

March 19, 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 March 12 letter to Mr. Henry Rentz, you requested formal acceptance of your QuadGuard 69/90 Low Maintenance Crash Cushion (LMC) as a non-gating redirective attenuator meeting the National Cooperative Highway Research Program (NCHRP) Report 350 evaluation criteria at Test Level 3 (TL-3). To support your request, you also sent us copies of your report entitled "QuadGuard 69/90-LMC System Qualification to NCHRP 350 Test Level 3 Engineering Summary" dated March 1998, which included the full report prepared by E-TECH Testing Services, Inc., entitled "NCHRP Report 350 Crash Test Results for the QuadGuard 69/90-LMC System", also dated March 1998, and a video tape showing the full scale tests that you conducted on the 69/90-LMC system.

We noted that the QuadGuard 69/90-LMC uses the same framework as the QuadGuard-Wide systems that were accepted as TL-3 attenuators in my letter to you dated July 16, 1997, with the only significant changes being the addition of four 20-mm diameter holes in each diaphragm to install the elastomeric energy-absorbing cylinders and four mounting tabs to attach the two indexing chains in each bay which contains a reusable cylinder. Because of the similarity of the designs and the acceptable results of tests 3-31, 3-36, 3-37, 3-38, and 3-39 on the QuadGuard-Wide system, we agreed beforehand to waive these tests on the 69/90-LMC, and to reassess the need for test 3-33 after reviewing the results of test 3-32. Having done so, we agree that test 3-33 may also be waived. Enclosures 1 and 2 summarize the results of tests 3-30 and 3-32, respectively. Enclosure 3 shows the overall dimensions of the two different-width QuadGuard 69/90-LMC units.

Based on our review of the information you provided, we concur that the QuadGuard 69/90-LMC, as tested, meets the acceptance criteria for an NCHRP Report 350 TL-3 crash cushion. It

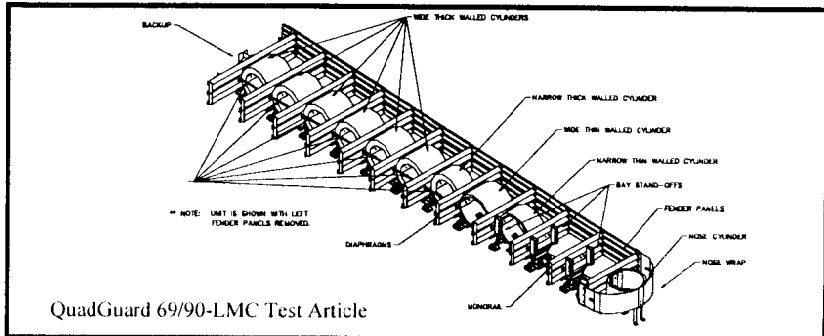
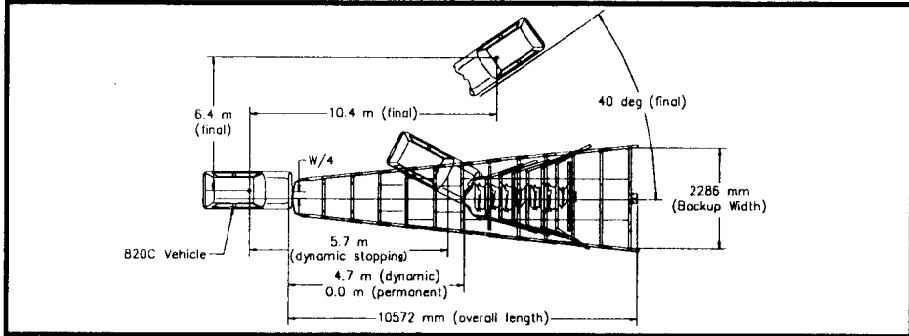
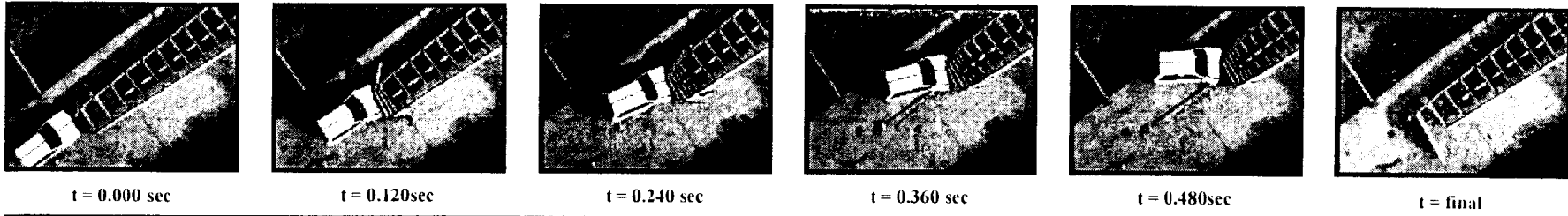
may be used on the National Highway System (NHS) when such use is requested by a transportation agency. Because it is a proprietary device, its use on Federal-aid projects, except exempt, non-NHS projects, remains subject to the conditions listed in Title 23, Code of Federal Regulations, Section 635.411, copies of which have previously been sent to you.

