



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

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

September 23, 2009

In Reply Refer To:  
HSSD/B-184A

Mr. Rick Mauer  
Outside National Sales Representative  
Nucor Steel Marion, Incorporated  
P.O. Box 837  
Greenland, NH 03840

Dear Mr. Mauer:

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

Name of system: Nu-Cable with 20 foot post spacing  
Type of system: Cable Barrier  
Test Level: NCHRP Report 350 TL-4  
Testing conducted by: Holmes Solutions  
Date of request: April 9, 2009  
Date of completed package: July 10, 2009

You requested that we concur in the design deflection distance for this system which is 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 systems should meet the guidelines contained in the NCHRP Report 350. The FHWA Memorandum: ACTION: "Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

### **Description**

The Test Level 4 (TL-4) Nu-Cable barrier system consists of four steel cables mounted on 4 lb/ft Nucor Steel Marion Rib-Bak U-channel posts. This system was found acceptable in the following FHWA acceptance letters:

B-167	February 24, 2008	4-strand Nucor Wire Rope Barrier System TL-4
B-184	December 9, 2008	Nu-Cable TL-4 with Extended Hanging Hook



## Crash Testing

The Nucor Nu-Cable System consists of four 19-mm (3/4-in) wire rope cables attached at heights of 380 mm, 640 mm, 790 mm, and 890 mm (15 in, 25 in, 31 in, and 35 in) above ground level. The lower two cables are attached using locking hook bolts which connect directly to the U-posts. The top two cables are supported by a top clip which engages with the top of the U-post section.

All posts in the Nucor Wire Rope Barrier System were installed directly into plastic sockets that have been cast into 300-mm diameter x 750-mm (12-in x 30-in) deep concrete foundations. The posts were spaced at 6.1-m (20-ft) centers along the length of the barrier. The overall barrier length was 103.7 m (340 feet) plus an additional 8.0 m (26.3 feet) of terminal end at either end of the barrier.

The tested system was identical to that found acceptable in FHWA acceptance letter B-184 with the addition of a stainless steel retaining band holding the top of the hanger clip against the post. This band prevents the cables from prematurely disengaging from the U-channel posts.

The intent of the crash test was to establish the “design deflection distance” for the TL-4 Nu-Cable system using the 2000P test vehicle. The test designations for this impact is NCHRP Report 350 Test 3-11 or 4-11 as all vehicle and impact parameters are the same regardless of the test level rating of the barrier.

The 2000P vehicle impacted with a velocity of 99.5 km/h at an angle of 25 degrees as seen in the enclosed test data summary sheet. The vehicle remained in contact with the barrier and had a maximum dynamic deflection of 2.55 m (8.37 feet). Occupant risk values and vehicle trajectory for this test were acceptable.

## Findings

The system described above and detailed in the enclosed drawing is acceptable for use on the NHS under the range of conditions tested, when such use is acceptable to a highway agency.

Although the barrier performed well under ideal test impact conditions with the two test vehicles, 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 100m (330-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-184A 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 Nucor Nu-Cable barrier systems 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.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, 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.

