



U.S. Department  
of Transportation  
**Federal Highway  
Administration**

1200 New Jersey Ave., SE  
Washington, D.C. 20590

December 23, 2011

In Reply Refer To:  
HSST/ CC-123T

Mr. Barry D. Stephens, P.E.  
Sr. Vice President Engineering  
Energy Absorption Systems  
3617 Cincinnati Avenue  
Rocklin, CA 95678

Dear Mr. Stephens:

This letter is in response to your request for the Federal Highway Administration (FHWA) to review a roadside safety system for eligibility for reimbursement under the Federal-aid highway program.

Name of device: Trinity End Terminal (TREND™ 350), Tangent  
Type of device: Redirective, Gating End Terminal (W-Beam)  
Test Level: NCHRP Report 350 Test Level 3 (TL-3)  
Testing conducted by: E-Tech Testing Services, Inc.  
Date of request: December 17, 2010  
Date of completed package: October 26, 2011  
Task Force 13 Designator: SEW25; TREND End Terminal Tangent

### **Decision**

The following device was found acceptable, with details provided below:

- The TREND™ 350 End Terminal, Tangent

Based on a review of crash test results submitted by the manufacturer certifying the device described herein meets the crashworthiness criteria of the National Cooperative Highway Research Program (NCHRP) Report 350, the device is eligible for reimbursement under the Federal-aid highway program. Eligibility for reimbursement under the Federal-aid highway program does not establish approval or endorsement by the FHWA for any particular purpose or use.

The FHWA, the Department of Transportation, and the United States Government do not endorse products or services and the issuance of a reimbursement eligibility letter is not an endorsement of any product or service.

### **Requirements**

Roadside safety devices should meet the guidelines contained in the National Cooperative Highway Research Program Report 350 (NCHRP Report 350). The FHWA Memorandum

FHWA: HSST: WLongstreet: ms:x60087:12/8/11

Revised: sf:x62288:12/21/11

File: h://directory folder/HSST/ CC-123T\_Trinity End Terminal TREND

“ACTION: Identifying Acceptable Highway Safety Features” of July 24, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

### **Description**

The TREND™ 350 End Terminal family of products includes the TREND™ 350 End Terminal, Tangent. This new product is designed to shield the end of w-beam guardrail in roadside tangent installations. The beginning of length of need (BLON= the point where 20 degree redirection occurs under 350 guidelines) for the TREND™ 350 End Terminal, Tangent is cited as the third post.

The TREND™ 350 End Terminal, Tangent is based on AASHTO w-beam rail that has been modified to include slots. These slots extend the length of the rail from the guardrail bolts that hold the rail together. When an errant vehicle strikes the impact head of the terminal in an end on impact, the vehicle’s energy is safely absorbed by the terminal’s rail sections as each of the adjacent pairs of rail sections slide past each other. The vehicle’s kinetic energy is dissipated by tearing of the panel slots, re-shaping of the panels by a calibrated fin at the back of each panel, and by friction. A lightweight impact head is attached to the front of the unit to engage the front vehicles impacting the nose.

The TREND™ 350 End Terminal, Tangent uses end terminal posts and anchorage components that were previously tested to NCHRP 350. These posts designs, known as the Hinged Breakaway Assembly (HBA) and Steel Yielding Terminal Post (SYTP), have seen extensive use in the ET family of end terminals and also have previously been accepted by the FHWA. The TREND™ 350 End Terminal, Tangent design uses an HBA post in the first post position and an SYTP post in the second post position. These first two posts are joined together by another standard end terminal component, the Angle Strut. The TREND™ 350 End Terminal, Tangent also uses four standard line posts resulting in total system length of 39 feet 2 inches. The FHWA letters for the above cited components are HSA-10/CC-12F (HBA & Angle Strut), HSA-10/CC-12L (W6X8.5 SYTP), and HAS-10/CC-12Q (ET with line posts).

Details of this system are included as an enclosure to this correspondence.

### **Crash Testing**

The following NCHRP Report 350 tests were completed for the TREND™ 350 End Terminal, Tangent:

#### **A. TREND™ 350 End Terminal; Tangent Configuration:**

1. Test 3-30 (820C/ 100kph/ 0° w/4 Offset):  
Impact speed = 99.7 km/h, Long.  $\Delta V$  = 9.7 m/s, Long. Ridedown = -12.9 g.
2. Test 3-31 (2000P/ 100kph/ 0° Nose):  
Impact speed = 97.0 km/h, Long.  $\Delta V$  = 6.8 m/s, Long. Ridedown = -8.9 g.
3. Test 3-32 (820C/ 100kph/ 15° Nose):  
Impact speed = 100.4 km/h, Long.  $\Delta V$  = 8.6 m/s, Long. Ridedown = -11.8 g.
4. Test 3-33 (2000P/ 100kph/ 15° Nose):  
Impact speed = 101.1 km/h, Long.  $\Delta V$  = 5.6 m/s, Long. Ridedown = 10.3 g.

5. Test 3-34 (820C/ 100kph/ 15°/ CIP):  
Impact speed = 97.7 km/h, Lat.  $\Delta V$  = 5.0 m/s, Lat. Ridedown = 11.1 g.
6. Test 3-35 (2000P/ 100kph/ 20°/ BLON):  
Impact speed = 100.4 km/h, Long.  $\Delta V$  = 5.6 m/s, Long. Ridedown = -14.4 g.
7. Test 3-39 (2000P/ 100kph/ 20°/ L/2):  
Impact speed = 99.7 km/h, Long.  $\Delta V$  = 4.8 m/s, Long. Ridedown = -12.6 g

Test summaries of the above tests are included as an enclosure to this correspondence.

### **Findings**

Based on the successful completion of the described NCHRP Report 350 testing, FHWA concurs that the TREND™ 350 End Terminal, Tangent meets the evaluation criteria for NCHRP Report 350 redirective, gating end terminals at TL-3 impact conditions.

In addition, FHWA concurs that the testing of the TREND™ 350 End Terminal, Tangent was conducted at the worst-case guardrail height of 27-3/4 inches and it is acceptable to use the TREND End Terminal when attached to guardrail with heights between 27-3/4 inches and 31 inches. (SGR04a from 27 3/4 inches to 30 inches, MGS from 27 3/4 inches to 31 inches, and the various proprietary 31-inch designs.)

Therefore, the system described and detailed in the attached form is eligible for reimbursement and should be installed under the range of conditions tested, when such use is acceptable to a highway agency.

Please note the following standard provisions that apply to FHWA eligibility letters:

- This letter includes an AASHTO/ARTBA/AGC Task Force 13 designator that should be used to identify any new or updated Task Force 13 drawings.
- This finding of eligibility is limited to the crashworthiness characteristics of the devices and does not cover their structural features, or conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke this letter.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of is designated as number CC-123T and shall not be reproduced except in full. This letter and the test documentation upon

which it is based are public information. All such letters and documentation may be reviewed at our office upon request.

- The TREND End Terminal, Tangent is a patented product and is considered proprietary. If proprietary devices are specified by highway agency for use on Federal-aid projects, except exempt, non-NHS projects, (a) they must be supplied through competitive bidding with equally suitable unpatented items: (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists: or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The finding of eligibility letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

Michael S. Griffith  
Director, Office of Safety Technologies  
Office of Safety



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Director, Office of Safety Technologies  
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