July 20, 2020



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

In Reply Refer To: HSST-1/B-340

Mr. Ron Faulkenberry Gibraltar Global LLC 1208 Houston Clinton Drive Burnet, Texas 78611 USA

Dear Mr. Faulkenberry:

This letter is in response to your May 08, 2020 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number B-340 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

• Gibraltar Global TL-3 Cable Barrier System, 4H:1V Slope

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials'(AASHTO) Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the AASHTO's MASH. Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: Gibraltar Global TL-3 Cable Barrier System, 4H:1V Slope Type of system: Longitudinal Barrier Test Level: MASH Test Level 3 (TL3) Testing conducted by: Applus IDIADA KARCO Engineering, LLC. Date of request: May 08, 2020

FHWA concurs with the recommendation of the accredited crash testing laboratory on the attached form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of AASHTO's MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number B-340 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 upon request.
- This 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.
- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

Sincerely,

Michael S. Fiffith

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

Enclosures

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Request for Federal Aid Reimbursement Eligibility of Highway Flexible Barriers

	Date of Request:	July 15, 2020		New	○ Resubmission
	Name:	Bruno Haesbaert			
tter	Company:	Applus IDIADA KARCOEngineering	g, LLC.		
Address: 9270 Holly Road, Adelanto, CA 92301			301		
Suł	Country: United States of America				
To: Michael S. Griffith, Director FHWA, Office of Safety Technologies					

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device & Testing C	Criterion !-!-!		! -	! - !	
System Type	Barrier Placement in V-Ditch S:Single Barrier; D: Double Barrier SBP:Slope Break Point	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'B': Flexible Barriers (Ro <u>SorD: 0to4ft. Offset SBP 4H:1V</u>	Physical Testing	Gibraltar Global TL-3 Cable Barrier System	AASHTO MASH	TL3

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	Ron Faulkenberry	Same asSubmitter	
Company Name:	Gibraltar Global LLC	Same asSubmitter	
Address:	1208 Houston Clinton Drive, Burnet, Texas 78611	Same asSubmitter	
Country:	United States of America	Same asSubmitter	
Enter below all disclosures of financial interests as required by the FHWA `Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.			
Gibraltar Global, LLC. and Applus IDIADA Karco Engineering, LLC. share no (\$0.00) financial interests between the two organizations. This includes no (\$0.00) financial interest but not limited to:			
 i. Compensation, including wages, salaries, commissions, professional fees, or fees for business referrals (dollar valuesare not needed); ii. Consulting relationships; iii. Research funding or other forms of research support; 			
iv. Patents, copyrights, and other intellectual property interests; v. Licenses or contractual relationships; or			

vi. Business ownership and investment interest

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PRODUCT DESCRIPTION

New Hardwareor
 Significant Modification

The Gibraltar Global TL-3 Cable Barrier System is a high tension 4-cable longitudinal barrier. The barrier consists of four (4) 0.75 in. (19 mm) steel cables, C-section steel posts, steel sockets, aluminum hair pinsand steel lock plates. The C-section posts were placed on alternating sides of the cablesand aluminum hair pins held the cables in place. The top two (2) cables of the system were stitched together making the cablesalternate in the top hairpin location. The hair pins held the cablesat 20.0 in (508 mm), 30.0 in (762 mm) and 39.0 in. (991 mm) above grade. The cable barrier system was terminated on both ends with Gibraltar end terminals. The total astested length was 613.7 ft. (187.1 m) long. As recommended in MASH the cable tension wasset to the recommended tension at 100 degrees Fahrenheit. The cables were tensioned to 4200 lbs (18.7 kN). The post spacings used for this test series were as follows:

- Flat Terrain narrowest: 7.0 ft. (2.1 m)

- Flat Terrain widest: 21.0 ft. (6.4 m)

- 4h:1VDitch narrowest: 7.0 ft. (2.1 m)

- 4h:1VDitch widest: 16.0ft. (4.9m).

Test 4-10 and 4-11 were tested on flat terrain and were run asa part of the TL-4 submittal for letter B-316. Test 3-10 and 3-11 were tested on flat terrain. Tests 3-13, 3-14, 3-16, 3-17, and 3-18 were tested in a 46 ft. wide 4H:1V V-ditch. The road surface of the ditch was a minimum of 6 in. deep compacted AASHTOM147-65 soil. The post sockets were embedded in 12 in, diameter by 36 in, deep concrete foundations with a minimum compressive strength of 2500 psi. Tests 3-13, 3-14, and 3-17 were positioned on the front slope while 3-16 and 3-18 were positioned on the back slope.