Sincerely yours,

(original signed by Dwight A. Horne)

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

3 Enclosures
Acceptance Letter CC-45



General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-30
Test No.	01-7615-001
Date	2/24/98
Test Article	
Type	Energy Absorption Systems, Inc.
.....	11 bay QuadGuard 69/90-LMC
.....	System
Installation Length	10572 mm
Size and/or dimension and material	
of key elements	2286 mm Backup Width
.....	
.....	
Test Vehicle	
Type	Production Model
Designation	820C
Model	1989 Ford Festiva
.....	Hatchback
Mass (kg)	
Curb	805.8
Test inertial	825.2
Dummy(s)	75.0
Gross Static	900.2
Impact Conditions	
Speed (km/h)	97.04
Angle (deg)	0.0
Impact Severity (kJ)	299.67

Exit conditions

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

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	10.21
y-direction	1.03
Ridedown Acceleration (g's)	
x-direction	-15.74
y-direction	13.76
THIV (m/s)	10.30
PHD (g's)	13.30
ASI	1.22

Test Article Deflections (m)

Dynamic	4.7
Permanent	0.0

Vehicle Damage

Exterior	
VDS	FD-4
CDC	12FDEW3
Interior	
OCDI	AS0000000

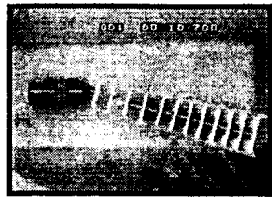
Post-Impact Vehicular Behavior (deg - gyro @ c.g.)

Maximum Roll Angle	12.50
Maximum Pitch Angle	-12.49
Maximum Yaw Angle	139.72

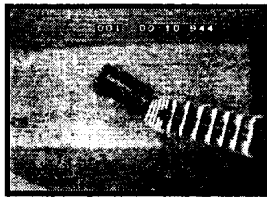
Figure 1. Summary of Results - QuadGuard 69/90-LMC System Test 01-7615-001

QuadGuard 69/90-LMC System Crash Test Results - 5 of 19

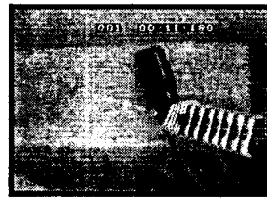
E-TECH Testing Services, Inc.