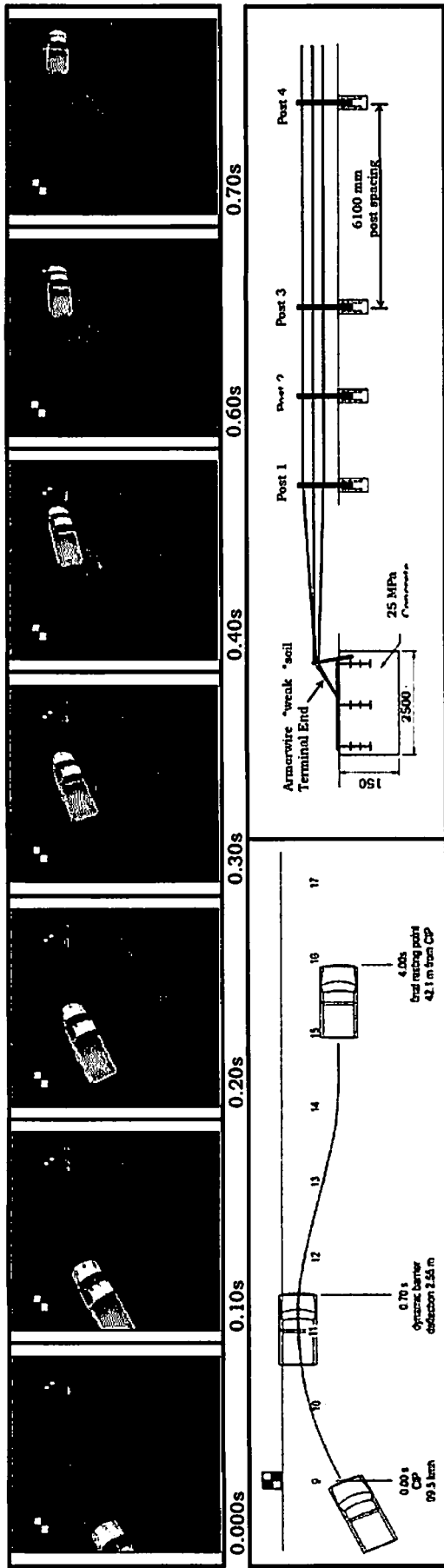
Sincerely yours,



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

Enclosures

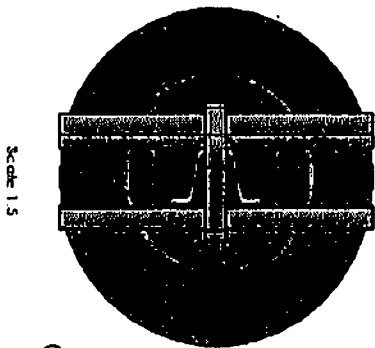
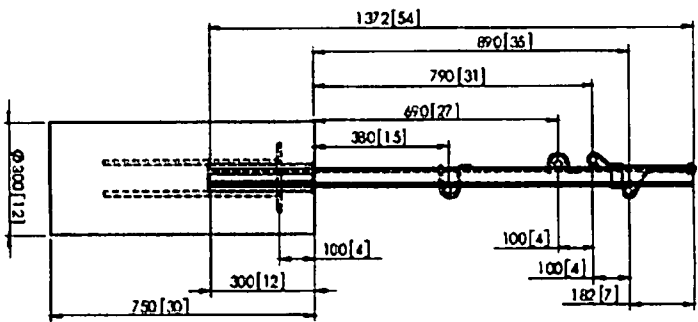




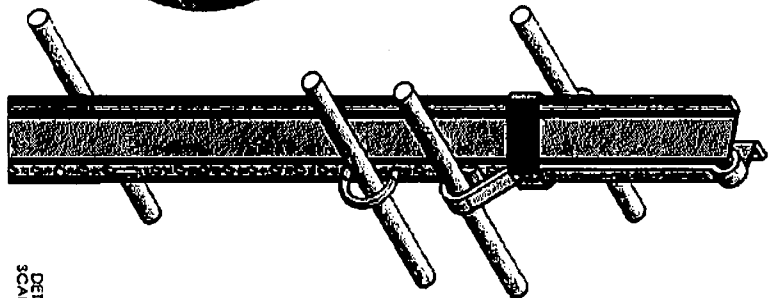
<b>General Information</b>	Test Agency ..... Holmes Solutions, New Zealand	<b>Impact Conditions</b>	Speed (km/h) ..... 99.5
Test Designation..... NCHRP 350 Test 3-11	Test No..... 0570723118	Angle (deg)..... 25	Dynamic (m)..... 2.55'
Date..... 2/1/2008	Test Article Type	Speed (km/h)..... 0	Permanent (m)..... 0.40'
Name or Manufacturer... Median wire rope barrier with 4 cables supported on Nucor 4 pound posts	Production Model	Angle (deg)..... 0	Working width (m)..... 2.55'
Installation Length ..... Nucor Marion Inc.	1997 Chevrolet Silverado	Speed (km/h)..... 0	Vehicle Damage Exterior
Material or Key Elements 4 Cable Median Barrier with Nucor Steel 4 pound U post and weak soil Armorwire Terminal End	2080	Angle (deg)..... 0	VDS ..... 11-FL-4
<b>Soil Type and Condition</b>	0	Occupant Risk Values	CDC..... 10FLML4
	2080	Impact Velocity (m/s)	Maximum Exterior
		x-direction..... 3.7	Vehicle Crush (mm)..... 340 mm
		y-direction..... -2.9	Interior
		THIV (km/h)..... 17.1	OCDI..... AS0000000
		Ridedown Accelerations	Max. Occ. Compart.
		x-direction (g's)..... -6.2	Deformation (mm)..... 10
		y-direction (g's)..... 5.9	<b>Post-Impact Behaviour</b>
		PHD (g's)..... 7.3	Max. Yaw Angle (deg)..... -27.9
		ASI..... 0.46	Max. Pitch Angle (deg)..... 9.2
		Max. 0.050-s Average	Max Roll Angle (deg)..... 9.4
		x-direction (g's)..... -2.7	
		y-direction (g's)..... 3.0	
		z-direction (g's)..... 3.5	

\* Deflections measured as lateral deflection of the cables

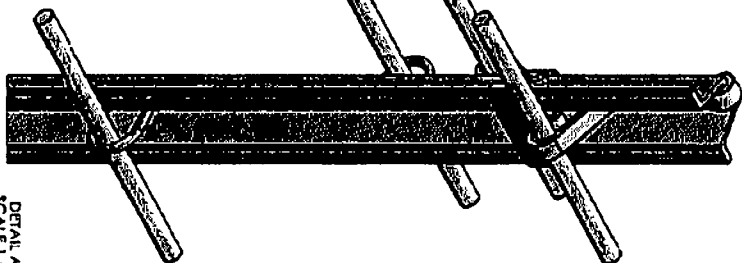
Figure 3.5 Summary of results for test 0570723118 (NCHRP 350 Test 3-11).



Scale 1:5



DETAIL B  
SCALE 1:5



DETAIL A  
SCALE 1:5

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REV	CHANGES	DATE

SCALE: 1:15		DRAWN BY		DATE		INT.		APPROV BY		DATE		INT.	

NucorWire Post Assembly		SHEET		DRAWING NUMBER		REV	



8 Paul Matthews Rd.  
Ashbury Auckland NZ  
Tel: 04 9 415 2971  
Fax: 04 9 415 2973  
8503armotel.co.nz

Figure 2.1 b Steel Line Posts