



U.S. Department
of Transportation

**Federal Highway
Administration**

June 18, 1998

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

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 April 15 letter to Mr. Henry Rentz, you requested acceptance of the QuadTrend for use on the National Highway System (NHS) at National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3). The QuadTrend is a modified version of the TREND, a product intended to function both as a gating, redirective end terminal and as a transition element to a rigid longitudinal barrier. The original TREND was formally accepted by the Federal Highway Administration for use as an NCHRP Report 230 device on January 8, 1986.

To support your request, you sent copies of your report entitled "QuadTrend- End Treatment: Qualification to NCHRP 350 TL- 3 - Engineering Summary," dated March 10, 1998, which included the full report prepared by E-TECH Testing Services, Inc., entitled "NCHRP Report 350 Crash Test Results for the QuadTrend-350," dated March 1998, and a video tape showing the full scale tests that you conducted on the QuadTrend. Revised copies of the two reports, both dated June 1998, were delivered to Mr. Richard Powers of my staff on June 17.

The QuadTrend- System is a redirective terminal/transition consisting of interlocking telescoping Quad-beam fender panels, six wide flange posts on slip base supports, sand containers on posts 1, 3, and 4, a tension strap on the field side of the unit, and a ground-level redirecting cable. The primary difference from the TREND is the use of Quad-beam fender panels in place of the original Thrie-beam panels used on the TREND. The QuadTrend system, as tested, is shown on Enclosure 1.

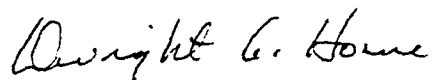
Since the QuadTrend is a gating terminal; NCHRP-Report 350 specifies that tests 3-30 through 3-35 and test 3-39 be run to certify this device at Test Level 3 (TL-3). You stated that NCHRP Report 230 test 45 (which was run to certify the TREND) was equivalent to NCHRP Report 350 test 3-30 which need not be repeated since the Quad-beam fender panels are approximately the same weight as the Thrie-beam panels used in test 45, and there were no other significant design changes that were likely to degrade the QuadTrend's end-on performance with the 820-kg car. We reviewed the video and written summary of test 45 and agree that test 3-30 would probably be redundant and thus can be waived. You further stated that test 3-34 (small car at 15 degrees at the Critical Impact Point) need not be run because it is less critical than the NCHRP Report 230 test 30 (4500-pound car at 25 degrees 15 feet upstream from the connection to the rigid barrier). We do not believe these two tests are readily comparable. Test 3-34 is the NCHRP Report 350 equivalent of the NCHRP Report 230 test 44 (an 1800-pound car at 15 degrees midway between the nose and the beginning of the terminal's length of need) which was not run for the TREND certification. Nevertheless, we can agree to waive test 3-34 based on our comparison of the specific QuadTrend design details at the assumed critical impact point (i.e., at post 2) and the results of tests that have been run on other NCHRP Report 350 parallel terminals at the same location. A one-page summary of the tests that you did run, and summaries of each individual test, including NCHRP Report 230 test 45, are enclosed as Enclosure 2.

Two items appear critical to ensure satisfactory in-service performance of the QuadTrend - the structural rigidity of the vertical concrete barrier to which it is attached and the grading behind the terminal where the redirecting cable is located. The information you submitted did not include details on the attachment of the QuadTrend to the concrete wall or the reinforcing and embedment details of the wall itself. The concrete barrier to which the QuadTrend is attached must be a chamfered vertical wall (as tested), designed to resist a lateral ultimate load of 60 kips (414 MPa) to prevent overturning or significant deflection and a longitudinal load of 120 kips (828 MPa) to prevent pull-out or rupture of the end shoe.

Grading around the QuadTrend should conform to the recommended grading for all gating-type terminals. The roadway approaches to the terminal should be 1 to 10 (or flatter) and this grading should be extended at least one meter behind the terminal at which point it can be rounded to a somewhat steeper slope where necessary. Since a vehicle impacting the end of the QuadTrend will be guided along the redirecting cable, it is critical that this path be unobstructed and traversable. The need for a nearly flat runout path is evident in test 3-31 in which the impacting pickup truck was subjected to high roll and pitch angles as it was redirected behind the QuadTrend along the ground cable.

Based on our review of the information you provided, we concur that the QuadTrend, as tested, meets the acceptance criteria for an NCHRP Report 350 TL-3 terminal when used to shield the end of a rigid, vertical concrete barrier as noted above. It may be used on the National Highway System (NHS) when such use is specified by, or acceptable to, 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 when its use is specified by the contracting authority.

Sincerely yours,

A handwritten signature in black ink that reads "Dwight A. Horne". The signature is written in a cursive style with a large initial 'D'.

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

2 Enclosures