

December 30, 1998

Refer to: HNG-14

J. M. Essex, P.E.
Senior Vice President, Sales
Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601

Dear Mr. Essex:

In your November 23 letter, you requested the Federal Highway Administration's review and acceptance of a QuadGuard family of crash cushions that is outwardly identical to the previously-accepted QuadGuard-LMC family, but which uses high density polyethylene (HDPE) cylinders in lieu of the elastomeric cylinders used in the QuadGuard-LMC. Although your letter asked for acceptance of an 11-bay unit at test level 3 (TL-3) and a 7-bay unit at TL-2, Mr. Douglas Bernard subsequently requested that this acceptance letter address the 11-bay unit only.

To support your request, you sent me copies of a November 1998 test report entitled: "QuadGuard Elite System Qualification to NCHRP 350 Test Level 3 Engineering Summary," which included a report prepared by E-Tech Testing Services, Inc. entitled: "NCHRP Report 350 Crash Test Results for the QuadGuard Elite System" and was also dated November 1998. Video tape copies of the crash tests you conducted were provided as well.

The QuadGuard Elite is an 11-bay unit having a nominal length of 10820 mm. It can be configured with backup widths of 610 mm, 762 mm, 914 mm, 1753 mm, or 2286 mm. Enclosure 1 shows a cutaway view of the narrowest and the widest units and the cylinder mounting details. There are no cylinders in the first two bays. Because the QuadGuard Elite has essentially the same framework and outer dimensions as the QuadGuard-LMC family, I agreed in my October 21 letter to you that tests 3-31 on the narrowest unit and test 3-32 on the widest unit appeared most critical and would allow us to evaluate the new design. Our review of these tests shows that all appropriate National Cooperative Highway Research Program (NCHRP) Report 350 evaluation criteria were met. Test summaries are enclosed as Enclosure 2.

Based on our review of the information you provided, we agree that the 11-bay QuadGuard Elite meets the acceptance criteria for an NCHRP Report 350 crash cushion at TL-3. It may be used on the National Highway System (NHS) when such use is requested by a transportation agency. Because it is a proprietary device, its use on Federal-aid projects, except exempt, non-NHS projects, is subject to the conditions listed in Title 23, Code of Federal Regulations, Section 635.411, copies of which have previously been sent to you. Please do not hesitate to call Mr. Richard Powers of my staff at (202) 366-1320 if you have any questions.

Sincerely yours,

(original signed by Dwight A. Horne)

