U.S. Department of Transportation
Federal Highway Administration

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

September 9, 2010

In Reply Refer To:
HSSD/B-82D

Mr. Mark Tonks
Group Managing Director
Hill & Smith Limited
Springvale Business & Industrial Park
Billson, Wolverhampton, West Midlands
WV14 0QL United Kingdom

Dear Mr. Tonks:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of a roadside safety system for use on the National Highway System (NHS).

Name of system:	Brifen Wire Rope Safety Fence
Type of system:	High Tension Cable Barrier
Test Level:	NCHRP Report 350 TL-4
Testing conducted by:	SouthWest Research Institute
Task Force 13 Designator:	PENDING
Date of request:	May 13, 2010
Date initially acknowledged:	May 18, 2010
Date of completed package:	June 1, 2010

You requested that we find this system acceptable for use on the NHS under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

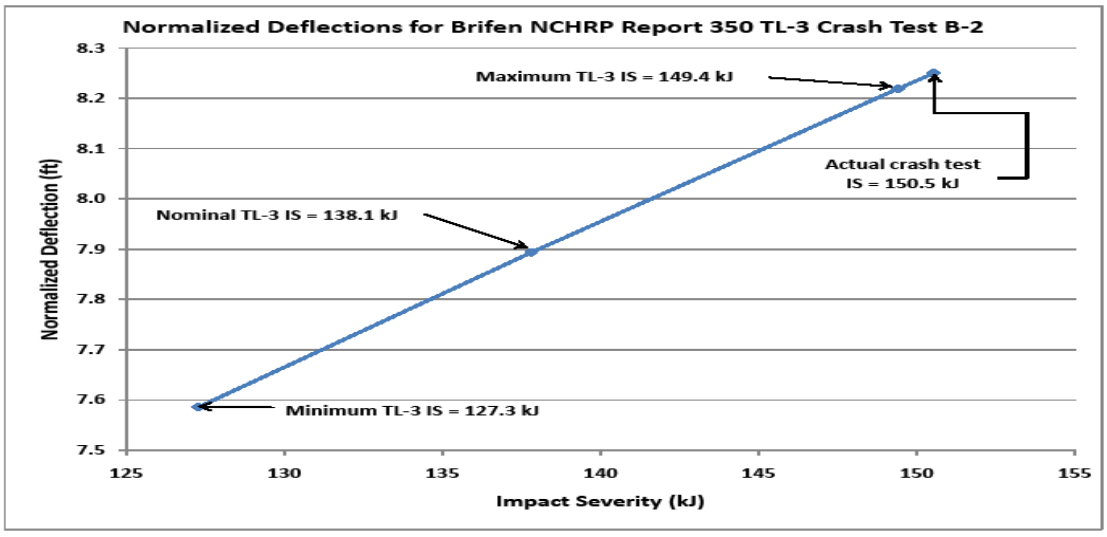
Requirements
Roadside safety devices should meet the guidelines contained in the NCHRP Report 350 or the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware. The FHWA memorandum "Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Description
On May 19, 2010, you and your representative, Dr. Richard McGinnis, met with Mr. Artimovich of my staff and provided him with a copy of a test report prepared by the Southwest Research Institute (SwRI) entitled "NCHRP Report 350, Test 3-11 Full-Scale Crash Evaluation of a

Brifen® Wire Rope Safety Fence (WRSF) (Deflection Test), SwRI Test Number B-2." This report detailed a test conducted by personnel from the SwRI at a temporary site in Ardmore, Oklahoma. The 60-meter (197-foot) long test article was a standard 4-cable Brifen® WRSF with cable heights of 36.5 in (930 mm), 30.5 in (770 mm), 24.5 in (620 mm), and 18.5 in (470 mm). The 21-ft (6.4-m) spaced posts were 4 in (100 mm) by 2-3/16 in (55 mm) by 0.1793 in (4.5 mm) in cross-section and were placed in steel sockets embedded in concrete foundations. This system is identical to the Brifen Test level 4 (TL-4) system described in FHWA acceptance letter B-82B dated March 27, 2005, except for the post spacing and the three lower cables are each 0.4 in (10 mm) lower than the original design. The difference in the cable heights is within the allowable construction tolerance. The purpose of this test was to ascertain the dynamic deflection of a Brifen installation with 21-ft (6.4-m) post spacing.

