U.S. Department of Transportation
Federal Highway Administration

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

May 7, 2012

In Reply Refer To:
HSST/CC-112A

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

Dear Mr. Stephens:

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 device:	8-bay QuadGuard® Elite M10 8-bay QuadGuard Elite M10 Wide 4-bay QuadGuard® Elite M10 4-bay QuadGuard Elite M10 Wide
Type of device:	Impact Attenuator and Transitions
Test Level:	MASH Test Level 2 (TL-2) and Test Level 3 (TL-3)
Testing conducted by:	E-Tech Testing Services, Inc.
Task Force 13 Designator:	8-bay QuadGuard® Elite M10: SCI33 8-bay QuadGuard® Elite M10 Wide: SCI34 4-bay QuadGuard® Elite M10: SCI35 4-bay QuadGuard® Elite M10 Wide: SCI36
Date of request:	July 8, 2011
Date of completed package:	March 8, 2012

Decision:
The following device is eligible, with details provided:

- TL2 4-bay QuadGuard®; Elite M10 and Elite M10 Wide
- TL3 8-bay QuadGuard®; Elite M10 and Elite M10 Wide

Based on a review of crash test results submitted by the manufacturer certifying 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), 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 the FHWA for any particular purpose or use.

FHWA: HSST: WLongstreet: sf: x60087:3/16/12: Revised 5/7/12
File: h://directory folder/HSST/ CC-112A_QuadGuard Elite M10.docx
cc: HSST Will Longstreet

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.

Requirements
To be found eligible for Federal-aid funding, roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH).

Description
The QuadGuard Elite M10 (QGE M10) is a redirective, non-gating crash cushion. The TL2 QGE M10 is a 4-bay system and the TL3 QGE M10 is an 8-bay system. The Elite M10 family of systems is basically the existing successfully crash tested QuadGuard M10 components (i.e., Eligibility Letter CC-112 dated February 2011) that substitutes standard crushable cartridges specified in the QuadGuard M10 with high density polyethylene (HDPE) Cylinder Assemblies. The QGE M10 8-bay system has an overall length of 7.97 m [26'-2"] and the QGE M10 4-bay system has an overall length of 4.60 m [15'-1"]. The overall height of both systems is 817 mm [32 inches]. The QGE M10 system can be configured with backup widths of 610 mm [24 inches], 762 mm [30 inches], and 914 mm [36 inches]. The QGE M10 Wide systems can be configured with backup widths of 1753 [69 inches] and 2285 mm [90 inches]. Both QGE M10 and QGE M10 Wide systems consists of energy absorbing cylinder assemblies that are surrounded by a framework of steel Quad-Beam™ guardrail that can telescope rearward during head-on impacts. The systems have a center monorail that will resist lateral movement during side angle impacts and a backup structure that will resist movement during head-on impacts.

Details of the 4-bay and the 8-bay QGE M10 systems (for narrow & wide) are included as an enclosure to this correspondence.

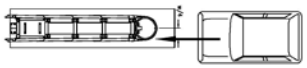
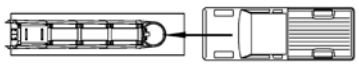
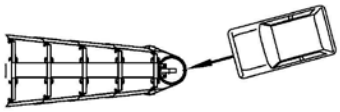
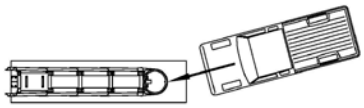
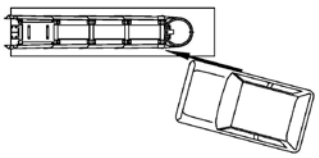
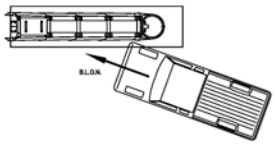
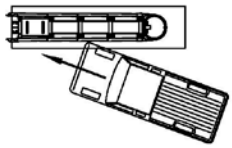
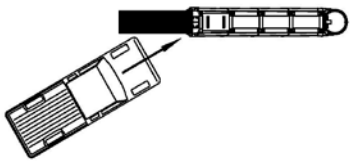
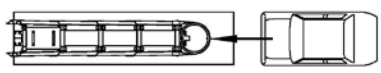
Findings
The following crash testing was conducted according to the MASH.

I. TL2: 4-bay QuadGuard®; Elite M10 and Elite M10 Wide
   A. MASH Test 2-31:
      Conducted on Elite M10 with backup width = 610 mm (24 inches).
      Impact speed = 70.3 km/h
      Ridedown = -17.8 g's
      Longitudinal ΔV = 7.9 m/s

   B. MASH Test 2-32:
      Conducted on Elite M10 Wide with backup width = 2285 mm (90 inches).
      Impact speed = 70.3 km/h
      Ridedown = -12.0 g's
      Longitudinal ΔV = 9.9 m/s

   Analysis conducted of Test 2-31 data and as per formulas provided for the mid-sized vehicle contained in AASHTO MASH Section G. Analysis results determined MASH Test 2-38 (i.e., 1500A crash test) is not required.

   The following table lists all required crash tests as per MASH for Test Level 2:

Illustration	Test #	Completed	Notes
	2-30	NO	Test 2-32 was completed as "Worst Case" for the 1100C.
	2-31	YES	Passed all ORV's. 4-Bay 610 mm [24 inches] Narrow System was tested and passed all Occupant Risk Values.
	2-32	YES	Passed all ORV's. 4-Bay 2285 mm [90 inches] Wide System was tested.
	2-33	NO	Test 2-31 tested system capacity for 2270P and is considered worst case.
	2-34	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	2-35	NO	Due to the lateral stiffness of the QuadGuard M10, this test is the same as test 2-36 and can be waived.
	2-36	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	2-37	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 6-Bay 610 mm [24 inches] Narrow System attached to a w-beam transition.
	2-38	YES	The recommended MASH analysis was completed and all calculated ORV's passed.

A one-page test summary for each conducted crash test is included as enclosure to this correspondence.

II. TL3: 8-bay QuadGuard®; Elite M10 and Elite M10 Wide

A. MASH Test 3-31:
Conducted on Elite M10 with backup width = 610 mm (24 inches).
Impact speed = 96.4 km/h
Ridedown = -13.1 g's
Longitudinal ΔV = 9.3 m/s

B. MASH Test 3-32:
Conducted on Elite M10 Wide with backup width = 2285 mm (90 inches).
Impact speed = 98.3 km/h
Ridedown = -8.9 g's
Longitudinal ΔV = 11.8 m/s

Analysis conducted of Test 3-31 data and as per formulas provided for the mid-sized vehicle contained in AASHTO MASH Section G. Analysis results determined MASH Test 3-38 (i.e., 1500A crash test) is not required.

In addition, the following requests are based upon previous testing results from original QuadGuard family of systems (i.e., CC-112 dated February 11, 2011):

A. The occupant risk values of Test 3-31 & Test 3-32 were determined to be within parameters set by MASH are also considered to be worst case scenario (i.e., risk values higher than Tests 3-30 & 3-33). Therefore both Test 3-30 & Test 3-33 were not conducted.
B. The redirective tests 3-34, 3-36, and 3-37 were determined to be within parameters set by MASH. Since previously successfully crash tested QuadGuard M10 metallic structural components are identical to the QuadGuard Elite M10, tests 3-34, 3-36, and 3-37 were not conducted.

The following table lists all required crash tests as per MASH for Test Level 3:

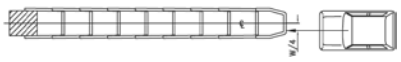
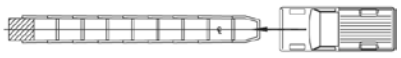
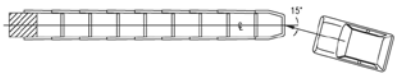
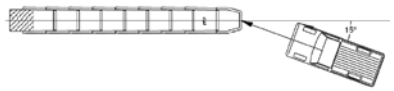
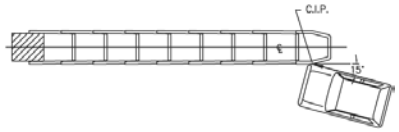
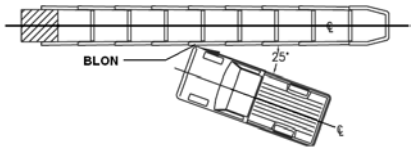
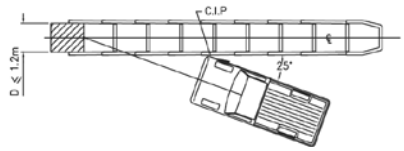
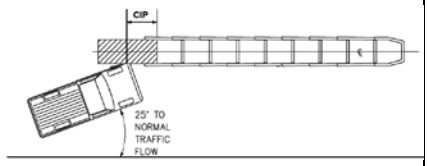
Illustration	Test #	Completed	Notes
	3-30	NO	Test 3-32 was completed as "Worst Case" for the 1100C.
	3-31	YES	Passed all ORV's. 8-Bay 610 mm [24 inches] Narrow System was tested and passed all Occupant Risk Values.
	3-32	YES	Passed all ORV's. 8-Bay 2285 mm [90 inches] Wide System was tested.

