



July 17, 2008

In Reply Refer To: HSSD/B-176A

Mr. John Addy  
Hill & Smith  
Springvale Business and Industrial Park  
Bliston, Wolverhampton, West Midlands, UK, WV14 OQL

Dear Mr. Addy:

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

Name of system: Zoneguard™, Standard and Minimum Deflection arrangements  
Type of system: portable longitudinal steel barrier  
Test Level: MASH-08 Test Level 3 (TL-3)  
Testing conducted by: Southwest Research Institute  
Date of request: May 30, 2008  
Date of follow-up: June 2, 2008

You requested that we find this system acceptable for use on the NHS under the provisions of the proposed American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware 2008 (MASH-08) for both the standard and minimum deflection arrangements of Zoneguard™.

### **Requirements**

Roadside safety systems should meet the guidelines contained in the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features". FHWA Memorandum "ACTION: Identifying Acceptable Highway Safety Features" of July 25, 1997 provides further guidance on crash testing requirements of longitudinal barriers. You have chosen to anticipate the adoption of MASH-08, an option that FHWA has offered with the understanding that additional testing may need to be done if changes to the test criteria are made before MASH-08 is formally adopted.

### **Description**

The Zoneguard™ portable longitudinal barrier system is comprised of 8 gauge, 0.165 in (4.2 mm) thick, ASTM A36 pressed, galvanized steel panels assembled in 50 ft (15.24 m) long sections. Each section is 2.69 ft (820 mm) high with a base width of 2.3 ft (700 mm) and a top beam width of 0.52 ft (157 mm). The Zoneguard™ has a step 0.5 ft (150 mm) wide on each side just above surface level, which slopes upward to meet the upper beam section. Each section

weighs approximately 3097 lb (1406 kg). The base of each 50 ft (15.24 m) long section has 12 rubber feet, 2.30 ft x 0.54 ft x 0.043 ft (700 mm x 165 mm x 13 mm), which are fixed using an adhesive compound.

### Crash Testing

The complete barrier test installations were each nominally 2.69 ft (820 mm) high, 2.3 ft (700 mm) wide, and 250 ft (76.2 m) long. Tests were conducted for two different anchoring patterns: (1) the standard arrangement which includes anchoring at each end of the barrier and (2) the minimum deflection arrangement which includes anchoring every 33.3 ft (10.2 m) along the barrier. The standard arrangement is anchored at points 1.64 ft (500 mm) and 16.67 ft (5.1 m) from each end on both sides for a total of four anchors per end. These anchors were 1.5 in (38 mm) diameter ASTM 1018 smooth rod, 12 in (305 mm) long and installed 8 in (200 mm) deep into concrete. The minimum deflection Zoneguard™ arrangement is identical to the standard arrangement described above apart from the addition of the intermediate threaded resin anchors placed in both sides of the “foot” section on 33.3 ft (10.2 m) centers. Alternate anchor designs certified by the manufacturer may be used to provide equal or greater anchorage strength to that provided for the test installations.

The following table summarizes the six tests conducted on the Zoneguard™ systems. The tests in **bold text** apply to this acceptance.

Test #	Test Criteria	Vehicle Mass	Standard or Min. Deflection	Impact Speed	Maximum Deflection*
<b>ZG-USA-1</b>	<b>350 &amp; MASH</b>	<b>1065 kg</b>	<b>Min. Deflection</b>	<b>103.5 km/hr</b>	<b>0.20 m</b>
ZG-USA-2	350	2118 kg	Min. Deflection	99.3 km/hr	0.31 m
<b>ZG-USA-3</b>	<b>MASH</b>	<b>2208 kg</b>	<b>Min. Deflection</b>	<b>101.5 km/hr</b>	<b>0.41 m</b>
ZG-USA-4	350	2118 kg	Standard	100.9 km/hr	1.83 m
<b>ZG-USA-5</b>	<b>MASH</b>	<b>2208 kg</b>	<b>Standard</b>	<b>104.0 km/hr</b>	<b>1.93 m</b>
ZG-USA-6	350	8165 kg	Standard	80.5 km/hr	1.45 m

\* This column shows the maximum dynamic deflection of the top of the barrier.

