U.S. Department
of Transportation
Federal Highway Administration

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

AUG 5 1996

Refer to: HNG-14

Mr. Roger N. Egan
Senior Vice President
Sales & Marketing
Energy Absorption Systems, Inc.
One East Wacker Drive
Chicago, Illinois 60601

Dear Mr. Egan:

In your June 24 letter to Mr. Gerald L. Eller, you requested the Federal Highway Administration's (FHWA) acceptance of the QuadGuard CZ for use as a temporary crash cushion in work zones. You stated that the QuadGuard CZ is essentially identical to that used in a permanent installation except for its anchoring system. Based on an analysis of the full-scale crash tests conducted to certify the permanent QuadGuard as a National Cooperative Highway Research Program Report 350 TL-3 attenuator, you concluded that test 3-37 (2000-kg pickup truck at 100 km/h impacting at 20 degrees at the beginning of the attenuator length of need) would be the most severe test of the anchoring system. The test 3-37 was successfully run and reported in "Quad Guard CZ Anchoring Test" prepared by Mr. John V. Machado and dated June 17, Revision A. The specific anchoring system used was the "MP-3 Longbolt System," which uses a two-part polyester grout to anchor 20-mm diameter x 460-mm long threaded rods to a foundation of 150-mm deep asphalt over a 150-mm deep compacted subbase. The rods are to be embedded to a minumum depth of 410 mm in 22-mm diameter drilled holes. A total of 50 anchors are needed. The anchor system is shown in Figure 1 and the summary test results are shown in Figure 2.

Based on the test results, we conclude that the QuadGuard CZ qualifies as a TL-3 attenuator *when anchored as tested*. When used in a location subject to reverse-direction impacts, a crash-tested transition design should be used to prevent snagging on the back end of the QuadGuard unit. Subject to the foregoing, the QuadGuard CZ may be used on projects on the National Highway System (NHS) when requested by a State agency. Since the QuadGuard CZ is a proprietary device, its use on Federal-Aid

projects, except exempt, non-NHS projects, is subject to the conditions stated in Title 23 Code of Federal Regulations, Section 635.411.

Sincerely yours,

David A. Pucci

for Seppo I. Sillan, Acting Chief
Federal-Aid and Design Division

2 Enclosures

Supplement to Geometric and Roadside Design Acceptance Letter CC-35 (CC-35A)

