



U.S. Department  
of Transportation

**Federal Highway  
Administration**

November 1, 2004

400 Seventh St., S.W.  
Washington, D.C. 20590

Refer to: HSA-10/CC-35G

Barry D. Stephens, P.E.  
Senior Vice President of Engineering  
Energy Absorption Systems, Incorporated  
3617 Cincinnati Avenue  
Rocklin, California 95765

Dear Mr. Stephens:

In my December 10, 2003 letter to you, the Federal Highway Administration accepted a modified design for your QuadGuard CZ in which the unit was mounted on a 42-inch wide steel plate anchored to the ground. In your recent October 1, 2004, letter, you requested formal acceptance of a new method for anchoring the steel plate to the ground which eliminates the need for a concrete or asphalt pad, thus making the attenuator easier to install for temporary use in many work zones. The new anchoring system, named the Drivable Pile Anchor (DPA) System and shown in Enclosure 1, consists of a set of steel wing plates (9.5-mm thick x 304-mm wide x 1791-mm long) bolted underneath the QuadGuard base plate and pinned to the ground with 152 mm x 152 mm x 6.35 mm square steel tubes driven 1848 mm deep into a strong soil through square holes in each wing plate. These steel tubes are then capped with a 254 mm x 254 mm x 19 mm steel plate using four 19 mm Grade 8 bolts.

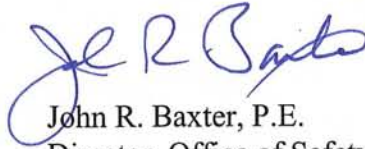
To verify acceptable crash performance of the DPA System, E-TECH Testing Services, Inc. conducted the two National Cooperative Highway Research Program (NCHRP) Report 350 tests that members of my staff had previously agreed would likely place the greatest loading on the anchoring system. In both instances, the QuadGuard performed as it had in previous tests when mounted to a concrete or asphalt pad and neither the steel base plate nor the wing plates showed any significant displacement. The summary results of test 3-33 and 3-38 are attached as Enclosures 2A and 2B, respectively. Since the new anchorage system was being tested rather than the QuadGuard itself, the failure of the data recording devices in test 3-38 does not invalidate the test because that test was successfully completed earlier with a permanently installed QuadGuard and vehicle crash and post-crash behavior was similar in both tests. I also noted that both new tests were conducted into a 9-bay unit at speeds of 113 km/h, over and above the standard test level 3 (TL-3) speed of 100 km/h.

Based on the information you provided, I agree that any of the previously accepted QuadGuard CZ configurations mounted on a steel plate bolted to a concrete or asphalt pad may also be anchored directly over a strong soil using the DPA anchoring system as described above and as



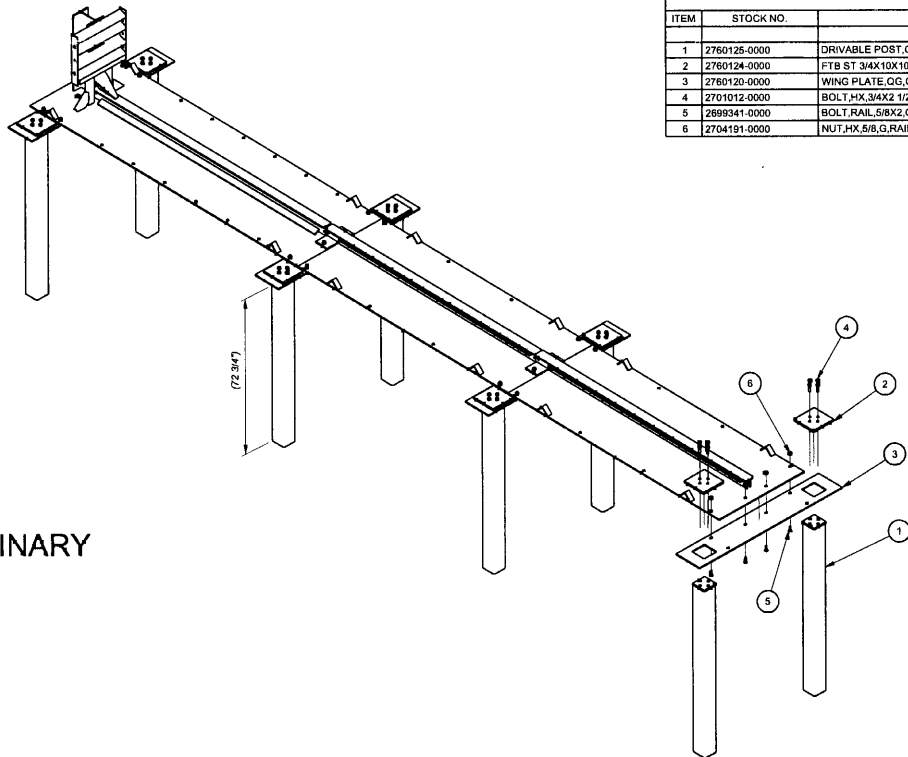
shown on the attached drawing. Both the NCHRP Report 350 test level and the number of wing plates required will depend on the number of bays used at a specific site, with a minimum of two wing plates needed for a 3-bay TL-2 design.