Illustration	Test #	Completed	Notes
	3-33	NO	Test 3-31 tested system capacity for 2270P and is considered worst case.
	3-34	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	3-35	NO	Due to the lateral stiffness of the QuadGuard M10, this test is the same as test 3-36 and can be waived.
	3-36	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	3-37	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 6-Bay 610 mm [24 inches] Narrow System attached to a w-beam transition.
	3-38	YES	The recommended MASH analysis was completed and all calculated ORV's passed.

A one-page test summary for each conducted crash test is included as enclosure to this correspondence.

In addition, the following transitions as described in CC-112 dated February 9, 2011 are also included within this correspondence for use with the TL2 4-bay QuadGuard®; Elite M10 and Elite M10 Wide; and the TL3 8-bay QuadGuard®; Elite M10 and Elite M10 Wide:

1. Transition QG M10 to W-beam
2. Transition QG M10 to thrie-Beam
3. QG 4" offset Transition to CMB
4. QG 9" offset Transition to CMB (No wide system version)
5. Transition QG to vertical wall
6. QG 6" offset transition to single slope barrier

Summary and Standard Provisions

The QuadGuard® Elite M10 4-bay and 8-bay systems as described herein meet the evaluation criteria for a MASH redirective, non-gating crash cushion at TL-2 and TL-3 impact conditions respectively, and are eligible for reimbursement, and may be installed under the range of conditions tested. It is further acknowledged that the QuadGuard Elite M10 can be installed with existing QuadGuard M10 Transition hardware.

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

- This letter provides a AASHTO/ARTBA/AGC Task Force 13 designator that should be used for the purpose of the creation of a new and/or the update of existing Task Force 13 drawing for posting on the on-line 'Guide to Standardized Highway Barrier Hardware' currently referenced in AASHTO Roadside Design Guide.
- This finding of eligibility does not cover other structural features of the systems, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may influence system conformance with MASH will require a new reimbursement eligibility letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals safety problems, or that the system is significantly different from the version that was crash tested, we reserve the right to modify or revoke this letter.
- You are expected to supply potential users with sufficient information on design and installation 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 crashworthiness requirements of the Manual for Assessing Safety Hardware.
- To prevent misunderstanding by others, this letter of eligibility is designated as a number CC-112A 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 QuadGuard® Elite M10 attenuators are patented products and considered proprietary. If proprietary devices are specified by highway agency for use on Federal-aid projects, except exempt, non-NHS 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 acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, 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 yours,

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

May 7, 2012

In Reply Refer To:
HSST/CC-112A

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

Dear Mr. Stephens:

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 device:	8-bay QuadGuard® Elite M10 8-bay QuadGuard Elite M10 Wide 4-bay QuadGuard® Elite M10 4-bay QuadGuard Elite M10 Wide
Type of device:	Impact Attenuator and Transitions
Test Level:	MASH Test Level 2 (TL-2) and Test Level 3 (TL-3)
Testing conducted by:	E-Tech Testing Services, Inc.
Task Force 13 Designator:	8-bay QuadGuard® Elite M10: SCI33 8-bay QuadGuard® Elite M10 Wide: SCI34 4-bay QuadGuard® Elite M10: SCI35 4-bay QuadGuard® Elite M10 Wide: SCI36
Date of request:	July 8, 2011
Date of completed package:	March 8, 2012

Decision:
The following device is eligible, with details provided:

- TL2 4-bay QuadGuard®; Elite M10 and Elite M10 Wide
- TL3 8-bay QuadGuard®; Elite M10 and Elite M10 Wide

Based on a review of crash test results submitted by the manufacturer certifying 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), 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 the 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.

Requirements
To be found eligible for Federal-aid funding, roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH).

Description
The QuadGuard Elite M10 (QGE M10) is a redirective, non-gating crash cushion. The TL2 QGE M10 is a 4-bay system and the TL3 QGE M10 is an 8-bay system. The Elite M10 family of systems is basically the existing successfully crash tested QuadGuard M10 components (i.e., Eligibility Letter CC-112 dated February 2011) that substitutes standard crushable cartridges specified in the QuadGuard M10 with high density polyethylene (HDPE) Cylinder Assemblies. The QGE M10 8-bay system has an overall length of 7.97 m [26'-2"] and the QGE M10 4-bay system has an overall length of 4.60 m [15'-1"]. The overall height of both systems is 817 mm [32 inches]. The QGE M10 system can be configured with backup widths of 610 mm [24 inches], 762 mm [30 inches], and 914 mm [36 inches]. The QGE M10 Wide systems can be configured with backup widths of 1753 [69 inches] and 2285 mm [90 inches]. Both QGE M10 and QGE M10 Wide systems consists of energy absorbing cylinder assemblies that are surrounded by a framework of steel Quad-Beam™ guardrail that can telescope rearward during head-on impacts. The systems have a center monorail that will resist lateral movement during side angle impacts and a backup structure that will resist movement during head-on impacts.

Details of the 4-bay and the 8-bay QGE M10 systems (for narrow & wide) are included as an enclosure to this correspondence.

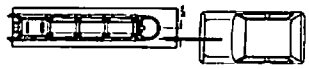
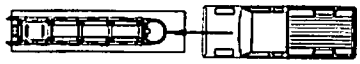
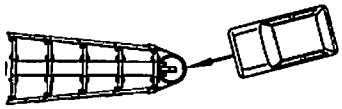
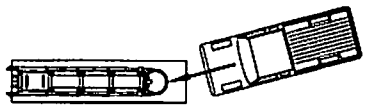
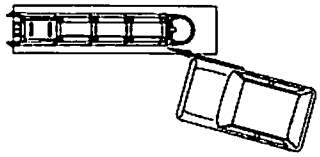
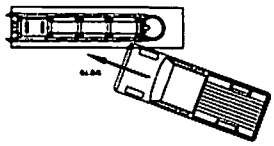
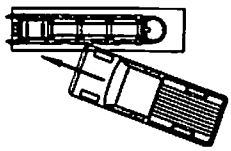
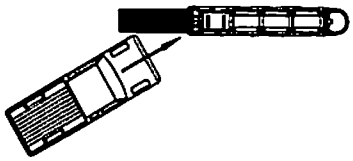
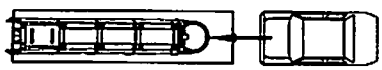
Findings
The following crash testing was conducted according to the MASH.

I. TL2: 4-bay QuadGuard®; Elite M10 and Elite M10 Wide
   A. MASH Test 2-31:
      Conducted on Elite M10 with backup width = 610 mm (24 inches).
      Impact speed = 70.3 km/h
      Ridedown = -17.8 g's
      Longitudinal ΔV = 7.9 m/s

   B. MASH Test 2-32:
      Conducted on Elite M10 Wide with backup width = 2285 mm (90 inches).
      Impact speed = 70.3 km/h
      Ridedown = -12.0 g's
      Longitudinal ΔV = 9.9 m/s

   Analysis conducted of Test 2-31 data and as per formulas provided for the mid-sized vehicle contained in AASHTO MASH Section G. Analysis results determined MASH Test 2-38 (i.e., 1500A crash test) is not required.