Gibraltar also offers various post and socket optionssuch as concrete socket foundations with steel or plastic sockets, driven steel sockets, and direct driven posts. Other options include swaged and wedge-type fittings which were installed and crash tested. Pre-stretched and non pre-stretched cable are permissible.

There was one modification made during the testing of the Gibraltar Global TL-34 Cable Barrier System during the MASH test program. Tests 3-11, 3-17, and 3-18 use the widest post spacing configuration. Test 3-11 used 21.0 ft. (6.4 m) and 3-17 used 18.0 ft. (5.5 m) post spacing. For Test 3-18, the post spacing for the line posts was reduced from 18.0 ft. (5.5 m) to 16.0 ft. (4.9 m). Complete details on the design modification is included in Attachment A to this submission and in the complete test reports.

A brief description of each crash test and its result:

Help

Required Test	Narrative	Evaluation
Number	Description	Results
3-10 (1100C)	Test 4-10 is the same as Test 3-10 and was run asa part of the TL-4 submittal for letter B-316. Therefore, Test 3-10 was not re-run, but the same information was used for this submittal. Applus IDIADA KARCOEngineering Project number P37379-01 was conducted with an 1100C test vehicle impacting the system midspan between postsat a nominal velocity and angle of 62 mph and 25 degrees, respectively. As recommend by MASH 2016 the narrowest allowable post spacing of 7.0 ft. (2.1 m) was used. The test vehicle, a 2011 KiaRio weighing 2,427.2 lbs (1,101.0 kg) impacted the system at aspeed and angle of 62.38 mph (100.39 km/h) and 25.1 degrees, respectively. The system redirected the vehicle and had a maximum working width of 7.6 ft. (2.3 m). The test vehicle sustained moderate damage. There was no potential for the article to penetrate the vehicle and the occupant compartment deformation limits were not exceeded. The Occupant Impact Velocities (OIV) and ridedown accelerations are within the recommended limits.	PASS

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Required Test Number	Narrative Description	Evaluation Results
	As recommend by MASH 2016 the narrowest allowable post spacing of 7.0 ft. (2.1 m) and the widest allowable post spacing of 21.0 ft. (6.4 m) was tested with the 2270P test vehicle.	
	Test 4-11 is the same as Test 3-11 and was run asa part of the TL-4 submittal for letter B-316. Therefore, Test 3-11 was not re-run, but the same information was used for this submittal. Both tests referenced here were part of the TL-4 submittal for letter B-316.	
	Applus IDIADA KARCOEngineering Project number P37358-01 was conducted with a 2270P test vehicle impacting the system 1.0 ft. (0.3 m) upstream of a post with the narrowest allowable post spacing of 7.0 ft. (2.1 m) at a nominal velocity and angle of 62 mph and 25 degrees, respectively. The test vehicle, a 2013 Chevrolet Silverado weighing 5,011.0 lbs (2,273.0 kg) impacted the system at aspeed and angle of 60.93 mph (98.06 km/h) and 25.3 degrees, respectively.	
3-11 (2270P)	respectively. The system redirected the vehicle and had a maximum working width of 7.9 ft. (2.4 m). The test vehicle sustained moderate damage. There was no potential for the article to penetrate the vehicle and the occupant compartment deformation limits were not exceeded. The Occupant Impact Velocities (OIV) and ridedown accelerations are within the recommended limits.	PASS
	Applus IDIADA KARCOEngineering Project number P37359-01 was conducted with a 2270P test vehicle impacting the system 1.0 ft. (0.3 m) upstream of a post with the widest allowable post spacing of 21.0 ft (6.4 m) at a nominal velocity and angle of 62 mph and 25 degrees, respectively. The test vehicle, a 2013 Chevrolet Silverado weighing 5,028.7 lbs (2,281.0 kg) impacted the system at aspeed and angle of 61.78 mph (99.43 km/h) and 25.1 degrees, respectively. The system redirected the	
	vehicle and had a maximum working width of 13.8 ft. (4.2 m). The test vehicle sustained moderate damage. There was no potential for the article to penetrate the vehicle and the occupant compartment deformation limits were not exceeded. The Occupant Impact Velocities (OIV) and ridedown accelerations are within the recommended limits.	