Sincerely yours,



John R. Baxter, P.E.  
Director, Office of Safety Design  
Office of Safety

2 Enclosures



PRELIMINARY

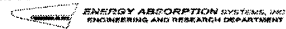
ITEM	STOCK NO.	DESCRIPTION	QTY.		
			BAYS>	3	4-6
1	2760125-0000	DRIVABLE POST,GG,CZ,DPA	4	6	8
2	2760124-0000	FTB ST 3/4X10X10,W HOLES	4	6	8
3	2760120-0000	WING PLATE,GG,CZ,DPA	2	3	4
4	2701012-0000	BOLT,HX,3/4X2 1/2,08,G	18	24	32
5	2699341-0000	BOLT,RAIL,5/8X2,G	10	16	22
6	2704191-0000	NUT,HX,5/8,G,RAIL	10	16	22

TABLE A

NO. OF BAYS	ASSEMBLY NO.	DESCRIPTION
3	3540070-0300	DRIVABLE PILE ANCHOR ASSY,GG,CZ,3 BAY
4-6	3540700-0600	DRIVABLE PILE ANCHOR ASSY,GG,CZ,4-6 BAY
7-9	3540700-0900	DRIVABLE PILE ANCHOR ASSY,GG,CZ,7-9 BAY

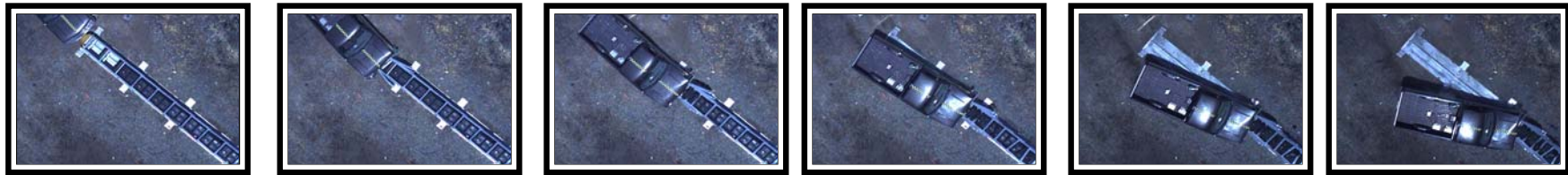
ASSEMBLY NO. SEE TABLE A

DESIGN:	D. Standridge	DATE:	8/9/2004
DRAWN:	A. Franklin	DATE:	8/6/2004
CHECKED:		DATE:	
APPROVED:		DATE:	
SJC:		DATE:	
SCALE:	35-40-70	SCALE:	



QUADGUARD DRIVABLE PILE ANCHOR (DPA) SYSTEM (9 - BAY SHOWN)

SCALE:	35-40-70	SHEET:	1 of 1	REV:	
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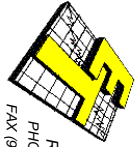
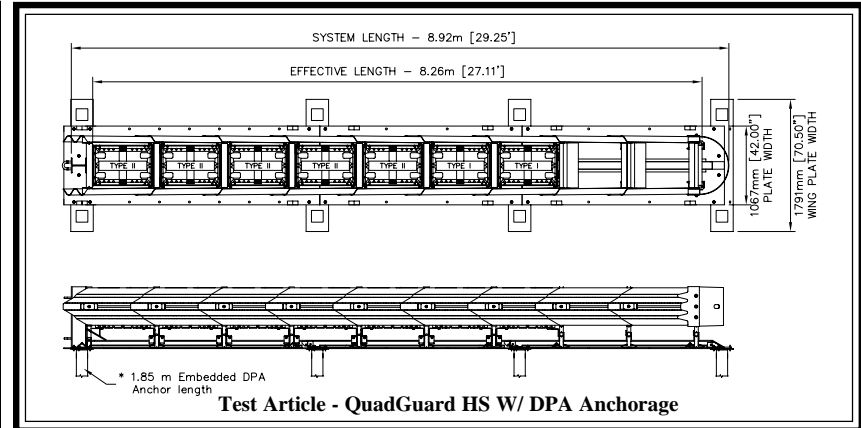
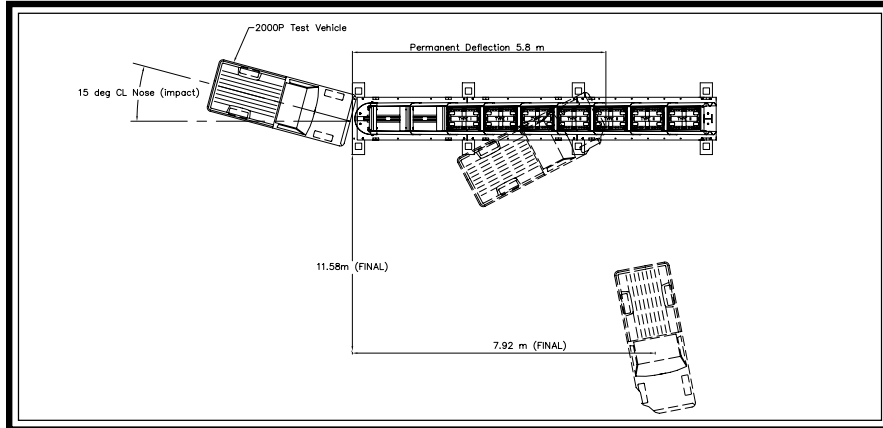
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t = 0.140 sec