   The following table lists all required crash tests as per MASH for Test Level 2:

Illustration	Test #	Completed	Notes
	2-30	NO	Test 2-32 was completed as "Worst Case" for the 1100C.
	2-31	YES	Passed all ORV's. 4-Bay 610 mm [24 inches] Narrow System was tested and passed all Occupant Risk Values.
	2-32	YES	Passed all ORV's. 4-Bay 2285 mm [90 inches] Wide System was tested.
	2-33	NO	Test 2-31 tested system capacity for 2270P and is considered worst case.
	2-34	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	2-35	NO	Due to the lateral stiffness of the QuadGuard M10, this test is the same as test 2-36 and can be waived.
	2-36	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	2-37	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 6-Bay 610 mm [24 inches] Narrow System attached to a w-beam transition.
	2-38	YES	The recommended MASH analysis was completed and all calculated ORV's passed.

A one-page test summary for each conducted crash test is included as enclosure to this correspondence.

II. TL3: 8-bay QuadGuard®; Elite M10 and Elite M10 Wide

A. MASH Test 3-31:
Conducted on Elite M10 with backup width = 610 mm (24 inches).
Impact speed = 96.4 km/h
Ridedown = -13.1 g's
Longitudinal ΔV = 9.3 m/s

B. MASH Test 3-32:
Conducted on Elite M10 Wide with backup width = 2285 mm (90 inches).
Impact speed = 98.3 km/h
Ridedown = -8.9 g's
Longitudinal ΔV = 11.8 m/s

Analysis conducted of Test 3-31 data and as per formulas provided for the mid-sized vehicle contained in AASHTO MASH Section G. Analysis results determined MASH Test 3-38 (i.e., 1500A crash test) is not required.

In addition, the following requests are based upon previous testing results from original QuadGuard family of systems (i.e., CC-112 dated February 11, 2011):

A. The occupant risk values of Test 3-31 & Test 3-32 were determined to be within parameters set by MASH are also considered to be worst case scenario (i.e., risk values higher than Tests 3-30 & 3-33). Therefore both Test 3-30 & Test 3-33 were not conducted.
B. The redirective tests 3-34, 3-36, and 3-37 were determined to be within parameters set by MASH. Since previously successfully crash tested QuadGuard M10 metallic structural components are identical to the QuadGuard Elite M10, tests 3-34, 3-36, and 3-37 were not conducted.

The following table lists all required crash tests as per MASH for Test Level 3:

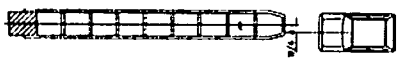
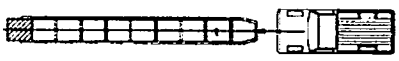
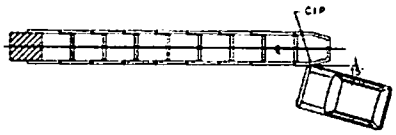
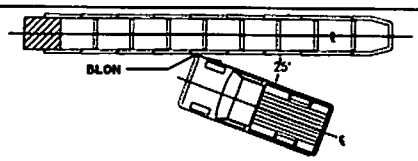
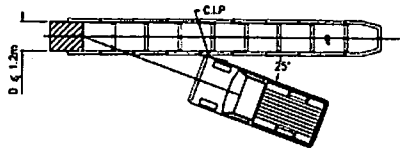
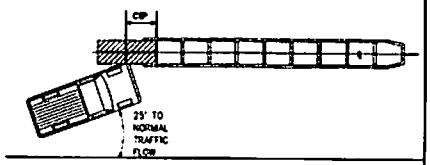
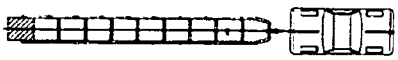
Illustration	Test #	Completed	Notes
	3-30	NO	Test 3-32 was completed as "Worst Case" for the 1100C.
	3-31	YES	Passed all ORV's. 8-Bay 610 mm [24 inches] Narrow System was tested and passed all Occupant Risk Values.
	3-32	YES	Passed all ORV's. 8-Bay 2285 mm [90 inches] Wide System was tested.

Illustration	Test #	Completed	Notes
	3-33	NO	Test 3-31 tested system capacity for 2270P and is considered worst case.
	3-34	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	3-35	NO	Due to the lateral stiffness of the QuadGuard M10, this test is the same as test 3-36 and can be waived.
	3-36	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 5-Bay 610 mm [24 inches] Narrow System was tested.
	3-37	NO	Test was conducted in the QG M10 test program and Passed all ORV's. 6-Bay 610 mm [24 inches] Narrow System attached to a w-beam transition.
	3-38	YES	The recommended MASH analysis was completed and all calculated ORV's passed.

A one-page test summary for each conducted crash test is included as enclosure to this correspondence.

In addition, the following transitions as described in CC-112 dated February 9, 2011 are also included within this correspondence for use with the TL2 4-bay QuadGuard®; Elite M10 and Elite M10 Wide; and the TL3 8-bay QuadGuard®; Elite M10 and Elite M10 Wide:

1. Transition QG M10 to W-beam
2. Transition QG M10 to thrie-Beam
3. QG 4" offset Transition to CMB
4. QG 9" offset Transition to CMB (No wide system version)
5. Transition QG to vertical wall
6. QG 6" offset transition to single slope barrier

Summary and Standard Provisions

The QuadGuard® Elite M10 4-bay and 8-bay systems as described herein meet the evaluation criteria for a MASH redirective, non-gating crash cushion at TL-2 and TL-3 impact conditions respectively, and are eligible for reimbursement, and may be installed under the range of conditions tested. It is further acknowledged that the QuadGuard Elite M10 can be installed with existing QuadGuard M10 Transition hardware.

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

- This letter provides a AASHTO/ARTBA/AGC Task Force 13 designator that should be used for the purpose of the creation of a new and/or the update of existing Task Force 13 drawing for posting on the on-line 'Guide to Standardized Highway Barrier Hardware' currently referenced in AASHTO Roadside Design Guide.
- This finding of eligibility does not cover other structural features of the systems, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may influence system conformance with MASH will require a new reimbursement eligibility letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals safety problems, or that the system is significantly different from the version that was crash tested, we reserve the right to modify or revoke this letter.
- You are expected to supply potential users with sufficient information on design and installation 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 crashworthiness requirements of the Manual for Assessing Safety Hardware.
- To prevent misunderstanding by others, this letter of eligibility is designated as a number CC-112A 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 QuadGuard® Elite M10 attenuators are patented products and considered proprietary. If proprietary devices are specified by highway agency for use on Federal-aid projects, except exempt, non-NHS 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.

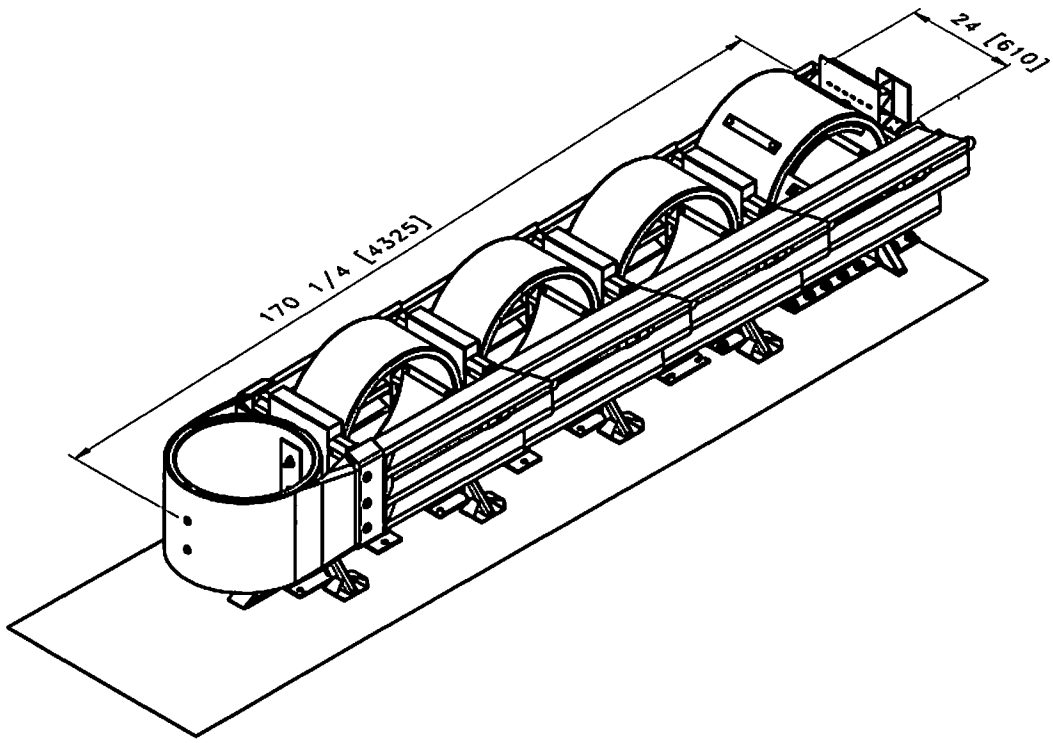
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