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	Applus IDIADA KARCOEngineering Project number P38018-01 was conducted with a	
	a nominal velocity and angle of 62 mph and 25 degrees, respectively. The system was	
	installed 4 ft. from the front SBP of a 46 ft.	
	Wide 4H:1V V-ditch. As recommend by	
	spacing of 7.0 ft. (2.1 m) was used.	
3-13 (2270P)	The test vehicle, a 2012 Chevrolet Silverado 1500 with a test inertial weight of 5,026.5 lbs (2,280.0 kg) impacted the system at a	PASS
	speed and angle of 63.31 mph (101.89 km/	
	system redirected the vehicle and had a	
	maximum working width of 12.5 ft. (3.8 m).	
	The test vehicle sustained moderate	
	damage. There was no potential for the	
	occupant compartment deformation limits	
	were not exceeded. The Occupant Impact	
	Velocities (OIV) and ridedown accelerations	
	are within the recommended limits.	
	Applus IDIADA KARCOEngineering Project	
	1100C test vehicle impacting the system at	
	a nominal velocity and angle of 62 mph and	
	25 degrees, respectively. The system was	
	installed 4 ft. from the front SBP of a 46 ft.	
	wide 4H:1V V-ditch. As recommend by	
	MASH 2016 the narrowest allowable post	
	spacing of 7.0 n. (2. rm) was used.	
	The test vehicle, a 2012 KiaRio with a test	
3-14 (1100C)	inertial weight of 2,428.4 lbs (1,101.5 kg)	PASS
,	Impacted the system at aspeed and angle	
	degrees respectively. The system redirected	
	the vehicle and had a maximum working	
	width of 5.5 ft. (1.7 m). The test vehicle	
	sustained moderate damage. There was no	
	potential for the article to penetrate the	
	vehicle and the occupant compartment	
	Occupant Impact Velocities (OIV) and	
	ridedown accelerations are within the	
	recommended limits.	
	Per MASH2016 this test is not applicable for	
	V-ditches greater than or equal to 26 ft,	
0.45 (44000)	measured from the front SBP to the back	Neg Delevent Test net so la tel
3-15 (1100C)	SBP. I his test isalso not necessary for	Non-Relevant lest, not conducted
	median ditch one on each side and 0 to 4 ft	
	from aSBP.	

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	Applus IDIADA KARCOEngineering Project number P39320-01 was conducted with an 1100C test vehicle impacting the system at a nominal velocity and angle of 62 mph and 25 degrees, respectively. The system was installed 4 ft. from the back SBP of a 46 ft. wide 4H:1V V-ditch. As recommend by MASH 2016 the narrowest allowable post spacing of 7.0 ft. (2.1 m) was used.	
3-16 (2270P)	The test vehicle, a 2009 KiaRio with a test inertial weight of 2,431.7 lbs (1,103.0 kg) entering the ditch at aspeed and angle of 61.91 mph (99.63 km/h) and 25.0 degrees, respectively. The system redirected the vehicle and had a maximum working width of 3.0 ft (0.9 m). The test vehicle sustained damage to the front end. There was no potential for the article to penetrate the vehicle and the occupant compartment deformation limits were not exceeded. The Occupant Impact Velocities (OIV) and ridedown accelerations are within the recommended limits.	PASS
	Applus IDIADA KARCOEngineering Project number P38113-02 was conducted with a 1500A test vehicle impacting the system at a nominal velocity and angle of 62 mph and 25 degrees, respectively. The system was installed 2 ft. from the front SBP of a 46 ft. wide 4H:1VV-ditch. With the system offset 2 ft. from the SBP the vehicle had the highest propensity to penetrate the system. As recommend by MASH 2016 the widest allowable post spacing of 18.0 ft. (5.5 m) was used.	
3-17 (1500A)	The test vehicle, a 2012 Chevrolet Malibu with a test inertial weight of 3,244.0 lbs (1,471.5 kg) impacted the system at aspeed and angle of 64.73 mph (104.17 km/h) and 24.6 degrees, respectively. The system redirected the vehicle and had a maximum working width of 13.5 ft. (4.1 m). The test vehicle sustained moderate damage. There was no potential for the article to penetrate the vehicle and the occupant compartment deformation limits were not exceeded. The Occupant Impact Velocities (OIV) and ridedown accelerations are within the recommended limits.	PASS

