



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

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

July 30, 2012

In Reply Refer To:  
HSST/CC-121

Mr. Barry D. Stephens, P.E.  
Sr. Vice President Engineering  
Energy Absorption Systems  
3617 Cincinnati Avenue  
Rocklin, CA 95765

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 System: 3-bay QuadGuard<sup>®</sup> M10 (QG M10) Narrow & Wide  
Type of System: Redirective Crash Cushion  
Test Level: AASHTO Manual for Assessing Safety Hardware (MASH) Test  
Level 2 (TL-2)  
Testing conducted by: E-Tech Testing Services, Inc.  
Task Force 13 Designators: SCI30: QG M10 Narrow  
SCI31: QG M10 Wide  
Date of request: March 3, 2011  
Date of completed package: June 15, 2012

### **Decision**

The following device is eligible, with details provided in the form which is attached as an integral part of this letter:

- TL-2 3-bay QuadGuard<sup>®</sup> M10 (QG M10) Narrow & 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 QG M10 Narrow and QG M10 Wide TL-2 systems are redirective, non-gating 3-bay crash cushions. The nose cartridge is not counted as a separate bay. The MASH design has been revised from the National Cooperative Highway Research Program (NCHRP) Report 350 design to include:

- a. reinforced lower front bracket
- b. new upper front bracket
- c. new cartridge types

The QG M10 3-bay system has an overall length of 13 feet (3.96 meters) and can be configured with backup widths of 24 inches (610 millimeters), 30 inches (762 millimeters), and 36 inches (914 millimeters) for QG M10 Narrow systems, and 69 inches (1753 millimeters) and 90 inches (2285 millimeters) for QG M10 Wide systems. The overall height is 32 inches (817 millimeters). The system consists of energy absorbing cartridges surrounded by a framework of steel Quad-Beam™ guardrail panels that telescope rearward during head-on impacts. The system has a backup structure that will resist movement during head-on impacts and a center monorail that will resist lateral movement during side impacts when anchored to an asphalt or concrete base as per manufacturer specifications.

Components from the TL-3 version of the QG II unit that are used on the new TL-2 3-bay QG M10 unit are:

- QG foundation-anchored center Monorail
- QG Fender Panels
- QG Diaphragms
- QG Backup
- MP-3®™ Concrete Anchors
- 14ga steel wrap-around sheet metal Nose
- 2 inch [50 mm] Lower Nose Cartridge Bracket
- 10ga steel rail guide Shims

Components that were modified or added to the TL-2 QG M10 to achieve the required performance include:

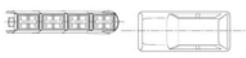
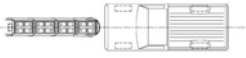


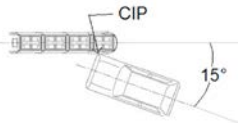
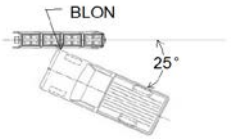
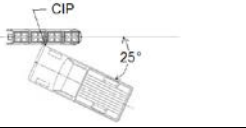
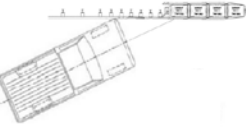

- QG Type M-I cartridges (3 required)
- QG Type M-II cartridges (1 required)
- A hold down bracket was added to the nose cartridge to contain the cartridge and maximize its energy absorption.
- The bottom nose cartridge bracket attached to the diaphragm was reinforced to help restrain the cartridge to maximize its energy absorption.

Design details of the 3-bay QG M10 systems, both narrow and wide are included as an enclosure to this correspondence.

## Findings

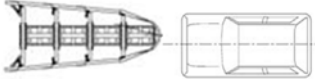
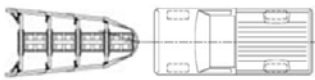
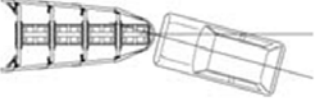
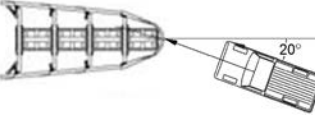
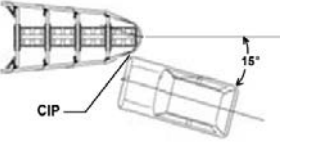
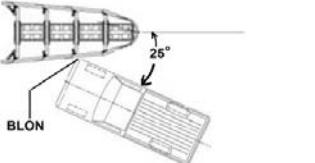
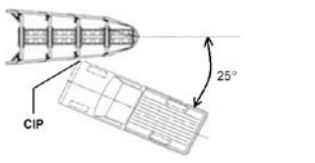
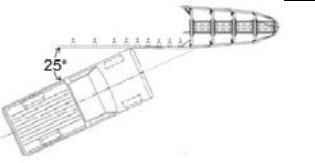

Full-scale physical crash testing was conducted according to the MASH. The following tables list all required crash tests per MASH for Test Level 2 Systems:

### Narrow Systems 24 inches (610 millimeters), 30 inches (762 millimeters), and 36 inches (914 millimeters)

Illustration	Test #	Completed	Notes
	2-30	NO	Test 2-32 was passed with a 3-Bay 2286 mm [90 inches] Wide System. This test was completed as worst case for the 1100C and thus Test 2-30 can be waived for the Narrow Systems.
	2-31	YES	3-Bay 610 mm [24 inches] Narrow System was tested. - Impact speed = 70.6 km/h - Ridedown = -15.1 g's - Longitudinal $\Delta V = 9.0$ m/s Passed all ORV's. In addition and as per AASHTO MASH Section G, an analysis was subsequently conducted on Test 2-31 data. The analysis results has determined MASH Test 2-38 (i.e., 1500A mid-sized vehicle) is required.
	2-32	NO	Test 2-32 was passed with a 3-Bay 2286 mm [90 inches] Wide System. This test was completed as worst case for the 1100C and thus Test 2-32 can be waived for the Narrow Systems.
	2-33	NO	Test 2-31 was passed with a 3-Bay 610 mm [24 inches] Narrow System, tested system capacity for the 2270P and is considered worst case and thus Test 2-33 can be waived for the Narrow Systems.
	2-34	NO	Test 3-34 was passed with a 6-Bay 610 mm [24 inches] Narrow System during the QG M10 TL-3 test program. Test 3-34 is more severe than Test 2-34 and thus Test 2-34 can be waived for the Narrow Systems.
	2-35	NO	Test 3-35 was passed with a 6-Bay 610 mm [24 inches] Narrow System during the QG M10 TL-3 test program. Due to the lateral stiffness of the QuadGuard M10, this test is the same as Test 2-36 and thus can be waived for the Narrow Systems.
	2-36	NO	Test 3-36 was passed on 6-Bay 610 mm [24 inches] System during the QG M10 TL-3 test program. Test 3-36 is more severe than Test 2-36 and thus Test 2-36 can be waived for Narrow Systems.
	2-37	NO	Test 3-37 was passed on 6-Bay 610 mm [24 inches] System during the QG M10 TL-3 test program. Test 3-37 is more severe than Test 2-37 and thus Test 2-37 can be waived.
	2-38	YES	3-Bay 610 mm [24 inches] Narrow System was tested. - Impact speed = 68.3 km/h - Ridedown = -15.9 g's - Longitudinal $\Delta V = 8.6$ m/s

Passed all ORV's for Test 2-38

**Wide Systems 69 inches (1753 millimeters) and 90 inches (2285 millimeters)**

Illustration	Test #	Completed	Notes
	2-30	NO	Test 2-32 was passed with a 3-Bay 2286 mm [90 inches] Wide System. This test was completed as worst case for the 1100C and thus Test 2-30 can be waived for the Wide Systems.
	2-31	NO	Test 2-31 was passed with a 3-Bay 610 mm [24 inches] Narrow System, tested system capacity for the 2270P and is considered worst case and thus Test 2-31 can be waived for the Wide Systems.
	2-32	YES	3-Bay 2286 mm (90 inches) Wide System was tested. - Impact speed = 70.3 km/h - Ridedown = -13.5 g's - Longitudinal $\Delta V = 9.9$ m/s Passed all ORV's.
	2-33	NO	Test 2-31 was passed with a 3-Bay 610 mm [24 inches] Narrow System, tested system capacity for the 2270P, and is considered worst case and thus Test 2-33 can be waived for the Wide Systems.
	2-34	NO	Test 3-34 was passed with a 3-Bay 610 mm [24 inches] Narrow System during the QG M10 TL-3 test program. Test 3-34 is more severe than Test 2-34 on a Wide System and thus Test 2-34 can be waived for the Wide Systems
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	2-36	NO	Test 3-36 was passed on 6-Bay 2286 mm [90 inches] Wide System during the QG M10 TL-3 test program. Test 3-36 is more severe than Test 2-36 on a Wide System and thus Test 2-36 can be waived for Wide Systems.
	2-37	NO	Test 3-37 was passed on 6-Bay 610 mm [24 inches] System during the QG M10 TL-3 test program. Test 3-37 is more severe than Test 2-37 on a Narrow System and thus Test 2-37 can be waived for Wide Systems
	2-38	NO	Test 2-38 was passed with a 3-Bay 610 mm [24 inches] Narrow System and is considered no different for a Wide System and thus Test 2-38 can be waived for the Wide Systems

Since the shorter 3-Bay wide system has a side that is at a steeper angle (10 degrees) than that of the 6-Bay wide system (5 degrees), this 3- Bay wide system installation specification must indicate the traffic-side panels as parallel as possible to the edge of the road or travel way, but no more than 5 degrees off parallel. One-page test summaries for each of the conducted crash tests are included as enclosures to this correspondence. In addition, NCHRP Report 350 crash test summary sheets as also included for 5-bay QG II (wide) and original QG (narrow) systems.

Manufacturer requests previous successfully conducted MASH TL-3 tests 3-34, 3-35, 3-36, and 3-37 be accepted in lieu of proposed MASH TL-2, tests 2-34, 2-35, 2-36, and 2-37 because the redirective ability of the QGM10 is not reduced due to its length due to most of anchor loading occurred in the immediate initial impact area and was not transmitted to adjacent diaphragms.

### **Summary and Standard Provisions**

Therefore, the system described and detailed within this correspondence is eligible for reimbursement and may be installed under the range of conditions tested.

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 test and evaluation criteria of the MASH.
- To prevent misunderstanding by others, this letter of eligibility is designated as number CC-121 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.