Michael S. Griffith

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

Enclosures



2011

QUADGUARD ELITE M10 NARROW 4-BAY

ENERGY ABSORPTION SYSTEMS, INC.
A TRINITY INDUSTRIES, INC. COMPANY

QM7024E

SHEET NO.	DATE:
1 of 1	7/7/2011

INTENDED USE

The QuadGuard® Elite M10 System is a member of the QuadGuard® Family designed to shield narrow or wide hazards. The QuadGuard® Elite M10 offers impact protection for both light and heavy vehicles. The system is intended to shield gore areas, bifurcations and rigid hazards such as bridge piers, tollbooths, and exposed ends of concrete barrier. The 4-Bay system is designed to safely dissipate the kinetic energy of errant passenger vehicles traveling at speeds up to 44 mph [70 km/h], *(see QuadGuard Elite M10 product literature for more detailed impact performance specifications.)*

When hit head-on, a series of cylinders, placed between rigid diaphragms and overlapping fender panels, compress. This action absorbs the kinetic energy from the impacting vehicle, bringing the vehicle to a controlled stop. When impacted along the side at an angle, the system redirects the vehicle away from the hazard and back into the flow of traffic.

During many impacts, most if not all components survive without damage. Two types of cylinders, the ME-1 and ME-2, are required, permitting convenient stocking of these easily replaceable elements. The QuadGuard® Elite M10 Narrow 4-Bay system is available for head-on design speeds up to 44 mph [70 km/h], for hazards from 24 in. [610 mm] to 36 in. [916 mm] in width.

The QuadGuard® Elite M10 Narrow 4-Bay System has been FHWA accepted for the TL-2 MASH test matrix for both light cars and high center-of-gravity pickup trucks traveling at speeds up to 44 mph [70 km/h] at angles up to 25 degrees. System characteristics include;

- Non-gating
- Redirecting
- Non-pocketing
- Bidirectional or Unidirectional Design
- Reusable

Length =15 ft. 1/2 in. [4.59 m]

Width = (standard) 24 in. [610 mm] Min
(standard) 36 in. [916 mm] Max

Speed = variable up to 44 mph [70 km/h]

APPROVALS

REFERENCES

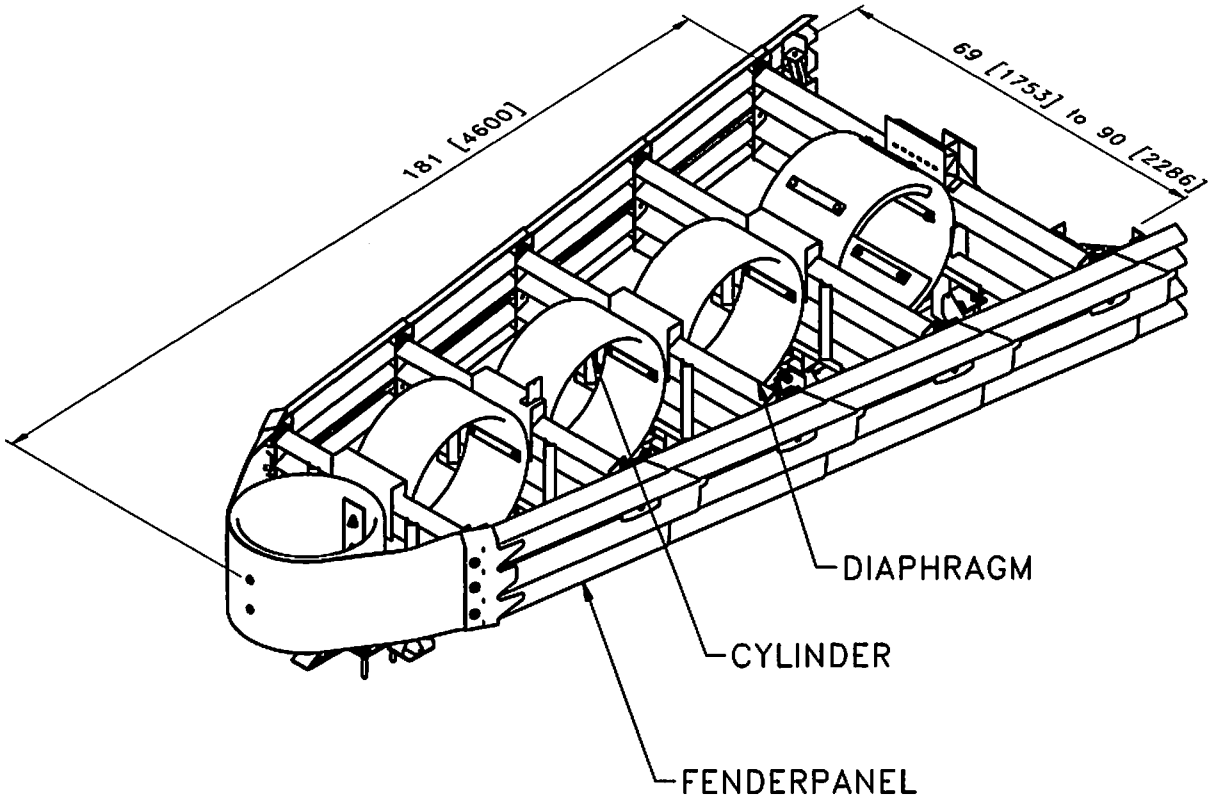
CONTACT INFORMATION

Corporate Offices:
2525 North Stemmons Freeway
Dallas, TX 75207
Telephone: (888) 323-6374
FAX: (800) 770-6755
http://www.energyabsorption.com/

QUADGUARD ELITE M10 NARROW 4-BAY

SHEET NO.	DATE
2 of 2	7/13/2011

ENERGY ABSORPTION SYSTEMS, INC.
A TRINITY INDUSTRIES, INC. COMPANY



2011

QUADGUARD ELITE M10 WIDE 4-BAY

ENERGY ABSORPTION SYSTEMS, INC.
A TRINITY INDUSTRIES, INC. COMPANY

QM7090E

SHEET NO.	DATE:
1 of 1	7/7/2011

INTENDED USE

The QuadGuard® Elite M10 System is a member of the QuadGuard® Family designed to shield narrow or wide hazards. The QuadGuard® Elite M10 offers impact protection for both light and heavy vehicles. The system is intended to shield gore areas, bifurcations and rigid hazards such as bridge piers, tollbooths, and exposed ends of concrete barrier. The 4-Bay system is designed to safely dissipate the kinetic energy of errant passenger vehicles traveling at speeds up to 44 mph [70 km/h], *(see QuadGuard Elite M10 product literature for more detailed impact performance specifications.)*

When hit head-on, a series of cylinders, placed between rigid diaphragms and overlapping fender panels, compress. This action absorbs the kinetic energy from the impacting vehicle, bringing the vehicle to a controlled stop. When impacted along the side at an angle, the system redirects the vehicle away from the hazard and back into the flow of traffic.

During many impacts, most if not all components survive without damage. Two types of cylinders, the ME-1 and ME-2, are required, permitting convenient stocking of these easily replaceable elements. The QuadGuard® Elite M10 Wide 4-Bay system is available for head-on design speeds up to 44 mph [70 km/h], for hazards from 69 in. [1753 mm] to 90 in. [2286 mm] in width.