Crash Testing

When impacted at 24.7 degrees and 101.2 km/h with a 2182-kg pickup truck, the dynamic deflection of the safety fence installation was reported to be 2.5 meters (8.25 feet). All NCHRP Report 350 evaluation criteria for this test were satisfactorily met. You indicate in your letter that the impact severity of the crash was computed to be 150.5 kJ which is 9 percent higher than the target value of 138.1 kJ for NCHRP Report 350 TL-3 crash tests. Further we note that you used a European Union equation to normalize the dynamic deflection and estimated that the deflection would have been approximately 7.9 ft had the impact severity been the standard NCHRP Report 350 TL-3 value of 138.1 kJ. The figure below shows the actual and normalized deflections for NCHRP Report 350 TL-3 impact severities (minimum, nominal, and maximum). As we have stated in earlier acceptance letters for cable barriers, the design deflection distance is based on a single standard test conducted under carefully controlled conditions. It should not be considered an exact distance, but rather as a single point within the range of deflections that can be expected under actual field conditions.



In the crash test rigging screws were purposely arranged so that they would be located in the area where vehicle-barrier contact occurs to demonstrate that their location does not affect barrier performance. Two rigging screws were located at post 9, and the other two rigging screws were located midspan between posts 8 and 9. The vehicle was in contact with the barrier from post 5 through post 10, inclusive. None of the rigging screws was damaged, and the performance of the barrier was not affected by the rigging screws.

Findings

In summary, based on the most recent crash test your Brifen 4-cable WRSF, remains acceptable as TL-3 and TL-4 traffic barriers and may be used on the NHS with any post spacing from 1.6m (5.2 ft) to 6.4m (21 ft) using driven posts, posts set in driven steel sleeves, or posts in socketed concrete foundations and with 4 cables as long as cable heights and other conditions are consistent with previous FHWA acceptance letters and when such use is specified by the contracting agency. As noted earlier in this letter, the purpose of the referenced crash test was to ascertain the dynamic deflection of a Brifen installation with 21-ft (6.4-m) post spacing. We concur that this design deflection is 7.9 feet.

We understand that all steel components used in any of the accepted Brifen systems are manufactured in the U.S. with U.S. steel and are not subject to the Buy America provisions of Title 23, U.S. Code (USC), Section 635.410.

Although the barrier performed well under ideal test impact conditions, the likelihood of passenger car underrides of **any cable system** may increase as the post spacing increases, particularly when the barrier is installed on non-level or slightly irregular terrain and the cables are not restrained from lifting at each post. Consequently, some transportation agencies have limited post spacing to approximately 6m (20 feet) for cable barriers. The dynamic deflection of the barrier is likely to increase when it is installed along the convex sides of horizontal curves, and when distances between anchorages exceed the 60-m (200-foot) test length.

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

- This acceptance is limited to the crashworthiness characteristics of the systems and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the system will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- 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 acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.

- To prevent misunderstanding by others, this letter of acceptance is designated as number B-82D 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.
- Brifen cable barriers are patented products and considered proprietary. If proprietary systems are specified by a 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.
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David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

Enclosures

FHWA:HSSD:NArtimovich:tb:61331:8/23/10
File: s://directory folder/nartimovich/B82_DBrifen_21_foot_spacing_fin.doc
cc: HSSD (Reader, HSA; Chron File, HSSD; NArtimovich, HSSD)

