October 19, 2001

HSA-10/CC35E

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

Dear Mr. Stevens:

Your September 18 letter was hand-carried to Mr. Richard Powers of my staff. In that letter you requested a formal Federal Highway Administration (FHWA) review and acceptance of a modified, high-speed QuadGuard crash cushion (QuadGuard HS) for which the full test matrix (minus one test) recommended in NCHRP Report 350 for a test level 3 (TL-3) device was run at a nominal speed of 110 km/h (70 mph). A copy of your report entitled "QuadGuard HS System Qualification to NCHRP 350 Test Level 3 at 70 mph – Engineering Summary & Test Results" and a videotape of the tests that were conducted by E-TECH Testing Services, Inc. were also delivered.

The tested nine-bay QuadGuard HS is similar to the six-bay unit that was formally accepted by the FHWA as a TL-3 crash cushion in 1996 but with one additional bay added at the rear of the unit and two empty bays added at the nose, making its total length 8900 mm. The nominal width remains the same as the standard QuadGuard at 610 mm. Bays 1 and 2 are formed by three lightweight space-frame diaphragms containing 150-mm diameter horizontal HDPE cylinders 610-mm long. Bays 3 and 4 contain the same Type I energy absorption cartridges used in other versions of the QuadGuard and the remaining 5 bays contain standard Type II cartridges. Other system components, such as the monorail, Quad-Beam fender panels and diaphragms, and nose assembly, are identical to those used in the original QuadGuard. Enclosure 1 shows pertinent details of the QuadGuard HS.

Report 350 recommends a series of eight tests to certify a redirective crash cushion as meeting all evaluation criteria. The test report you provided documents the results of seven tests. Test 3-30, which consists of the 820-kg test vehicle impacting head on at the quarter point of the vehicle was waived after reviewing the results of test 3-32, the small car impacting the nose at a 15 degree angle. Tests conducted in the past on redirective crash cushions similar in design to the QuadGuard have shown both tests result in similar post-crash vehicle trajectories, but with test 3-32 exhibiting the higher occupant impact velocities, the criterion most critical for head-on impacts with the 820-kg vehicle. In describing the results of test 3-39, the reverse-direction pickup truck test, your report states "…the pickup truck sustained floorboard buckling from this severe 70 mph impact with minor deformation to the interior left side door area. The amount of compartment deformation might cause leg injuries to an occupant, but was deemed survivable…" In your October 18 telephone conversation with Mr. Richard Powers of my staff, you advised him that the maximum occupant compartment deformation was not recorded (and can no longer be measured since that test was conducted over a year ago), but was less than 150 mm. Mr. Powers then agreed with your assessment that the degree of intrusion satisfied Report 350 evaluation criteria, and I concur with his decision. However, as with all safety appurtenances, users should be advised to monitor the in-service performance of QuadGuard HS in general, and in particular when it is used in locations where high-speed reverse-direction impacts are likely. Enclosure 2 shows the summary results of the tests that were successfully conducted.

Based on our review of the information you provided to us, we conclude that the nine-bay QuadGuard HS, as tested, is an acceptable crash cushion which meets applicable NCHRP Report 350 evaluation criteria for a test level 3 (TL-3) device **at the increased impact speed of approximately 113 km/h (70 mph)**.

As you know, the nationally recognized test impact speed for a TL-3 device is 100 km/h (62.2 mph) and I

commend your efforts in “raising the bar” for safety device performance. Nonetheless, since the selection of cost-effective safety devices for installation along a public road remains the prerogative of the appropriate highway authority, this letter should not be interpreted as giving either tacit encouragement to use, or discouragement against using, roadside hardware that exceeds currently accepted performance requirements.

Sincerely yours,

(Original signed by Frederick G. Wright, Jr.)

Frederick G. Wright, Jr.
Program Manager, Safety

2 Enclosures

Figures:

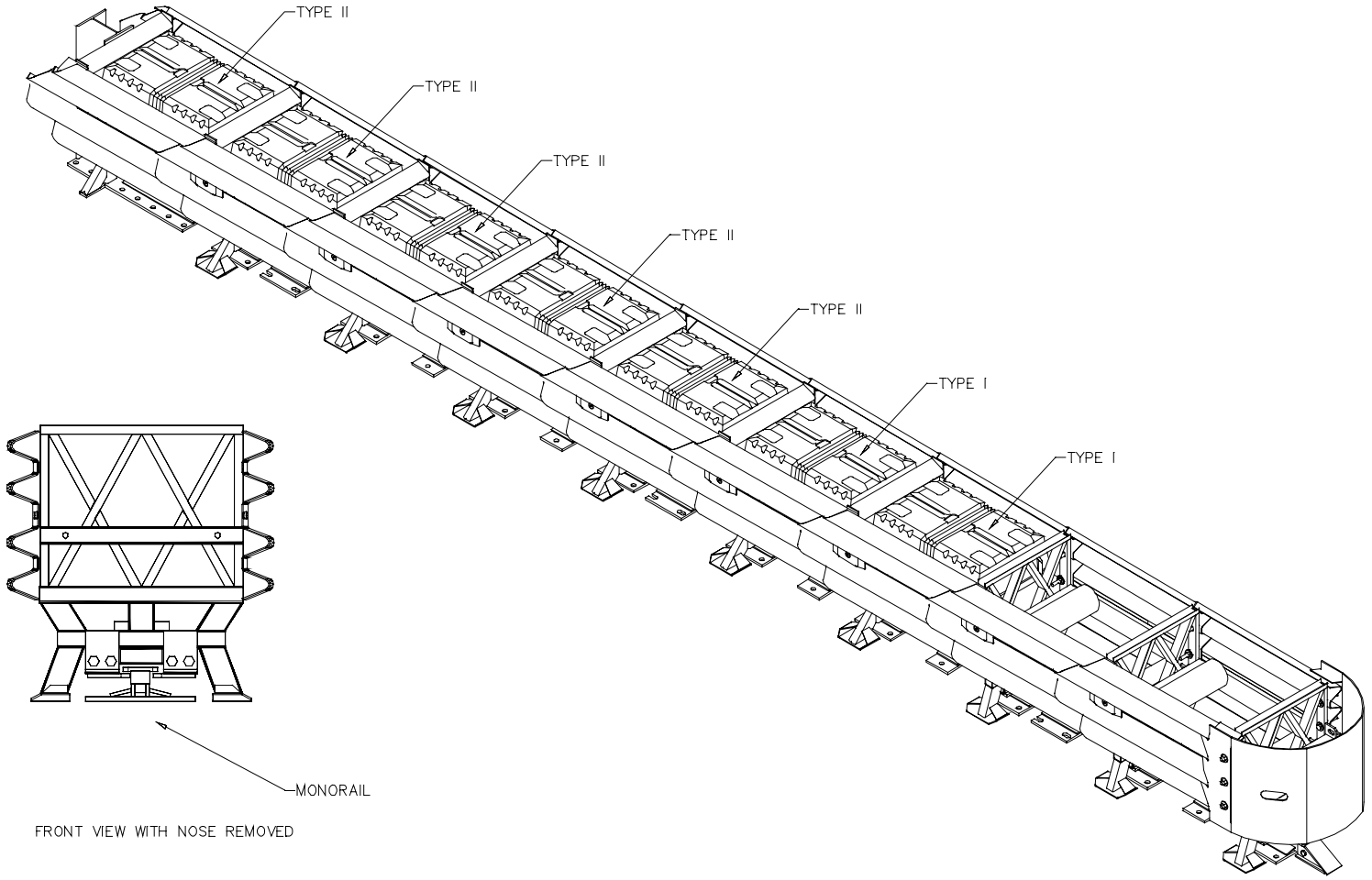


Figure 1: QuadGuard® HS (24") System

Figures (cont.):