The QuadGuard® Elite M10 4-Bay Wide System has been FHWA accepted for the TL-2 MASH test matrix for both light cars and high center-of-gravity pickup trucks traveling at speeds up to 44 mph [70 km/h] at angles up to 25 degrees. System characteristics include;

- Non-gating
- Redirecting
- Non-pocketing
- Bidirectional or Unidirectional Design
- Reusable

Length =15 ft. 1in. [4.60 m]

Width = (standard) 69 in. [1753 mm] Min
(standard) 90 in. [2286 mm] Max

Speed = variable up to 44 mph [70 km/h]

APPROVALS

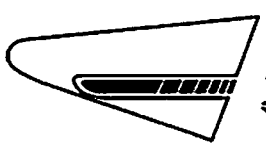
REFERENCES

CONTACT INFORMATION

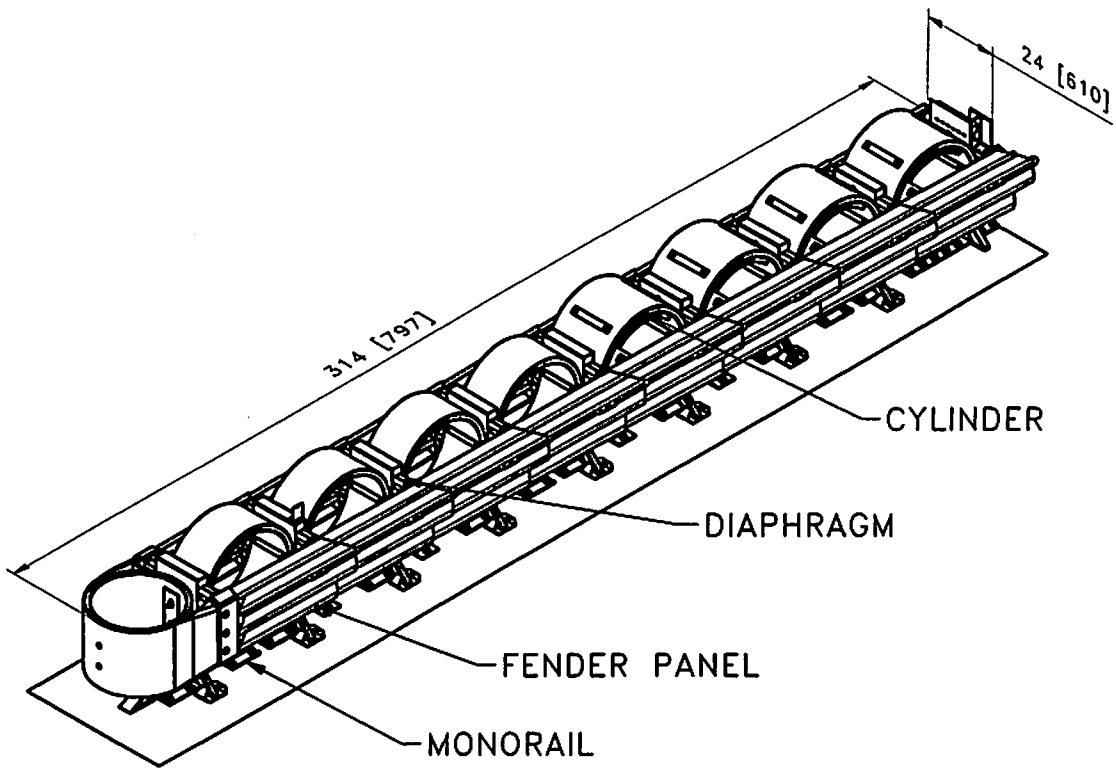
Corporate Offices:
2525 North Stemmons Freeway
Dallas, TX 75207
Telephone: (888) 323-6374
FAX: (800) 770-6755
http://www.energyabsorption.com/

QUADGUARD ELITE M10 WIDE 4-BAY

SHEET NO.	DATE
2 of 2	7/13/2011



ENERGY ABSORPTION SYSTEMS, INC.
A TRINITY INDUSTRIES, INC. COMPANY



2011

QUADGUARD ELITE M10 NARROW 8-BAY

ENERGY ABSORPTION SYSTEMS, INC.
A TRINITY INDUSTRIES, INC. COMPANY

QM10024E

SHEET NO.	DATE:
1 of 1	7/7/2011

INTENDED USE

The QuadGuard® Elite M10 System is a member of the QuadGuard® Family designed to shield narrow or wide hazards. The QuadGuard® Elite M10 offers impact protection for both light and heavy vehicles. The system is intended to shield gore areas, bifurcations and rigid hazards such as bridge piers, tollbooths, and exposed ends of concrete barrier. The 8-bay system is designed to safely dissipate the kinetic energy of errant passenger vehicles traveling at speeds up to 62 mph [100 km/h], *(see QuadGuard Elite M10 product literature for more detailed impact performance specifications.)*

When hit head-on, a series of cylinders, placed between rigid diaphragms and overlapping fender panels, compress. This action absorbs the kinetic energy from the impacting vehicle, bringing the vehicle to a controlled stop. When impacted along the side at an angle, the system redirects the vehicle away from the hazard and back into the flow of traffic.

During many impacts, most if not all components survive without damage. Two types of cylinders, the ME-1 and ME-2, are required, permitting convenient stocking of these easily replaceable elements. The QuadGuard® Elite M10 Narrow 8-bay system is available for head-on design speeds up to 62 mph [100 km/h], for hazards from 24 in. [610 mm] to 36 in. [916 mm] in width.

The QuadGuard® Elite M10 8-Bay System has been FHWA accepted for the TL-3 MASH test matrix for both light cars and high center-of-gravity pickup trucks traveling at speeds up to 62 mph [100 km/h] at angles up to 25 degrees. System characteristics include;

- Non-gating
- Redirecting
- Non-pocketing
- Bidirectional or Unidirectional Design
- Reusable

Length =25 ft. 10 in. [7.87 m]

Width = (standard) 24 in. [610 mm] Min
(standard) 36 in. [916 mm] Max

Speed = variable up to 62 mph [100 km/h]

APPROVALS

REFERENCES

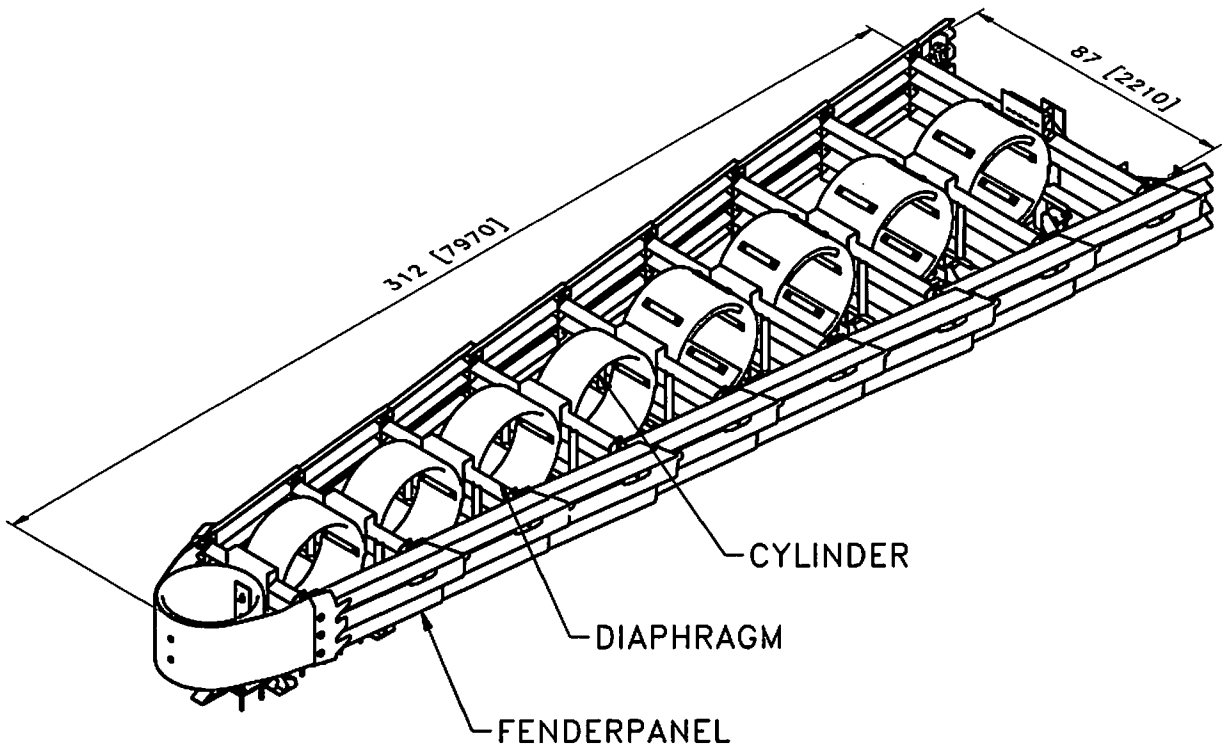
CONTACT INFORMATION

Corporate Offices:
2525 North Stemmons Freeway
Dallas, TX 75207
Telephone: (888) 323-6374
FAX: (800) 770-6755
http://www.energyabsorption.com/