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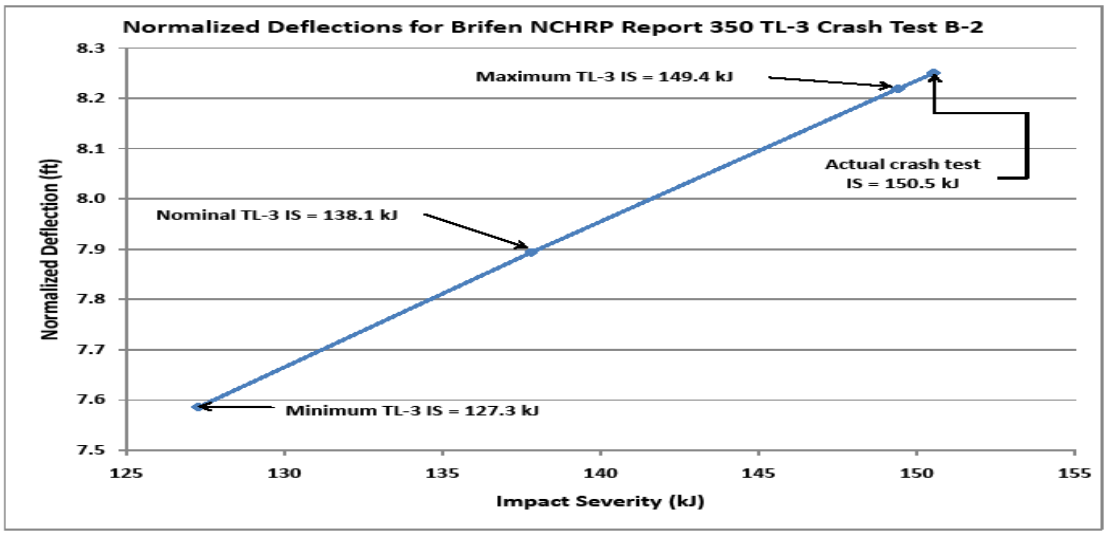

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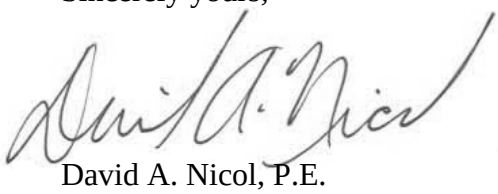

David A. Nicol, P.E.
Director, Office of Safety Design
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Enclosures