t = 0.210 sec

t = 0.280 sec

t = 0.350 sec



**E-TECH Testing Services, Inc.**  
 3617 B Cincinnati Avenue  
 Rocklin, CA 95765  
 PHONE (916) 645-8188  
 FAX (916) 645-3553

QuadGuard QH2409PY Test Results - 1 of 11

**General Information**

Test Agency ..... E-TECH Testing Services, Inc.  
 Test Designation ..... NCHRP 350 Test 3-33 (Modified)  
 Test No. .... 01-5500-007  
 Date ..... 08/03/04

**Test Article**

Type ..... Energy Absorption Systems, Inc.  
 QuadGuard QH2409PY  
 Installation Length ..... 9 bay 8.92 m long 0.61 m wide  
 Size and/or dimension and material  
 of key elements ..... (2) Type I cartridges in bays 3,4  
 (5) Type II cartridges in bays 5-9  
 Foundation and Anchoring ..... Anchoring plate and combined  
 wing anchor plate 1.79 m wide  
 with (8) Drivable Pile Anchors  
 (DPA) 1.85 m embedment into  
 NCHRP 350 strong soil

**Test Vehicle**

Type ..... Production Model  
 Designation ..... 2000P  
 Model ..... 1988 GMC C2500 Pickup  
 Mass (kg)  
 Curb ..... 1968  
 Test inertial ..... 1992  
 Dummy ..... N/A  
 Gross Static ..... 1992

**Impact Conditions**

Speed (km/h) ..... 113.7  
 Angle (deg) ..... 15  
 Impact Severity (kJ) ..... 993.2

**Exit conditions**

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

**Occupant Risk Values**

Impact Velocity (m/s)  
 x-direction ..... 8.5  
 y-direction ..... -2.3  
 Ridedown Acceleration (g's)  
 x-direction ..... -14.1  
 y-direction ..... -5.0

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

THIV (km/h) ..... 32.5  
 PHD (g's) ..... 14.3  
 ASI ..... 1.1

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

Maximum Roll Angle ..... -38.2  
 Maximum Pitch Angle ..... -11.0  
 Maximum Yaw Angle ..... -243.4

**Test Article Deflections (m)**

Permanent ..... 5.8

**Vehicle Damage (Primary Impact)**

**Exterior**  
 VDS ..... FC-4  
 CDC ..... 12FCEW3  
**Interior**  
 VCDI ..... AS0000000  
 Maximum Deformation (mm) ..... Negligible

**Figure 1. Summary of Results - QuadGuard QH2409PY Test 01-5500-007**

The results of this report relate only to the QuadGuard QH2409PY 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 238 - Issued 8/09/2004