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3-18 (2270P)	Applus IDIADA KARCOEngineering Project number P40079-01 was conducted with an 2270P test vehicle impacting the system at a nominal velocity and angle of 62 mph and 25 degrees, respectively. The system was installed 8 ft. from the back SBP of a 46 ft. wide 4H:1V V-ditch. As recommend by MASH 2016 the widest allowable post spacing of 16.0 ft. (4.9 m) was used. The test vehicle, a 2016 Chevrolet Silverado with a test inertial weight of 5,011.0 lbs (2,273.0 kg) entering the ditch at aspeed and angle of 62.92 mph (101.26 km/h) and 25.1 degrees, respectively. The system redirected the vehicle and had a maximum working width of 15.0 ft (4.6 m). The test vehicle sustained damage to the front end. There was no potential for the article to penetrate the vehicle and the occupant compartment deformation limits were not exceeded. The Occupant Impact Velocities (QIV) and ridedown accelerations are within	PASS	
	exceeded. The Occupant Impact Velocities (OIV) and ridedown accelerations are within the recommended limits.		
	the recommended limits.		

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	KARCOEngineering, INC	
LaboratorySignature:	Bruno Haesbaert	ed by Bruno Haesbaert)7.15 15:58:04 -07'00'
Address:	9270 Holly Road, Adelanto, CA 92301	Same asSubmitter
Country:	United States of America	Same asSubmitter
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371: July 2019 - July 2022	

Submitter Signature*: Bruno Haesbaert Date: 2020.07.15 15:58:15 -07'00'

Submit Form

ATTACHMENTS

Attach to this form:

- 1) Additional disclosures of related financial interest as indicated above.
- 2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
- 3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words

MASH Test 4-10 Summary



0.000 s





0.400 s



0.600 s



0.800 s







0.200 s

Test Agency KARCO Test No Test Designation	Applus IDIADA KARCO P3791-01 4-10
Test Date	12/06/17
TEST ARTICLE	
Name / Model	TL-4 Cable Barrier System
Туре	Longitudinal Barrier
Installation Length	. 597.7 ft. (182.2 m)
Deat Creating	

GENERAL INFORMATION

Туре	Longitudinal Barrier
Installation Length	. 597.7 ft. (182.2 m)
Post Spacing	7.0 ft. (2.1 m)
Key Elements	Cable, Hair Pins, Lock Plates
Road Surface	Concrete and Soil
Type / Designation	1100C
Year, Make, and Model	. 2011 Kia Rio
Curb Mass	2,489.0 l bs (1,129.0 kg)
Test Inertial Mass	. 2,427.2 lbs (1,101.0 kg)
Gross Static Mass	2,621.3 lbs (1,189.0 kg)

Figure 3 Summary of Test 4-10

mpact Conditions Impact Angle..... 25.1°

Exit Conditions

Exit Velocity
Exit Angle
Final Vehicle Position 236.8 ft. (72.2 m) Downstream
32.4 ft. (9.9 m) Right
Exit Box Criterion Exited within exit box
Vehicle Snagging Satisfactory
Vehicle Pocketing Satisfactory
Maximum Roll Angle 23.4°
Maximum Pitch Angle8.3°
Maximum Yaw Angle30.0°

Occupant Risk	
Longitudinal OIV	15.7 ft/s (4.8 m/s)
Lateral OIV	13.5 ft/s (4.1 m/s)
Longitudinal RA	-3.8 g
Lateral RA	5.2 g
THIV	23.3 ft/s (7.1 m/s)
PHD	5.5 g
ASI	0.50
Test Article Deflections	
Static	N/A
Dynamic	78.5 in. (2.0 m)
Working Width	90.9 in. (2.3 m)
Debris Field	13.0 ft. (4.0 m)
	Field Side
<u>Vehicle Damage</u>	Field Side
<u>Vehicle Damage</u> Vehicle Damage Scale	Field Side
<u>Vehicle Damage</u> Vehicle Damage Scale CDC	Field Side 11LFQ6 11LYAK8