QUADGUARD ELITE M10 NARROW 8-BAY

SHEET NO.	DATE
2 of 2	7/13/2011

ENERGY ABSORPTION SYSTEMS, INC.
A TRINITY INDUSTRIES, INC. COMPANY



2011

QUADGUARD ELITE M10 WIDE 8-BAY

ENERGY ABSORPTION SYSTEMS, INC.
A TRINITY INDUSTRIES, INC. COMPANY

QM10090E

SHEET NO.	DATE:
1 of 1	7/7/2011

INTENDED USE

The QuadGuard® Elite M10 System is a member of the QuadGuard® Family designed to shield narrow or wide hazards. The QuadGuard® Elite M10 offers impact protection for both light and heavy vehicles. The system is intended to shield gore areas, bifurcations and rigid hazards such as bridge piers, tollbooths, and exposed ends of concrete barrier. The 8-Bay system is designed to safely dissipate the kinetic energy of errant passenger vehicles traveling at speeds up to 62 mph [100 km/h], *(see QuadGuard Elite M10 product literature for more detailed impact performance specifications.)*

When hit head-on, a series of cylinders, placed between rigid diaphragms and overlapping fender panels, compress. This action absorbs the kinetic energy from the impacting vehicle, bringing the vehicle to a controlled stop. When impacted along the side at an angle, the system redirects the vehicle away from the hazard and back into the flow of traffic.

During many impacts, most if not all components survive without damage. Two types of cylinders, the ME-1 and ME-2, are required, permitting convenient stocking of these easily replaceable elements. The QuadGuard® Elite M10 Wide 4-Bay system is available for head-on design speeds up to 62 mph [100 km/h], for hazards from 69 in. [1753 mm] to 90 in. [2286 mm] in width.

The QuadGuard® Elite M10 8-Bay Wide System has been FHWA accepted for the TL-3 MASH test matrix for both light cars and high center-of-gravity pickup trucks traveling at speeds up to 62 mph [100 km/h] at angles up to 25 degrees. System characteristics include;

- Non-gating
- Redirecting
- Non-pocketing
- Bidirectional or Unidirectional Design
- Reusable

Length =26 ft. 0in. [7.97 m]

Width = (standard) 69 in. [1753 mm] Min
(standard) 90 in. [2286 mm] Max

Speed = variable up to 62 mph [100 km/h]

APPROVALS

REFERENCES

CONTACT INFORMATION

Corporate Offices:
2525 North Stemmons Freeway
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QUADGUARD ELITE M10 WIDE 8-BAY

SHEET NO.	DATE
2 of 2	7/13/2011

ENERGY ABSORPTION SYSTEMS, INC.
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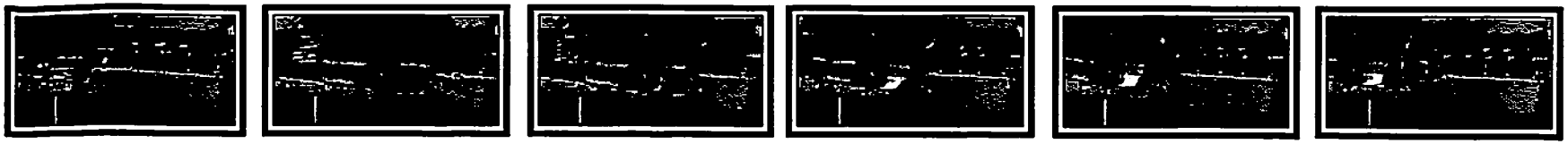
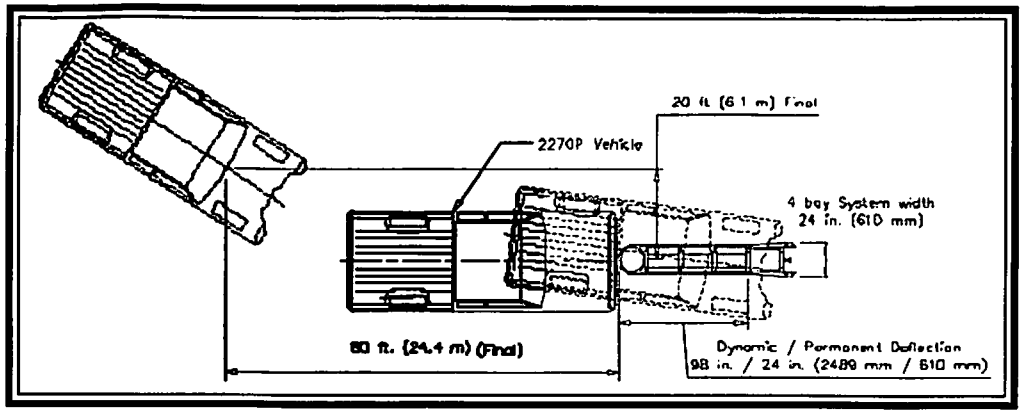
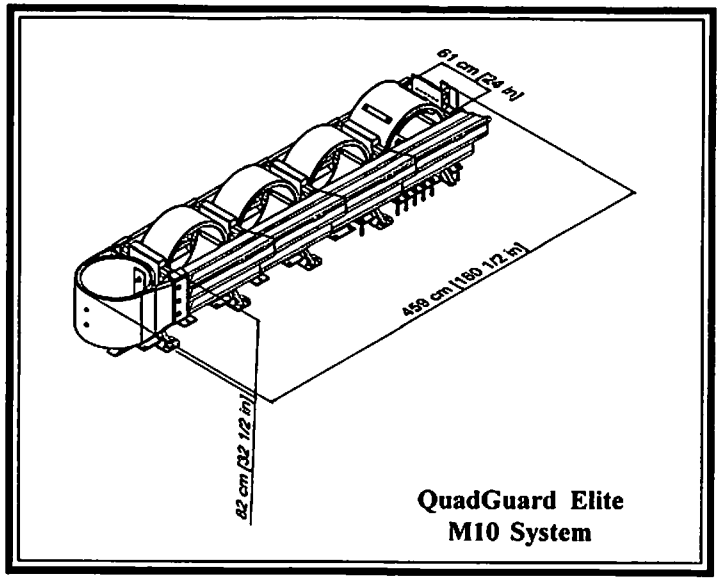






General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	MASH Test 2-31
Test No.	01-2800-003
Date	4/5/11

Test Article

Type	Energy Absorption System
	QuadGuard Elite M10 System
Installation Length	4 bay 180.5 in. (2590 mm) long
	24 in. (610) mm wide
Material and key elements	(5) energy absorbing HDPE cylinders
	AASHTO M180 Quad Panels
	ASTM A36 other, galvanized
	steel construction
Foundation Type and Condition	Unreinforced 27.6 Mpa concrete,
	clean and dry, with (66) 19 mm x
	178 mm ASTM A193 Grade B-7
	threaded studs and
	MP-3 Anchoring System

Test Vehicle

Type	Production Model
Designation	2270P
Model	2004 Dodge 1500 Quadcab Pickup
Mass	
Curb	4830 lb (2191 kg)
Test inertial	4936 lb (2239 kg)
Dummy	N/A
Gross Static	4936 lb (2239 kg)

Impact Conditions

Speed	43.7 mi/h (70.3 km/h)
Angle (deg)	0
Impact Severity	314.8 ft-kip (426.9 kJ)

Exit conditions

Speed (rebound)	13.7 mi/h (22.0 km/h)
Angle (deg - veh. c.g.)	2

Occupant Risk Values

Impact Velocity (absolute value)	
x-direction	26.0 ft/s (7.9 m/s)
y-direction	0.9 ft/s (0.3 m/s)
Ridedown Acceleration (g's - absolute value)	
x-direction	17.8
y-direction	1.8

European Committee for Normalization (EN) Values

THIV	17.7 mi/h (28.5 km/h)
PHD (g's)	17.8
ASI	1.1

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	2.8
Maximum Pitch Angle	2.4
Maximum Yaw Angle	12.0