Crash tests performed included tests 3-10U (“U” refers to tests run in compliance with the update to the NCHRP Report 350, now known as MASH-08) and 3-11 for the minimum deflection arrangement and tests 3-11 and 4-12 for the standard arrangement. Prior to crash testing we concurred in your request that the MASH-08 small passenger vehicle be considered a “worst case scenario” and a proper substitute for the 820C vehicle called for in Report 350. Enclosed with this acceptance letter are drawings of the test article and test summary sheets. The tests and the results met the FHWA requirements.

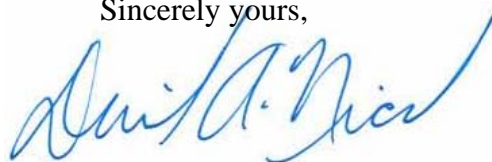
### Findings

The system described above and detailed in the enclosed drawings is acceptable for use on the NHS under the range of conditions tested, when acceptable to a State. When used across a bridge joint it should be noted that the Zoneguard™ can accommodate approximately 10 inches of movement.

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

- This acceptance is limited to the crashworthiness characteristics of the system and does not cover the structural features, nor does it cover 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 MASH-08.
- To prevent misunderstanding by others, this letter of acceptance is designated as number B-176A 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 Zoneguard™ portable longitudinal steel barrier system is a patented product and considered proprietary. If proprietary devices/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 device/system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device/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.

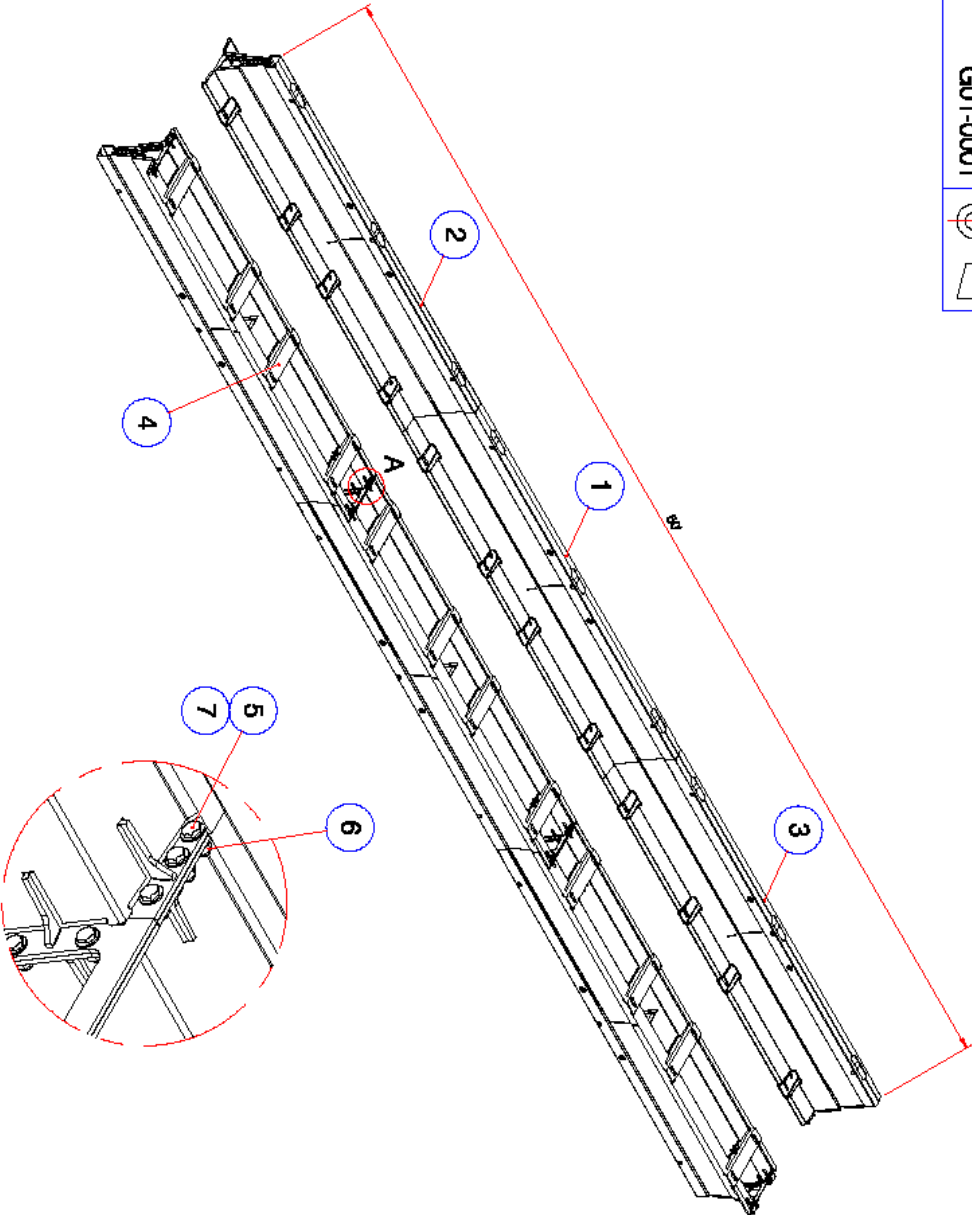
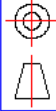
Sincerely yours,