- 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 FHWA does not 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

July 30, 2012

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Name of System:	3-bay QuadGuard <sup>®</sup> M10 (QG M10) Narrow & Wide
Type of System:	Redirective Crash Cushion
Test Level:	AASHTO Manual for Assessing Safety Hardware (MASH) Test Level 2 (TL-2)
Testing conducted by:	E-Tech Testing Services, Inc.
Task Force 13 Designators:	SCI30: QG M10 Narrow SCI31: QG M10 Wide
Date of request:	March 3, 2011
Date of completed package:	June 15, 2012

### **Decision**

The following device is eligible, with details provided in the form which is attached as an integral part of this letter:

- TL-2 3-bay QuadGuard<sup>®</sup> M10 (QG M10) Narrow & 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.

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## 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 QG M10 Narrow and QG M10 Wide TL-2 systems are redirective, non-gating 3-bay crash cushions. The nose cartridge is not counted as a separate bay. The MASH design has been revised from the National Cooperative Highway Research Program (NCHRP) Report 350 design to include:

- a. reinforced lower front bracket
- b. new upper front bracket
- c. new cartridge types

The QG M10 3-bay system has an overall length of 13 feet (3.96 meters) and can be configured with backup widths of 24 inches (610 millimeters), 30 inches (762 millimeters), and 36 inches (914 millimeters) for QG M10 Narrow systems, and 69 inches (1753 millimeters) and 90 inches (2285 millimeters) for QG M10 Wide systems. The overall height is 32 inches (817 millimeters). The system consists of energy absorbing cartridges surrounded by a framework of steel Quad-Beam™ guardrail panels that telescope rearward during head-on impacts. The system has a backup structure that will resist movement during head-on impacts and a center monorail that will resist lateral movement during side impacts when anchored to an asphalt or concrete base as per manufacturer specifications.

Components from the TL-3 version of the QG II unit that are used on the new TL-2 3-bay QG M10 unit are:

- QG foundation-anchored center Monorail
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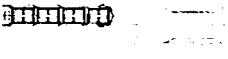

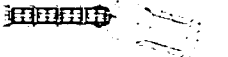

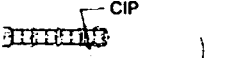

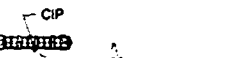
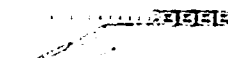
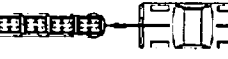
- QG Type M-I cartridges (3 required)
- QG Type M-II cartridges (1 required)
- A hold down bracket was added to the nose cartridge to contain the cartridge and maximize its energy absorption.
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Design details of the 3-bay QG M10 systems, both narrow and wide are included as an enclosure to this correspondence.


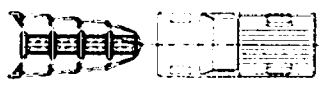
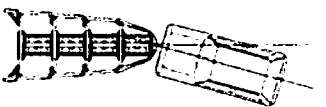
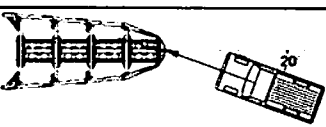
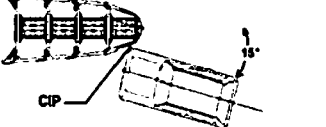
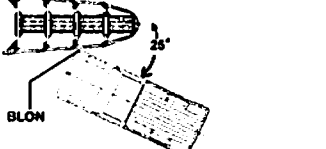
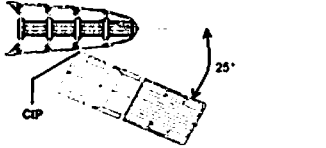


## Findings

Full-scale physical crash testing was conducted according to the MASH. The following tables list all required crash tests per MASH for Test Level 2 Systems:

### Narrow Systems 24 inches (610 millimeters), 30 inches (762 millimeters), and 36 inches (914 millimeters)

Illustration	Test #	Completed	Notes
	2-30	NO	Test 2-32 was passed with a 3-Bay 2286 mm [90 inches] Wide System. This test was completed as worst case for the 1100C and thus Test 2-30 can be waived for the Narrow Systems.
	2-31	YES	3-Bay 610 mm [24 inches] Narrow System was tested. - Impact speed = 70.6 km/h - Ridedown = -15.1 g's - Longitudinal $\Delta V = 9.0$ m/s Passed all ORV's. In addition and as per AASHTO MASH Section G, an analysis was subsequently conducted on Test 2-31 data. The analysis results has determined MASH Test 2-38 (i.e., 1500A mid-sized vehicle) is required.
	2-32	NO	Test 2-32 was passed with a 3-Bay 2286 mm [90 inches] Wide System. This test was completed as worst case for the 1100C and thus Test 2-32 can be waived for the Narrow Systems.
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	2-34	NO	Test 3-34 was passed with a 6-Bay 610 mm [24 inches] Narrow System during the QG M10 TL-3 test program. Test 3-34 is more severe than Test 2-34 and thus Test 2-34 can be waived for the Narrow Systems.
	2-35	NO	Test 3-35 was passed with a 6-Bay 610 mm [24 inches] Narrow System during the QG M10 TL-3 test program. Due to the lateral stiffness of the QuadGuard M10, this test is the same as Test 2-36 and thus can be waived for the Narrow Systems.
	2-36	NO	Test 3-36 was passed on 6-Bay 610 mm [24 inches] System during the QG M10 TL-3 test program. Test 3-36 is more severe than Test 2-36 and thus Test 2-36 can be waived for Narrow Systems.
	2-37	NO	Test 3-37 was passed on 6-Bay 610 mm [24 inches] System during the QG M10 TL-3 test program. Test 3-37 is more severe than Test 2-37 and thus Test 2-37 can be waived.
	2-38	YES	3-Bay 610 mm [24 inches] Narrow System was tested. - Impact speed = 68.3 km/h - Ridedown = -15.9 g's - Longitudinal $\Delta V = 8.6$ m/s Passed all ORV's for Test 2-38