Dwight A. Horne
Chief, Federal-Aid and Design Division

2 Enclosures
Acceptance Letter CC-57

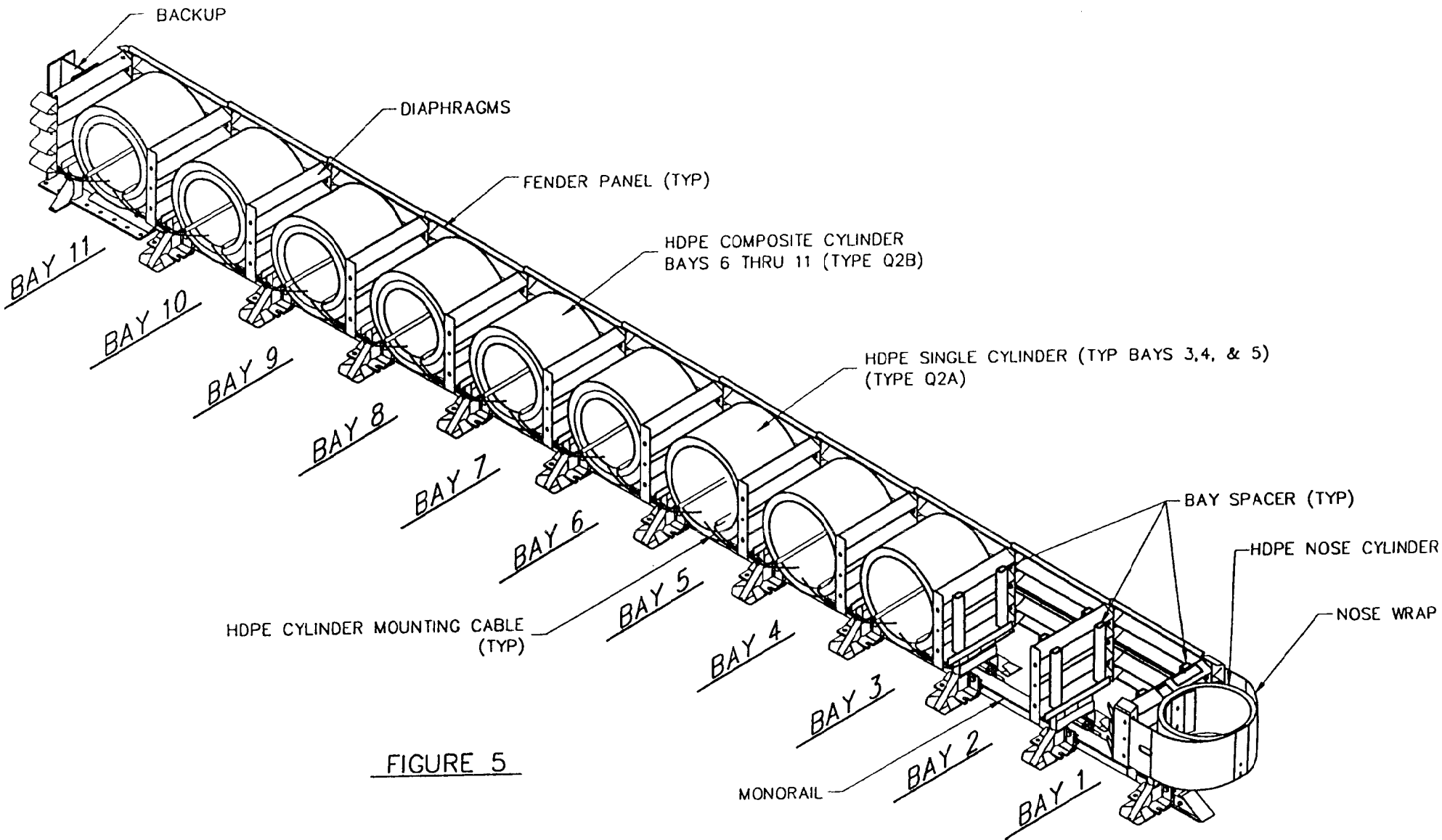



FIGURE 5

****NOTE:** UNIT IS SHOWN WITH LEFT FENDER PANELS REMOVED

 ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT			
24" WIDE QuadGuard® Elite System MAJOR SYSTEM COMPONENTS 11 BAYS			
SCALE	DWG.	SHEET	REV.
NTS	TL3-FIG-5	1 of 1	

Enclosure 1 (1 of 3)