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

Enclosures

Drawing No.  
G01-0001



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ITEM	DESCRIPTION	QTY	DWG. NO.
1	CENTRAL SECTION ASSY.	1	G01-0001
2	WALL BRACKET ASSY.	1	G01-0002
3	FRONT BRACKET ASSY.	1	G01-0003
4	SLABBER FOOT	12	G01-0005
5	WALL BRACKET ASSY. (1/2)	40	G01-1528
6	FRONT BRACKET ASSY. (1/2)	40	G01-1524
7	WALL BRACKET ASSY. (1/2)	80	G01-1528

ALL DIMENSIONS ARE IN DECIMAL INCHES.

A. PROD. REL.			
Drawn By	Checked	ECN	Drawn
KIRANCOOL	OCT. 07		STEEL
Scale	Material	Weight	**Kg
NIS	GALVANISE		

Zoneguard Assy.-  
Temporary.

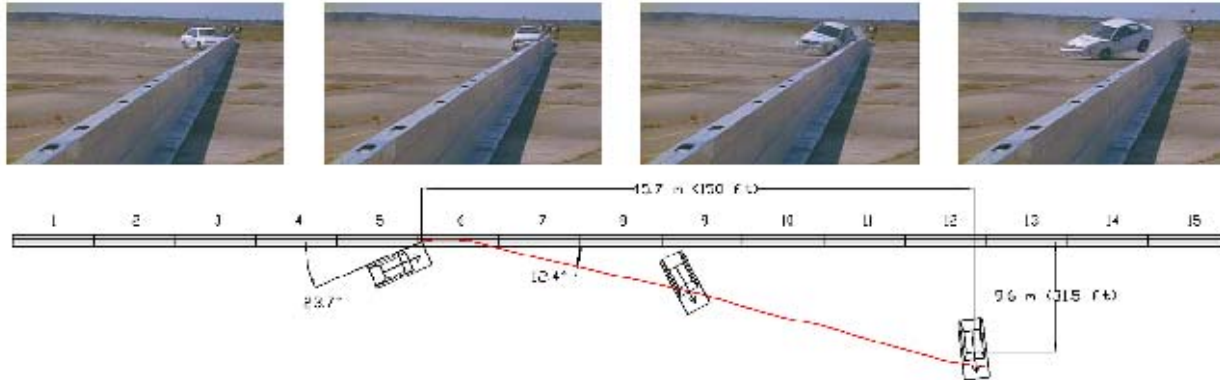
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Drawing No.  
G01-0001

