

November 14, 2008

1200 New Jersey Avenue, SE.
Washington, DC 20590

In Reply Refer To: HSSD/CC-57C

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 Federal Highway Administration (FHWA) acceptance of a roadside safety device for use on the National Highway System (NHS).

Name of device: 5-Bay QuadGuard® Elite
Type of device: Impact Attenuator
Test Level: NCHRP Report 350 TL-2
Testing conducted by: E-TECH Testing Services, Inc.
Date of request: April 28, 2008

You requested that we find this device acceptable for use on the NHS under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Requirements

Roadside safety devices should meet the guidelines contained in the NCHRP Report 350. The FHWA Memorandum "ACTION: Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Description

The redirective, non-gating crash cushion called the QuadGuard® Elite with a reduced length requirement of 5 bays is identical to the previously accepted 7-bay unit tested at test level 2 (TL-2) and accepted for use on June 17, 1999, in the FHWA Acceptance Letter C-57A, with the exception of 2 bays being removed from the rear of the system. The features of the 5-bay QuadGuard® Elite system are depicted in the enclosed drawing. The QuadGuard® Elite 5-bay system has an overall length of 5.45 m (17 feet, 10.5 inches), and can be configured with backup widths of 610 mm (24 inches), 762 mm (30 inches), 914 mm (36 inches), 1753 mm (69 inches), and 2286 mm (90 inches). The system consists of energy absorbing plastic cylinders surrounded

by a framework of steel Quad-Beam® guardrail that can telescope rearward during head-on impacts. There are no cylinders in the first two bays. The system has a center monorail that will resist lateral movement during side angle impacts and a back up structure that will resist movement during head-on impacts.

Crash Testing

The original 7-bay test data of NCHRP 350 Test 2-31 demonstrated that the 2000P vehicle impacting at 0 degree and a nominal speed of 70 km/h (43.5 mph) resulted in ridedown g's of 9.3 and Occupant Impact Velocity (ΔV) of 6.5 m/s. An engineering review of this previous data indicated excess capacity in the device and prompted a crash test to be done after removing Bays 6 and 7. The results were as follows: Impact speed: 70.0 km/h (43.5 mph), ridedown of 12.0 g's, and ΔV of 7.7 m/s.

Due to the elimination of bays at the rear of the system we concur that the test performed provides adequate capacity for head-on impacts. Furthermore, the small car 820C vehicle did not collapse beyond bay 5 in the original 7-bay testing. Therefore we agree that due to the front of the system not being changed the 820C vehicle crash characteristics should not be changed. Based upon the multiple redirective test impacts into the QuadGuard® and the basic structure of the reduced 5-bay Elite being unchanged, redirective tests are not required.

Findings

The QuadGuard® Elite 5-bay system meets the evaluation criteria for an NCHRP Report 350 redirective, non-gating crash cushion at TL-2 impact conditions and is acceptable for use on the NHS when such use is acceptable to the contracting authority.

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

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-57C 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 attenuators are patented products and considered proprietary. If proprietary devices are specified by a 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,



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

Enclosures



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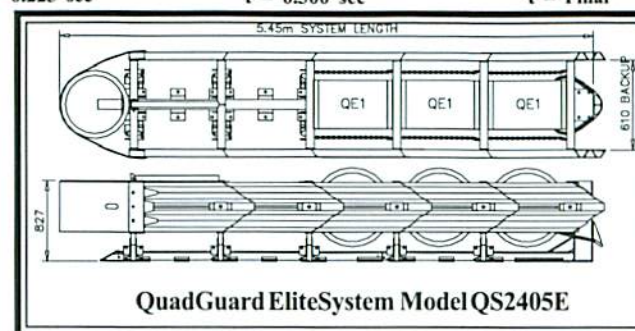
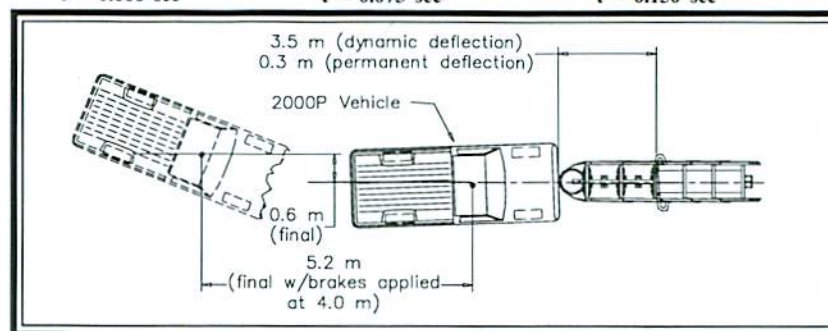
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QuadGuard EliteSystem Model QS2405E

General Information

| | |
|-------------------------------------|----------------------------------|
| Test Agency | E-TECH Testing Services, Inc. |
| Test Designation | NCHRP 350 Test 2-31 |
| Test No. | 01-3000-003 |
| Date | 1/28/08 |
| Test Article | |
| Type | Energy Absorption Systems, Inc. |
| | QuadGuard Elite System |
| | Model QS2405E |
| Installation Length, (mm) | 5 bay 5450 mm long 610 mm wide |
| Material and key elements | 5 bay system, (4) HDPE plastic |
| | energy absorbing elements |
| | Nose, Bays 3 through 5 |
| | P.C. Concrete, clean |
| Foundation Type and Anchoring | 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 Vehicle | |
| Type | Production Model |
| Designation | 2000P |
| Model | 1993 GMC C2500 |
| Mass (kg) | |
| Curb | 1928 |
| Test inertial | 1997 |
| Dummy | N/A |
| Gross Static | 1997 |

Impact Conditions

| | |
|----------------------------|-------|
| Speed (km/h) | 70.0 |
| Angle (deg) | 2 |
| Impact Severity (kJ) | 377.1 |

Exit conditions

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

Occupant Risk Values

| | |
|-----------------------------|-------|
| Impact Velocity (m/s) | |
| x-direction | 7.7 |
| y-direction | 0.1 |
| Ridedown Acceleration (g's) | |
| x-direction | -12.0 |
| y-direction | 2.6 |

European Committee for Normalization (CEN) Values

| | |
|-------------------|------|
| THIV (km/h) | 27.8 |
| PHD (g's) | 12.0 |
| ASI | 0.9 |

Test Article Deflections (m)

| | |
|-----------------|-----|
| Dynamic | 3.5 |
| Permanent | 0.3 |

Vehicle Damage

| | |
|--------------------------------------------------|------------|
| Exterior | |
| VDS | FC-3 |
| CDC | 12FCEW3 |
| Interior | |
| OCDI | AS0000000 |
| Maximum Deformation (mm) | Negligible |
| Post-Impact Vehicular Behavior (deg - rate gyro) | |
| Maximum Roll Angle | 4.8 |
| Maximum Pitch Angle | 25.0 |
| Maximum Yaw Angle | 26.1 |

Summary of Results - QuadGuard Elite Model QS2405E Test 01-3000-003

The results of this report relate only to the QuadGuard Elite Model QS2405E configuration tested. This report may not be reproduced except in full, without the prior written approval of E-TECH Testing Services, Inc. Prepared by: John F. LaTurner, P.E. - Manager. Report 327 - Issued 4/25/08