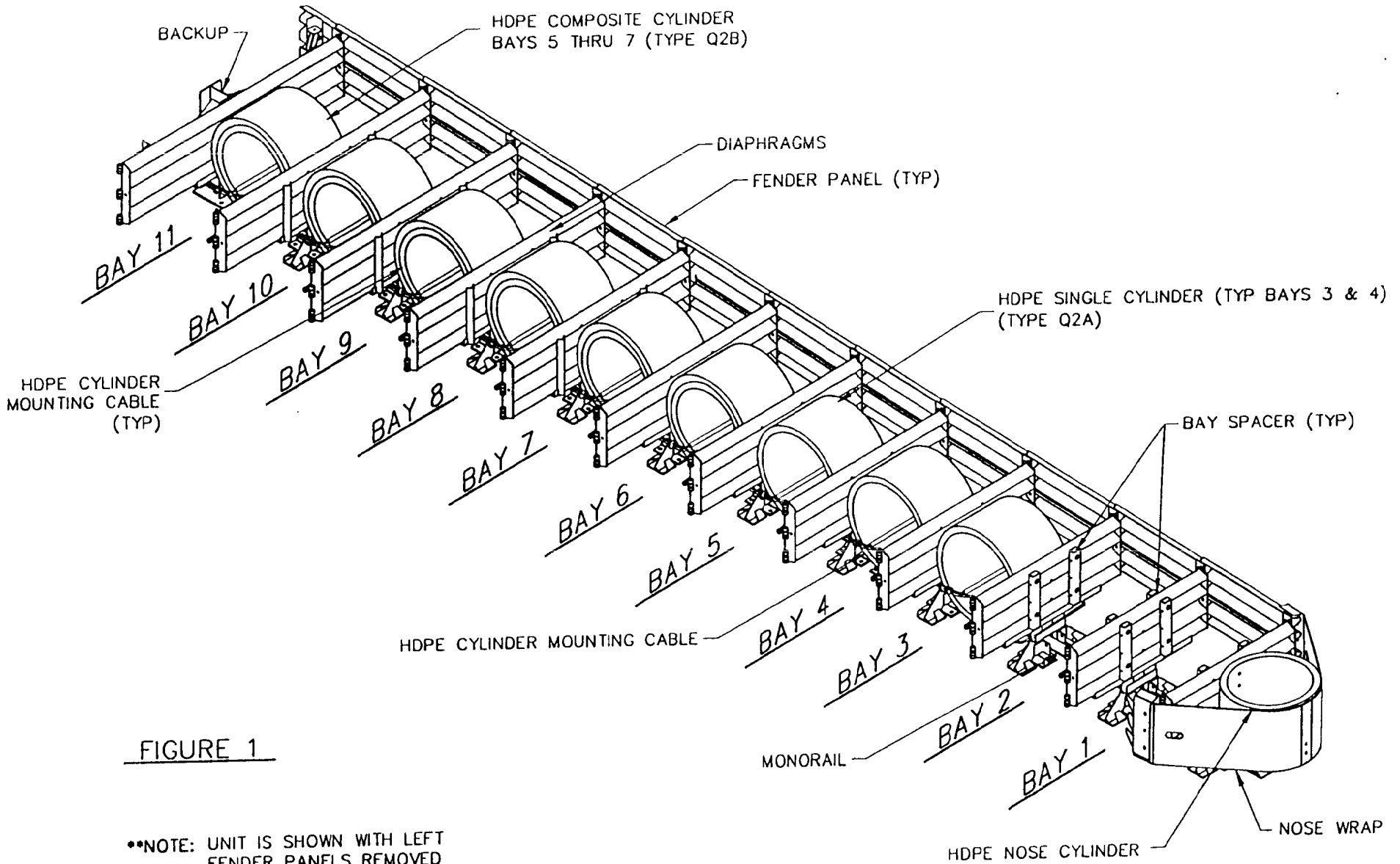



FIGURE 1

**NOTE: UNIT IS SHOWN WITH LEFT FENDER PANELS REMOVED

 ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT			
90" WIDE QuadGuard® Elite™ System, MAJOR SYSTEM COMPONENTS 11 BAYS			
SCALE	DWG. TL3-FIG-1	SHEET	REV

(C) 1971 ENERGY ABSORPTION SYSTEMS, INC.