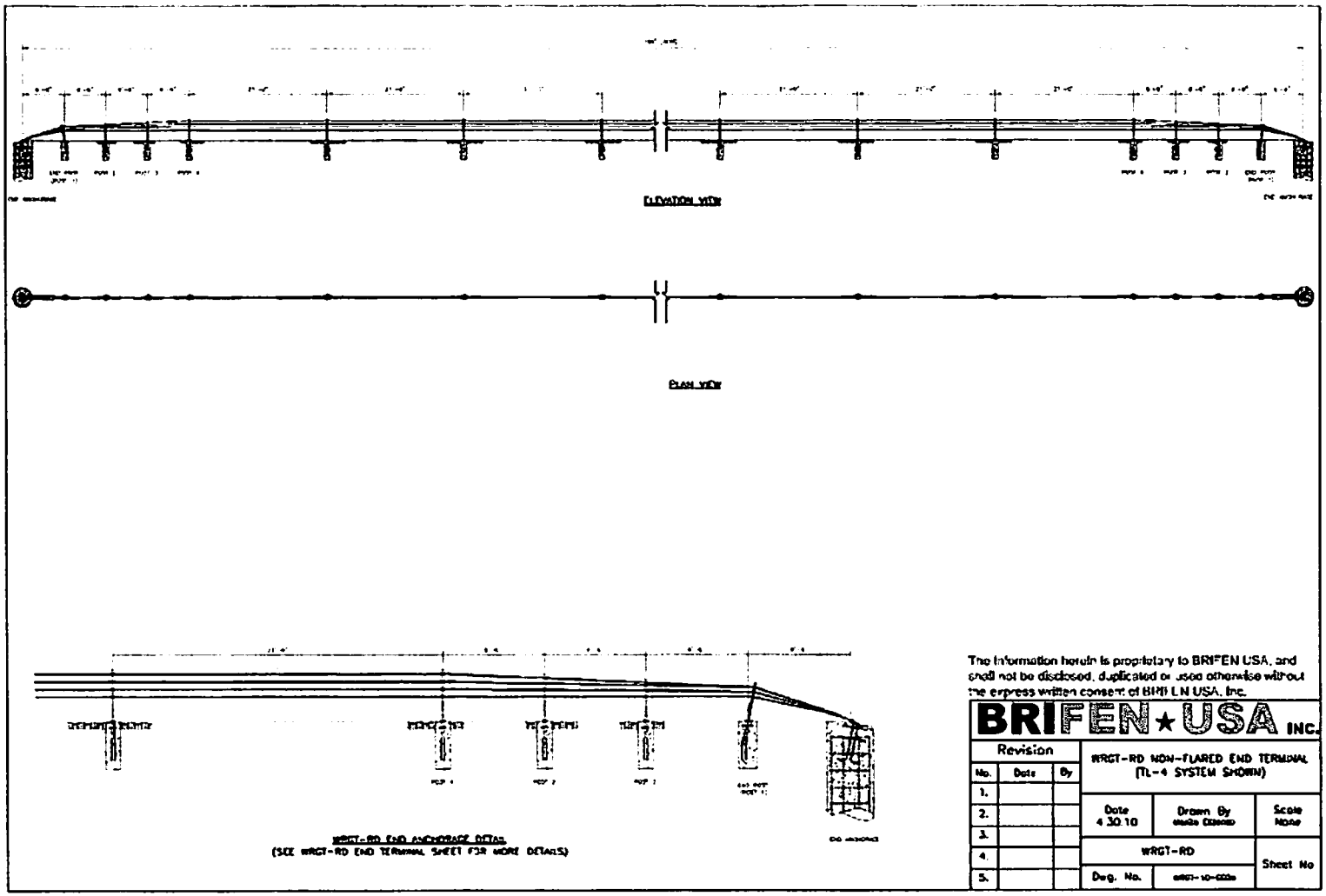
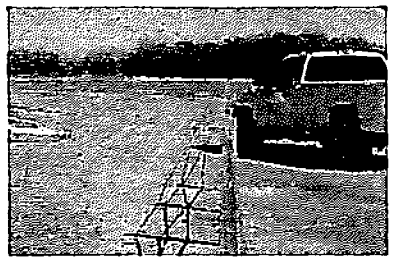
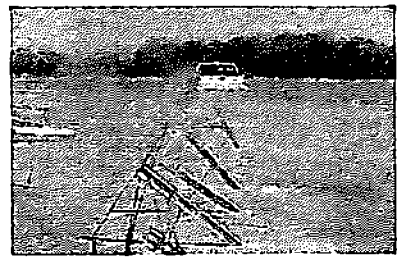
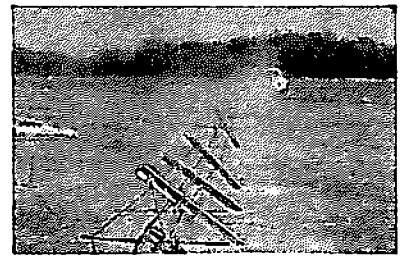
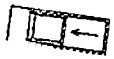


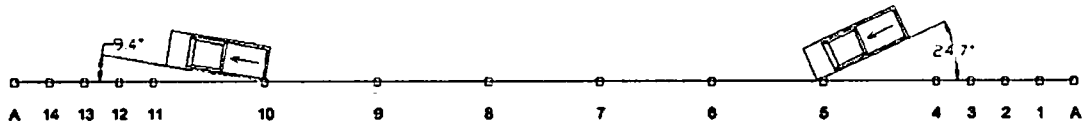
Figure A.1 – Brifen USA Wire Rope Safety Fence – Includes Brifen USA WRGT-RD Terminal