**Wide Systems 69 inches (1753 millimeters) and 90 inches (2285 millimeters)**

Illustration	Test #	Completed	Notes
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	2-34	NO	Test 3-34 was passed with a 3-Bay 610 mm [24 inches] Narrow System during the QG M10 TL-3 test program. Test 3-34 is more severe than Test 2-34 on a Wide System and thus Test 2-34 can be waived for the Wide Systems
	2-35	NO	Test 3-35 was passed with a 3-Bay 610 mm [24 inches] Narrow System during the QG M10 TL-3 test program. Test 3-35 is more severe than Test 2-35 on a Wide System and thus Test 2-35 can be waived for the Wide Systems
	2-36	NO	Test 3-36 was passed on 6-Bay 2286 mm [90 inches] Wide System during the QG M10 TL-3 test program. Test 3-36 is more severe than Test 2-36 on a Wide System and thus Test 2-36 can be waived for Wide Systems.
	2-37	NO	Test 3-37 was passed on 6-Bay 610 mm [24 inches] System during the QG M10 TL-3 test program. Test 3-37 is more severe than Test 2-37 on a Narrow System and thus Test 2-37 can be waived for Wide Systems
	2-38	NO	Test 2-38 was passed with a 3-Bay 610 mm [24 inches] Narrow System and is considered no different for a Wide System and thus Test 2-38 can be waived for the Wide Systems

Since the shorter 3-Bay wide system has a side that is at a steeper angle (10 degrees) than that of the 6-Bay wide system (5 degrees), this 3- Bay wide system installation specification must indicate the traffic-side panels as parallel as possible to the edge of the road or travel way, but no more than 5 degrees off parallel.

One-page test summaries for each of the conducted crash tests are included as enclosures to this correspondence. In addition, NCHRP Report 350 crash test summary sheets are also included for 5-bay QG II (wide) and original QG (narrow) systems.

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### **Summary and Standard Provisions**

Therefore, the system described and detailed within this correspondence is eligible for reimbursement and may be installed under the range of conditions tested.

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 test and evaluation criteria of the MASH.
- To prevent misunderstanding by others, this letter of eligibility is designated as number CC-121 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.

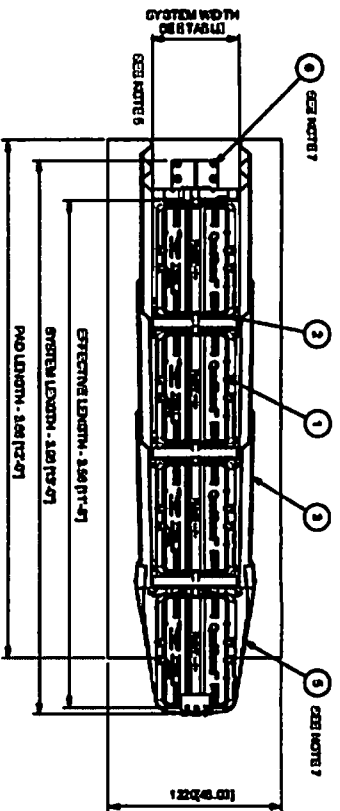
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The FHWA does not become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