**Table 4.1 – Summary of Test Results and Conditions**



24 of 26

**General Information**

Test Agency ..... Southwest Research Institute  
 Test Number ..... ZG-USA-1  
 Test Date ..... 10/01/2007  
 Test Category ..... 3-10 Update

**Test Article**

Type ..... Longitudinal Barrier  
 Installation Length ..... 76.2 m (250 ft)  
 Nom. Barrier Height ..... 0.82 m (2.69 ft)  
 Type of Primary Barrier ..... Portable Steel Barrier

**Soil**

NA – Installed on Concrete

**Test Vehicle**

Type ..... Small Car  
 Designation ..... 1100C  
 Model ..... 2002 Kia Rio  
 Mass (kg) ..... 1065  
 Inertial Mass(kg) ..... 1065  
 Dummy Mass (kg) ..... 73  
 Gross Static Mass (kg) ..... 1138

**Impact Conditions**

Speed (km/hr) ..... 103.4  
 Angle (degrees) ..... 23.7

**Exit Conditions**

Speed (km/hr) ..... 84 (calculated)  
 Angle (degrees) ..... 12

**Occupant Risk Values**

Impact Velocity (m/s)  
 x-direction ..... 5.0  
 y-direction ..... -7.2

**Ridedown Accelerations (g's)**

x-direction ..... 3.3  
 y-direction ..... 12.8

**Post Impact Vehicular Behavior**

Maximum Roll Angle (degrees) ..... -20.4 @ 0.420 sec.  
 Maximum Pitch Angle (degrees) ..... -9.9 @ 0.724 sec.  
 Maximum Yaw Angle (degrees) ..... 123.6 @ 2.767 sec.

**Test Article Deflection**

Dynamic (top of rail) ..... 0.20 m (8 in)  
 Dynamic (base of rail) ..... 0.10 m (4 in)  
 Permanent (top of rail) ..... 0.09 m (3.5 in)  
 Permanent (base of rail) ..... 0 m (0 in)

**Vehicle Damage**

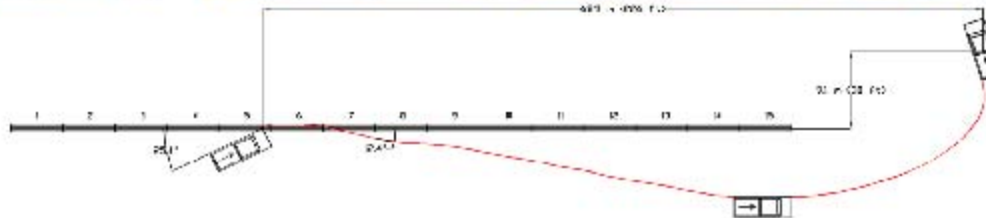
**Exterior**

CDC ..... 11LFEW9  
 VDS ..... 11-LFQ-3

**Interior**

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

**Table 4.1 – Summary of Test Results and Conditions**



22 of 24

**General Information**

Test Agency ..... Southwest Research Institute  
 Test Number ..... ZG-USA-3  
 Test Date ..... 10/02/2007  
 Test Category ..... 3-11 Update

**Test Article**

Type ..... Longitudinal Barrier  
 Installation Length ..... 76.2 m (250 ft)  
 Nom. Barrier Height ..... 0.82 m (2.69 ft)  
 Type of Primary Barrier ..... Portable Steel Barrier

**Soil**

NA – Installed on Concrete

**Test Vehicle**

Type ..... ¼-ton crew cab pickup  
 Designation ..... 2270P  
 Model ..... 2002 Dodge Ram 1500 Quad Cab  
 Mass (kg) ..... 2208  
 Inertial Mass(kg) ..... 2208  
 Dummy Mass (kg) ..... NA  
 Gross Static Mass (kg) ..... 2208