MASH Test 4-11 Summary



0.000 s

0.200 s

0.300 s







GENERAL INFORMATION	Impact Conditions	Occupant Risk
Test Agency Applus IDIADA KARCO	Impact Velocity	Longitudinal OIV 9.2 ft/s (2.8 m/s)
KARCO Test No P37358-01	Impact Angle	Lateral OIV 12.1 ft/s (3.7 m/s)
Test Designation 4-11	Location / Orientation 1.5 in. upstream from Post 42	Longitudinal RA4.0 g
Test Date 12/07/18	Impact Severity 113.6 kip-ft (154.0 kJ)	Lateral RA5.6 g
		THIV15.7 ft/s (4.8 m/s)
TEST ARTICLE	Exit Conditions	PHD 5.3 g
Name / Model TL-4 Cable Barrier System	Exit Velocity	ASI0.41
Type Longitudinal Barrier	Exit Angle 6.2°	
Installation Length 597.7 ft. (182.2 m)	Final Vehicle Position 256.6 ft. (78.2 m) Downstream	Test Article Deflections
Post Spacing7.0 ft (2.1 m)	3.1 ft. (0.9 m) Right	Static 0.5 ft. (0.2 m)
Key Elements Cable, Hair Pins, Lock Plates	Exit Box Criterion Exited within exit box	Dynamic7.9 ft. (2.4 m)
Road Surface Concrete and soil	Vehicle Snagging None	Working Width7.9 ft. (2.4 m)
TEST VEHICLE	Vehicle PocketingNone	Debris Field 10.0 ft. (3.0 m) Field
Type / Designation 2270P	Maximum Roll Angle 5.4 °	side
Year, Make, and Model 2013 Chevrolet Silverado 1500	Maximum Pitch Angle 3.6 °	Vehicle Damage
Curb Mass 5,261.2 lbs (2,386.5 kg)	Maximum Yaw Angle26.3 °	Vehicle Damage Scale 11-LFQ-3
Test Inertial Mass 5,011.0 lbs (2,273.0 kg)		CDC 11LYEW2
Gross Static Mass 5,011.0 lbs (2,273.0 kg)		Maximum Intrusion 0.5 in. (13 mm)

Figure 3 Summary of Test 4-11

MASH Test 4-11 Summary



0.000 s

0.200 s

0.400 s

0.600 s





GENERAL INFORMATION	Impact Conditions	Occupant Risk
Test Agency Applus IDIADA KARCO	Impact Velocity	Longitudinal OIV 8.5 ft/s (2.6 m/s)
KARCO Test No P37359-01	Impact Angle25.1°	Lateral OIV 9.5 ft/s (2.9 m/s)
Test Designation 4-11	Location / Orientation 11.5 in. (292 mm) upstream from post 17	Longitudinal RA2.6 g
Test Date 12/07/18	Impact Severity115.5 kip-ft (156.5 kJ)	Lateral RA 3.4 g
		THIV13.1 ft/s (4.0 m/s)
TEST ARTICLE	Exit Conditions	PHD 3.7 g
Name / Model TL-4 Cable Barrier System	Exit Velocity 47.40 mph (76.28 km/h)	ASI0.31
Type Longitudinal Barrier	Exit Angle2.4°	
Installation Length 597.7 ft. (182.2 m)	Final Vehicle Position315.3 ft. (96.1 m) Downstream	Test Article Deflections
Post Spacing 21.0 ft. (6.4 m)	0.7 ft. (0.2 m) Traffic side	StaticN/A
Key Elements Cable, Hair Pins, Lock Plates	Exit Box Criteria Met Yes	Dynamic 13.8 ft. (4.2 m)
Road Surface Concrete and Soil	Vehicle Snagging Satisfactory	Working Width 13.8 ft. (4.2 m)
TEST VEHICLE	Vehicle Pocketing Satisfactory	Debris (lateral) 14.5 ft. (4.4 m)
Type / Designation2270P	Maximum Roll Angle3.1 °	Vehicle Damage*
Year, Make, and Model 2013 Chevrolet Silverado 1500	Maximum Pitch Angle2.9 °	Vehicle Damage Scale 11-LFQ-3
Curb Mass 5,067.2 lbs (2,298.5 kg)	Maximum Yaw Angle25.7 °	CDC 11LFEN2
Test Inertial Mass5,028.7 lbs (2,281.0 kg)		Maximum Intrusion none
Gross Static Mass 5,028.7 lbs (2,281.0 kg)		*Vehicle damaged assessed before secondary impact.