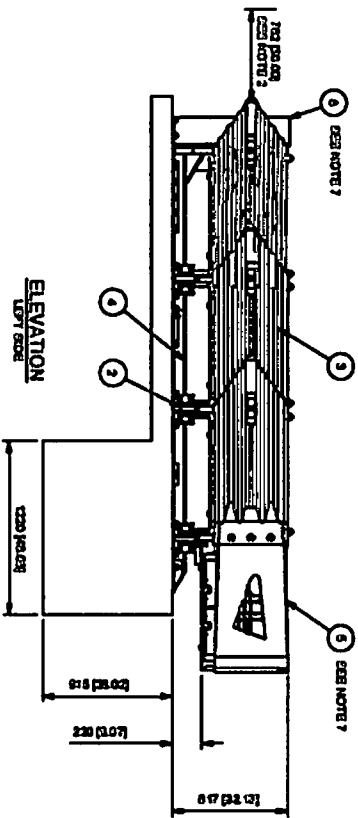


Michael S. Griffith  
Director, Office of Safety Technologies  
Office of Safety

Enclosures



PLAN



ELEVATION  
LEFT SIDE

- NOTES
1. IN CONFORMANCE WITH THE ABOVE 2000 RPOC/CED DESIGN GUIDE, MANUFACTURER RECOMMENDING REMOVAL OF ALL CURBS AND CHAINS TO PREVENT PROPER CONTACT PERFORMANCE.
  2. RPOC/CED SHALL USE WALKER FOR RUBBER FLOORING PANELS TO CURBS REQUIRING UPON! IMPACT THE P.O. ON WALK.
  3. 150 P.C. AND REINFORCED 28 MPA (4000 PSI) P.C. CONCRETE PAVEMENT SHALL BE 150 MM (6 IN) THICKNESS OVERDRAIN FROM PERMITS P.C. CONCRETE REINFORCEMENT, REINFORCED AT LEAST 180 MM (7 IN) WALKER BY 150 MM (6 IN) WALKER.
  4. SEE THIS QUADGUARD M10 SYSTEM PRODUCT MANUAL FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS. BEFORE PLACING A SYSTEM AT A GIVEN SITE, PERFORMANCE AND COVER OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT 800-598-6574.
  5. THESE NOTES ARE THE PROPERTY OF THE CUSTOMER. THEY SHALL BE AN INTEGRAL PART OF THE QUADGUARD M10 SYSTEM TO THE OBJECT BEING ORDERED.
  6. UNITS OF MANUFACTURE AND MATERIALS (CHECKED UNLESS OTHERWISE NOTED)
  7. DUCTS, MONORAIL, AND HOSE ASSEMBLIES ARE NOT INCLUDED IN MODEL NUMBER ORDER ESTIMATE.
  8. THE QUADGUARD M10 SYSTEM HAS BEEN TESTED TO MEET

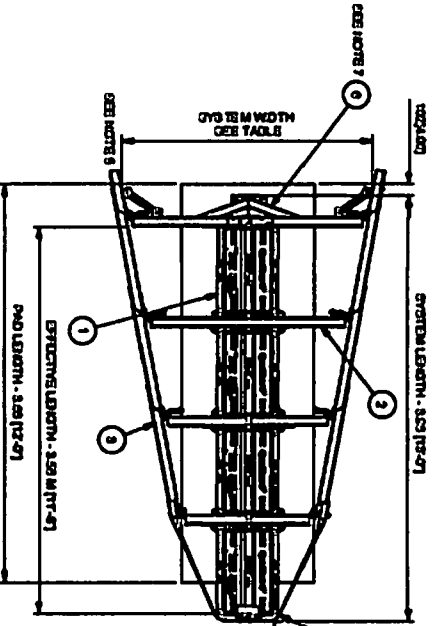
<p>1 CARTRIDGE</p> <p>2 MONORAIL</p> <p>3 DYNAMICAL</p> <p>4 HOSE ASSEMBLY</p> <p>5 FLOOR PANEL</p> <p>6 GROUP</p>	<p>7 DYNAMICAL</p> <p>8 HOSE ASSEMBLY</p> <p>9 GROUP</p>	<p>10 CARTRIDGE</p> <p>11 MONORAIL</p> <p>12 DYNAMICAL</p> <p>13 HOSE ASSEMBLY</p> <p>14 FLOOR PANEL</p> <p>15 GROUP</p>	<p>16 CARTRIDGE</p> <p>17 MONORAIL</p> <p>18 DYNAMICAL</p> <p>19 HOSE ASSEMBLY</p> <p>20 FLOOR PANEL</p> <p>21 GROUP</p>
<p>DATE</p> <p>REV</p> <p>BY</p> <p>CHK</p> <p>APP</p>	<p>DATE</p> <p>REV</p> <p>BY</p> <p>CHK</p> <p>APP</p>	<p>DATE</p> <p>REV</p> <p>BY</p> <p>CHK</p> <p>APP</p>	<p>DATE</p> <p>REV</p> <p>BY</p> <p>CHK</p> <p>APP</p>
<p>REVISED ORDER</p> <p>NO. OF UNITS</p>	<p>REVISED ORDER</p> <p>NO. OF UNITS</p>	<p>REVISED ORDER</p> <p>NO. OF UNITS</p>	<p>REVISED ORDER</p> <p>NO. OF UNITS</p>