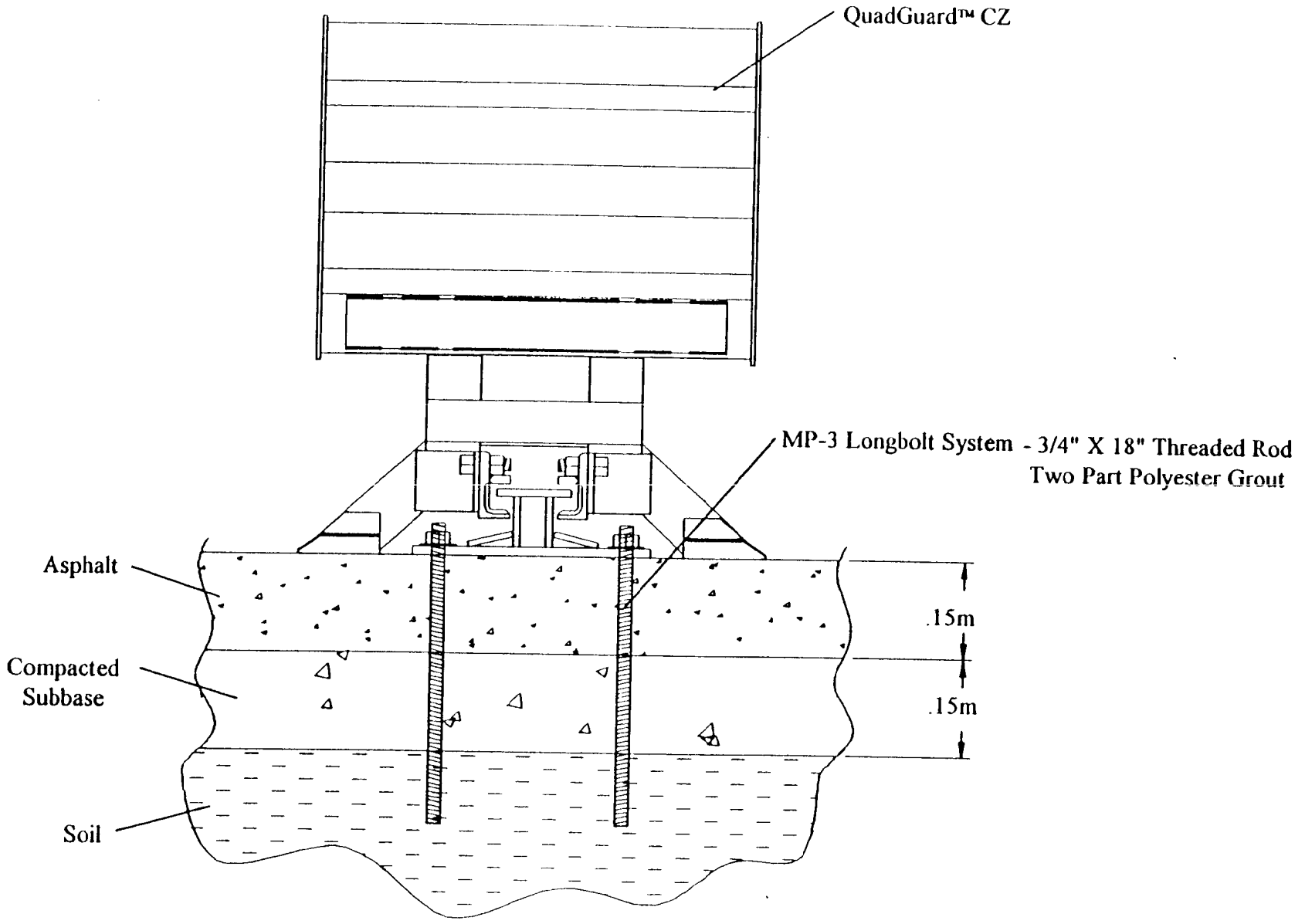
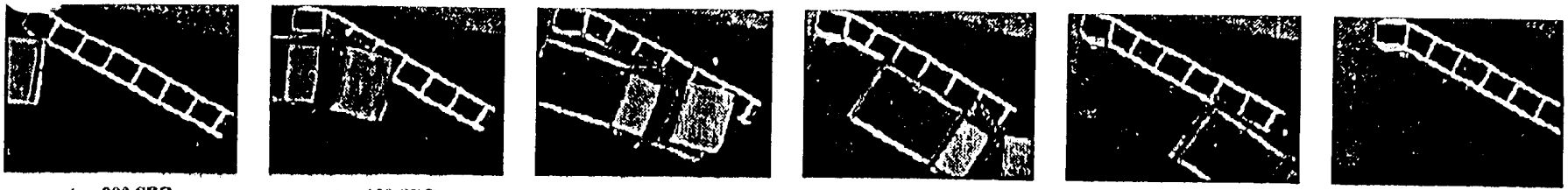
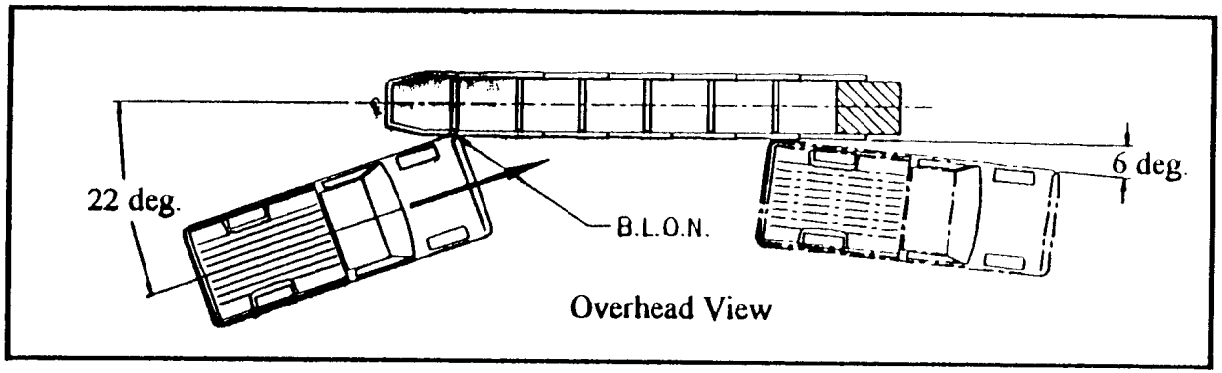
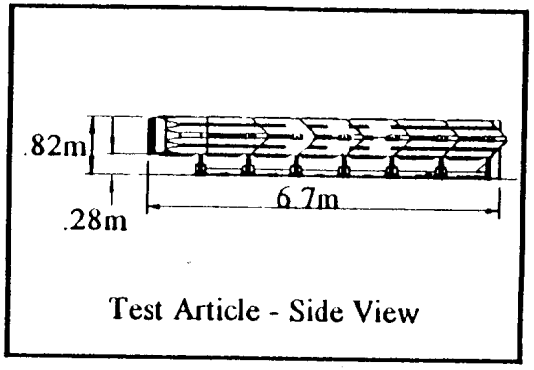