Table 3.1 – Summary of Test Results and Conditions







General Information
- Test Agency ..... Southwest Research Institute
- Test Number B-2
- Test Date 04/07/2010
- Test Category 3-11

Test Article
- Type ..... Longitudinal Barrier
- Installation Length ..... 60 m (197 ft)
- Nom. Barrier Height ..... 0.93 m (3.05 ft)
- Type of Primary Barrier ..... Wire Rope Safety Fence

Soil ..... Concrete Footings Embedded in Conrete Runaway

Test Vehicle
- Type ..... ¾-ton pickup
- Designation 2000P
- Model ..... 1999 Chevrolet 2500
- Mass (kg) 2182
- Inertial Mass(kg) 2182
- Dummy Mass (kg) ..... NA
- Gross Static Mass (kg) 2182

Impact Conditions
- Speed (km/hr) 101.2
- Angle (degrees) 24.7

Exit Conditions
- Speed (km/hr) ..... 82.7 (calculated)
- Angle (degrees) 9.4

Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 1.9
  - y-direction ..... -2.9
- Ridedown Accelerations (g's)
  - x-direction ..... -5.9
  - y-direction 5.5

Post Impact Vehicular Behavior
- Maximum Roll Angle (degrees) ..... 4.3 @ 0.7281 sec.
- Maximum Pitch Angle (degrees) ..... 2.3 @ 0.3563 sec.
- Maximum Yaw Angle (degrees) ..... 37.0 @ 1.8557 sec.

Test Article Deflection
- Dynamic ..... 2.5 m (8.2 ft)
- Permanent (top of barrier) ..... 1.13 m (3.7 ft)
- Permanent (base of barrier) ..... 0 m (0 in)

Vehicle Damage

Exterior
- CDC 11LFEW9
- VDS 11-LFQ-3

Interior
- OCDI LF0000000
- Max. Deform. (mm) 0

Table 3.2 – Summary of Test Evaluation Results – (NCHRP Report 350 Evaluation Criteria)

Evaluation Factor	Evaluation Criteria	Crash Test Results	Pass/Fail
Structural Adequacy	A. Test article should contain and redirect the vehicle; the test vehicle should not penetrate, underride, or override the installation although controlled lateral deflection of the test article is acceptable.	The longitudinal barrier redirected the vehicle back toward the roadway with 2.5 m (8.2 ft) of maximum dynamic lateral deflection. Vehicle did not penetrate, underride, or override the installation.	**Pass**
Occupant Risk	D. Detached elements, fragments or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present an undue hazard to other traffic, pedestrians, or personnel in a work zone. Deformation of, or intrusions into, the occupant compartment that could cause serious injuries should not be permitted.	There were no fragments or other debris from the test article. There was no intrusion into the occupant compartment	**Pass**
	F. The vehicle should remain upright during and after collision although moderate roll, pitching, and yawing are acceptable.	The vehicle remained stable during and after the collision, with a maximum roll of 4.3 degrees, and a maximum pitch of 2.3 degrees.	**Pass**
Vehicle Trajectory	K. After collision it is preferable that the vehicle's trajectory not intrude into adjacent traffic lanes.	Vehicle was redirected without any external brakes. After the vehicle was redirected, the vehicle traveled away from the barrier.	**Pass**
	L. The occupant impact velocity in the longitudinal direction should not exceed 12 m/s and the occupant ridedown acceleration in the longitudinal direction should not exceed 20 g's.	Occupant impact velocities: Longitudinal: 1.9 m/s Occupant ridedown accelerations: Longitudinal: 5.9 g's	**Pass**
	M. The exit angle from the test article preferably should be less than 60 percent of the test impact angle, measured at time of vehicle loss of contact with test device.	Impact angle: 24.7 degrees 60% of impact angle: 14.8 degrees Exit angle: 9.4 degrees	**Pass**