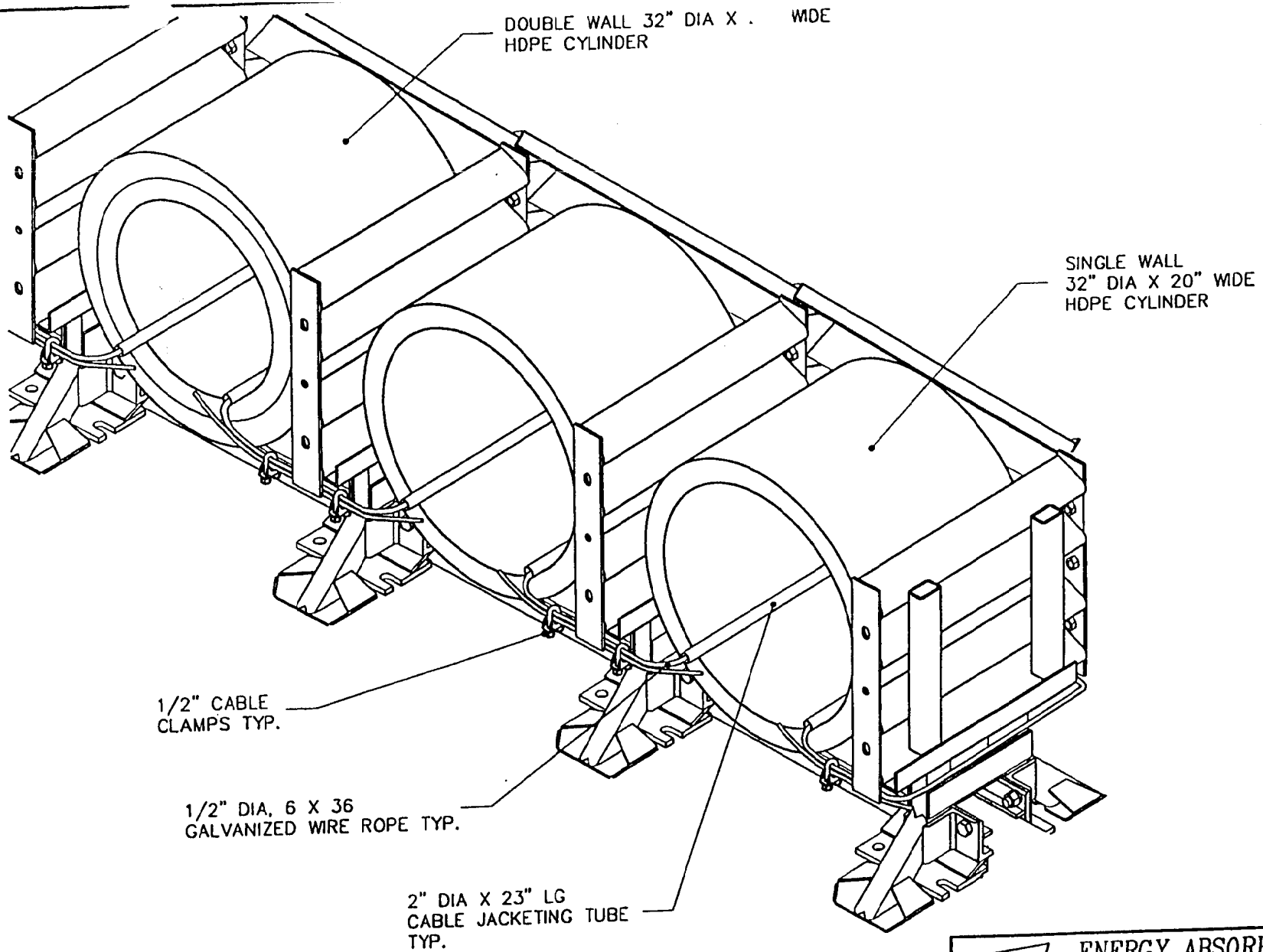



FIGURE 7

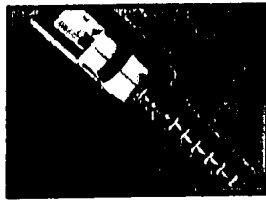
 ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT			
<h2>HDPE CYLINDER MOUNTING</h2>			
SCALE	DWG.	SHEET	REV
	TL3-FIG-7		