Figure 1. Anchoring Details - QuadGuard™ CZ Test 159-058







General Information	
Test Agency	E-TECH Testing Services, Inc.
Test No.	159-058
Date	5/14/96
Test Article	
Type	Energy Absorption Systems
	Quad Guard CZ system
Installation Length, (m)	6.4
Size and/or dimension and material of key elements	6 bay system, 7 energy absorbing cartridges
Foundation Type and Condition	.15 m Asphalt Concrete, .15 m Compacted Subbase
Test Vehicle	
Type	Production Model
Designation	2000P
Model	1974 Chevrolet 3/4Ton Pickup
Mass (kg)	
Curb	2036
Test inertial	2037
Dummy(s)	N/A
Gross Static	2037
Impact Conditions	
Speed (km/h)	96.97
Angle (deg)	22
Impact Severity (kJ)	107.73

Exit conditions	
Speed (km/h)	64.80
Angle (deg)	6
Occupant Risk Values	
Impact Velocity (m/s)	
x-direction	7.15
y-direction	7.62
Ridedown Acceleration (g's)	
x-direction	-6.72
y-direction	8.54
THIV (optional)	10.91
PHD (optional)	13.59
ASI (optional)	1.48
Test Article Deflections (m)	
Dynamic	N/A
Permanent	N/A
Vehicle Damage	
Exterior	
VDS	LFQ-6
CDC	11LDEW2
Interior	
OCDI	LF0010000
Post-Impact Vehicular Behavior (deg)	
Maximum Roll Angle	-7.29
Maximum Pitch Angle	3.35
Maximum Yaw Angle	32.07

Figure 2. Summary of Results - QuadGuard™ CZ Test 159-058

U.S. Department
of Transportation
Federal Highway Administration

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

OCT 17 1996

Refer to: HNG-14

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

Dear Mr. Essex:

My June 21 acceptance letter to Mr. Roger Egan restricted the use of your QuadGuard impact attenuator to locations where reverse direction hits were unlikely, pending development and testing of suitable transition designs.

On October 3 Messrs. Bernard and Stevens provided members of my staff with a copy of your October 1 letter to Mr. Gerald Eller, which forwarded data on three reverse-direction crash tests that were run on transition designs for use with the QuadGuard in locations where reverse-direction hits are possible. In your letter you requested the Federal Highway Administration's acceptance of these specific designs. The test results are documented in a report by E-TECH Testing Services, Inc. dated September 1996 and entitled "NCHRP Report 350 Crash Test Results for the QuadGuard Transitions." The specific tests run and their results are shown as Enclosure 1. The two designs tested are Enclosures 2 and 3.

Having reviewed these data, we have concluded that the tested, reverse-direction transition designs satisfactorily meet the evaluation criteria appropriate for a TL-3 appurtenance. Thus, they are acceptable for use with the QuadGuard attenuator at locations where reverse-direction impacts are possible. We noted that the wood-post, w-beam transition was tested in a weak soil and with rail on only one side of the posts, as in a *roadside* (guardrail) installation. We consider this test as also supporting acceptance of the wood-post, w-beam guardrail-QuadGuard transition in strong soil and a comparable *median* barrier-QuadGuard transition in either soil. It also supports our acceptance, for use in either soil type, of a wood-post, thrie-beam barrier transition to the QuadGuard in either a guardrail configuration (as shown in Enclosure 4) or a median barrier configuration.

We noted that in the test of the concrete-safety-shape-to-QuadGuard transition the concrete safety shape was reinforced and anchored to prevent movement. An equivelant design must be used in the field to ensure satisfactory performance.

In summary, the QuadGuard may now be used on the National Highway System, when requested by a highway agency, in bi-directional applications with a wood-post, w-beam or thrie-beam guardrail or median barrier in either strong or weak soil or with an adequately reinforced and anchored vertical-face (as shown in Enclosure 5) or safety-shape concrete barrier when an appropriate one of the previously described transition designs is used.

By copy of this letter, the FHWA field offices will be informed of our action. Please address any questions or comments to Mr. James Hatton at (202) 366-1329.

Sincerely yours,

Seppo I. Sillan, Acting Chief
Federal-Aid and Design Division

5 Enclosures

Supplement 2 to Geometric and Safety Design Group Acceptance Letter CC-35 (CC-35B)