Figure 4 Summary of Test 4-11

MASH Test 3-13 Summary





0.300 s

0.700 s



1.400 s

3.330 s



GENERAL INFORMATION	Impact Conditions	Occupant Risk
Test Agency Applus IDIADA KARCO Engineering	Impact Velocity 63.31 mph (101.89 km/h)	Longitudinal OIV 5.9 ft/s (1.8 m/s)
Test No P38018-01	Impact Angle25.7°	Lateral OIV 6.6 ft/s (2.0 m/s)
Test Designation 3-13	Target Location 1.0 ft. upstream of post no. 41	Longitudinal RA2.6 g
Test Date 03/20/18		Lateral RA 2.5 g
	Impact Severity 126.7 kip-ft (171.7 kJ)	THIV
TEST ARTICLE		PHD 2.9 g
Name / Model TL-4 Cable Barrier System	Exit Conditions	ASI0.24
Type Longitudinal Barrier	Exit VelocityN/A	
Installation Length 613.7 ft. (187.1 m)	Exit AngleN/A	Test Article Deflections
Key Elements Cable, Hair Pins, Lock Plates	Final Vehicle Position 220.1 ft. (67.1 m)	Static 2.1 ft (0.6 m)
Road Surface AASHTO M147-65 Grade B	25.5 ft. (7.8 m)	Dynamic 11.0 ft (3.4 m)
Post Spacing 7.0 ft. (2.1 m)	Exit Box Criteria Met N/A	Working Width 12.5 ft (3.8 m)
	Vehicle SnaggingNone	Debris Field Lateral
TEST VEHICLE	Vehicle Pocketing Satisfactory	
Type / Designation 2270P	Maximum Roll Angle*111.6 °	Vehicle Damage
Year, Make, and Model 2012 Chevrolet Silverado 1500	Maximum Pitch Angle 16.1 °	Vehicle Damage Scale 11-LFQ-3
Curb Mass 5,134.5 lbs (2,329.0 kg)	Maximum Yaw Angle 15.1 °	CDC 11LYEW2
Test Inertial Mass 5,026.5 lbs (2,280.0 kg)	*Channel malfunction	Maximum Intrusion 0.25 in. (6.4 mm)

Figure 3 Summary of Test 3-13

Gross Static Mass..... 5,026.5 lbs (2,280.0 kg)

MASH Test 3-14 Summary





GENERAL INFORMATION	Impact Conditions	Occupant Risk
Test Agency Applus IDIADA KARCO Engineering	Impact Velocity 60.97 mph (98.12 km/h)	Longitudinal OIV 10.8 ft/s (3.3 m/s)
Test No P38112-01	Impact Angle25.3°	Lateral OIV 14.1 ft/s (4.3 m/s)
Test Designation 3-14	Location / Orientation Midspan between posts	Longitudinal RA4.9 g
Test Date 04/02/18	Impact Severity55.1 kip-ft (74.7 kJ)	Lateral RA7.5 g
		THIV
TEST ARTICLE		PHD
Name / Model TL-4 Cable Barrier System	Exit Conditions	ASI0.64
Type Longitudinal Barrier	Exit Velocity Vehicle did not exit	
Installation Length 613.7 ft. (187.1 m)	Exit AngleN/A	Test Article Deflections
Key Elements Cable, Hair Pins, Lock Plates	Final Vehicle Position 124.0 ft. (37.8 m) Downstream	Static 0.5 ft (0.2 m)
Road Surface AASHTO M147-65 Grade B	1.1 ft. (0.3 m) Left	Dynamic 5.5 ft (1.7 m)
Post Spacing 7.0 ft. (2.1 m)	Exit Box Criteria Met N/A	Working Width 5.5 ft (1.7 m)
	Vehicle Snagging None	Debris (lateral)
TEST VEHICLE	Vehicle Pocketing Satisfactory	
Type / Designation 1100C	Maximum Roll Angle	Vehicle Damage
Year, Make, and Model2012 Kia Rio	Maximum Pitch Angle 16.6 °	Vehicle Damage Scale 11-LFQ-4
Curb Mass 2,401.9 lbs (1,089.5 kg)	Maximum Yaw Angle55.0 °	CDC 11LYAW3
Test Inertial Mass 2,428.4 lbs (1,101.5 kg)		Maximum Intrusion 0.4 in. (10 mm)
Gross Static Mass 2,599.2 lbs (1,179.0 kg)		