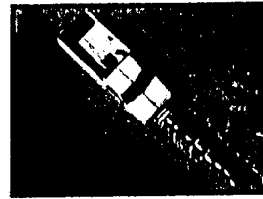
t = 0.000 sec



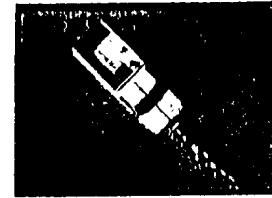
t = 0.120 sec



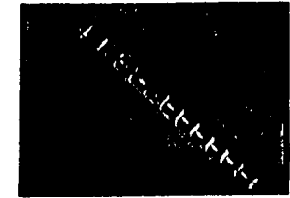
t = 0.240 sec



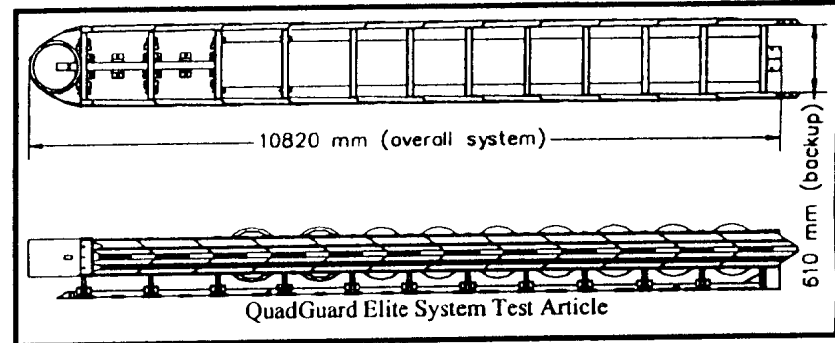
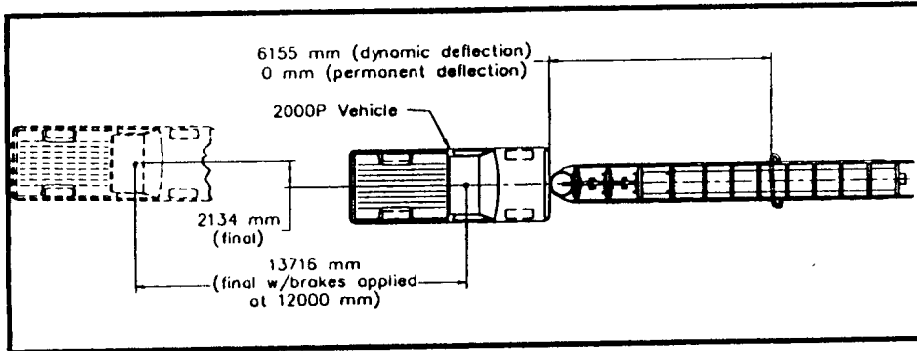
t = 0.360 sec



t = 0.480 sec



t = final



General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation NCHRP 350 Test 3-31
 Test No. 01-7611-002
 Date 10/9/98

Test Article

Type Energy Absorption Systems, Inc.
 11 bay QuadGuard
 Elite System

Size and/or dimension and material

of key elements 10820 mm System Length
 610 mm Backup Width

Test Vehicle

Type Production Model
 3/4T Pickup
 Designation 2000P
 Model 1989 GMC C2500

Mass (kg)

Curb 1921.0
 Test inertial 2019.0
 Dummy(s) N/A
 Gross Static 2019.0

Impact Conditions

Speed (km/h) 101.05
 Angle (deg) 0.0
 Impact Severity (kJ) 795.38

Exit conditions (rebound)

Speed (km/h) 36.0

Occupant Risk Values

Impact Velocity (m/s)
 x-direction 8.64
 y-direction 0.31

Ridedown Acceleration (g's)

x-direction -12.40
 y-direction -3.41

THIV (m/s)

PHD (g's) 11.82

ASI

..... 0.91

Test Article Deflections (mm)

Dynamic 6155
 Permanent 0 (restored)

Vehicle Damage

Exterior
 VDS FD-2
 CDC 12FDEW2

Interior

OCDI AS000000

Post-Impact Vehicular Behavior (deg - gyro @ c.g.)

Maximum Roll Angle -5.86
 Maximum Pitch Angle -4.95
 Maximum Yaw Angle 11.96

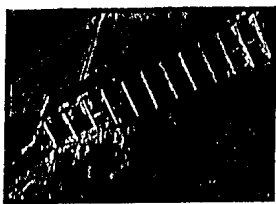


E-TECH Testing Services, Inc.

