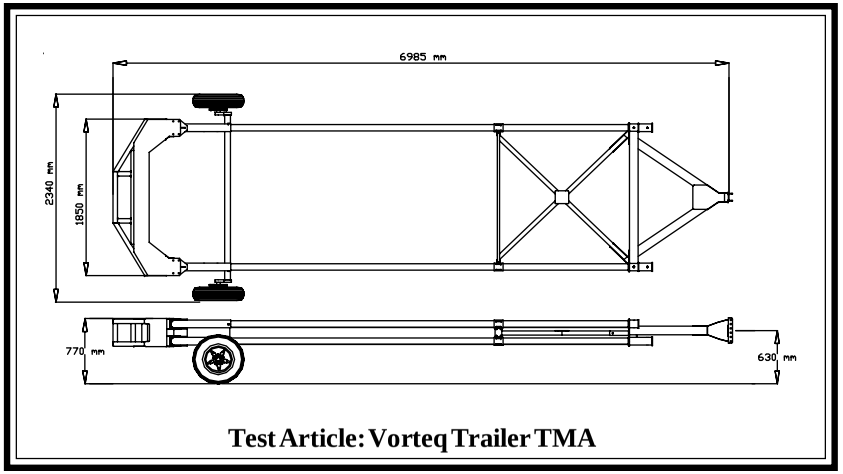

Test Article: Vorteq Trailer TMA

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-51
Test No.	01-4232-001
Date	11/29/07

Test Article

Type	Energy Absorption Systems, Inc.
	Vorteq™ Trailer TMA
Installation Length, (mm)	6985 (overall system)
Material and key elements	(4) 76 mm OD x 3 mm thick x
	4978 mm ASTM A513 Type 1 HREW
	low carbon steel Frame Tubes
Foundation Type and Condition	Concrete, clean and dry

Test Vehicle

Type	Production Model
Designation	2000P Pickup
Model	1988 Chevrolet C-2500
Mass (kg)	
Curb	1893
Test inertial	1999
Dummy	N/A
Gross Static	1999

Support Vehicle

Model	N/A (rigid wall)
Test Inertial Mass (kg)	N/A (rigid wall)
Restraint	Immobile

Impact Conditions

Speed (km/h)	101.8
Angle (deg)	0
Impact Severity (kJ)	798.6

Exit conditions

Speed (km/h)	N/A
Angle (deg)	N/A

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	8.5
y-direction	-0.3
Ridedown Acceleration (g's)	
x-direction	-19.1
y-direction	-5.3
Support Vehicle Acceleration (g's)	
x-direction	N/A (immobile)

European Committee for Normalization (CEN) Values

THIV (km/h)	30.5
PHD (g's)	19.1
ASI	1.2

Test Article Deflections (m)

Dynamic	4.3
Permanent	4.3

Vehicle Damage

Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
OCDI	AS0000000
Maximum Deformation (mm)	Negligible

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	3.2
Maximum Pitch Angle	21.6
Maximum Yaw Angle	4.4

Figure 6. Summary of Results - Vorteq Trailer TMA Test 01-4232-001