**Impact Conditions**

Speed (km/hr) ..... 101.5  
 Angle (degrees) ..... 25.4

**Exit Conditions**

Speed (km/hr) ..... 71 (calculated)  
 Angle (degrees) ..... 12.4

**Occupant Risk Values**

Impact Velocity (m/s)  
 x-direction ..... 4.5  
 y-direction ..... -5.6  
 Ridedown Accelerations (g's)  
 x-direction ..... -8.3  
 y-direction ..... 14.1

**Post Impact Vehicular Behavior (values limited to data < 1.000 seconds)**

Maximum Roll Angle (degrees) ..... -13.6 @ 0.539 sec.  
 Maximum Pitch Angle (degrees) ..... -14.6 @ 0.554 sec.  
 Maximum Yaw Angle (degrees) ..... 49.5 @ 1.000 sec.

**Test Article Deflection**

Dynamic (top of barrier) ..... 0.41 m (16 in)  
 Dynamic (base of barrier) ..... 0.13 m (5 in)  
 Permanent (top of barrier) ..... 0.08 m (3 in)  
 Permanent (base of barrier) ..... 0 m (0 in)

**Vehicle Damage**

**Exterior**

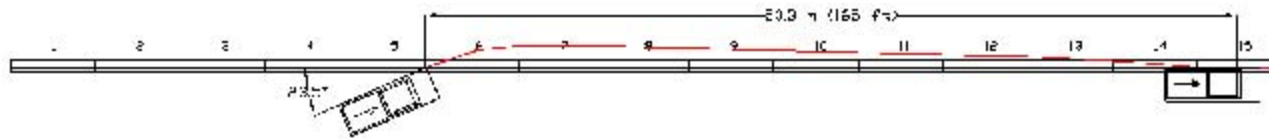
CDC ..... 11LFEW5  
 VDS ..... 11-LFQ-3

**Interior**

OCDI ..... LF(0)(-1)(7)  
 (- values = expansion of OC) (-4)(0)(0)(0)  
 Max. Deform. (mm) ..... 127



**Table 4.1 – Summary of Test Results and Conditions**



24 of 26

**General Information**

Test Agency ..... Southwest Research Institute  
 Test Number ..... ZG-USA-5  
 Test Date ..... 10/02/2007  
 Test Category ..... 3-11 Update

**Test Article**

Type ..... Longitudinal Barrier  
 Installation Length ..... 76.2 m (250 ft)  
 Nom. Barrier Height ..... 0.82 m (2.69 ft)  
 Type of Primary Barrier ..... Portable Steel Barrier

**Soil** ..... NA – Installed on Concrete

**Test Vehicle**

Type ..... ¼-ton crew cab pickup  
 Designation ..... 2270P  
 Model ..... 2002 Dodge Ram 1500 Quad Cab  
 Mass (kg) ..... 2208  
 Inertial Mass(kg) ..... 2208  
 Dummy Mass (kg) ..... NA  
 Gross Static Mass (kg) ..... 2208

**Impact Conditions**

Speed (km/hr) ..... 104.0  
 Angle (degrees) ..... 23.5

**Exit Conditions**

Speed (km/hr) ..... 0  
 Angle (degrees) ..... 0

**Occupant Risk Values**

Impact Velocity (m/s)  
 x-direction ..... 4.3  
 y-direction ..... -4.3

Ridedown Accelerations (g's)  
 x-direction ..... -4.4  
 y-direction ..... 6.3

**Post Impact Vehicular Behavior**

Maximum Roll Angle (degrees) ..... 12.1 @ 0.855 sec.  
 Maximum Pitch Angle (degrees) ..... -6.0 @ 0.573 sec.  
 Maximum Yaw Angle (degrees) ..... 30.7 @ 0.368 sec.

**Test Article Deflection**

Dynamic (top of barrier) ..... 1.93 m (76 in)  
 Dynamic (base of barrier) ..... 1.88 m (74 in)  
 Permanent (base of barrier) ..... 1.70 m (67 in)

**Vehicle Damage**

**Exterior**  
 CDC ..... 11LFEW5  
 VDS ..... 11-LFQ-3  
**Interior**  
 OCDI ..... LF0000000  
 Max. Deform. (mm) ..... 0