UNDERSTANDING

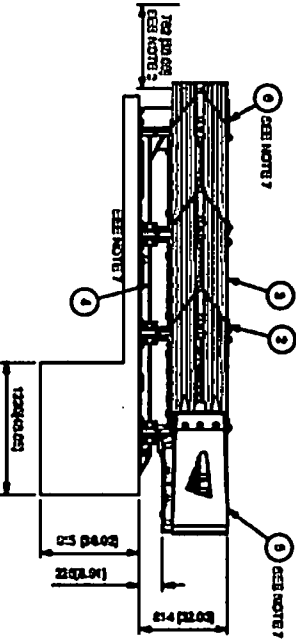
ENERGY ASSISTED SYSTEMS, INC.  
DESIGNING AND BUILDING THE FUTURE

QUADGUARD® M10 3 BAY SYSTEM  
MANUAL SYSTEM WITH TRACTION BRUSH GROUP

QUADGUARD M10 3 BAY SYSTEM



PLAN



ELEVATION

- NOTES:**
1. IS COMPATIBLE WITH THE ASHITO 2000 ROOFLOAD DESIGN GUIDELINES. STRUCTURE REQUIRES REMOVAL OF ALL CURBS AND BARRIERS TO EXISTING PROPOSED DRIVE THROUGH.
  2. ROOFLOAD SHALL BE BASED FOR 2000 WIND SPEEDS TO SURE ROOFLOADS UPON IMPACT FOR 100 MPH WIND.
  3. TO BE PAID FOR BY CUSTOMER AS A PORTION OF THE TOTAL COST OF THE SYSTEM. THE PRICE WILL BE BASED UPON THE QUANTITY ORDERED. SEE NOTE 1 FOR MORE INFORMATION.
  4. SEE THE QUADGUARD H10 SYSTEM PRODUCT MANUAL FOR A DESCRIPTION OF THE SYSTEM. RECOMMENDED CHARACTERISTICS AND DESIGN LIMITS ARE PROVIDED IN THE PRODUCT MANUAL. CONSULTATION AND COOPERATION OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (800) 883-8774.
  5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN APPROPRIATE TRAFFIC SIGN FROM THE QUADGUARD H10 SYSTEM TO THE OBJECT BEING PROTECTED.
  6. WEIGHT OF QUADGUARD H10 SYSTEM AND HULL WEIGHTS ARE NOT INCLUDED IN WEIGHT, ORDER EDVANTLY.
  7. QUADGUARD H10 AND HOCX ASSSEMBLIES ARE NOT INCLUDED IN WEIGHT, ORDER EDVANTLY.
  8. THE QUADGUARD H10 HAS BEEN TESTED TO WACCA.

- 1 CHAIRS
- 2 BACKPACK
- 3 FENDER PANEL
- 4 MONORAIL
- 5 HOCX ASSEMBLY
- 6 HOCX

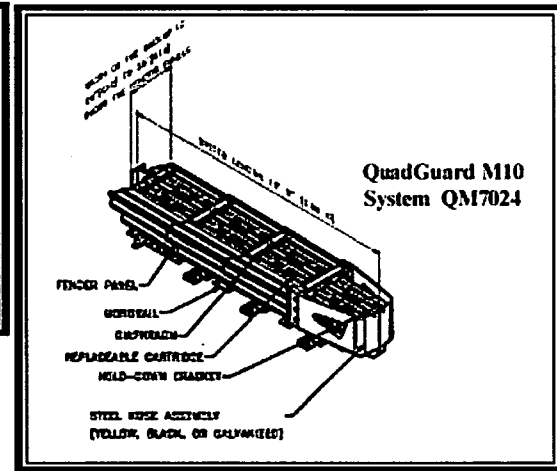
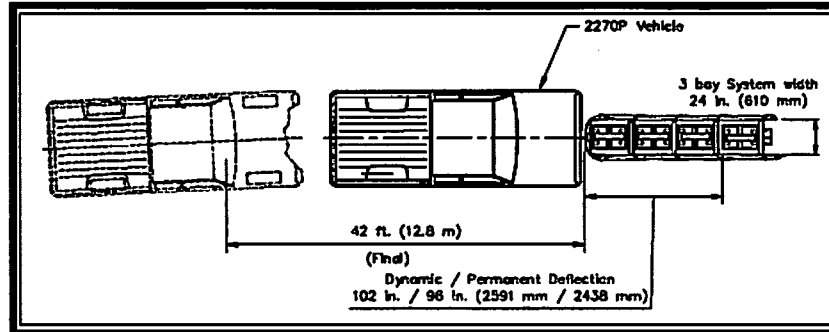
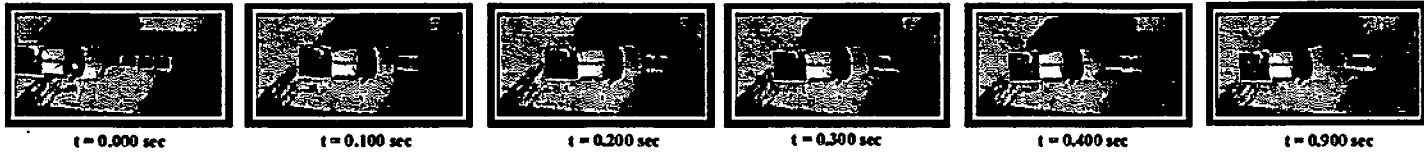
Rev	By	Chk	App

BAY 1	BAY 2	BAY 3	BAY 4	MAX. DESIGN SPEED	NO. OF CHAIRS

**REFERENCES**

NO.	DESCRIPTION	REV	DATE

**QUADGUARD H10 3 BAY SYSTEM**  
 MADE SPECIFIC TO THIS PROJECT  
 QUADGUARD H10 3 BAY SYSTEM  
 MADE SPECIFIC TO THIS PROJECT



**General Information**

Test Agency ..... E-TECH Testing Services, Inc.  
 Test Designation ..... MASH Test 2-31  
 Test No. .... 01-2810-001  
 Date ..... 11/5/10