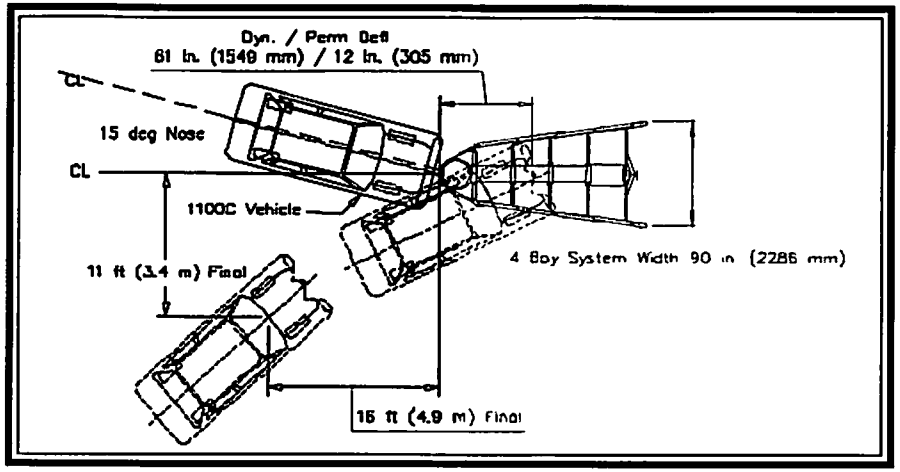
Test Article Deflections

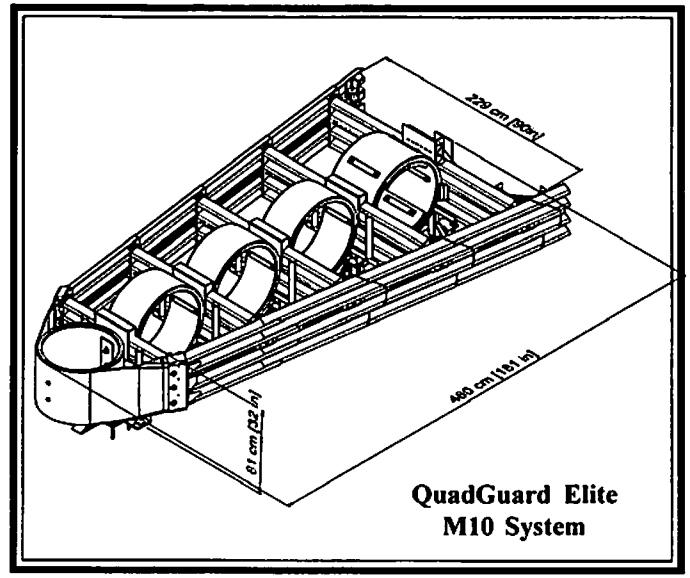
Dynamic	98in. (2489 mm)
Permanent	24 in. (610 mm)

Vehicle Damage (Primary Impact)

Exterior	
VDS	FD-4
CDC	12FDEW4
Interior	
VCDI	AS0000000
Maximum Deformation	Negligible

Figure 1. Summary of Results - QuadGuard Elite M10 System Test 01-2800-003





QuadGuard Elite
M10 System

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	MASH Test 2-32
Test No.	01-2800-004
Date	4/14/11

Test Article

Type	Energy Absorption System
	QuadGuard Elite M10 System
Installation Length	4 bay 181 in. (4600mm) long
	90 in. (2286) mm wide
Material and key elements	(5) energy absorbing HDPE cylinders
	AASHTO M180 Quad Panels
	ASTM A36 other, galvanized
	steel construction
Foundation Type and Condition	Unreinforced 27.6 Mpa concrete,
	clean and dry, with (66) 19 mm x
	178 mm ASTM A193 Grade B-7
	threaded studs and
	MP-3 Anchoring System

Test Vehicle

Type	Production Model
Designation	1100C
Model	2004 Kia Rio 4 Door Sedan

Mass

Curb	2297 lb (1042 kg)
Test inertial	2434 lb (1104 kg)
Dummy	165 lb (75 kg)
Gross Static	2599 lb (1179 kg)

Impact Conditions

Speed	43.7 mi/h (70.3 km/h)
Angle (deg)	15
Impact Severity	155.2 ft-kip (210.5 kJ)

Exit conditions

Speed (rebound)	13.7 mi/h (22 km/h)
Angle (deg - veh. c.g.)	20

Occupant Risk Values (absolute value)

Impact Velocity	
x-direction	32.6 ft/s (9.9 m/s)
y-direction	1.3 ft/s (0.4 m/s)
Ridedown Acceleration (g's)	
x-direction	12.0
y-direction	2.8

European Committee for Normalization (EN) Values

THIV	22.5 mi/h (36.2 km/h)
PHD (g's)	12.0
ASI	0.9

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-3.7
Maximum Pitch Angle	-4.9
Maximum Yaw Angle	-49.8

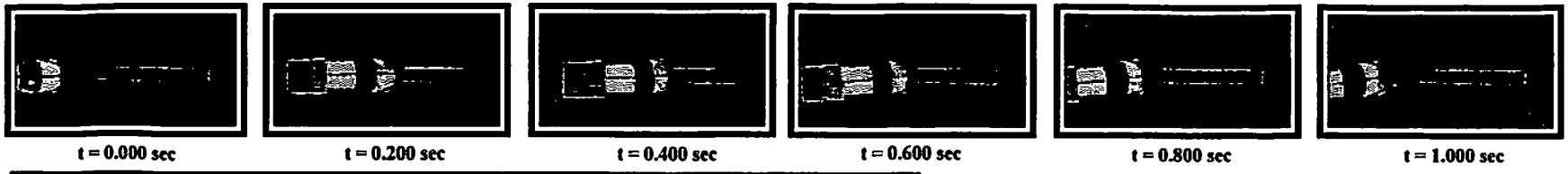
Test Article Deflections

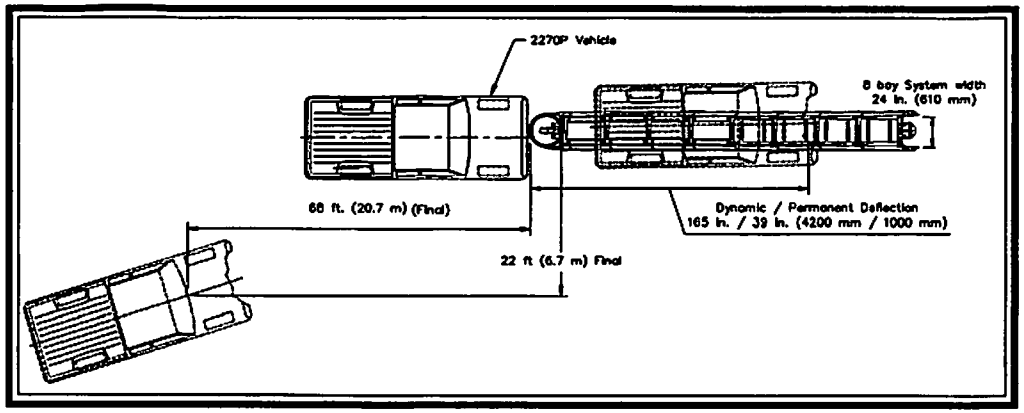
Dynamic	61 in. (1549 mm)
Permanent	12 in. (610 mm)

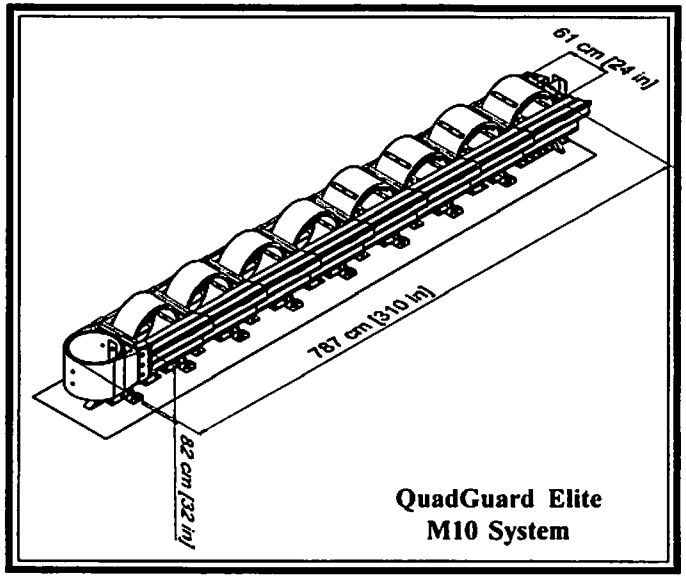
Vehicle Damage (Primary Impact)