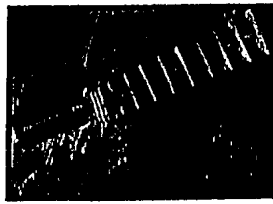
QuadGuard Elite™ System Crash Test Results - 5 of 19

Enclosure 2 (1 of 2)

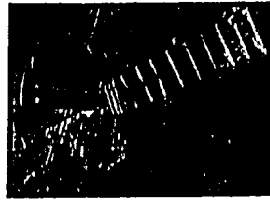
Figure 1. Summary of Results - QuadGuard Elite System Test 01-7611-002



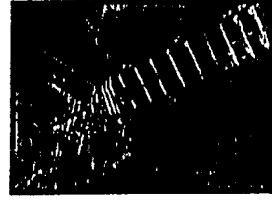
t = 0.000 sec



t = 0.180 sec



t = 0.360 sec



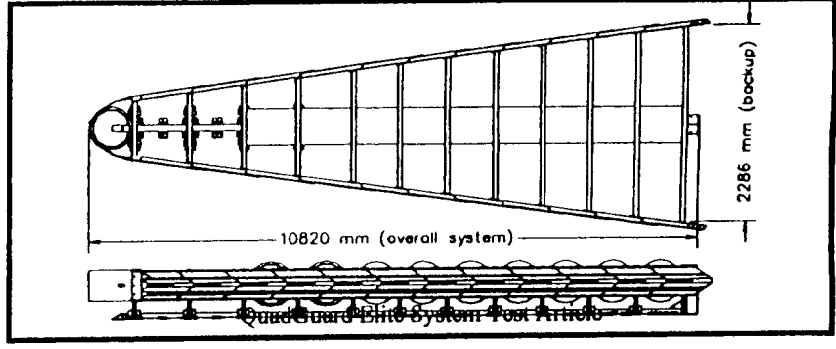
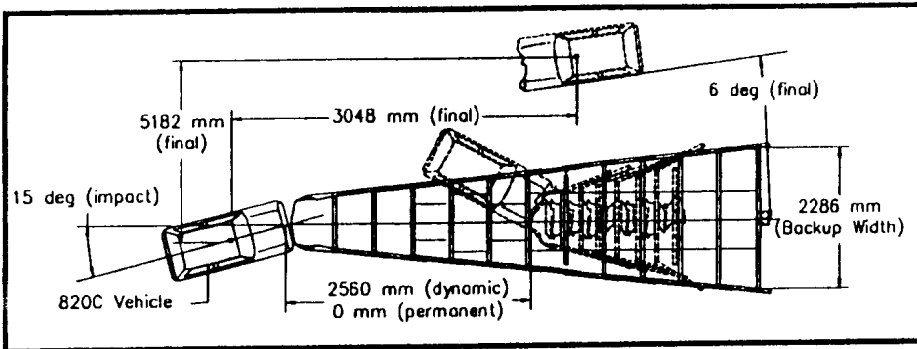
t = 0.540 sec



t = 0.720 sec



t = final



General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation NCHRP 350 Test 3-32
 Test No. 01-7611-001
 Date 9/29/98

Test Article

Type Energy Absorption Systems, Inc.
 11 bay QuadGuard
 Elite System

Size and/or dimension and material
 of key elements 10820 mm System Length
 2286 mm Backup Width

Test Vehicle

Type Production Model
 Small Car
 Designation 820C
 Model 1988 Ford Festiva

Mass (kg)

Curb 797.8
 Test inertial 821.2
 Dummy(s) 75.0
 Gross Static 896.2

Impact Conditions

Speed (km/h) 100.35
 Angle (deg) 15.0
 Impact Severity (kJ) 319.06

Exit conditions (rebound)

Speed (km/h) N/A

Occupant Risk Values

Impact Velocity (m/s)
 x-direction 11.26
 y-direction 1.00
 Ridedown Acceleration (g's)
 x-direction -16.13
 y-direction 8.73
 THIV (m/s) 11.56
 PHD (g's) 15.16
 ASI 1.42

Test Article Deflections (mm)

Dynamic 2560
 Permanent 0 (restored)

Vehicle Damage

Exterior
 VDS FD-4
 CDC 12FDEW4
 Interior
 OCDI AS000000

Post-Impact Vehicular Behavior (deg - gyro @ c.g.)

Maximum Roll Angle 23.12
 Maximum Pitch Angle -22.96
 Maximum Yaw Angle 201.41



E-TECH Testing Services, Inc.

QuadGuard Elite™ System Crash Test Results - 11 of 19

Enclosure 2 (2 of 2)

Figure 6. Summary of Results - QuadGuard Elite System Test 01-7611-001