Figure 3 Summary of Test 3-14

MASH 2016 Test 3-16 Summary



0.000 s

0.140 s

0.280 s

0.420 s

2.300 s

3.260 s



GENERAL INFORMATION	Impact Conditions	Occupant Risk
Test Agency Applus IDIADA KARCO	Impact Velocity	Longitudinal OIV 0.7 ft/s (0.2 m/s)
Test No P39320-01	Impact Angle	Lateral OIV
Test Designation	Location / Orientation	Longitudinal RA11.2 g
Test Date 11/05/19	Impact Severity 55.6 kip-ft (75.4 kJ)	Lateral RA 5,1 g
		THIV
TEST ARTICLE	Exit Conditions	PHD 11.4 g
Name / Model TL-4 Cable Barrier System	Exit Velocity	ASI
Type Longitidinal Barrier	Exit Angle	
Installation Length	Final Vehicle Position 39.5 ft. (12 m) Downstream	Test Article Deflections
Key Elements Cable, Hair Pins, Lockplates	4.5 ft. (1.4 m) Right	Static
Road Surface AASHTO M147-65 Grade B	Exit Box Criteria Met Yes	Dynamic
Post Spacing	Vehicle Snagging Satisfactory	Working Width
	Vehicle Pocketing Satisfactory	Debris Field No debris field
TEST VEHICLE	Vehicle StabilitySatisfactory	
Type / Designation 1100C	Maximum Roll Angle69.4 °	Vehicle Damage
Year, Make, and Model 2009 Kia Rio	Maximum Pitch Angle 50.5 °	Vehicle Damage Scale 11-LFQ-1
Curb Mass	Maximum Yaw Angle44.3 °	CDC 11FDEK1 and 11LFES1
Test Inertial Mass 2,431.7 lbs (1,103.0 kg)		Maximum Intrusion 0.4 in. (10 mm) at toepan

Figure 2 Summary of Test 3-16

MASH Test 3-17 Summary





GENERAL INFORMATION	Impact Conditions	Occupant Risk
Test Agency Applus IDIADA KARCO Engineering	Impact Velocity	Longitudinal OIV 11.2 ft/s (3.4 m/s)
Test No P38113-02	Impact Angle	Lateral OIV 17.1 ft/s (5.2 m/s)
Test Designation 3-17	Location / Orientation Midspan between posts	Longitudinal RA2.3 g
Test Date 04/30/18	Impact Severity 78.7 kip-ft (106.8 kJ)	Lateral RA4.0 g
		THIV
TEST ARTICLE	Exit Conditions	PHD 4.0 g
Name / Model TL-4 Cable Barrier Sytem	Exit Velocity	ASI0.37
Type	Exit Angle6.5°	
Installation Length 614.4 ft. (187.3 m)	Final Vehicle Position 374.9 ft. (114.3 m) Downstream	Test Article Deflections
Key Elements hair pins, lock plate, cable	16.5 ft. (5.0 m) Traffic Side	Static 0.5 ft (0.2 m)
Road Surface AASHTO M147-65 Grade B	Exit Box Criteria Met Yes	Dynamic
Post Spacing	Vehicle Snagging None	Working Width 13.5 ft (4.1 m)
	Vehicle Pocketing Satisfactory	Debris (lateral)
TEST VEHICLE	Maximum Roll Angle29.9 °	
Type / Designation 1500A	Maximum Pitch Angle 15.3 °	Vehicle Damage
Year, Make, and Model 2012 Chevy Malibu	Maximum Yaw Angle 33.7 °	Vehicle Damage Scale 11-LFQ-4
Curb Mass		CDC 11LYEW3
Test Inertial Mass		Maximum Intrusion 0.7 in. (17 mm)

Figure 3 Summary of Test 3-17

Gross Static Mass...... 3,244.0 lbs (1471.5 kg)