Exterior	
VDS	FD-2
CDC	12FDEW2
Interior	
VCDI	AS0000000
Maximum Deformation	Negligible

Figure 6. Summary of Results - QuadGuard Elite M10 System Test 01-2800-004







General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	MASH Test 3-31
Test No.	01-2800-001
Date	12/2/10

Test Article

Type	Energy Absorption System
	QuadGuard Elite M10 System
Installation Length	8 bay 322 in. (8179 mm) long
	24 in. (610) mm wide
Material and key elements	(9) energy absorbing HDPE cylinders
	AASHTO M180 Quad Panels
	ASTM A36 other, galvanized
	steel construction
Foundation Type and Condition	Unreinforced 27.6 Mpa concrete,
	clean and dry, with (66) 19 mm x
	178 mm ASTM A193 Grade B-7
	threaded studs and
	MP-3 Anchoring System

Test Vehicle

Type	Production Model
Designation	2270P
Model	2004 Dodge 1500 Quadcab Pickup
Mass	
Curb	4821 lb (2187 kg)
Test inertial	5015 lb (2275 kg)
Dummy	N/A
Gross Static	5015 lb (2275 kg)

Impact Conditions

Speed	59.9 mi/h (96.4 km/h)
Angle (deg)	0
Impact Severity	601.1 ft-kip (815.1 kJ)

Exit conditions

Speed (rebound)	19.7 mi/h (31.7 km/h)
Angle (deg - veh. c.g.)	7

Occupant Risk Values

Impact Velocity (absolute value)	
x-direction	30.4 ft/s (9.3 m/s)
y-direction	0.8 ft/s (0.2 m/s)
Ridedown Acceleration (g's - absolute value)	
x-direction	13.1
y-direction	3.3

European Committee for Normalization (EN) Values

THIV	20.8 mi/h (33.4 km/h)
PHD (g's)	13.2
ASI	0.9

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-4.3
Maximum Pitch Angle	-9.4
Maximum Yaw Angle	-22.6

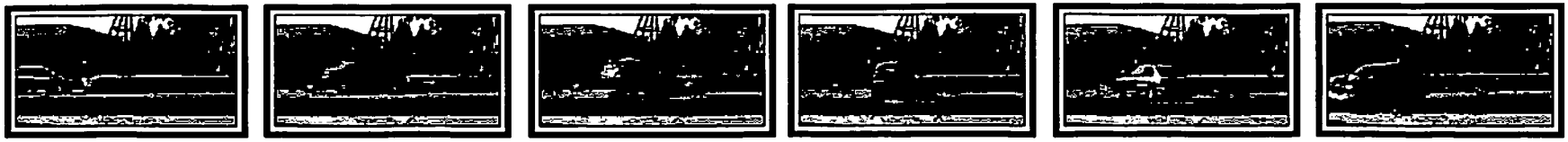
Test Article Deflections

Dynamic	165 in. (4200 mm)
Permanent	39 in. (1000 mm)

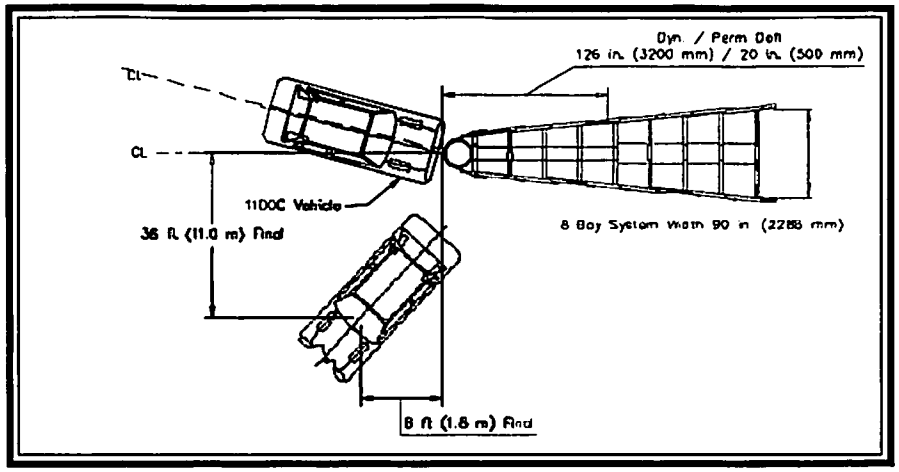
Vehicle Damage (Primary Impact)

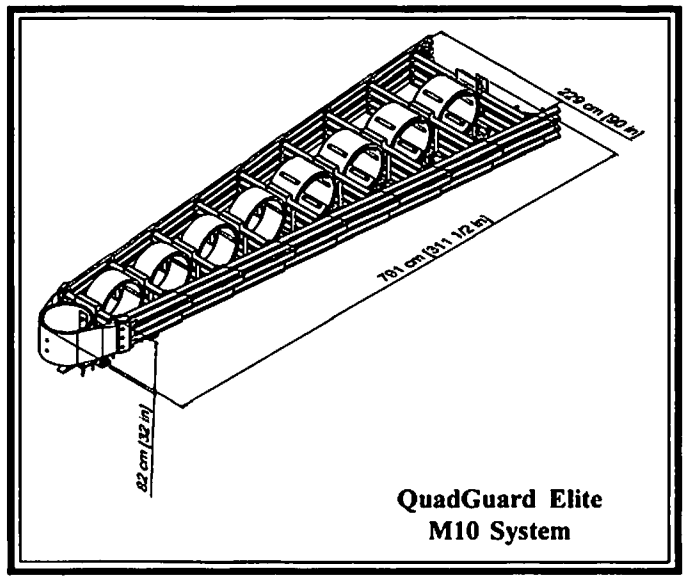
Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
VCDI	AS0000000
Maximum Deformation	Negligible

Figure 1. Summary of Results - QuadGuard Elite M10 System Test 01-2800-001



t = 0.000 sec | t = 0.200 sec | t = 0.400 sec | t = 0.600 sec | t = 0.800 sec | t = 2.000 sec





QuadGuard Elite
M10 System

General Information	
Test Agency	E-TECH Testing Services, Inc.
Test Designation	MASH Test 3-32
Test No.	01-2800-002
Date	2/23/11
Test Article	
Type	Energy Absorption System
	QuadGuard Elite M10 System
Installation Length	8 bay 322 in. (8179 mm) long
	90 in. (2286) mm wide
Material and key elements	(9) energy absorbing HDPE cylinders
	AASHTO M180 Quad Panels
	ASTM A36 other, galvanized
	steel construction
Foundation Type and Condition	Unreinforced 27.6 Mpa concrete,
	clean and dry, with (66) 19 mm x
	178 mm ASTM A193 Grade B-7
	threaded studs and
	MP-3 Anchoring System
Test Vehicle	
Type	Production Model
Designation	1100C
Model	2004 Kia Rio 4 Door Sedan
Mass	
Curb	2432 lb (1103 kg)
Test inertial	2480 lb (1125 kg)
Dummy	165 lb (75 kg)
Gross Static	2646 lb (1200 kg)
Impact Conditions	
Speed	61.1 mi/h (98.3 km/h)
Angle (deg)	15
Impact Severity	309.4 ft-kip (419.6 kJ)

Exit conditions	
Speed	N/A
Angle (deg - veh. c.g.)	N/A
Occupant Risk Values (absolute value)	
Impact Velocity	
x-direction	38.7 ft/s (11.8 m/s)
y-direction	1.3 ft/s (0.4 m/s)
Ridedown Acceleration (g's)	
x-direction	8.9
y-direction	4.6
European Committee for Normalization (EN) Values	
THIV	26.7 mi/h (42.9 km/h)
PHD (g's)	9.8
ASI	1.2
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	-21.6
Maximum Pitch Angle	-13.4
Maximum Yaw Angle	-238.0
Test Article Deflections	
Dynamic	126 in. (3200 mm)
Permanent	20 in. (500 mm)
Vehicle Damage (Primary Impact)	
Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
VCDI	AS0000000
Maximum Deformation	Negligible

Figure 6. Summary of Results - QuadGuard Elite M10 System Test 01-2800-002