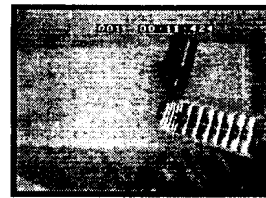
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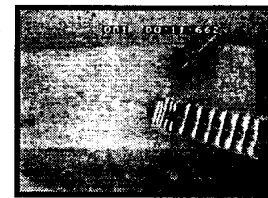
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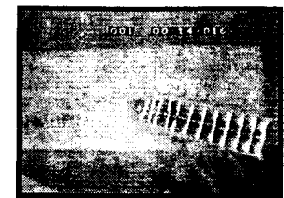
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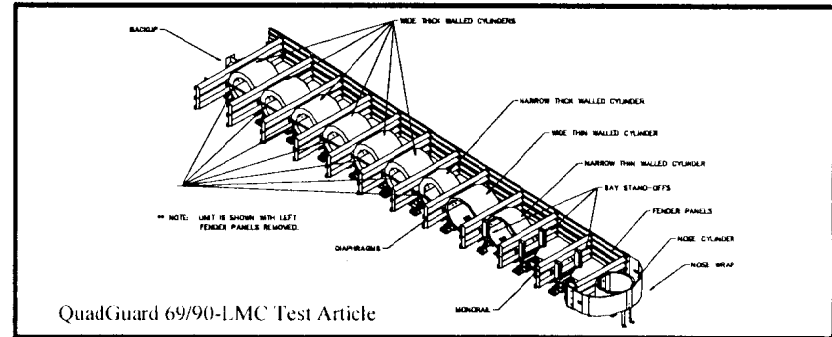
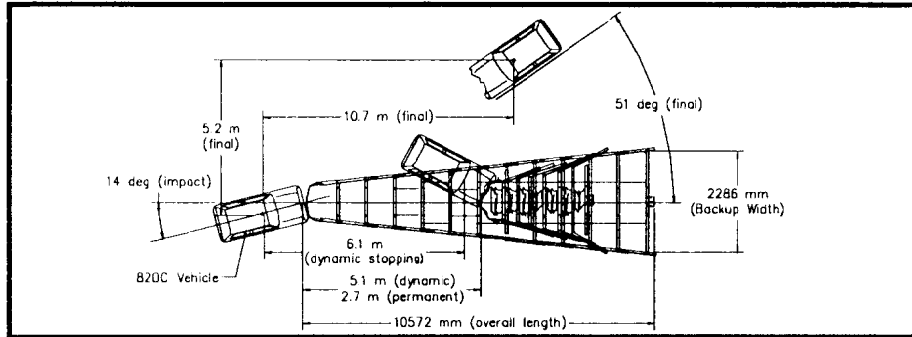
t = 0.360 sec



t = 0.480 sec



t = final



General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation NCHRP 350 Test 3-32
 Test No. 01-7615-002
 Date 3/3/98

Test Article

Type Energy Absorption Systems, Inc.
 11 bay QuadGuard 69/90-LMC
 System
 Installation Length 10572 mm

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

Test Vehicle

Type Production Model
 Designation 820C
 Model 1988 Ford Festiva
 Hatchback
 Mass (kg)
 Curb 769.0
 Test inertial 825.0
 Dummy(s) 75.0
 Gross Static 900.0

Impact Conditions

Speed (km/h) 101.69
 Angle (deg) 14.0
 Impact Severity (kJ) 329.20

Exit conditions

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

Occupant Risk Values

Impact Velocity (m/s)
 x-direction 10.40
 y-direction 1.40
 Ridedown Acceleration (g's)
 x-direction -15.70
 y-direction 14.60
 THIV (m/s) 10.77
 PHD (g's) 15.60
 ASI 1.13

Test Article Deflections (m)

Dynamic 5.1
 Permanent 2.7

Vehicle Damage

Exterior
 VDS FD-4
 CDC 12FDEW3
 Interior
 OCDI AS0000000

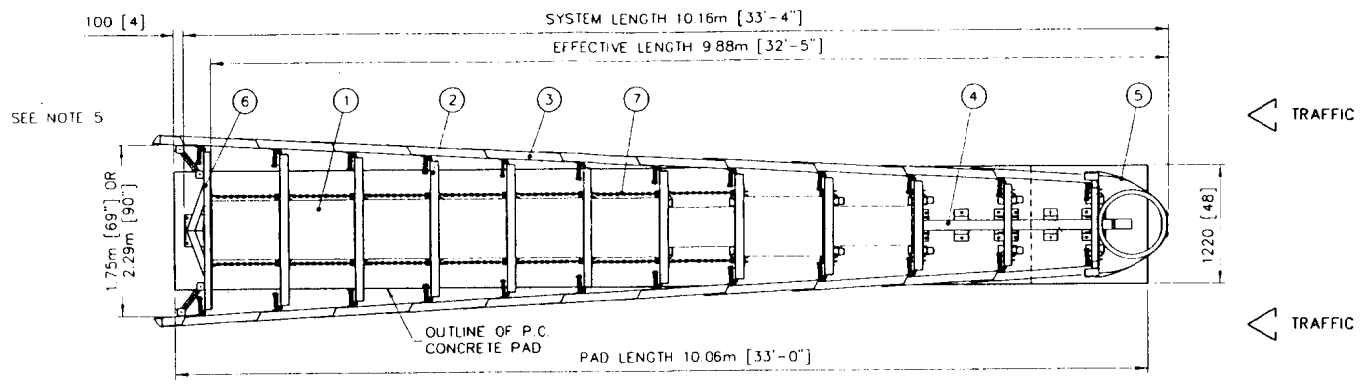
Post-Impact Vehicular Behavior (deg - gyro @ c.g.)