**Test Article**

Type ..... Energy Absorption System  
 QuadGuard M10 System QM7024  
 Installation Length ..... 3 bay 13 ft. (3962 mm) long  
 24 in. (610) mm wide  
 Material and key elements ..... (4) energy absorbing cartridges  
 (3) Type M-I and (1) Type M-II  
 AASHTO M180 Quad Panels  
 ASTM A36 other, galvanized  
 steel construction  
 Foundation Type and Condition ..... Unreinforced 27.6 Mpa concrete,  
 clean and dry, with (32) 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 ..... 4804 lb (2179 kg)  
 Test inertial ..... 4969 lb (2254 kg)  
 Dummy ..... N/A  
 Gross Static ..... 4969 lb (2254 kg)

**Impact Conditions**

Speed ..... 43.9 mi/h (70.6 km/h)  
 Angle (deg) ..... 0  
 Impact Severity ..... 320.0 ft-kip (433.9 kJ)

**Exit conditions**

Speed ..... N/A  
 Angle (deg - veh. e.g.) ..... N/A

**Occupant Risk Values**

Impact Velocity (absolute value)  
 x-direction ..... 29.6 ft/s (9.0 m/s)  
 y-direction ..... 0.2 ft/s (0.1 m/s)

Ridedown Acceleration (g's - absolute value)  
 x-direction ..... 15.1  
 y-direction ..... 2.0

**European Committee for Normalization (EN) Values**

THIV ..... 20.2 mi/h (32.5 km/h)  
 PHD (g's) ..... 15.1  
 ASI ..... 1.1

**Post-Impact Vehicular Behavior (deg - rate gyro)**

Maximum Roll Angle ..... -1.3  
 Maximum Pitch Angle ..... -3.7  
 Maximum Yaw Angle ..... -4.9

**Test Article Deflections**

Dynamic ..... 102 in. (2591 mm)  
 Permanent ..... 96 in. (2438 mm)

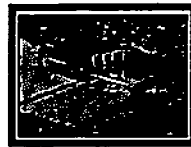
**Vehicle Damage (Primary Impact)**

Exterior  
 VDS ..... FD-4  
 CDC ..... 12FDEW4  
 Interior  
 VCDI ..... AS000000  
 Maximum Deformation ..... Negligible





t = 0.000 sec



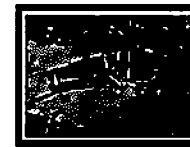
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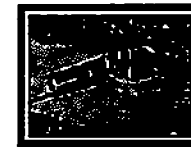
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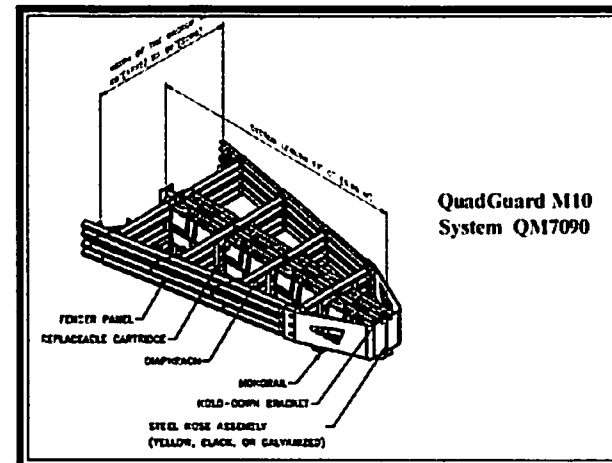
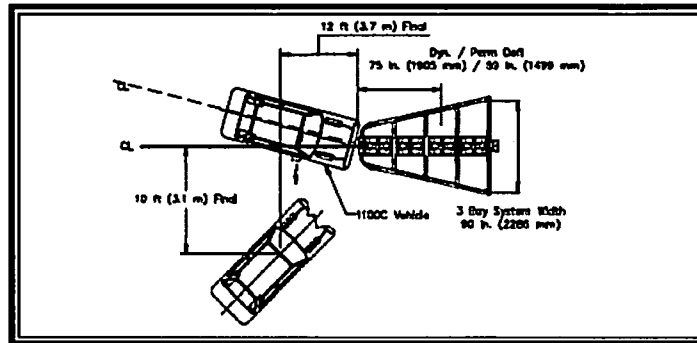
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t = 0.400 sec



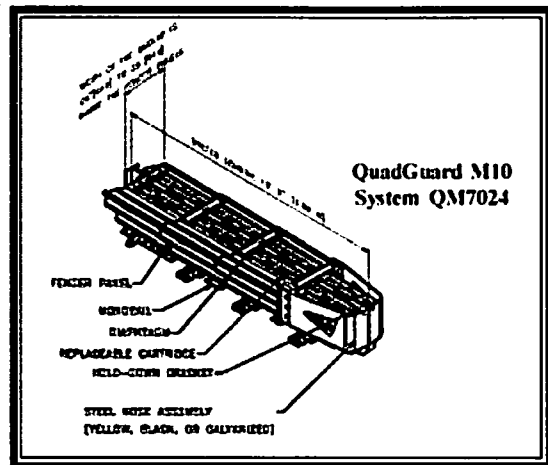
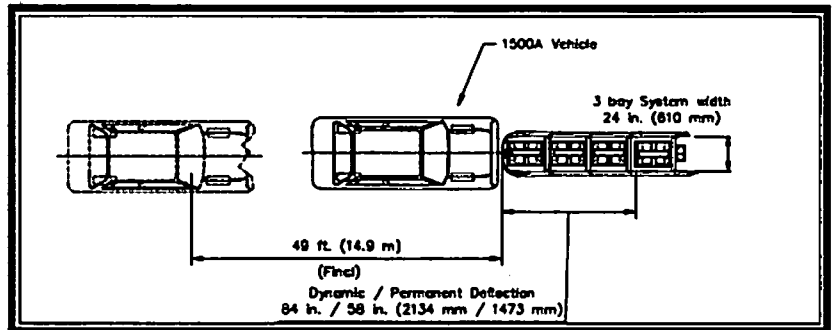
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**General Information**