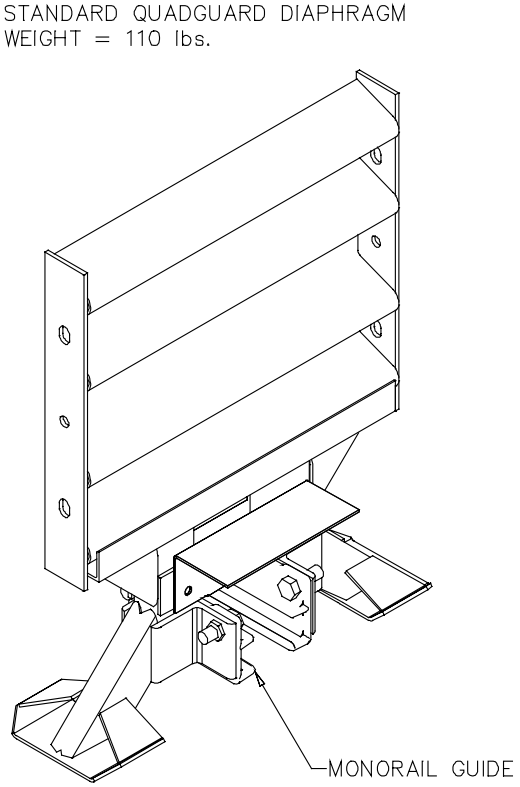


Figure 2: QuadGuard® QuadBeam™ Diaphragm Assembly

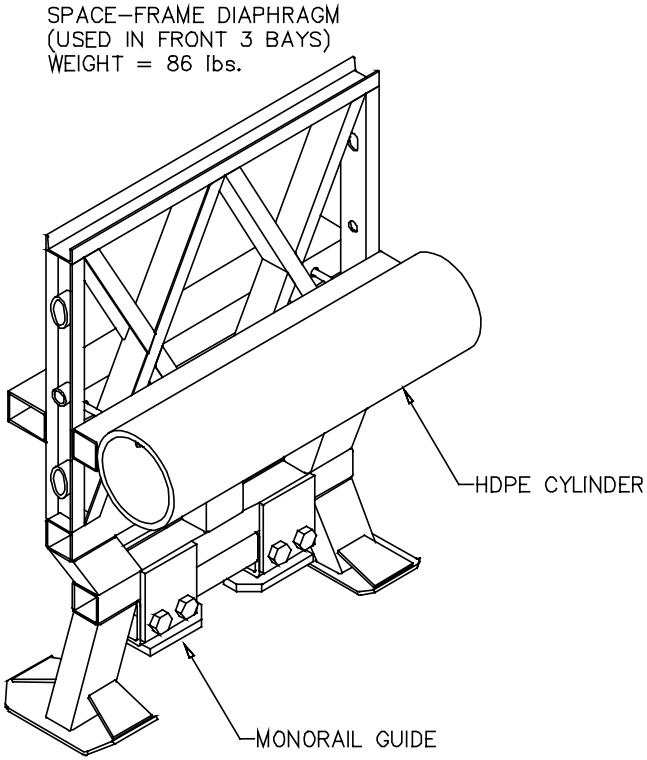
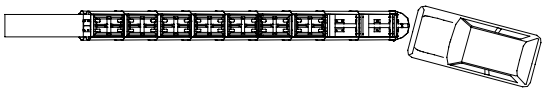
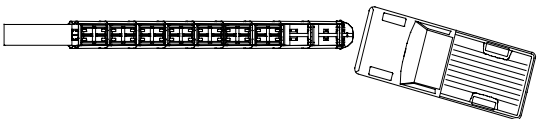
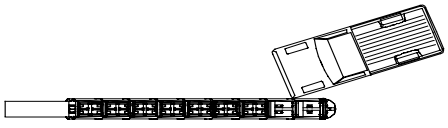
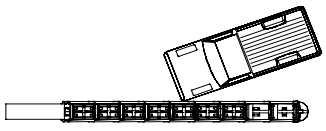
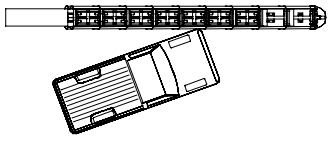


Figure 3: QuadGuard® HS Space-Frame Diaphragm Assembly

QuadGuard HS Test Matrix Summary

NCHRP 350 Test	Test Results	Comments
 Test 3-31, 2000P / 70mph / 0° 0 Offset	Long. Delta V = 8.6 m/s Lateral Delta V = -0.5 m/s Long. Ridedown = -14.4 G Lateral Ridedown = -4.7 G Actual Speed = 111.9 km/h	Results Within Occupant Risk Limits
 Test 3-32, 820C / 70mph / 15° Nose	Long. Delta V = 11.1 m/s Lateral Delta V = -0.5 m/s Long. Ridedown = -13.8 G Lateral Ridedown = 5.5 G Actual Speed = 111.9 km/h	Results Within Occupant Risk Limits
 Test 3-33, 2000P / 70mph / 15°Nose	Long. Delta V = 9.2 m/s Lateral Delta V = -1.9 m/s Long. Ridedown = -15.5 G Lateral Ridedown = -6.7 G Actual Speed = 115.5 km/h	Results Within Occupant Risk Limits
 Test 3-36, 820C / 70mph / 15°BLON	Long. Delta V = 4.1 m/s Lateral Delta V = -6.8 m/s Long. Ridedown = -10.4 G Lateral Ridedown = -13.4 G Actual Speed = 113.7 km/h	Results Within Occupant Risk Limits
 Test 3-37, 2000P / 70mph / 20° BLON	Long. Delta V = 5.4 m/s Lateral Delta V = 7.8 m/s Long. Ridedown = -14.0 G Lateral Ridedown = 11.5 G Actual Speed = 112.8 km/h	Results Within Occupant Risk Limits
 Test 3-38, 2000P / 70mph / 20° CIP	Long. Delta V = 5.2 m/s Lateral Delta V = 7.0 m/s Long. Ridedown = -10.9 G Lateral Ridedown = 16.9 G Actual Speed = 114.6 km/h	Results Within Occupant Risk Limits
 Test 3-39, 2000P / 70mph / 20° L/2 WW	Long. Delta V = 8.2 m/s Lateral Delta V = 4.0 m/s Long. Ridedown = -13.7 G Lateral Ridedown = 6.8 G Actual Speed = 113.7 km/h	Results Within Occupant Risk Limits