Maximum Roll Angle 13.08
 Maximum Pitch Angle -19.56
 Maximum Yaw Angle 143.06

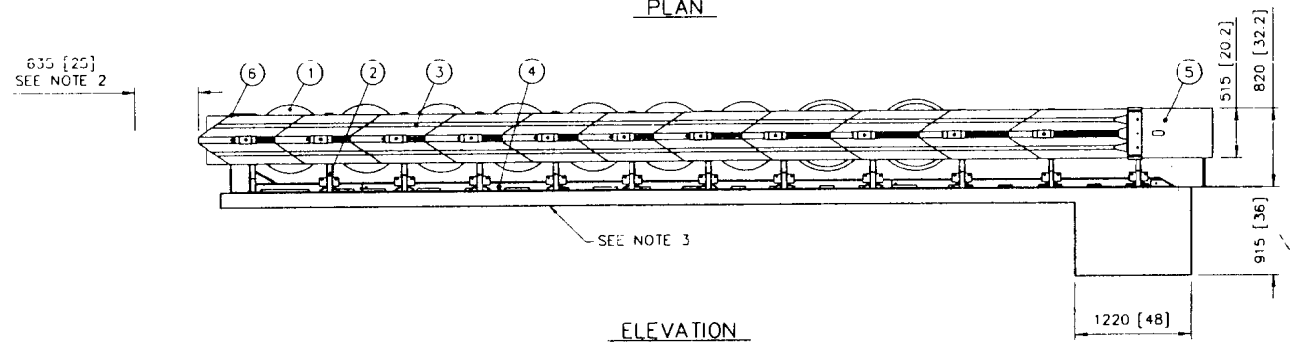


E-TECH Testing Services, Inc.

Figure 6. Summary of Results - QuadGuard 69/90-LMC System Test 01-7615-002



PLAN



ELEVATION
LEFT SIDE

- NOTES:
- IN COMPLIANCE WITH THE AASHTO 1995 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
 - PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 635 [25.00] MIN.
 - 150 [6.00] MIN REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE PAD OR 200 [8.00] MIN. NON-REINFORCED 28 MPa [4000 PSI] P.C. CONCRETE ROADWAY.
 - SEE THE "QUADGUARD LMC SYSTEM DESIGN MANUAL" CODED FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT 1-888-32-ENERG.
 - WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY A TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
 - UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
 - BACKUP ASSEMBLY NOT INCLUDED IN MODEL NUMBER.

UNIDIRECTIONAL
MODEL NO. QF6911L
MODEL NO. QF9011L

KEY	(1) ELASTOMERIC CYLINDERS	(4) MONORAIL	(7) CHAIN ASSEMBLY
	(2) DIAPHRAGM	(5) NOSE ASSEMBLY	
	(3) FENDER PANEL	(6) BACKUP	

REFERENCES	
SERIAL#	DIAPHRAGM ASSY 3540342-0000
	NOSE ASSY 3540457-0000
SALES ORDER#	FENDER PANEL ASSY 3540370-0000
	BACKUP ASSY 3540393-0000
EH PROJECT#	RAIL ASSY 35-40-46
DESIGN SPEED	35-40-47
	100 kph [62 mph]
	CONCRETE PAD 35-09-64
NOSE COLOR	CYLINDER ASSY 35-40-47
	35-09-64
NUMBER OF UNITS	NOSE ASSEMBLY 3540458-0000
	CHAIN ASSY 3540455-0000

DRAWN	D. Staus	DATE	3/5/98
DESIGNED	R. Blaski	DATE	3/5/98
CHECKED	K. Kim	DATE	3-6-98
APPROVED	[Signature]	DATE	3-6-98
CAD FILE	QLFTSCVR-U.dwg		



ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® 69/90 LMC SYSTEM
w/ 69" or 90" TENSION STRUT BACKUP

SCALE: 1=50
PART: QLF TSCVR-U
SHEET: 1 of 1