MASH 2016 Test 3-18 Summary













1.175 s

1.335 s

1.975 s



	1-	
GENERAL INFORMATION	Impact Conditions	Occupant Risk
Test Agency Applus IDIADA KARCO	Impact Velocity 62.92 mph (101.26 km/h)	Longitudinal OIV 0.7 ft/s (0.2 m/s)
Test No P40079-01	Impact Angle 25.1°	Lateral OIV 4.6 ft/s (1.4 m/s)
Test Designation	Location / Orientation 4.0 ft upstream from post 22	Longitudinal RA18.5 g
Test Date	Impact Severity 119.3 kip-ft (161.8 kJ)	Lateral RA3.4 g
		THIV 4.6 ft/s (1.4 m/s)
TEST ARTICLE	Exit Conditions	PHD 18.5 g
Name / Model TL-4 Cable Barrier System	Exit Velocity N/A	ASI 1.10
Type Longitidinal Barrier	Exit AngleN/A	
Installation Length 598.6 ft. (182.5 m)	Final Vehicle Position 69.8 ft. (21.3 m) Downstream	Test Article Deflections
Key Elements Cable, Hair Pins, Lockplates	7.9 ft. (2.4 m) Left	Static
Road Surface AASHTO M147-65 Grade B	Exit Box Criteria Met Yes	Dynamic
Post Spacing 16.0 ft. (4.9 m)	Vehicle Snagging Satisfactory	Working Width 15.0 ft (4.6 m)
	Vehicle Pocketing Satisfactory	Debris Field No debris field
TEST VEHICLE	Vehicle Stability Satisfactory	
Type / Designation 2270P	Maximum Roll Angle53.7 °	Vehicle Damage
Year, Make, and Model 2016 Chevrolet Silverado	Maximum Pitch Angle 44.0 °	Vehicle Damage Scale 11-LFQ-1
Curb Mass 5,145.5 lbs (2,334.0 kg)	Maximum Yaw Angle 40.9 °	CDC 11FDEK1 and 11LFES1
Test Inertial Mass 5,011.0 lbs (2,273.0 kg)		Maximum Intrusion 0.7 in. (18 mm) at toepan
Gross Static Mass 5,011.0 lbs (2,273.0 kg)		

Figure 2 Summary of Test 3-18







	TL-4 4 Cable	Interchanging
GIRRALTAR	Gibraltar Cable	e Barrier Systems
4	Scale:	Date:
Ca alle	NTS	1-2-19
'A	Layout:	Drafter:
A BP	ANSI B	JP





3. The Cable Barrier System shall be installed on shoulders or on medians with slopes of 6:1 or flatter. If installed on slopes steeper than 6:1 up to 4:1 the TL-4 system performs as a TL-3 and Gibraltar must be contacted for various guidelines related to placement. (Max. Post

6.A. For socketed post, continue digging 12" diameter, 15" deep into rock or the required plan depth, whichever comes first.

- 6.B. For driven post, core drill a 4" diameter hole 18" deep into rock or the required plan depth, whichever comes first.
- 6.C. For Anchor post, continue digging 24" diameter, 30" deep into rock or the required plan depth, whichever comes first.

- 9.A. Without mowstrip, 36" Deep x 12" diameter foundations with #3 rebar ring x 8" diameter with two #4 rebar vertical bars
- 9.B. With 4" minimum depth hot mix asphalt, 30" deep x 12" diameter foundations with #3 rebar ring x 8" diameter with two #4 rebar vertical bars 30" long or 30" welded rebar
- 9.C. With 3" minimum depth concrete mowstrip, 24" deep x 12"

MASH TEST	Line Post Spacing
3-10	7'-0"
3-11	7'-0"
3-11	21'-0"
4-12	21'-0"

Cable	Tension
Ch	art*

-10 °F	8600
0 °F	8200
10 °F	7800
20 °F	7400
30 °F	7000
40 °F	6600
50 °F	6200
60 °F	5800
70 °F	5400
80 °F	5000
90 °F	4600
100 °F	4200
110 °F	3800

*Allowable Deviation from Chart +/- 10%

MASH 4 Cable Tests PROPRIETARY TO GIBRALTAR

TL-4 4M Cable System Layout

Gibraltar Cable Barrier Systems

1-7-2019

BH