t = 0.000 sec

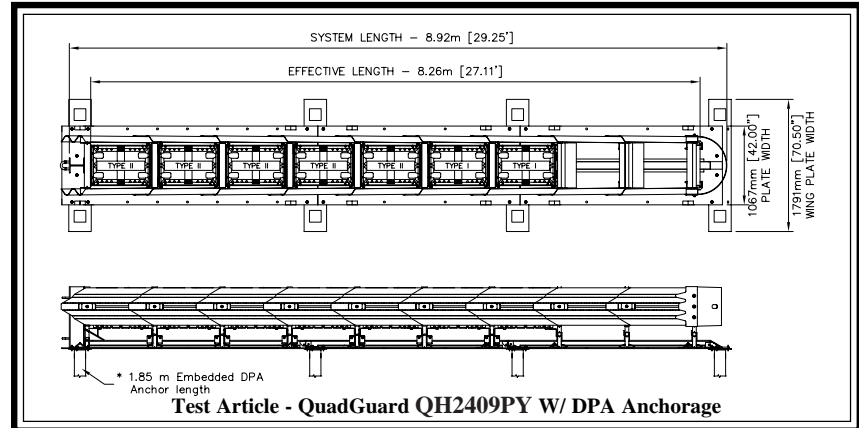
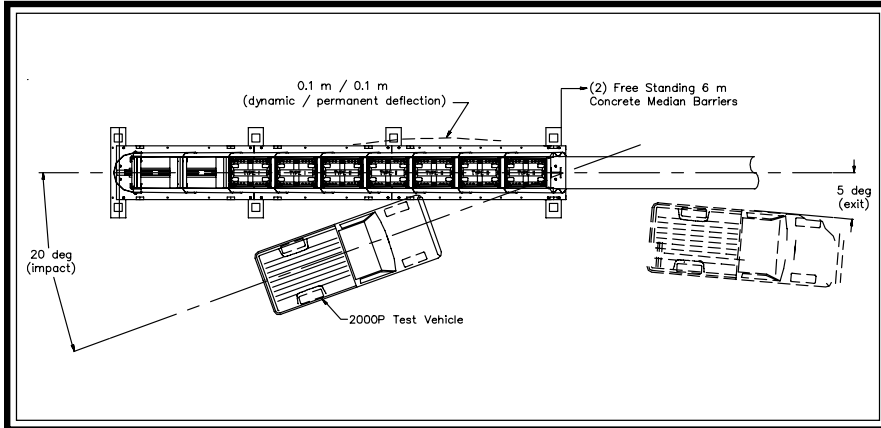
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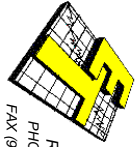
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t = 0.192 sec

t = 0.240 sec



Test Article - QuadGuard QH2409PY W/ DPA Anchorage



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QuadGuard Drivable Pile Anchor (DPA) System Test Results - 1 of 5

**General Information**

Test Agency ..... E-TECH Testing Services, Inc.  
 Test Designation ..... NCHRP 350 Test 3-38 (Modified)  
 Test No. .... 01-5500-008  
 Date ..... 09/22/04

**Test Article**

Type ..... Energy Absorption Systems, Inc.  
 QuadGuard QH2409PY  
 Installation Length ..... 9 bay 8.92 m long 0.61 m wide  
 Size and/or dimension and material  
 of key elements ..... (2) Type I cartridges in bays 3,4  
 (5) Type II cartridges in bays 5-9  
 Foundation and Anchoring ..... Anchoring plate and combined  
 wing anchor plate 1.79 m wide  
 with (8) Drivable Pile Anchors  
 (DPA) 1.85 m embedment into  
 NCHRP 350 strong soil

**Test Vehicle**

Type ..... Production Model  
 Designation ..... 2000P  
 Model ..... 1989 Chevrolet C2500 Pickup  
 Mass (kg)  
 Curb ..... 1978  
 Test inertial ..... 1994  
 Dummy ..... N/A  
 Gross Static ..... 1994

**Impact Conditions**

Speed (km/h) ..... 113.6  
 Angle (deg) ..... 20  
 Impact Severity (kJ) ..... 116.2

**Exit conditions**

Speed (km/h) ..... N/A\*  
 Angle (deg) ..... 5

**Occupant Risk Values** ..... N/A\*

Impact Velocity (m/s)  
 x-direction  
 y-direction  
 Ridedown Acceleration (g's)  
 x-direction  
 y-direction

**European Committee for Normalization (CEN) Values** N/A\*

THIV (km/h)  
 PHD (g's)  
 ASI

**Post-Impact Vehicular Behavior (deg - rate gyro) .....** N/A\*

Maximum Roll Angle  
 Maximum Pitch Angle  
 Maximum Yaw Angle

**Test Article Deflections (m)**

Dynamic / Permanent ..... 0.1/ 0.1

**Vehicle Damage (Primary Impact)**

Exterior  
 VDS ..... LFQ-4  
 CDC ..... 11LFEW2  
 Interior  
 VCDI ..... AS0000000  
 Maximum Deformation (mm) ..... 50

\* Notes: Data lost, data acquisition did not trigger.  
 Speed acquired from fifth wheel

**Figure 1. Summary of Results - QuadGuard QH2409PY Test 01-5500-008**

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 Prepared by: John F. LaTurner, P.E. - Manager. Report 240 - Issued 9/28/2004