Test Agency .....	E-TECH Testing Services, Inc.
Test Designation .....	MASH Test 3-32
Test No. ....	01-2810-003
Date .....	1/20/11
Test Article	
Type .....	Energy Absorption System
Installation Length .....	QuadGuard M10 System QM7090
Material and key elements .....	5 bay 19 ft. (5790 mm) long
Foundation Type and Condition .....	90 in. (2286) mm wide
Test Vehicle	
Type .....	(4) energy absorbing cartridges
Designation .....	(3) Type M-I and (1) Type M-II
Model .....	AASHITO M180 Quad Panels
Mass	ASTM A36 other, galvanized steel construction
Curb .....	Unreinforced 27.6 Mpa concrete, clean and dry, with (46) 19 mm x 178 mm ASTM A193 Grade B-7 threaded studs and MP-3 Anchoring System
Test inertial	
Dummy .....	Production Model
Gross Static .....	1100C
Impact Conditions	
Speed .....	2003 Kia Rio 4 Door Sedan
Angle (deg) .....	
Impact Severity .....	

Exit conditions		
Speed .....	N/A	
Angle (deg - veh. c.g.) .....	N/A	
Occupant Risk Values (absolute value)		
Impact Velocity		
x-direction .....	32.3 ft/s (9.9 m/s)	
y-direction .....	2.3 ft/s (0.7 m/s)	
Ridedown Acceleration (g's)		
x-direction .....	13.5	
y-direction .....	7.3	
European Committee for Normalization (EN) Values		
THIV .....	22.1 mi/h (35.6 km/h)	
PHD (g's) .....	13.7	
ASI .....	1.1	
Post-Impact Vehicular Behavior (deg - rate gyro)		
Maximum Roll Angle .....	6.0	
Maximum Pitch Angle .....	-2.8	
Maximum Yaw Angle .....	-52.6	
Test Article Deflections		
Dynamic .....	75 in. (1905 mm)	
Permanent .....	59 in. (1499 mm)	
Vehicle Damage (Primary Impact)		
Exterior		
VDS .....	FD-2	
CDC .....	12FDEW2	
Interior		
VCDI .....	AS0000000	
Maximum Deformation .....	Negligible	



**General Information**

Test Agency .....	E-TECH Testing Services, Inc.
Test Designation .....	MASH Test 2-38
Test No. ....	01-2810-002
Date .....	12/15/10
<b>Test Article</b>	
Type .....	Energy Absorption System
.....	QuadGuard M10 System QM7024
Installation Length .....	3 bay 13 ft. (3962 mm) long
.....	24 in. (610) mm wide
Material and key elements .....	(4) energy absorbing cartridges
.....	(3) Type M-I and (1) Type M-II
.....	AASHTO M180 Quad Panels
.....	ASTM A36 other, galvanized
.....	steel construction
Foundation Type and Condition .....	Unreinforced 27.6 Mpa concrete,
.....	clean and dry, with (32) 19 mm x
.....	178 mm ASTM A193 Grade B-7
.....	threaded studs and
.....	MP-3 Anchoring System

**Test Vehicle**

Type .....	Production Model
Designation .....	1500A
Model .....	2005 Ford Taurus
<b>Mass</b>	
Curb .....	3251 lb (1475 kg)
Test inertial .....	3250 lb (1474 kg)
Dummy .....	N/A
Gross Static .....	3250 lb (1474 kg)

**Impact Conditions**

Speed .....	42.5 mi/h (68.3 km/h)
Angle (deg) .....	0
Impact Severity .....	195.7 ft-kip (265.4 kJ)

**Exit conditions**

Speed .....	N/A
Angle (deg - veh. c.g.) .....	N/A
<b>Occupant Risk Values</b>	
Impact Velocity (absolute value)	
x-direction .....	28.4 ft/s (8.6 m/s)
y-direction .....	0.2 ft/s (0.0 m/s)
Ridedown Acceleration (g's - absolute value)	
x-direction .....	15.9
y-direction .....	1.1
<b>European Committee for Normalization (EN) Values</b>	
THIV .....	19.3 mi/h (31.1 km/h)
PHD (g's) .....	15.9
ASI .....	1.2
<b>Post-Impact Vehicular Behavior (deg - rate gyro)</b>	
Maximum Roll Angle .....	-1.5
Maximum Pitch Angle .....	2.6
Maximum Yaw Angle .....	-5.9
<b>Test Article Deflections</b>	
Dynamic .....	84 in. (2134 mm)
Permanent .....	58 in. (1473 mm)
<b>Vehicle Damage (Primary Impact)</b>	
<b>Exterior</b>	
VDS .....	FD-2
CDC .....	12FDEW2
<b>Interior</b>	
VCDI .....	AS000000
Maximum Deformation .....	Negligible